The syntax/morphology interface

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1. Introduction

Morphological structure and syntactic structure are clearly mutually dependent. Within a given language, plural subjects can require plural forms of finite verbs, derivational affixation can change a verb's argument structure requirements, and comparative clauses can be introduced by adjectives which must be appropriately inflected. Complex word-internal structure in polysynthetic languages represents the same logical content as sentence-internal structure in isolating languages, with broad but not infinitely variable gradience between these extremes. Morphology and syntax share a vocabulary of categories and features — nouns, verbs, tenses, cases, etc. They both exhibit hierarchical structure and headedness. Any adequate grammatical theory must provide an account of the interaction between the two and explicate in what ways it is constrained.

In this article, I first briefly exemplify a number of morphological phenomena which have syntactic repercussions, to illustrate the range of issues investigators confront. I then sketch a variety of grammatical architectures and their general approach to the interaction between morphology and syntax, paying attention to what empirical territory is considered the domain of independent morphological processes vs. the domain of properly syntactic processes in each. Finally, I provide a more in-depth look at the theory of the morphosyntactic interface with which I am most familiar, Distributed Morphology, and briefly describe specific problems associated with syntacticocentric approaches to derivational morphology at the interface.

2. Overview: Morphology and syntax

There is often a sense of directionality to the morphology-syntax interface; there are cases where the morphology seems to drive the syntax, and other cases where the syntax appears to drive the morphology. This intuition corresponds roughly to the derivation/inflection distinction, where that distinction is relevant.

2.1 Derivational morphology and syntax

Derivational morphology can produce complex word-forms which have radically different syntactic properties than those of the stem to which the morphology attaches. It can, for example, change the syntactic category or subcategory of a word, and thereby alter its selectional properties. Derivational morphology can also radically alter a word's selectional properties without changing its category.

To take an example from English, as a verb, *invite* requires an internal argument (1)); when nominalized as *invitation*, both the internal and external arguments are apparently optional (2)). When the arguments do appear, however, their syntactic properties are appropriate to the nominal syntax in which they find themselves; the internal argument, for example, is prepositionally case-licensed by *of* (2)b) rather than receiving accusative case from *invite* (1)b).[1]

[1] See Chomsky 1970, 1981, Lebeaux 1986, Alexiadou 2001, and references in section 4 of this paper, among many others.

(1)) a. *Mary invited to the party.
b. Mary invited Susan to the party.

(2)) a. The invitation to the party
b. Mary's invitation of Susan to the party

In other languages, argument-structure changing morphology, such as causative, desiderative, applicative or passive suffixes, can adjust a sentence's thematic structure so as to require additional arguments, or surpress extant arguments. The Hiaki desiderative suffix in (3)b) introduces a new external argument, *Peo*; the applicative suffix in (3)c) introduces a new internal argument, *Jose*.[2]

(3)) a. Juan nooka
Juan speak
"Juan is speaking."

b. Peo Juan-ta nok-ii'aa
Peo Juan-acc speak-desid.tr
"Peo wants Juan to speak."

c. Juan Jose-ta nok-ria
Juan Jose-acc speak-appl
"Juan is speaking for Jose."

Similarly, English *out*-prefixation creates a transitive verb from an intransitive one, adding an internal argument; compare *to swim* and *to outswim*. The direction of influence can go the other way, from syntax to morphology, even with derivational morphology, however: English *re-* prefixation is incompatible with adjectival resultative

[2] Some analyses of applicative constructions cross-linguistically include Baker 1992, Marantz 1993, McGinnis 2001, O'Herin 2001, Pylkkanen 2002, Georgala et al. 2008, among others. For discussion of desideratives affixes in various languages, see Gerdts 1988, Johns 1999, Kim and Maling 1994, among others.

constructions (and verb-particle constructions), even when the verb that is the target of prefixation is independently compatible with them: [3]

(4)) a. John opened the discussion (up).
b. John reopened the discussion (*up).
c. Bill cooked the meat (tender).
d. Bill recooked the meat (*tender).

This is a small sampling of the kinds of patterns that an adequate theory of the morphology/syntax interface must account for in the derivational realm.

It is usually the case that the choice of derivational structure is optional in the way that lexical choices are optional; if a Hiaki speaker decided not to use the applicative, for example, a periphrasitic alternative is available in which the sentence in (3)a) with an underived verb is simply supplemented with a postpositional phrase, *Peo-vetchi'ivo*, 'for Peo'. Nothing about the grammar forces the choice of a particular derived form.

This optionality of marking is consistent with the observation that morphosyntactic derivation can be 'gappy'. Although the Hiaki cases discussed above are completely productive, other syntactically relevant derivational processes can fail with particular stems or classes of stems. Such failures can be specific to particular affixes in combination with particular stems (compare, e.g., English *electric~electricity, plastic~plasticity* with *metallic~*metallicity, dramatic~*dramaticity*); alternatively, a gap may be due to semantic/selectional clash between the affix and a class of stems. English agentive nominalization fails with stative transitive verbs (**knower, *wanter, *resemblant* vs. *teacher, writer, applicant*) since such verbs are not compatible with

[3] *Out*-prefixation has been discussed in Bresnan 1982, Keyser and Roeper 1984, Roberts 1985, Levin 1999, among others; for discussion of *re*-prefixation see Wechsler 1989, Keyser and Roeper 1992, Harley 2004, Lieber 2004, Williams 2006, Marantz 2010, among others.)

agentive external arguments. A theory of the syntax/morphology interface thus also needs to attend to such morphosyntactic 'gaps'.

2.2 Inflectional morphology and syntax

Inflectional morphology, in contrast, is generally mandatory, and is often driven by the presence of a particular syntactic configuration, rather than the other way around. A second person plural subject requires a particular form of the finite verb in French; there is no optionality:

(5)) a. Vous parlez
2pl speak.2pl.pres
'You are speaking.'

b. *Vous parle/parles/parlent/parlons/parler
2pl speak/speak.2sg/speak.3pl/speak.1pl/speak.inf

Similarly, the Icelandic preposition *frá* 'from', requires a dative DP complement; other case forms are not appropriate:

(6)) frá borginni/*borgina
from the.city.dat/the.city.acc

Such relationships are paradigm cases of syntactic phenomena, in that they depend on structural, rather than linear, configurations, and persist over unbounded dependencies; the extracted plural subject *Which books* in (7) triggers plural *were* no matter how many clause boundaries intervene:

(7)) a. Which books$_i$ did John say Martha claimed Bill thought … e_i were/*was on the table?

The relationship between syntactic configurations and inflectional morphology can be extremely complex. In Georgian, for example, a single set of verbal agreement

forms represent the person and number features of both subject and object, with the same morphological exponents sometimes indexing the number of the object and sometimes the number of the subject. Given the forms in (8)), for example, one could reasonably conclude that the *-t* suffix represents plural subject number:

(8) a. gv-xatav 'You (sg) paint us.'
b. gv-xatav-t 'You (pl) paint us.'

The forms in **Error! Reference source not found.**), from the same paradigm, however, show that *-t* is also triggered by plural object number:[4]

(9) a. g-xatav 'I paint you (sg).'
b. g-xatav-t 'I paint you (pl).

