The Status of Heads in Morphology

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Summary

Headedness is a pervasive phenomenon throughout different components of the grammar, which fundamentally encodes an asymmetry between two or more items, such that one is in some sense more important than the other(s). In phonology for instance, the nucleus is the head of the syllable, and not the onset or the coda, whereas in syntax, the verb is the head of a verb phrase, rather than any complements or specifiers that it combines with. It makes sense, then, to question whether the notion of headedness applies to the morphology as well, specifically, do words — complex or simplex — have heads that determine the properties of the word as a whole. Intuitively it makes sense that words have heads: a noun that is derived from an adjective like *redness* can function only as a noun, and the presence of *red* in the structure does not confer on the whole form the ability to function as an adjective as well.

However, this question is a complex one for a variety of reasons. Whilst it seems clear for some phenomena such as category determination that words have heads, there is a lot of evidence to suggest that the properties of complex words are not *all* derived from one morpheme, but rather a the features are gathered from potentially numerous morphemes within the same word. Furthermore, properties that characterise heads compared to dependents, particularly based on syntactic behaviour, do not unambigously pick out a single element, but the tests applied to morphology at times pick out affixes, and at times pick out bases as the head of the whole word.

Keywords: headedness, feature-percolation, compounding, derivation, category determination, Distributed Morphology

1 Headedness and how it would apply to morphology

The distinction between heads and non-heads is an asymmetry between different elements, where a head has a superordinate role to play over the other elements. The difference between heads and dependents forms a central distinction in linguistic theory, holding across various components of grammar and many different theories within them. For instance, in many traditional theories of syntax, there exists some difference between heads and non-heads, with heads providing the 'main' information about a given phrase, and dependents providing ancillary properties and information. This is formalised in many different guises, from the X'-schema present in Government and Binding Theory

and (some versions of) Minimalism, to Head Driven Phrase Structure Grammar, as well as Lexical Function Grammar. Also in phonology, the notion 'head' has come, in some frameworks, to play a central role, such as Government Phonology and Dependency Phonology. We thus expect the same to hold within morphology: within words there should be some sub-part that is more important or prominent than others, which has the effect of donating the main information of the word. This is even more so for theories of morphology where morphology is situated very closely to the syntax, as the natural expectation is that they share a great overlap of properties.

At a first glance, the proposal that complex words are headed seems to be self-evident. Consider the following examples, involving the simplex word *person*, and the complex words formed from that base *persons, personal* and *personality*.

(1) a. There is a person at the door.
b. There are persons in the water.
c. There is something deeply personal about this.
d. Her personality is more than enough to win her admirers.

We can see that the simplex form *person* behaves as a noun. It occurs in nominal environments, such as the complement of the indefinite article, and inflects for plurality like other nominals.[1] The derived form *personal*, is by way of contrast an adjective. In (1c), the environment for *personal* is clearly adjectival: whilst *deeply* modifies either adjectives or verbs, in the frame *something deeply X about this*, position X can only be filled by elements that are clearly adjectival, but not by verbal elements, compare:

(2) a. There is something deeply suspicious/fishy/worrisome about this.
b. * There is something deeply concerns/suspects/fishes about this.

Furthermore, *personal* does not inflect for either plurality, nor inflect for verbal morphology (**two personals, *she personals*).[2] Finally, with the addition of the suffix *-ity*, *personality* behaves once more as a noun. The complement of possessives like *his* is clearly a nominal environment, and once more *personalities* inflects for plural like other nominals of English (*multiple personalities*).

The patterns in (1) are not surprising or novel in any way. That the addition of derivational morphology can change the category of a word is one of the basic insights of morphology. The standard explanation, that will be outlined in more detail in section 2 is as follows. The base *person* has the category NOUN. The suffix *-al* has the category ADJECTIVE, and is specified to attach to nominals with the resulting combination being an adjective. Finally, the suffix *-ity* has the category NOUN, and attaches to adjectives, with the resulting combination being a nominal. This is diagrammed in the following:

(3) a. [person$_{N}$]$_{N}$
b. [[person$_{N}$]$_{N}$ al$_{ADJ}$]$_{ADJ}$

c. [[[person$_{N}$]$_{N}$ al$_{ADJ}$]$_{ADJ}$] ity$_{N}$]$_{N}$

Of interest, however, is the fact that it is seemingly only the outermost specification that matters. For instance, although *personal* contains a nominal base, it cannot occur in a nominal environment. In the same way, though *personality* has an adjectival structure inside it, it cannot occur in an adjectival environment:

(4) a. * His personal is grating.
b. * There is something personality about all this.

There are two insights that can be taken away from this. Firstly, there is one element in the word that donates its category to the complex word as a whole, and as such can be considered the head of the construction. Secondly, *only* the features of the head element seem to matter. Though *personality* contains adjectival structure, this is not enough to license it to appear in an adjective environment. Put another way, only the features of the head are inherited by the complex word, at least in this simple example. As will be clear throughout the remainder of this article, things are more complicated than these examples suggest, but they serve to illustrate the point: in a complex word where there are multiple affixes that all bear some feature F (feature being somewhat broadly defined to include categories), there will be one affix that is more prominent than the rest, and as such, can be considered the head. Thus we see the asymmetry between heads and non-heads: heads are superordinate to non-heads.

This chapter is organised as follows. The discussion begins in sections 2 and 3 with consideration of an influential line of research, that there is some operation of percolation, where the features of individual morphemes percolate through the structure and define the features of the complex word as a whole. The discussion will mostly centre around the issue of category determination, but also consider other features. The focus will be the highly influential approach of Williams (1981) (section 2) who argues that the head of the word is the rightmost morpheme in the word. Section 3 explores some proposals that emerge in light of challenges that Williams (1981) faces, and how they can be addressed whilst maintaining a percolation based framework. In slightly different ways, these maintain the view that the head can be defined positionally during the word. In section 4, further properties are discussed that heads ought to show, mostly through discusion of what characteristics syntactic heads show, and how these apply to the morphology. It will be shown that many of these diagnostics are either inapplicable in the morphology, or they fail to identify the same morpheme as in Williams' and Lieber's work.[3] Section 5 discusses how the concept of headedness, and the properties outlined earlier in the paper, fit in to the theory of Distributed Morphology (Halle and Marantz, 1993). Section 6 concludes.