Case alternations repesent one of the most salient interactions between inflectional morphology and syntactic structure, from the familiar patterns of the English passive to the complex relationship between case, transitivity and finiteness in the ergative/absolutive language Warlpiri (data from Woolford 2006 and Legate 2008):[5]

(10) a. *Intransitive finite clause: Absolutive on subject*
Ngaju ka-rna parnka-mi
I.ABS pres-1SG run-NONPAST
'I am running'

b. *Intransitive nonfinite clause: Dative on subject*
…ngaju-ku jarda-nguna-nja-rlarni
…I-DAT sleep-lie-NONFIN-OBVC
'…while I was asleep'

[4] For a sampling of approaches to Georgan agreement, see Marantz 1991, Halle & Marantz 1993, King 1994, Bejar 2000, 2003, Béjar and Rezac 2004, Anderson 1986, 1992, Carmack 1997, Stump 2001, Stewart 2001, Lomashvili and Harley (forthcoming) or Gurevich 2006

[5] For an overview of approaches to erg/absolutive case systems, see Aldridge 2008.

c. *Transitive finite clause: Ergative on subject*

Karnta-ngku	ka-rla	kurdu-ku	miyi	yi-nyi.
woman-ERG	pres-3DAT	child-DAT	food.ABS	give-NONPAST

"The woman is giving the child food."

d. *Transitive nonfinite clause: Dative on subject*

…karnta-ku	kurdu-ku	miyi	yi-nja-rlarni
…woman-DAT	child-DAT	food.ABS	give-NONFIN-OBVC

'…while the woman is giving food to the baby'

e. *Transitive nonfinite clause: Ergative on subject*

…ngati-nyanu-rlu	karla-nja-rlarni
…mother-POSS-ERG	dig-NONFIN-OBVC

'…while his mother was digging (for something)'

Any theory of the syntax/morphology interface must be able to provide a mechanism to account for these and other complex interactions between syntactic configuration and morphological form. Theoretical approaches to alternations between periphrastic and affixal representations of the same morphosyntactic feature, for example, vary significantly between different grammatical architectures; consider English comparative affixation exemplified in (11)), and Korean negative *do*-support in (12)):[6]

(11) a. smarter/more intelligent than Bill *intelligenter
b. greener/more verdant than my lawn *verdanter
c. heaver/more massive than an elephant *massiver

(12) a.

Chelswu-ka	chayk-ul	ilk-ess-ta	
Chelswu-nom	book-acc	read-past-decl	

'Chelswu read the book'

b.

Chelswu-ka	chayk-ul	ilk-ci	ani	ha-ess-ta
Chelswu-nom	book-acc	read-ci	neg	do-past-decl

'Chelswu did not read the book.'

[6] For approaches to English comparatives, see Poser 1992, Kennedy 1999, Bhatt and Pancheva 2004, Kiparsky 2005 Embick 2007, among others. On Korean *do*-support, see Hagstrom 1996, Jo 2000, among others.

In the former, the syntactic construction apparently fills a morphological paradigm gap created by the restrictive morphophonological selectional properties of the English comparative *-er* suffix, while in the latter, the morphology seems to provide an alternative verbal host when syntax interposes a negative particle between the exponents of tense and the main verb stem, resulting in a periphrastic expression of tense in a negative clause and an affixal expression in an affirmative one.

2.3 Clitics and dimensions of wordhood

In the above discussion, we have not yet considered the notion of 'word', taking it for granted that the distinction between word-internal structure (morphology) and word-external structure (syntax) is not problematic. The default division of labor assumes that morphology governs the hierarchical and linear arrangement of word-internal structure, while syntax governs the hierarchichal and linear arrangement of words themselves. Given this intuition about the machinery, it follows that there should be a clear notion of what a 'word' is, that is, the kind of thing that morphology constructs and syntax manipulates. Syntactic manipulation of word-internal elements should be by definition impossible.

There are many contentious questions associated with this intuitive division, however. Perhaps the most salient cases which represent a direct challenge to this set of assumptions are clitics. Clitics are morphologically dependent bound forms, like other affixes, but are (often) linearly positioned as if they are syntactically independent. They form single word-sized units with their hosts, yet it is prima facie implausible that the host+clitic word represents a single syntactic terminal node. In many cases, it is

implausible that these single phonological words represent a syntactic constituent of any kind. In such cases, it seems necessary to allow the syntax to manipulate and position these bound, word-internal exponents independently of the hosts to which they attch.

Consider the formation of the phonological words in (13)).

(13)	a.	That man over <u>there's</u> working this morning.	/ð□□z/
	b.	You <u>aren't</u> helping.	/□□nt/
	c.	<u>You're</u> not helping.	/j□□/

(13)a) illustrates a canonical example of a promiscuous 'leaner' enclitic (Zwicky 1985, Klavans 1980, Selkirk 1996). It suffixes to a stem to its left. The stem which hosts it is not a member of the same syntactic constituent as the clitic itself; the clitic is the tensed auxiliary verb, and its stem *there* is embedded within a prepositional phrase embedded within the subject DP. Despite having fewer phonological words, the usual syntactic analysis of a sentence like (13)a) does not differ in any detail from the synonymous sentence with the full auxiliary *is* rather than the clitic *'s* — that is, not many analyses treat *there's* in such a sentence as a paradigmatically inflected form of *there*. Similarly, the syntax and truth-conditional semantics of (13)b and c) are identical, despite the fact that they contain significantly different sets of phonological words, [□j□□ □n□t □h□lp□ŋ] in one case, and [□juw □□□nt □h□lp□ŋ] in the other.

The problems posed by clitics, however, extend beyond the treatment of apparently easily-characterized 'leaners' like *'s,* or the treatment of bound variants of free forms whose placement is linearly identical to that of the corresponding free words, like *'re*. In the case of 'special' clitics, like the Romance pronominal clitics, the syntax treats the bound forms significantly differently from the corresponding free forms, and, in fact, seems to use a dedicated variety of syntactic movement to get the clitic to its host. This

phrasal movement can be recursively iterated, like other phrasal movements, as illustrated by the Spanish clitic-climbing data in (14)) below (examples from Bok-Bennema 2005):

(14) a. Juana quisiera poder hacer=lo.
Juana want.cond.past.3sg can do=it
'Juana would want to be able to do it.'

b. Juana quisiera poder=lo$_i$ hacer e_i
Juana want.cond.past.3sg can=it do

c. Juana lo$_i$=quisiera poder hacer e_i
Juana it=want.cond.past.3sg can do

Similar questions are raised by 2nd-position clitics, a relatively frequent phenomenon crosslinguistically. Clitics suggest that the foundational idea that that phonological words are syntactic constituents—in particular, that phonological words correspond to syntactic terminal nodes—should not go unexamined. For example, if one were to draw a tree in which the phonological word *you're* (/j□□/) occupied a single syntactic terminal node, what would the syntactic category of that node be? Is it a V of some kind, perhaps Aux or Infl? Or is it an N of some kind, a pronominal D, for example? From a larger perspective, such facts could even cause one to consider whether the evidence of affixation is relevant for the syntactic analysis at all. In any case, tightly interwoven sets of assumptions concerning the nature of wordhood and the locus of word-formation sharply distinguish many of the current principal frameworks for morphosyntactic analysis.

3. Frameworks

Theories of morphology vary considerably in the details of articulation of the interface between morphology and syntax. Compounding this variation is considerable

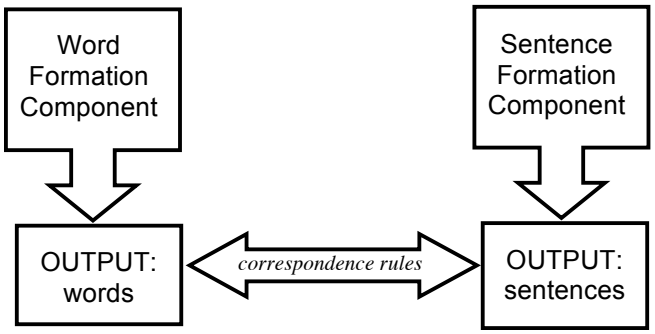
variation in the theories of morphology and syntax themselves. This often can make it difficult to compare theories, but certain dimensions of analytical variation are useful in categorizing approaches; we will next survey some of them here.

3.1 'Word' as an independent level of grammatical organization: Lexicalism

One primary dimension of variation is that of being a 'lexicalist' theory—a theory in which the notion 'word' has an independent status, on a par with the notion 'sentence'. Lexicalist theories subscribe to some version of the Lexical Integrity Hypothesis (Lapointe 1980), according to which words are built by distinct mechanisms, which are encapsulated from the mechanisms that create syntactic structure. In such theories, there are levels of representation and rules of grammatical structure dedicated to word-formation. Lexical insertion introduces these word forms into sentential syntactic structure, along with their concommitant feature structures. Conventions governing featural relationships in the syntactic structure enforce the required matches between, for example, the form of an inflected verb and its subject's phi-features—if the features don't match, the syntactic configuration cannot be established. In lexicalist theories, syntax has no access to word-internal structure, and whole words must be syntactic constituents; word structure and syntactic structure are only related to each other by the lexical insertion operation. Most 'correspondence'-type grammatical architectures, in which parallel and independent grammatical representations are placed in correspondence by interface constraints relating each submodule to the others, are lexicalist in this sense; Autolexical Syntax (e.g. Sadock 1991), the Parallel Architecture (e.g. Jackendoff 1997), Representation Theory (Williams 2003), Lexical Functional Grammar (e.g. Bresnan

2000), Role and Reference Grammar (e.g. Van Valin and La Polla 1997) and the approach described in Ackema and Neeleman 2004 are all examples. Jackendoff (2010) describes Lamb (1966)'s Stratificational Grammar as the 'granddaddy of them all.' An oversimplified schema of this kind of approach is provided in (15)

(15)



In such theories, mismatches between wordhood and syntactic constituency can be characterized by allowing nonoptimal correspondences to surface in cases where optimal morphological structure cannot be mapped to optimal syntactic structure. The theoretical action is in the development and explication of the constraints governing the correspondences, and their interactions and relative importance with respect to each other.

3.2 Derivation, inflection, and weakly lexicalist theories

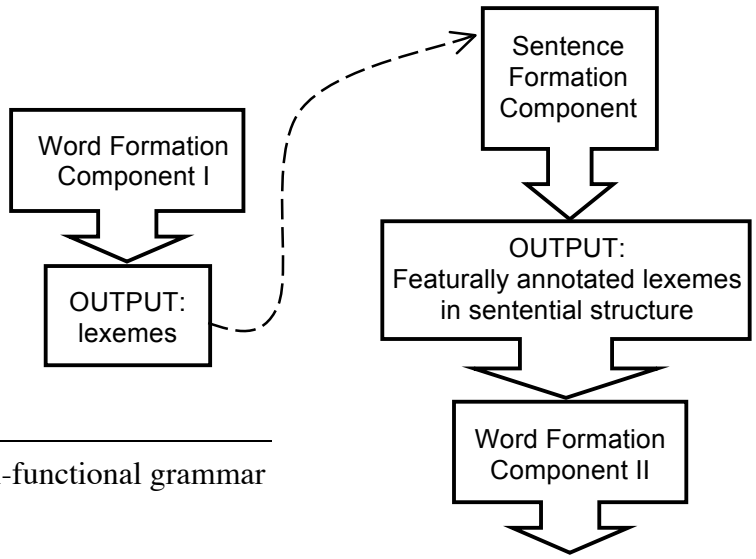
Lexicalist theories can nonetheless vary with respect to the units that they identify as word-forms. A strongly lexicalist theory treats both inflectional and derivational forms as internally impenetrable to syntax; even the formation of clitic+host wordforms may be accomplished within the morphological component, as in the HPSG[7] analysis of French clitics of Miller and Sag (1997), or the PFM[8] theory described in Stump (2001). LFG[9] is

[7] Head-driven phrase structure grammar
[8] Paradigm-function morphology

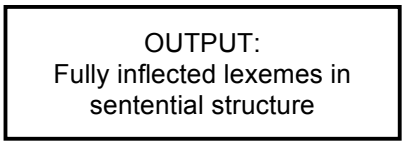
also a strongly lexicalist theory (see, e.g., Bresnan 2001). The 'checking' version of Minimalism proposed in Chomsky 1995 was also a species of strong lexicalist theory.

In contrast, weakly lexicalist theories treat derivational morphology as encapsulated with respect to syntax, but allow inflectional morphology to be determined by the syntactic component (rather than simply verifying a correspondence between inflectional marking and syntactic configuration). This corresponds to the intuition that derivational morphology can determine syntactic outcomes, while syntax seems to determine inflectional outcomes. In such theories, a word-formation component produces derivationally complex but uninflected word-forms (often termed 'lexemes'). Lexemes are complete stems ready for inflection; their internal structure is insulated from syntactic inspection. Weakly lexicalist theories thus conform to the lexicalist hypothesis at the lexeme level. These word-forms acquire the morphosyntactic features relevant for their inflection by virtue of their position in the clause structure and their participation in certain syntactic relationships. The syntactic representation interacts with a second morphological component, which applies inflectional morpholexical rules to the newly featurally enriched stems to derive the appropriate inflected form of the lexeme. An oversimplified schema is provided in (16):

(16)



[9] Lexical-functional grammar



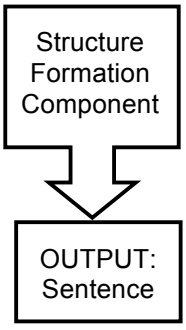
Inflectional morphology, then, is not encapsulated with respect to the syntax, though derivational morphology is; hence the 'weak' in 'weak lexicalist hypothesis'. The theories proposed by Aronoff (1976, 1994) and Anderson (1992) fall into this general family.

Both types of Lexicalist theory are compatible with a relatively sparse view of the syntactic component (à la Jackendoff and Culicover 2005), using a minimum of functional superstructure. Neither derivational affixes nor inflectional features head their own projections in the syntactic tree. An internally morphologically complex noun like *celebration* and a monomorphemic one like *party* are equivalent in terms of their internal syntactic structure—neither has any—though not in their internal morpological structure.