As we proceed through the paper, the reader should bear in mind that the aim is not a comprehensive overview of work on heads and head properties in morphology. This task would be far too large to accomplish in a single chapter. Rather, attention is focussed to

a few relevant issues that serve well the issues surrounding the status, and identification of heads in morphology.

2 Category Determination and the Right-hand Head Rule

In research that considers the issue of category determination, a number of approaches have been developed which attempt to explain how a complex word comes to have just one overall category. Underlying various these approaches is the idea that there is a general operation of *percolation*: the features of a non-terminal node in the tree are inherited from the elements that it dominates.

Before discussing percolation in morphology, we illustrate the workings of percolation with X'-Theory from syntax. X'-Theory states that there is a phrase structure that is common to all syntactic projections:

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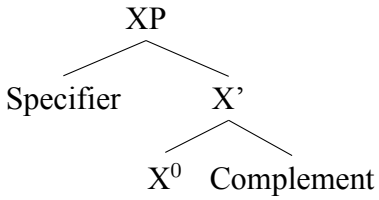
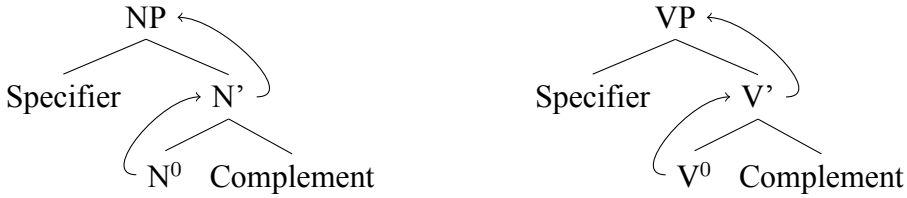


In the diagram above, X serves as a variable. In X'-Theory, syntactic phrases receive the label NP, DP, VP, PP etc. depending on what the head of the element is. Thus, the head of an NP is N^0, the head of VP V^0, and so on. Importantly, there is a general schema for syntactic phrases, and the label of the variable X is percolated up through the tree, as an element of category X^0 is in the head position.

(6)



Percolation then simply refers to the ability of features to move through the tree: features on nodes are inherited from the structure that the nodes dominate. Effectively, the properties of a complex structure should be only the properties of the terminal nodes of the structure. However, we can see that there is an asymmetry in X'-Theory: only the category of the head position percolates. Thus, the combination of a verb and a NP complement is V, and not V and N.

2.1 The Right-hand-Head Rule

One of the most famous attempts to identify what would constitute the head of a word comes from Williams (1981), who argues that the rightmost morpheme of the word is the head of the word, a conclusion that holds at least for English.

(7) Right-hand Head Rule (RHR)
The head of the word is the rightmost morpheme in the word

The RHR rule garners quite a lot of support from a variety of places, and does not just hold for English. Williams bases most of his argumentation on what element determines the category of the word. Generally, with some counter-examples that we will discuss below, this appears to be the rightmost morpheme in the word. For English, the pattern is very robust, and we give a couple of examples below:

(8) a. [[drive$_{V}$] er$_{N}$]$_{N}$
b. [[[person$_{N}$] al$_{Adj}$] ise$_{V}$]$_{V}$

The RHR is also seen in compounding. Generally — again, with a few counter-examples discussed in section 2.2 — the rightmost member of a compound determines the major categorial and inflectional features of the compound as a whole.

Member 1	Category	Member 2	Category	Overall
tennis	Noun	court	Noun	Noun
black	Adj	board	Noun	Noun
long	Adj	shot	Noun	Noun
over	Prep	dose	Verb	Verb

Table 1: Category determination in English compounds

Furthermore, it is not just the category that is determined by the rightmost element, but the inflectional features of word as a whole. English is rather uninteresting in this domain, lacking inflection beyond number, however, looking beyond English, we can see clear effects of the RHR in determining inflection. In particular, clear patterns arise in languages with grammatical gender. Firstly, consider Dutch, a language with two genders, common and neuter. Like its close neighbour German, the gender is not expressed through a suffix on the noun, but rather through the shape of the determiner. Common nouns like *kikker* and *uil* combine with the definite determiner 'de' whilst neuter nouns like *monster* and *huis* combine with the definite determiner 'het', as shown in the following.

(9) a. *de kikker* 'the frog'
b. *de uil* 'the owl'

c. *het monster* ‘the monster’

d. *het huis* ‘the house’

Dutch also has a highly productive system of diminutive formation, with some allomorphic variant of *-tje* used (see van der Hulst, 2007 and references therein on the conditioning of the allomorph). Interestingly for our purposes, irrespective of what the diminutive morpheme attaches to, the result is always a noun with neuter gender. That is, all of the forms that are suffixed with the diminutive combine with ‘het’, and not with ‘de’, regardless of what determiner the base would otherwise combine with (compare (9a) with (10a)). Furthermore, the diminutive can combine with other categories, like the preposition in (10c), but the result is consistenly a noun that combines with ‘het’:

(10) a. *het kikker-tje* ‘the frog-DIM’

b. *het monster-tje* ‘the monster-DIM’

c. *het ommetje* ‘a short walk’ (lit. the about-DIM)

This pattern is explained in the following way. The diminutive in the above forms is the rightmost morpheme in the word, thus should determine the category and inflectional information. If we assume that the diminutive suffix has the catogory N and the gender specification [+Neuter], then we straightforwardly derive the facts in (10).[4]

The same effects for inflectional morphology are found in compounding too. Sticking with Dutch, Table 2 shows that the category of the compound as a whole is determined by the rightmost member of the entire compound, see Don (2009) for further discussion.

Member 1	Category	Member 2	Category	Overall	Gloss
vlees	N	soep	N	N	‘meat soup’
speel	V	veld	N	N	‘play field’
snel	Adj	trein	N	N	‘fast train’
steen	N	rood	Adj	Adj	‘stone red’
drijf	V	nat	Adj	Adj	‘soaking wet’

Table 2: Category determination in Dutch compounds

Regarding what inflectional features the compound has as a whole, this too is determined by the properties of the rightmost member. This is illustrated in Table 3 with German, a language with three genders, masculine, feminine and neuter.[5]

It is worth noting that certain plural formations in English are irregular, in that the noun does not combine with one of the regular plural suffixes (orthographic *-s*), but rather through a change to the vowel in the stem. Such alternations, though they show certian sub-regularities (for instance through analogy), are irregular and phonologically

Member 1	Gender	Member 2	Gender	Overall	Gloss
Raub	M	Kopie	F	F	'pirate copy'
Buch	NT	Laden	M	M	'book shop'
Not	F	Arzt	M	M	'emergency doctor'
Brief	M	Papier	NT	NT	'writing paper'
Konto	NT	Nummer	F	F	'account number'

Table 3: Gender determination from the rightmost element in German compounds

unpredictable. Examples are *foot∼feet, goose∼geese* and *tooth∼teeth*. Perhaps unsurprisingly in the context of the RHR, when these words appear as the head of a compound, plural formation of the compound as a whole is irregular. That is, the final member shows up in the irregular plural form, and the compound as a whole does not take plural morphology.