3.3 The syntax of words: Non-lexicalist approaches

Many approaches to complex word-formation, however, adopt a non-lexicalist architecture, in which the syntactic component constructs words and phrases alike. In such theories, there is no distinct word-formation module, and word-internal structure participates in syntactic operations and semantic interpretation in the same way that word-external structure does. Morphemes, not phonological words, are typically taken to correspond to individual syntactic terminal nodes. An oversimplified schema is provided in (17)

(17)



Most such approaches adopt a broadly Minimalist view of the structure-building component (Chomsky 1995, 2000, *et seq.*), but can vary considerably in the nature and amount of special mechanisms they employ to create the complex structures that will end up being realized as phonological word-size units. In such approaches, the more stringent selectional requirements of morphemes and their typically more rigid ordering requirements are not ascribable to differences between the operations available in different components of the grammar, but must have some other source; all structure is built by the iteration of the single operation which Chomsky calls Merge.[10]

At one end of the syntacticocentric spectrum one can find proposals which derive morpheme orders without any non-syntactic operations at all, often involving Kayne's Antisymmetry Theory (Kayne 1994). Antisymmetry deterministically maps c-command relationships onto linear order. In this as in other syntacticocentric approaches, morphological pieces head the terminal nodes of syntactic projections. Because the Antisymmetry requirement forces all head-movement to be leftward and left-adjoining, head movement—movement of V° to T°, for example—will necessarily result in a [V°-T°]$_{T°}$ sequence, never in a [T°-V°]$_{T°}$ sequence. Complex words which apparently involve suffixation of a lower to a higher constituent (e.g. Zulu [Agr°-V°] sequences) , or which appear to involve rightward head-movement (e.g. Japanese [V°-T°] sequences, which follow all other phrasal material), must then be derived via phrasal remnant movement,

[10] To be carefully distinguished from the DM-specific postsyntactic operation of (M-)Merge*r*.

rather than head-movement. The repeated application of remnant movement results in a linearly adjacent string of heads in the appropriate syntactic position, which can then agglutinate into a single word-form, motivated by their affixal morphophonology. The V° preceding T° in Japanese, for example, would head a VP out of which all arguments have been moved. That VP occupies some specifier c-commanding the TP, headed by the T° element in situ. All arguments and other constituents occupy still higher specifier position. In such a configuration, V° is the only phonologically realized element in a constituent which c-commands TP, whose only phonologically realized element is T°. By the LCA, c-command determines precedence and so V° precedes T°. See Koopman and Szabolsci 2000's analysis of Hungarian verbs for a detailed example of such an approach, or Harbour 2008 for an analysis of discontinuous agreement morphology which appeals to the LCA to ensure that person morphemes appear as prefixes while number morphemes appear as suffixes.

At perhaps the opposite end of the syntacticocentric spectrum, the original Distributed Morphology framework (Halle and Marantz 1993) adopts the basic premise that individual morphemes instantiate terminal nodes in syntactic structure proper, but introduces several additional post-syntactic operations to manipulate the ordering, hierarchy and content of syntactic terminal nodes as they are mapped to morphophonology. The operations include reordering ("Morphological Merger"), insertion of new terminal nodes ("Dissociated Morphemes"), deletion ("Impoverishment"), unification ("Fusion") and splitting ("Fission"), as well as allowing the stipulation of the prefixal or suffixal status of particular items. The net effect is to allow for a considerably looser correspondence between the order and hierarchy

determined by the syntactic structure proper and the ultimate morphophonological form. However, in the unmarked case, individual morphemes are still expected to exhibit a corresponding correlation with the structure and interpretation of the clause; the additional operations introducing deviations from this idea are marked options employed by a grammar only when necessary to accommodate otherwise unexpected data. Syntactic and morphological structure are interrelated because they are, fundamentally, the same thing.

Many variations on the syntacticocentric approach occupy the non-lexicalist spectrum between these two extremes; one feature they tend to have in common, however, is a relatively elaborate functional superstructure in the syntactic tree. This is a natural consequence of assuming an overall one-to-one correspondence between syntactic terminal nodes and morphemes. Other clearly articulated syntacticocentric theories are represented in the work of Emonds (2000), Alexiadou (2001), Borer (2005), Baker (1996), Ramchand (2008), Travis (forthcoming), among others; most of the above adopt the general syntacticocentric program within broadly Chomskyan syntactic theory but do not elaborate as extensively on morphophonological interface issues. See section 4 below for further discussion and exemplification of certain issues in the syntactic approach to word-formation. First, however, we briefly consider one more dimension of theoretical variation: realizational vs. projection-based approaches to morphology.

3.4 Late vs. Early Insertion theories: Realization vs. Projection and Percolation

Weakly lexicalist theories, in which at least some phonological spell-out of word forms follows the syntactic derivation, were dubbed 'realizational' by Anderson (1992), since morpholexical rules simply 'realize' the morphological and morphosyntactic

features of the grammar, rather than introducing features on their own. Beard (1995)'s Lexeme-Morpheme Base Morphology is realizational in this sense, although more radically so; *all* spell-out of both derivation and inflection, occurs post-syntactically, interpreting the morphological and morphosyntactic features associated with a stem.[11]

Realizational theories can be contrasted with 'early insertion' approaches, like the syntacticocentric proposal of Lieber (1992, 2004), where sub-word phonological exponents are treated as true Saussurean signs (what Stump 2001 refers to as *incremental* theories of morphology) For Lieber, affixes, like roots and stems, are phonological strings listed in the lexicon with particular morphosyntactic features and meanings, and are built up into complex structures whose semantics derive from the features associated with each exponent by percolation.

Distributed Morphology, in contrast, is agressively realizational, like Beard's Lexeme-Morpheme Base theory. All types of word-internal structures, inflectional and derivational, are assembled by the syntactic component. Rather than assembling actual affixes, as in Lieber's theory, the syntactic component assembles abstract feature bundles, with associated interpretations. These bundles are only provided with phonological exponence postsyntactically, when a series of Vocabulary Items relating phonological information with morphosyntactic features compete for insertion into terminal nodes of the morphosyntactic structure. The realizational character of Distributed Morphology is characterized by the term 'Late Insertion', referring to the fact that insertion of phonological exponents follows all syntactic operations. This process is illustrated with a sample derivation in section 4.2 below.

[11] See also Borer (1998: 153)'s discussion of type (2) vs type (3) models.

3.5 Typology of theories of the morphosyntactic interface

We can thus cagetorize theories of morphosyntax according to their theoretical choices on a number of dimensions. Are they lexicalist or nonlexicalist? Nonlexicalist theories have only a single structure-building component (the syntax), while lexicalist theories involve some form of generative lexicon, with a separate system of principles and operations, which builds complex word-forms, as well as a generative syntactic component that builds sentences. If a theory is lexicalist, is it strongly lexicalist or weakly lexicalist? Strongly lexicalist and nonlexicalist theories share the important characteric of treating derivational and inflectional morphology in the same component of the grammar, making use of the same theoretical machinery, while weakly lexicalist theories posit a word-formation component which treats derivation and a separate postsyntactic component which treats inflection. On the other hand, nonlexicalist and weakly lexicalist theories share the property that syntax is responsible for some or all morphological structure building. Finally, one can ask of any theory, is it realizational or Saussurean?[12]

[12] A further dimension of variation with some repercussions for the morphology-syntax interface is that between *process-based* and *piece-based* theories of morphological marking, which Stump (2001) terms *inferential* vs. *lexical* theories. This distinction depends on whether a theory views affixation as the central morphological operation, treating non-concatenative morphological processes such as ablaut as essentially incidental decoration, implemented via readjustment rules or the like. Such a concatenative view would be *piece-based* ('lexical'). The process-based ('inferential') approach, in contrast, treats affixation, ablaut, truncation, and other morphophonological markers on an equal footing, viewing all morphological marking, concatenative or otherwise, as instantiating a rewriting function that changes the shape of a stem in a specified way in a particular featural context. The debate concerning this theoretical choice, however, has been little attended to in syntactic circles, being a more purely morphological issue, somewhat orthogonal to morphosyntax. It is worth noting, however, that most syntacticians tend to think in terms of piece-based, concatenative morphology,

I now turn to a more detailed exposition of the development of syntacticocentric morphology, ultimately focussing on the non-lexicalist, realizational theory of Distributed Morphology (DM henceforth), and illustrate how typical DM analyses interact with the Minimalist syntactic architecture within which they are couched. The combination of Distributed Morphology and Minimalist syntactic theory allows the development of fully articulated analyses in which the mapping from syntax to both morphophonological form and to logical form can be (though often isn't) quite fully specified. Significant theoretical problems nonetheless remain, of course, but the attraction of a fully-integrated system, in which morphological considerations have clear implications for specific syntactic and even model-theoretic semantic analyses, and vice versa, should be clear.

4. Syntacticocentric morphology

4.1 Brief history within Chomskyan linguistic theory:

The line of syntactic analysis pursued in generative linguistic theory has undergone considerable alteration on many separate occasions, and the generative view of the relationship between syntax and phonology is no exception. The framework in *Syntactic Structures* was non-lexicalist (proposing, e.g. the Affix Hopping transformation to attach English verbal suffixes to their hosts), as was the generative semantics approach which emerged in the late sixties and early 70s (see, e.g. McCawley 1968), in which complex multiclausal structures could be collapsed via Predicate Raising and spelled-out

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and hence most syntacticocentric morphological theories adopt this kind of view. If one's morphological component is realizational and postsyntactic, however, there is no technical obstacle to adopting a process-based/inferential approach, e.g. like that of Anderson (1992).

as a single morphological word. Partially in reaction to such proposals, Chomsky 1970 argued that certain derivational processes, such as nominalization, must occur in the pre-syntactic Base component, ushering in an era of Lexicalism within generative grammar. A strongly Lexicalist architecture, including an argument-structure-manipulating word-formation component as well as the syntactic component, was broadly adopted within generative grammar until the late 1980s; perhaps the most comprehensive proposal concerning the properties of that word-formation component and its interaction with syntax is put forward in DiSciullo and Williams 1987.

At this point, two lines of research conspired to suggest that a nonlexicalist framework was perhaps better suited to capture certain properties of the syntax-morphology interface. Within Government and Binding theory, the work of Baker 1985, 1988 played a central role in this development. He showed that morphological structures 'mirrored' syntactic structures in languages where morphological reordering is possible (Baker 1985). Consider, for example, the following two sentences from Hiaki:

(18) a. Maria-ta=ne uka uusi-ta bwik-tua-sae.
Maria-ACC=1sg.NOM the.acc child-ACC sing-CAUS-DIR
"I am telling Maria to make the child sing."

b. Maria-ta=ne uka uusi-ta bwik-sae-tua
Maria-ACC=1sg.NOM the.acc child-ACC sing-DIR-CAUS
"I am making Maria tell the child to sing."

Depending on the order of affixation of the directive and the causative suffixes, the nominative first person subject is interpreted as the director or the causer, respectively, in precisely the same way that the periphrastic English translations vary in interpretation depending on the embedded or matrix position of the corresponding verbs. Based on similar facts concerning the relative scope and order of argument-structure affixes in

various languages, Baker argued that the theory must explain why morphological structure should so closely track syntactic structure and semantic interpretation; identifying morphological and syntactic structure provided one way to do that.

A related line of work was developed in 1984 by Lisa Travis. She observed that in structures where heads appeared undergo reordering with other syntactic constituents, (English auxiliary movement in question formation, for example), that reordering seemed to be subject to a rigid structural constraint, namely that it was limited to movement to the closest c-commanding head, being unable to skip any intervening c-commanding head. (Such skipping would result in an XP intervening between the moved head and its trace, creating an ECP violation). The properties of what Travis called the Head-Movement Constraint showed that head-movement was sensitive to the same kinds of constraints and structural relations as phrasal movement.

The clinching development was Baker's employment of head movement to derive noun-incorporation and verbal complex predicate structures in Mohawk and other languages. Baker pointed out that noun incorporation in Mohawk was limited to incorporation of a direct object argument into its governing verb:

(19) Owira'a waha'-wahr-ake' (Baker 1988)
Baby Agr-meat-ate
"The baby ate meat."

Incorporation of an external agent argument into the verb are ungrammatical in Mohawk. Baker pointed out that if noun-incorporation structures were created from a syntactic representation by head-moving independent morphemes, Travis's Head Movement Constraint allows the agent-incorporation restriction to be explained syntactically. The explanation went essentially as follows: Because the trace of head-movement is subject to

the ECP, like other traces of syntactic movement, ungoverned traces result in ungrammaticality. Subject noun incorporation, moving 'down' to incorporate into a verb which the subject c-commands, would leave such an ill-formed, ungoverned trace.[13]

The corollary, of course, is that the approach also provided a way to derive the Mirror Principle. If syntactic head movement assembles independent morphemes, obeying strict locality constraints, the Mirror Principle is predicted. The linear order of morphemes should match their position in the syntactic hierarchy, since the former are derived by head-movement of the latter, which must always be stepwise and upwards in the tree, due to the Head Movement Constraint. Consequently, variation in the order of morphemes as in the Hiaki example (18) above is predicted to reflect a variation in the syntactic structure which generated them, and hence is predicted to correlate with a variation in the interpretive scope of the various morphemes at LF.

The combination of Travis's and Baker's proposals showed that treating certain complex morphological forms as syntactically derived could result in compelling accounts of some patterns of ungrammaticality in word-building, such as the ban on Agent incorporation. At least some word-formation processes, besides sharing a common vocabulary of categories with syntax, seem to be subject to independently motivated, purely syntactic locality constraints, and are sensitive to purely syntactic structural

[13] This formulation is not without problems, as pointed out by, e.g. Borer (1998: 168); head-movement of a verb past the position of base-generation of the subject will result in government of the subject by the verb, hence predicting the possibility of incorporation of the subject into the verb in its higher position. In ECP-less theories of locality and economy constraints, however, this problem may not arise, as locality is defined with respect to the initial Probe-Goal relationship, not with respect to the well-formedness of the empty category resulting from movement.

relationship such as c-command.[14] Consequently, the approach represented an explanatory advance over the postulation of independent mechanisms for the two. Once Rizzi (1990) unified the locality constraints on all three types of movement (head, A and A') with the idea of Relativized Minimality, the era of economy-driven Minimalist syntactic architecture was ushered in.

4.2 Distributed Morphology

Distributed Morphology (Halle and Marantz 1993) is a syntacticocentric, realizational, piece-based, non-Lexicalist theory of word (and sentence) formation. A Minimalist syntactic component constructs complex hierarchical representations from meaningful and syntactically atomic abstract items, such as $[+pl]_{Num}$, $[+def]_{D}$ $\sqrt{CAT}$, $[+past]_{T}$, etc. These elements have selectional and featural requirements which must be satisfied in order for any representation containing them to converge at the interfaces with the sensory/motor apparatus and the conceptual/intentional apparatus-that is, at PF and LF, respectively. The abstract items undergo Merge, Move and Agree operations, incrementally forming larger and larger syntactic structures, until some pre-determined point at which Spell-Out occurs. The complex structure is then sent to Spell-Out-shipped off for interpretation at the interfaces, both PF and LF. It is the interface with PF that concerns us here.