(11) a. false teeth
b. maple leaves
c. desert cacti

Thus, under Williams' RHR, we see that there is a clear asymmetry between the rightmost morpheme in a word and all others: it is only the rightmost morpheme that donates the category and inflectional features of the word, and as such is superordinate. The rightmost morpheme is therefore the head of the word.

2.2 Counter-examples to the RHR

Though Williams' approach is successful in a large number of cases, it is not without problems. Williams himself notes two types of exceptions to the RHR. Firstly, there are items that are *exocentric*, in that they contain no overt element that can be plausibly classified as the head of the item.

(12) a. This was just a **shakedown**
b. He did a **push up**

Exocentric compounds like these are found not only in English, but there are many instances of them across languages. In contrast to the endocentric compounds that we saw above, in exocentric compounds where the rightmost member would form an irregular plural, the plural marking for the compound is regular.

(13) a. The Toronto Maple Leafs
b. Sabre tooths used to roam the earth long before the evolution of the modern tiger.

This is presumably since these compounds lack a head, and as such, plural marking reverts to a regular default. What these exocentric forms show is that if we take Williams' rule to correctly characterise the head of a word, then we also have to recognise that it is not *necessary* that words have heads, but rather a preference to do so. If this is true, then we cannot say that the head of a word is always the rightmost element. Williams' condition would need weakening to say that *if* there is a head, then it is the rightmost element.

The second type of exception comes from words where, in English, the left element of a word appears to be the head. Williams notes that the prefix *en-*, which derives verbs from nouns (and adjectives) is an example of this.

(14) N → V
   a. rage → enrage
   b. dear → endear

Note that the prefixes are clearly heads here, since they determine that the whole form can combine with further affixes. Normally, *dear* cannot combine with *-ment* (**dearment*), yet this is possible after prefixation of *en-* (*endearment*). Williams calls this property 'potentiation', and claims it to be characteristic of heads.

Lieber (1990) notes that the same types of examples can be found in German. The prefixes *ver-* and *be-* attach to nouns, adjectives, verbs and adverbs, with the outcome being a verb:[6]

(15) a. N → V
   Freund 'friend' → befreunden 'to make friends'
   b. Adj → V
   besser 'better' → verbessern 'to improve'
   jung 'young' → verjüngen 'to rejuvenate'
   ruhig 'calm' → beruhigen 'to calm (down)'
   lastig 'tiresome' → belastig 'to bother'
   c. V → V
   laufen 'to run' → verlaufen 'to go'
   lieben 'to love' → belieben 'to adore'
   d. Adv → V
   langsam 'slowly' → verlangsamen 'to slow down'

In both the English and the German examples, the prefix clearly determines the category of the derived word, since the output is always a verb. Williams concludes that examples like these are exceptions, and that they are the heads of these words in these cases. However, the mechanism by which this overrides the default assignment of headhood to the rightmost element is unclear.

In defense of the RHR, Neeleman and Schipper (1992) suggest that similar examples of apparently verbalising prefixes in Dutch (e.g. *kogel* 'bullet' ∼ *bekogelen* 'to pelt', *grijs* 'grey' ∼ *vergrijzen* 'to become grey') involve conversion of an adjective to a verb already before the prefix attaches to the structure. The conversion is carried out by a zero suffix that attaches to the root before the attachment of the prefix. A word such as *ontgroenen* 'to undergo initiation', which is formed of the adjective *groen* 'green' and the verbalising prefix *ont-* on this analysis actually has the more complex structure below:[7]

(16) [*ont* [$groen_{Adj}$ $\emptyset_{V}$]$_{V}$]$_{V}$

Such a structure allows one to retain the RHR, since the zero-affix is the rightmost affix, and is specified for being a verb. Neeleman and Schipper motivate such an analysis on the grounds of the argument structure of the complex verbs, showing that sometimes in conversion, an optional AGENT argument is added to the structure. They argue that this AGENT cannot have come from the prefix, and as such, will have been added in the process of conversion.

Lieber (1990) points out two further issues for Williams' approach: (a) transparent suffixes; and (b) the existence of left-headed compounds. If the head of the word is the rightmost suffix, then, Lieber points out, on the strongest version of the RHR, as all suffixes are (potential) heads, we expect suffixes to be fully specified for the relevant information. The existence of a suffix that does not have certain features that it is able to percolate is unexpected. Cases like these do arise, which Lieber terms 'transparent suffixes'. She gives the example of the Spanish diminutive suffix *-ito* (citing Jaeggli, 1970), which can attach to both adjectives and verbs. The category of the resulting complex form is the same as the input; that is, the complex form with the suffix has the same category as the base to which the base it attaches to. This is surprising, since we do not expect to see the base determining the category when it has a suffix as well.

(17) a. grande-sit-o 'quite large'
b. madre-sit-a 'mother-DIM-F'

As to left-headed compounds, consider examples from Vietnam in Table 4 (Lieber, 1990). Here it seems that the category is determined by the leftmost element in the compound, eg. [nha_{N} $thuong_{V}$]$_{N}$.

From these data, one might suppose that Vietnamese observes the Left-hand-Head-Rule, and that we should formulate Williams' rule as a parametric statement that languages can vary between, whose setting is guided by other characteristics of the language. Such a parameter could look like (18). It is known that languages differ from each other as to whether the head of a syntactic phrase precedes or follows its complement, and to some extent this proposal would be analagous to that, a point that will be returned to in section 3.2.

(18) The head of a word is the {leftmost/rightmost} morpheme.