4.2.1 Late Insertion, the Elsewhere Principle and Positions of Exponence

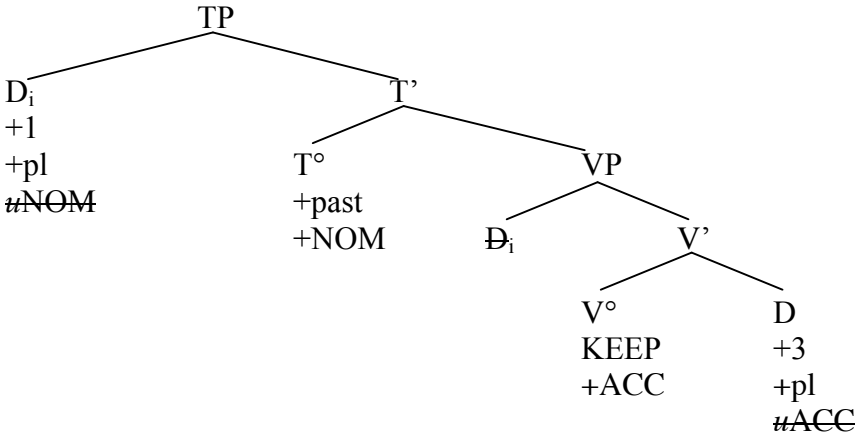
[14] In what I consider to be an important precursor to the Minimalist Bare Phrase Structure theory, with its emphasis on the Merge relationship, Roeper and Siegel (1978) showed that the availability of a syntactic sisterhood relationship was the most accurate predictor of incorporation in English synthetic compounds.

Let us consider a simplified sample derivation of a sentence in Distributed Morphology. Imagine an initial Numeration, input to the syntactic feature-building operations, consisting of abstract feature bundles such as those listed in (20):

(20) { [$_{D}$+1,+pl, *u*NOM], [$_{T}$+past, +NOM], [$_{D}$+3, +pl, +ACC], [$_{V}$KEEP, *u*ACC] }

The syntax merges and moves these feature bundles to create a syntactic tree in which all the necessary feature-checking has been accomplished. For example, the uninterpretable Nominative case feature on $[+1, +pl]_{D}$ has been valued and deleted under an Agree relationship with the T° head; similarly the uninterpretable Accusative case feature on [+3, +pl] has been valued and deleted under Agree with the transitive verb.[15]

(21)



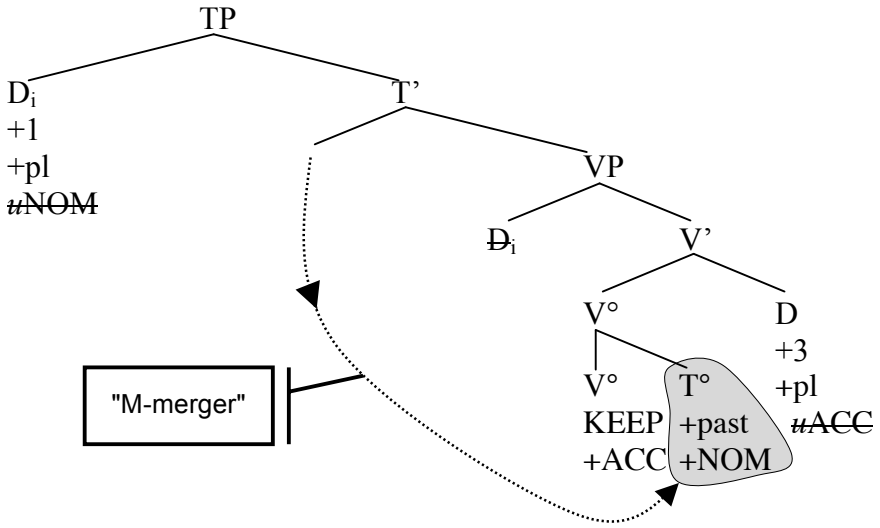
The (simplified) tree in (21) is then handed off to Spell-Out, for interpretation at both LF and PF. At LF, the denotations of the abstract elements from the Numeration are accessed and composed into an interpretable representation via a finite set of licit composition operations—function application, predicate modification, type-lifting, and possibly

[15] This structure and operation in particular has been considerably simplified: the VP in this tree corresponds to a complex phrasal structure including (minimally) an active VoiceP in the full analysis; it is this Voice° head which in fact is assumed to bear the structural accusative feature which checks the object's uninterpretable Case feature. See, e.g. the discussion of Kratzer (1996) below.

others; each binary constituent is interpreted by composing the denotations of its daughter constituents.

Analogously, at PF, certain purely morphological operations apply to transform the abstract syntactic hierarchical structure into a linear string of phonologically interpretable segments. Certain operations can apply to the morphological terminal nodes to adjust their content or position: Impoverishment, Fission, and Fusion, among others. "Morphological Merger" is another example of such a postsyntactic operation. In English, the [+past] and [+present] T° nodes are ill-formed as free words on their own, so a morphological repair operation of M-merger[16] applies prior to phonological realization. It attaches the T° terminal node to the V° terminal node, a modern implementation of Chomsky (1957)'s Affix-hopping operation, illustrated below:

(22)



This operation, by hypothesis, is sensitive to adjacency in the hierarchical syntactic structure, so, for example, if a Neg° head intervenes, or if T° has head-moved to the C°

[16] Here I will not distinguish between Local Dislocation and Lowering; see Embick and Noyer (2001, 2006) for discussion and motivation of the difference. M-merger is called "Merger Under Adjacency" in Bobaljik (1994).

position, it cannot occur, and instead an alternative morphological repair applies, involving insertion of a 'dissociated' V° terminal node to support T° ('do'-insertion, see Bobaljik 1994).

At this point, the structure is ready for phonological material, and Vocabulary Insertion can occur. Each terminal node in the syntactic structure has an associated *position-of-exponence*, which must be discharged by insertion of a Vocabulary Item. To accomplish this, a list of phonological pieces is accessed. These pieces, termed Vocabulary Items, are pairs of phonological and morphosyntactic information. Crucially, the morphosyntactic information can be underspecified: A Vocabulary Item's morphosyntactic features must be a subset of the features in the terminal node it realizes: it can have fewer features than the terminal node, for example, but it cannot have more features than are present in the node, or conflicting features. During the Vocabulary Insertion operation, all Vocabulary Items which are compatible with the terminal nodes of the representation under consideration compete to realize the available positions-of-exponence. In keeping with Kiparksy's (1973) Elsewhere principle, only the most highly specified VI will be inserted and discharge the position of exponence.[17]

So, for example, assuming that the VI *we* (/wij/) is specified for [+1, +pl, +nom], and the VI *I* (/aj/) is specified for [+1, +nom], both will be compatible with the terminal node of the D° head in subject position in our toy derivation, and both will compete for insertion at that node. However, *we* will be inserted, blocking *I*, as it is more highly specified. Let us assume the following Vocabulary Items and feature specifications:

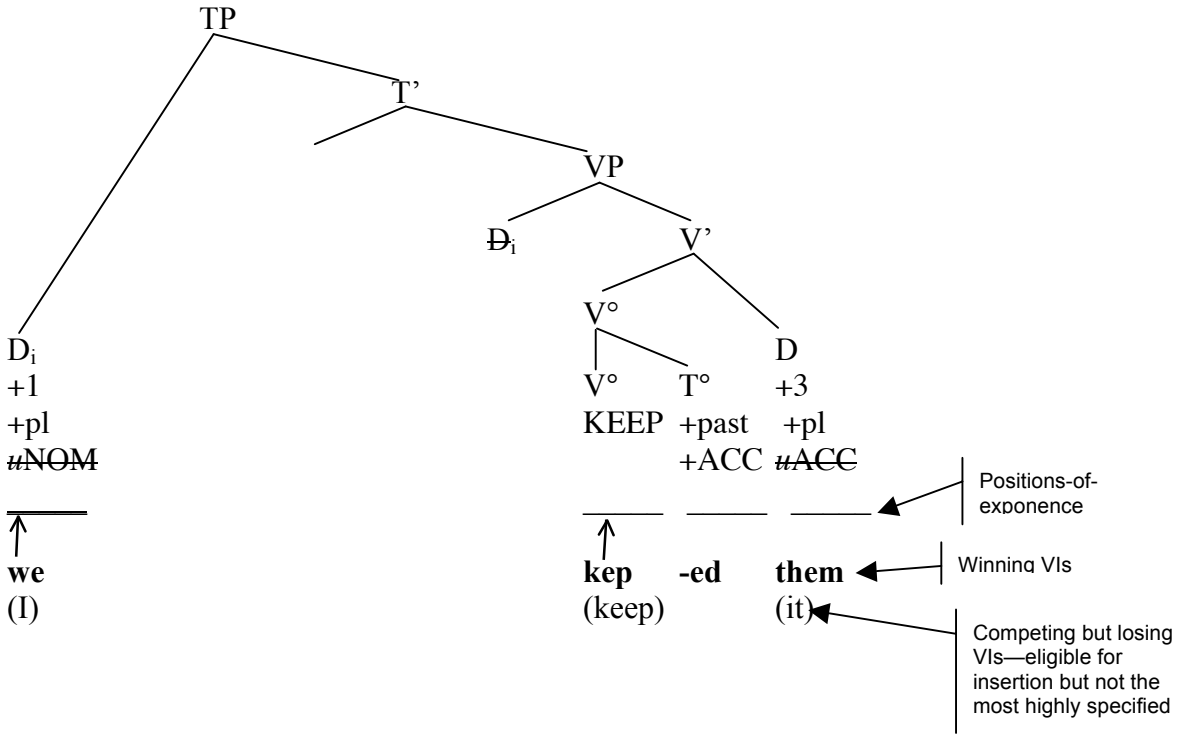
(23) a. we ←→ [+1, +pl, +nom]

[17] Though see Caha (2009) for an interesting alternative formulation of competition in terms of a *superset* principle.

b. I ←→ [+1, +nom]
c. them ←→ [+3, +pl, +acc]
d. it ←→ [+3]
e. kep- ←→ [KEEP] / ____ [+past]
f. keep ←→ [KEEP]
g. -ed ←→ [+past]

The Vocabulary Items *I, we, it, kep-, keep, -ed,* and *them* are all compatible with the available positions, but only the most highly specified VI at each slot succeeds in actually realizing the terminal node.[18] The competition is illustrated at the bottom of the tree.

(24)



Following Vocabulary Insertion, then, the representation includes a hierarchically organized linear string of phonogical segments which can then be interpreted by the

[18] In earlier Distributed Morphology proposals, lexical items like KEEP would have been treated as undifferentiated roots, acquiring both Encyclopedic content and phonological content at the Late Insertion operation. However, later argumentation, notably that presented in Pfau (2009), suggests that roots must be differentiated in the syntactic component. This allows me here to treat the irregular past stem *kep-* as a competing allomorph of *keep*, rather than with a morphological readjustment rule; see e.g. Siddiqi (2009) for discussion of this and other alternatives.

phonogical component, undergoing phonologically conditioned allomorphy (in this case, past tense [d] will be devoiced to [t] in the environment of voiceless [p] by virtue of the phonotactic requirements on English complex codas), stress assignment, phrasal phonology and reduction processes.

The approach allows a natural account of mirror principle effects, while still providing mechanisms which permit structures to surface in which the mirror principle fails to hold. It provides an explicit account of the relationship between syntax and morphology, and most it calls for only a single generative engine — it requires no special word-building mechanisms in the lexical component. That is, there is no need for a separate level of paradigmatic structure to generate inflected and/or derived word forms, or to capture the blocking effect. Further, it should be clear that the syntactic Agree operation of Minimalist theory, being subject to locality constraints, will make clear predictions concerning the possible positions and featural content of terminal nodes in the structure. The mechanisms by which inflectional morphology is interpreted, positioned, and realized in the theory, as well as the relevance of syntactic operations for morphological form and vice versa, should be clear. For more explict discussion of many of the details, see Embick and Noyer (2006) and references cited therein.

4.3 High/low derivation and the Elsewhere principle

One of the most productive types of analysis that has emerged from the above research program focusses on word-formation on the idiosyncratic/productive cusp. Individual derivational affixes can be very polyfunctional, instantiating what seem to be distinct but related processes. English *–ed*, for example, forms adjectives, verbal passives

and perfective participles as well as the past tense. The *–ing* suffix generates deverbal nouns, gerunds, and the progressive participle. Japanese *–sase* can generate both lexical causation in inchoative/causative pairs and productive causation in other contexts. Typically, the domain of application of such polyfunctional morphology is broader in some of its functions than others; *-sase*, for example, can generate a productive causative from almost any independent verb stem, but is blocked from forming lexical causatives with many inchoative verb roots by irregular causative suffixes specific to a small class of roots. English adjectival participles are more irregular than English passive participles, e.g. adjective *molten* vs participle *melted* and adjective *open* vs participle *opened*, so regular *-ed* has a narrower domain of application in the former than the latter.

In modern syntacticocentric approaches, this pattern in which one affix can span the derivational/inflectional divide in a series of increasingly productive functions can be analyzed as involving the lower or higher attachment of a head containing the relevant conditioning feature in the extended projection of a given category. The mechanism of morphological competition means that polyfunctional lexical item can be treated as the 'elsewhere', most underspecified vocabulary item which realizes that feature. Consequently, that item will realize that same feature in multiple different syntactic contexts, when it is not blocked by a more specific, locally conditioned vocabulary item. The lower in the tree, closer to the lexical root, the greater the likelihood of both semantic and morphological irregularity and the more 'lexical' the alternation; the higher in the

tree, the more functional structure intervening between the relevant node and the lexical root, the more productive and regular the alternation.[19]