Member 1	Category	Member 2	Category		Overall
nha 'institute	N	thuong 'to be wounded'	V	nha-thuong = 'hospital'	N
nguoti 'person'	N	o' 'to be in a place'	V	nguoti-o' = 'servant'	N
lam 'to do'	V	viec 'thing'	N	lam-viec = 'to work'	V
lam 'to do'	V	ruong 'rice field'	N	lam-ruong = 'to farm'	V

Table 4: Left headed compounds in Vietnamese

2.3 Interim summary

Faced with this wealth of evidence, it is clear that the RHR cannot be maintained in its strongest form as the sole predictor of what will be the head. There are then a number of possible options. Firstly, one could wish to maintain that there is a given head in the word that is defined by a certain position, but if said element is missing some specification, then there could be a system of back-up rules that will find a source for that feature. In such an approach, headedness is a task performed by committee, and not by a single element. There can be potentially numerous 'heads' in a word, that all club together to donate the relevant properties to the complex word. Secondly, one could assume that a language has multiple patterns of headedness that coexist in the grammar of the speakers, such that some elements are right-headed, whilst others are left-headed. In section 3.1 we consider the former, whilst in section 3.2 we will see evidence for this latter position. Finally, one can eschew the notion of head altogether, and assume that words are headless. This option we will consider in section 4.2.

3 Alternatives to the RHR

In this section we consider alternatives to Williams' RHR that still operate within the general purview of percolation. Our discussion involves mostly the Relativised Right-hand Head Rule of di Sciullo and Williams (1987) and the Feature Percolation Conventions of Lieber (1990), however, there are notable other approaches that operate in a similar vein, such as Kiparsky (1982a) and Selkirk (1982).

3.1 Headedness by Committee

As noted in section 2.2, there are numerous challenges to the strongest version of the RHR. Partly in response to problems such as the Spanish diminutive (17), di Sciullo and Williams (1987) propose that the RHR should be relativised to allow for other mor-

phemes in the word to pick up the slack, in case the rightmost element is missing some feature.

(19) The Relativised Right-hand Head Rule (RRHR)
The head_F of a word is the rightmost element of the word marked for the feature F.

This rule states that all else being equal, the rightmost morpheme of the word will be the head of the word as a whole, and as such, determine all the features of the word. However, in case that morpheme is missing some feature, then the value for that feature can be taken from the rightmost morpheme that bears that feature.[8] That morpheme becomes the relativised head of the word *for that feature*. Returning to the Spanish diminutive examples above (17), assuming that the diminutive suffix has no category, nor a specification for grammatical gender, then the RRHR will ensure that with diminutive suffixation, the resulting complex word will have the category and gender of the base, since this element bears these features, in contrast to the diminutive.

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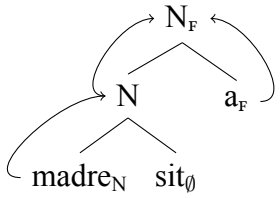
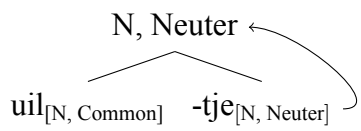


Crucially, as di Sciullo and Williams point out, this allows one to maintain some version of the RHR (i.e. the RRHR) whilst incorportating the ability to backtrack and look for another source for a feature.

A contrast between the behaviour of the Spanish diminutive and the Dutch diminutive is instructive. The Spanish diminutive, as we have seen, contains no category information nor a gender specification, and so the category and gender will percolate from elsewhere. In contrast, the Dutch diminutive is specified for both category and gender, since the result of adding the diminutive suffix is uniformly a neuter noun.

(21) a. de uil
b. het uiltje

(22)



However, it is not clear how the RRHR will fare with the variation in compounding, such as in Vietnamese. And, whilst one could explain that away by saying that there is parametric variation around the world, it is not clear how far this would expand beyond compounding.

Another approach which incorporates the ability of multiple nodes to contribute to the overall information carried by the word comes from Lieber (1990).[9] Rather than referencing the rightmost element in the word for being a head, Lieber makes crucial use of the distinction between stems and affixes, such that when an affix combines with a stem, it is — with an important qualification to follow — the features of the affix that will percolate. All else being equal then, affixes are then crucially privileged over stems for determining the properties of words. In brief, in Lieber's approach features are percolated iteratively as the structure is built, with each additional node donating its feature(s) to the overall information of a word, overwriting features of the same type that already exist in the structure. Crucially, if an item contributes a feature of a certain type, and no other element does, then no matter where in the structure this item is, that feature will percolate to the overall information of a word (i.e. it is not the case that information is determined solely by some element that is the head). Lieber defines four Feature Percolation Conventions, and the properties of words come from the interaction of these:

(23) Feature Percolation Conventions

a. Convention I (PCI)
All features of a stem morpheme, including category features percolate to the first non-branching node dominating that morpheme.

b. Convention II (PCII)
All features of an affix morpheme, including category features, percolate to the first branching node dominating that morpheme.

c. Convention III (PCIII)
If a branching node fails to obtain features by Convention II, features from the next lowest labelled node are automatically percolated up to the unlabelled branching node.

d. Convention IV (Compounds) (PCIV)
In compound words in English, features from the righthand stem are percolated up to the branching node dominating the stems.

What the conventions in (23) serve to do is to ensure that the entire word form will be composed of the features of its constituents. Let's consider first the effect of Feature Conventions I and II. Firstly, the rule for stems (23a) makes reference to non-branching nodes, and states that the features of the stem percolate to the node above it. However, when an affix attaches to a stem, it is the features of the affix that percolate upwards, per convention II (23b). The affixation creates a branching structure, and only affixes are able to percolate their features in a branching structure. Because stems project only a non-branching node above them, but affixes do not, this ensures affixes will label the structure when they are combined with a stem. Convention II also ensures that when further affixes are added to an already complex form, it is the features of the most recently

added affix that take priority; since all affixes are required to percolate their features to the first node above them. Crucially, if an affix in the structure already has percolated its features, there is no need, nor possibility, to percolate them further to higher nodes.

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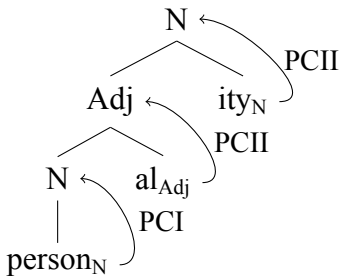
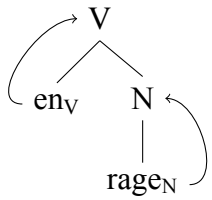
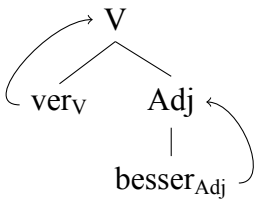


Though information in Lieber's system is percolated by all items in the structure, it will be the affix merged latest in a derivation that will, all else being equal, percolate its features. This allows Lieber to naturally account for the instances where the left element is the determinant of the category of the complex word, as in the case of category determining prefixes. All that needs to be said about such items is that the prefix bears a specification for grammatical category, and, since the prefix is an affix, it will overwrite the category information of the stem, per (23b). This is a welcome result, since we no longer need to treat category defining prefixes as being exceptions to a rule: rather, they are predicted by the system when the prefix is highest in the structure.

(25) a.



b.



Similar to, but differing in important ways from, the RRHR, Lieber's system also allows for multiple nodes to contribute to the overall information of a complex word. Convention III ensures that if a particular affix is not specified for a particular feature, the structure will look to previous nodes in the structure to one that contains said feature, and that value will be percolated once more. Lieber highlights the effect of this convention using the Latin form *dixerāmus*, which is the first person plural pluperfect of *dicere* 'to say'. Lieber proposes that the category [V] brings with it features like [±perfect] (aspect), [±present] (tense) and [αperson,βplural] for person and number. Not all of the

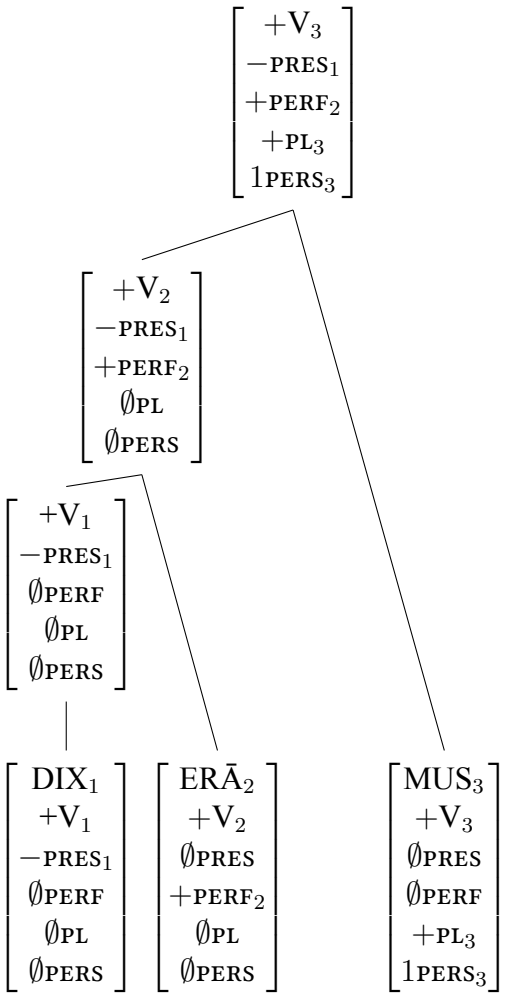


Figure 1: Percolation by committee

features are specified for each node. *Dix-* is the past stem, *-erā* the perfect morpheme, and *-mus* first person plural. In Figure 1, we show the feature percolation derivation for the example as a whole, indicating which features come from where by means of subscripting. The person and number features are added by the highest affix *-mus*, as expected by PCII. However, this affix lacks a specification for tense and aspect. Thus, PCIII applies, and the aspect information is supplied by *-erā*, which is specified for [+perfect]. However, since this affix lacks a specification for tense, then PCIII applies again, and the missing information for tense is supplied by *dix-*.

Since PCIII allows 'missing' feature information to be copied from lower down in the structure as a back up when PCII fails to yield a full specification, 'morphosyntactically empty' suffixes such as the Spanish diminutive no longer cause a theoretical problem.

There is no longer the expectation that every single affix contains a category specification or full specification for inflectional features, given that the missing information can be supplied from elsewhere. Empty suffixes then simply represent the state of affairs when a particular suffix is devoid of a particular feature. There is then not a single head node in Lieber's system, but rather, a system that ensures that the topmost node of a complex word will contain all the relevant information, with the features percolating from potentially more than one of the member morphemes.[10]

As a final point, compounds are treated differently in Lieber's approach. That is, they have their own separate rule of percolation, (23d), which references both a specific linear direction and a specific language. That is, whilst the other conventions are supposed to hold universally, compounds are treated differently per language, which allows the flexibility to account for the variation between on the one hand, Dutch, and on the other, Vietnamese, with respect to which member is the head of compound.

3.2 Mixed Systems

Whilst Williams' and Lieber's systems define a consistent position to serve as the head — though other elements can take over in case the element in that position is missing some specification — it is not always clear that there should always be a single position that determines the head of some phrase. Hoeksema (1992) for instance proposes that within a single language there is often variation as to what counts as the head.

Hoeksema draws a parallel with syntax: it is well known that the head direction parameter is varies depending on different syntactic categories. Whilst there are languages that are consistently head-inital, such as the Celtic languages, which display VSO word order and N-modifier order and prepositions (see Tallerman (2005) and Borsley et al. (2007)), as well as languages that are very strongly head-final (such as Japanese), there are a great many languages that vary between the two positions. Dutch, for instance, is a verb-final language but its CP structures are uniformly head-initial. That there is variability in syntax indicates for Hoeksema, that we wouldn't necesarily expect inflexibility in morphology. If morphology and syntax follow the same design prinicples that Universal Grammar provides, then it is perhaps surprising if morphology sticks rigidly to one headedness rule, whilst syntax is able to have coexisting rules of head placement even within the same language.