In the case of higher attachment we expect to see evidence of the presence of these functional projections in the form of syntactic and semantic properties associated with the functional categories which are included in the derived form, and we expect the absence of such properties in the low-attachment forms. An example of an early proposal of this type is Kratzer (1996), in which Abney's distinction between of-*ing* and acc-*ing* gerunds in English is reinterpreted as an argument concerning the locus of attachment of the *–ing* suffix. In Kratzer's proposal, there are two separate projections in the syntax of the VP: the VP itself, which selects for the internal argument, and a higher VoiceP, which introduces the external argument and is responsible for the assignment of accusative case to the object. Kratzer proposes that *–ing* can attach high, to the VoiceP projection above the VP, or lower, to the simple VP, and that this variation in size of the complement of *–ing* accounts for the variable presence of accusative case: The subject noun phrase in *Mary's reading Pride and Prejudice upset Bill* involves an *–ing* attached outside VoiceP, so accusative case is available for the object DP *Pride and Prejudice* within the nominal, while the *–ing* attaches low, to the VP, in *Mary's reading of Pride and Prejudice upset Bill*. In the latter case, although the verb in the VP is able to select for its internal argument *Pride and Prejudice*, there is no accusative case available due to the absence of VoiceP in the internal structure of the nominal; a Last Resort operation thus must insert

[19] If the syntactic derivation proceeds in phases, and the contents of a lower phase are indeed inaccessible to the contents of higher phases at the point of Spell-Out and vocabulary insertion, then conditioning of irregular morphology by the lexical root is predicted to be impossible across a phase boundary. See Embick (2010) for development of this idea.

of to inherently case-mark the object. The same pieces of morphology is inserted into both the higher and lower nominalizing heads, as no more specific nominalizer is present to block its insertion in one or the other environment, but the resulting forms have importantly distinct properties.

For high/low attachment analyses of participial, nominalizing and causativizing morphology in a variety of languages, see Miyagawa 1994, 1998, Marantz 1997, Travis 2000, Embick 2004, Fortin 2004, Jackson 2005, Alexiadou and Anagnostopoulou 2005, Svenonius 2005, among others.

4.4 Hybrid approaches: Borer

Despite the productivity of the conceptual framework described in the previous section, important problems remain, which certain types of alternative approaches are to date considerably more adept at accomodating. For example, the important contrast between Argument Structure deverbal nominals and morphophonologically identical Result nominals identified by Grimshaw 1990 is difficult to account for purely in terms of high vs. low attachment of nominalizing morphology. AS nominals, as in *The Romans' destruction of the city took three days*, exhibit a number of verbal properties, including mandatory selection of internal arguments and rich event-structural semantics; R nominals, as in *The destruction was extensive*, on the other hand, exhibit no such properties, despite having identical word-internal structure (*[[de-struct]-ion]*).

Particularly difficult for the DM approach to account for are R nominals which contain overt verbal morphology, such as *nominalization*: $[[[[\text{nomin}]_{\sqrt{}}\text{-al}]_{a}\text{-iz}]_{v}\text{-ation}]_{n}$. These nominals are systematically ambiguous between an AS reading (as in *Frequent*

nominalization of verbs is typical of academic writing) and an R reading (as in *That nominalization bears stress on the penultimate syllable*). As pointed out by Borer 2003, Ackema and Neeleman 2004 and Alexiadou 2009, these structures pose a significant problem, in that they contain overt verbalizing morphology (*-ize*). In DM, since each morpheme realizes a syntactic terminal node, the mere presence of *–ize* should definitively diagnose the presence of verbal structure. However, on the R reading of such nominalizations, no verbal syntactic structural properties are present; that was the crucial result discovered by Grimshaw (1990).

Borer argues that this type of alternation can be handled more perspicaciously in a model in which the same primitives can enter into word-formation operations either pre-syntactically or in the syntax proper. That is, a lexical mechanism of word formation is available in the grammar alongside with the syntactic mechanism. This parallel model is a natural development of earlier approaches to the kind of high/low attachment data described in the previous section. Earlier approaches characterized this kind of variation in terms of affix attachment to lexical items vs. affix attachment to phrases, as in the treatments of adjectival vs verbal passive forms proposed in Jackendoff 1977 and Borer 1984. The hybrid morphological system proposed in Borer 1991, 1998, called Parallel Morphology, develops this line of thought.

In the Parallel Morphology framework, lexical entries (affixes and roots) can participate in structure-building operations in two ways. They may be assembled into words presyntactically, in a word-formation component which does not involve projection of any phrase-level constituents. The output of this presyntactic structure building enters the phrasal syntactic derivation just like any other word-form, lacking

complex internal syntactic structure of any kind. Thus, the R nominalization *nominalization* can enter the syntax as a head of category N, and subsequently projects and behaves just like any other N element, mono- or multi-morphemic.

Alternatively, individual affixes can enter the syntax independently, generating phrasal projections just like any other syntactic terminal node, and getting assembled into complex multimorphemic words like *nominalization* via syntactic mechanisms, such as head-movement.[20] In that case, each root and affix will project a syntactic XP, and the syntactic selectional requirements associated with each root and affix will need to be satisfied. Hence, the presence of a verbal VP projection headed by *–ize* entails that AS nominals will need to satisfy verbal selectional restrictions, resulting in the mandatory presence of the syntactic arguments of the verb, and the interpretive effects associated with VP functional structure are predicted to be present, producing the event-structure semantics of such forms. Insofar as high/low attachment analyses have merit, they are certainly still implementable in Parallel Morphology terms, with the additional option of deriving complex words presyntactically as well.

For a full discussion of some of the above issues, including the nature and interpretation of the verbal functional structure which may be contained within nominalizations, see Alexiadou 2010.

5. Conclusion

The above discussion can only hope to scratch the surface of the active research questions concerning the morphology-syntax interface, providing some pointers to

[20] or via postsyntactic mechanisms like M-merger.

relevant recent work and a rough overview of the rapidly evolving theoretical terrain. It should be clear, however, that there are some enduring and recurring themes, particularly concerning the difference or lack therof between syntactic and morphological structure-building—the difference between lexicalist and non-lexicalist approaches. Empirical and methodological advances of recent years, however, may help shed new light into these dark corners. One development of primary importance is the explosion of theoretical research on lesser-studied and typologically distinct languages over the past decade or more. Many assumptions about the word/phrase distinction have had to be abandoned that in retrospect turned out to only be valid with respect to English and typologically similar languages. The upshot of this influx of new empirical insight is that some strongly Lexicalist and strongly non-Lexicalist approaches are rather surprisingly converging on similar architectures, in that more and more syntactic structure-building is accomplished in the lexical component of Lexicalist approaches like HPSG, and we have seen that non-lexicalist approaches like DM are moving more and more or even all morphological structure-building into the syntactic component. When syntactic and morphological structures are both being assembled with the same generative mechanism, the problem of the syntax/morphology interface has been handled in a reductive way – namely, there is no such interface; syntax and morphology are two names for the same thing.

Another development which has the promise to strongly inform our future understanding of the syntax/morphology relationship is the increasing use of psycholinguistic methodologies to probe the time course of on-line morphological processing and production, and the increasing recognition of the relevance of such research to theoretical questions. Of course such methodologies have been in use for

several decades, and have yielded considerable insight already (not even touched on above, unfortunately). However, as theories come to make more and more fine-grained predictions, it is possible that such methodologies will become indispensable in deciding between alternative hypotheses; self-guided introspection about well-formedness becomes increasingly unreliable. And such methodologies are becoming more and more portable and accessible, enabling researchers to use these tools to study languages that are not easily accessible within the university laboratory context—many of which, as noted above, have typological properties that promise to shed considerable new light on the morphology/syntax interface. I look forward very much to watching the state of the art evolve over the coming decade.

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