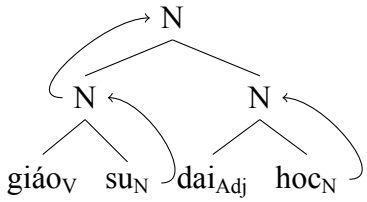
Returning to compounding, this argument is supported by the fact that there are some languages which have both left-headed and right-headed compounds. We noted above that Vietnamese has been argued by Lieber to have left-headed compounds, but Hoeksema notes that Vietnamese has compounds which have been entirely or partially loaned from Chinese. Such compounds are right-headed:

(26) a. [triet$_{V/Adj}$-hoc$_N$]$_N$ 'wise-study = philosophy'
b. [ái$_V$-luc$_N$]$_N$ 'love-power = affinity'

These data are interesting for two reasons. Firstly, they show that Vietnamese, in addition to the left-headed compounds that we discussed above, is able to generate right-headed compounds. The second point of interest that Hoeksema notes is that such compounds can be further combined with Vietnamese (i.e. non-loaned) vocabulary to form larger compound structures. When they do so, then the position of the head can be non-peripheral, i.e. neither leftmost nor rightmost. The head in (27a) is *su*, the second member of the compound, whilst in (27c) it is *co*.[11] One can see with these examples, that first complex member is right-headed, and but the compound as a whole is left-headed, since it is the leftmost complex element that determines the head of the whole form, even though the head of *that* complex structure comes from the rightmost element in that structure.

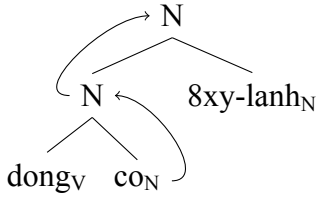
(27) a. [[giáo$_V$ su$_N$]$_N$ [dai$_{Adj}$ hoc$_N$]$_N$]$_N$ 'teach-master-great-study = professor'

b.



c. [[dong$_V$ co$_N$]$_N$ 8xy-lanh$_N$]$_N$ 'move-machine-8cylinder = 8-cylinder engine'

d.



Speakers of Vietnamese then, seem to have coexisting rules of head assignment as a part of their grammar. For some compounds, they are right-headed, whilst as a default, the language will pick out the leftmost member of a compound to be the head. Returning to the parallel with syntax, for Hoeksema, this shows that the variability in head direction attested for syntactic phrases carries over to the morphology as well.

The Vietnamese examples are perhaps complicated by the fact that the variation in compounding happens to coincide with the fact that some of the compounds (the right-headed ones) are loaned from Chinese. However, Hoeksema points out further examples of mixed headedness in compounding, from Italian (Scalise, 1988). Here the headedness can be seen both from the semantics, as well as the fact that the locus of inflection is rightmost for the right-headed compounds, and leftmost for the left-headed compounds. These issues will be explored further in the next section. However, for current purposes, it is enough to note that Italian compounds sometimes appear to be left-headed and sometimes right-headed.

(28) a. Right-headed

SINGULAR	PLURAL	
terre-moto	terre-moti	‘earth quake(s)’
sangui-suga	sangui-sughe	‘bloodsucker(s) = leech(es)’

b. Left-headed

SINGULAR	PLURAL	
divano letto	divani letto	‘divan-bed(s)’
nave traghetto	navi traghetto	‘ferry-boat(s)’

Note that we have termed systems such as Hoeksema’s *mixed*. Though the RRHR and Lieber’s approach share with Hoeksema’s system that the head is not uniquely defined in a word, in the sense that there is not one element that defines the totality of the characteristics of the entire word, their systems differ from Hoeksema’s in that they provide a mechanism to identify an element that would serve as the head, and a back up for finding otherwise. Hoeksema’s proposal is different, since it argues that although there *is* a head for a complex word, the child learning a language is likely to encounter various coexisting patterns of headedness in the morphology, and they must find a way to classify structures into the different patterns that they encounter. It is then mixed in the sense that there is not one rule, but rather many that the child must integrate into their emerging grammatical knowledge.

3.3 Interim Summary

As noted in section 2.2, there were a number of problems for Williams’ RHR, which led to percolation based approaches developing to allow for the possibility of both back-up percolation (what we have termed here ‘headedness by committee’), as well as flexibility within the system to handle cases of cross-linguistic variation. In this section, we have surveyed two strands of approaches. Firstly, were the RRHR of di Sciullo and Williams (1987) and Lieber’s Feature Percolation Conditions, which allowed for multiple elements to donate features to the complex word as a whole. The asymmetry between heads and non-heads becomes a little fuzzier in these approaches, since there is no longer a single morpheme that is superordinate to the others. Rather, there can be various asymmetries within a word, because different affixes are superordinate over the others depending on which feature is under discussion. Secondly, we have seen evidence for a mixed system of Hoeksema, who argues that headedness may not always be determined by the highest or the most peripheral of elements, but rather, various different patterns can coexist within a single grammar.

4 Further Properties of Heads

Throughout the previous section we have looked mostly at category determination, and seen that in percolation based theories, affixes have been seen as somewhat special when

compared with the base or stem. This is explicitly written into Lieber's system, since affixes will always project their features over a stem. The connection is less direct in the RHR and RRHR, but in a structure with a base and a suffix, the suffix will (all else being equal) serve as the head of that element. As noted in the introduction, headedness is a concept that is employed in various domains in linguistics, not just morphology, but there are long traditions of employing heads in theories of syntax and phonology as well. In this section, insights from syntax feed into the discussion of how to identify heads in morphology. The head properties in syntax that will be paid most attention to are explained in detail in Zwicky (1985) and Hudson (1987).

4.1 Zwicky on heads in syntax and morphology

The determination of the grammatical category is certainly an important one, however, it is far from the only property that complex words bear. This is even more so if one considers the semantic properties of complex words, as well as other morphosyntactic characteristics. The question of what should be considered a head has also attracted a great deal of attention in other domains, particularly work in syntax working in traditions of dependency grammar.

Zwicky (1985) offers a discussion of what constitutes a head, starting from a syntactic perspective before considering the issue from a morphological perspective. It should be noted at the outset that Zwicky's characteristics are not without controversy, even from a syntactic perspective. Hudson (1987) offers a critical reevaluation of Zwicky's head characteristics and proposes some adjustments.

The first characteristic is *hyponymity*, that is, in a combination of [X+Y], where X is the head (shown in boldface), then [X+Y] is a hyponym of X.

(29) a. [Adj+**N**] a *hungry owl* is a type of owl.
b. [**V**+N] *playing football* is a type of playing

Secondly, the head of a phrase is the item that subcategorises for other items. For instance, verbs place all kinds of subcategorisation requirements on arguments that they combine with. *Sleep* is an intransitive verb and only combines with one (non-modificational) argument, *kiss* combines with two arguments, whilst *put* combines with three arguments.

(30) a. Mary slept
b. * Mary slept the bed
c. John kissed Chris
d. * John kissed
e. * John kissed Chris Mark
f. Jenny put the dirt in the bin
g. * Jenny put

h. * Jenny put the dirt
i. * Jenny put in the bin

Furthermore, verbs can select for the category: *wonder* selects for a CP as its complement, and cannot combine with an NP:

(31) a. Mary wondered if Jenny was funny
b. * Mary wondered the thought.

In these examples, it is the verb that determines what criteria the argument must fulfill, and in that sense, it is the head of the construction.

Zwicky notes that the head of a syntactic phrase is the item that bears the inflectional morphology associated with the phrase as a whole. For example, in [Aux+VP], Aux would count as the head, since it is the auxiliary that inflects for the features of the subjects, rather than the verb (*she has bought/I have bought*).

Zwicky further contends that heads show the property of *government*, that is, they determine the shape of non-heads of the phrase. This property is closely related to subcategorisation, but differs in the sense that we are not dealing with the number or type of constituents that are selected by a particular element, but rather the form that they must appear in. This is shown by quirky case, such as in Icelandic. In the following examples (from Sigurðsson, 2012), we see that the subject of (32a) *þeim* is idiosyncratically in dative case, whereas in (32b) *þá* it is idiosyncratically in accusative case.[12]

(32) a. Var þeim ejju hjáoað?
was them.DAT not helped
'Were they not helped.'
b. Hafði þá rekið að landi?
had them.ACC drifted to land
'Had they drifted ashore?'

Zwicky discusses other properties that supposedly hold of syntactic heads, however, since these are difficult to apply to the morphology, we do not discuss them further here.

4.2 Against heads in morphology

4.2.1 Inconsistent heads

Bauer (1990) discusses the criteria that Zwicky identifies for syntax, and applies them to the morphology. Furthermore, Bauer adds a couple of his own criteria that he claims are implicit in Zwicky and Hudson's discussions. The list that he arrives at are the following list of nine points that characterise heads in syntax.

(33) i. A phrase is a hyponym of its head. (from Zwicky)

ii. The head of a phrase is the subcategorisand. (from Zwicky)
iii. The head of a phrase is the morphosyntactic locus. (from Zwicky)
iv. The head of the phrase is the governor. (from Zwicky)
v. The head of the phrase is the distributional equivalent of the whole phrase. (from Zwicky)
vi. The head is obligatory. (from Zwicky)
vii. The head of a phrase is lexical, not phrasal. (added by Bauer)
viii. The head of the phrase characterises the phrase as a whole. (added by Bauer)
ix. Language internal evidence can give clues as to what counts as the head. (added by Bauer)

We focus our discussion on only (i), (ii), (iii), (vi) and (viii). What (i) - (iv) refer to are discussed in the preceding subsection. (viii) is taken by Bauer to mean category determination, which was discussed earlier in sections 2 and 3.

As Bauer (1990) points out, the issue of headedness in morphology becomes more complicated when consider these properties, which have been noted to hold with respect to syntactic heads, are taken int account. In an approach like Williams' and Lieber's, one would expect the rightmost or outermost affix to serve as the head with respect to all of these properties. It is clear that (at least the strongest versions of) the percolation based systems (eg. Williams, 1981) will face issues with some of these.

In lieu of repeating all of Bauer's discussion here, we focus on only a couple, showing that whilst some of the tests clearly point to affixes being the head of a derived word (ii,viii), others are unclear (i,iii), whilst some clearly point to the base (vi).[13] Starting with the characterisation of the word as a whole, there have been plenty of examples in this paper of the affix determining the category over the base. However, one can see that it is possible for the prefix, even if it is not a category changing prefix, to determine (some) of the properties of the word as a whole. Consider the following examples (from Bauer, 1990), which show that the prefixes *dis-* and *re-* influence the preposition selected for by the word, and the category selected for by the word respectively.

(34) a. Lee connected the wire *to* the battery.
b. * Lee connected the wire *from* the battery.
c. Lee disconnected the wire *from* the battery.
d. * Lee disconnected the wire *to* the battery.

(35) a. Pat iterated his objections.
b. * Pat iterated that he objected.
c. Pat reiterated his objections.
d. Pat reiterated that he objected.

Here, it is clearly the case that the prefix is determining at least some of the grammatical properties of the construction as a whole. In (34), the prefix combines with the verb and alters the preposition which it uses to introduce the goal argument. From (35), one can see that the prefix has an effect on what category can be selected by the verb, since it allows the verb to additionally select for a CP complement which it is not able to select in the absence of the prefix. Clearly then, the prefix is determining some properties of the word as a whole, and appears to be behaving at least in part as a head. This conclusion is apparently bolstered further by the following nominalisations, where it can be seen that the nominalisation of *connect*, *connection*, allows for both *to* and *from* when introducing a locative. By way of contrast, with the negative prefix *dis-*, only *from* is possible, which suggests that *dis-* genuinely restricts the verb in (34b) to only use the proposition *from*, and not *to*.[14]

(36) a. The connection to the battery was secure.
b. The connection from the battery was secure.
c. * The disconnection to the battery went badly.
d. The disconnection from the battery went badly.

Thus, there is plenty of evidence for the affix being priviliged over the base in some way, and therefore plausibly displaying head characteristics.

In terms of subcategorisation, Bauer concedes that affixes can be argued to select for the base. He notes that in many cases the shape of the affix is determined by the base that it attaches to. For instance, in allomorphy of the plural morpheme in English, whilst the choice of the regular plural affix varies predictably between [z], [s] and [ɪz], there are a number of irregular plural allomorphs: *-en*, which famously attaches to *ox*, *-i* which attaches to Latinate words ending in *-us* (*alumni, cacti, hippopatami*), as well as the Greek *-odes* which forms the plural *octopodes*. Arguably, in these cases, the affix is selecting for the base, since it is the affix which is selecting for the type of base which it combines with. With prefixes, this is also apparently the case. Bauer notes the choice of the negative prefix between *un-* and *in-* can be seen in a similar way, for instance in the contrast between *unhappy* and *inedible*. The proposal then is that because it is the affix that determines which properties it attaches to, then it is the element that is doing the subcategorising.

Yet, this test does not unambigously pick out affixes as the head of the construction. A reviewer points out to us that it is possible to see the subcategorisation as going the other way, whereby it is the bases that restrict what kind of affixes they combine with. Zwicky (1985) argues precisely this, arguing that some adjectives in English can select to combine with *-en*, such as *quicken, soften* and *harden*, whereas, others do not combine with this affix (**longen, *easien, *difficulten*). Bauer argues that Zwicky's cases can be reanalysed as the affix selecting for the base, that *-en* is in these cases arguably selecting for the base according to, amongst other factors, phonological shape. However, a

complete analysis is not given. Whilst we do not wish to adjudicate between the two viewpoints here here, it suffices to highlight that there is some ambiguity over whether cases like these show the affix to be selecting for the base or vice versa. Relevant for current purposes is that there does seem to be one element that serves as the head, in that it is able to subcategorise for another element. Bauer claims that there are many cases where the affix is the one that is subcategorising for other items, and since Zwicky's case *can* be plausibly analysed in this manner as well, then by Occam's Razor we ought to assume that affixes always select for bases, but not the other way around.

With this wrinkle put aside, despite the fact that these two tests seem to suggest that affixes are more likely than the base to be the head in an affixed word, other tests are less conclusive. In terms of hyponymity, this is relatively easy to determine for compounds:

(37) a. A *blackboard* is a type of board.
b. A *rattlesnake* is a type of snake.

However, it is often more difficult to do this for complex words derived by affixation. With some affixes, it is easy to determine. For an affix like the English nominalising suffix *-er*, one can determine a meaning for it, namely 'something that Xs', where X is the verb that the affix attaches to. In these cases, a *writer* is someone who writes, and *someone who Xs* is a hyponym of this. However, Bauer points out that for many words, such as *dialectal*, it is difficult to determine whether it shows the property of hyponymity, as it is difficult to pin down the semantics of the affix. *-al* is a suffix that changes a noun to an adjective, but with less clear semantic contribution. Similarly, for a noun like *kingdom* it is difficult to determine how it would behave relative to the hyponym test, given that there is no clear semantics for *-dom*. Is it legitimate to claim that *a kingdom is a type of dom*, for instance? It is possible to make the argument (for instance with analogy to *fiefdom* etc.), yet it is far from clear. Overall, the hyponyimty test does not always yield a clear result.

In terms of the morphosyntactic locus, Bauer notes that this criterion again does not produce some clear results. Inflectional morphology is famously found outside of derivational affixes, and so one can take this to be indicative of the derivational suffix being the head of a word.

Finally, Bauer points out that some tests explicitly suggest that the base is the head, over the affix. He points out that in terms of obligatoriness, if one were to construct a rule such that words can be characterised by, it would plausibly be the following. If so, then it is clear that the only obligatory element of a word is the base, and not the affix which we would expect according to the (R)RHR:

(38) Word $\rightarrow$ Base (+ suffix)

Overall, Bauer (1990) arrives at the summary in Table 5. As can be seen in the table, the diagnostics give a confusing pattern for how the morphology patterns with respect

Criterion	i	ii	iii	iv	v	vi	vii	viii	ix
Suffixation:									
Class-changing:	?a	a	?	?	n/a	b	?a	a	?
Class-maintaining:	?b	a	?	?	?b	b	?a	a	?
Prefixation									
Class-changing:	?	a	b	?	n/a	b	a	a	?
Class-maintaining:	?	a	b	?	b	b	a	a	?
Inflectional	?	?	?	b	n/a	b	a	b	?

Table 5: Summary of Bauer's conclusions regarding Zwicky's tests, *a* indicates that the affix is the head, *b* indicates that the base is the head, *?* indicates that the test does not produce a clear result.

to Zwicky's characteristics. In many of the tests, the result is unclear, and for the others, it is fairly evenly split between the base being more head-like and the affix being more head-like. The listing in the table of (i) - (ix) corresponds to the tests in (33).

Applying Zwicky's tests then seems to give mixed results. In Bauer's discussion it is only subcatagorisation (ii) and characterisation (viii) that clearly and consistently pick out an affix as the head.

4.3 Further problems for percolation

Bauer points out further issues for the notion of percolation. Firstly, he points out that there are instances where a complex word gains a feature that does not come from either the base or the affix. For instance, some English words seem to have a syntactic feature [+collective]. These words are nouns that are grammatically singular, but notionally denote pluralities, such as *team, committee* and *clergy*. That they bear some feature that indicates their internal plurality is suggested by the fact that in certain dialects, they can control plural agreement (for a discussion of this phenomena in dialects of English, see Corbett, 1979; Elbourne, 1999; Sauerland and Elbourne, 2002; Smith, 2015; Smith, 2017). Pertinent to the current point is that some complex words gain the feature [+collective] without either of the constituent parts bearing said feature. Thus, whilst there are examples like *administration, community, government* and *peasantry*, which all appear to gain the [+collective] feature from the suffixes *-ation, -ity, -ment* and *-ry* respectively, there are also examples like *restoration, volubility, commandment* and *chemistry*, which involve the same suffixes but have no [+collective] feature. Importantly, the bases of the former examples *also* do not obviously bear the feature [+collective] (e.g. the noun *peasant* is clearly not a noun with the semantics of internal plurality). The [+collective] feature then has come from the *combination* of the root and the affix, but is not inherited from any of the constituent parts.

Tthe following set of examples can be further added to this issue, which involve

prefixation of *re-* once more (cf. (35)). In (35) it was shown that *re-* can have the effect of allowing the complex word to select for a CP complement. However, the ability to select for a CP complement does not come from simply the prefix, as can be seen from (39d):

(39) a. Kirsty removed the book.
b. * Kirsty removed that the book from the shelf.
c. Kirsty replayed the game she won.
d. * Kirsty replayed that she won the game.

A comparison of (35) and (39), shows that the prefix *re-* can sometimes lead to the ability of the complex word to combine with a different or additional complement type, but this is not always the case. Thus, it is not possible to claim that the ability to combine with a CP complement is determined by the prefix. Nor apparently, is it a property of just the stem, given that there is a difference between (35a) and (35b). The picture that emerges is that the complement type is determined by the combination of both the affix and the root, and thus, there is not a unique element that determines this.

4.4 Interim conclusion

This section has shown various reasons to be suspicious that there is a consistent head in morphology. Though the results of section 2 and 3 show that is is possible, though not necessarily an easy task, to define some element that counts as the head for the determinant and some morphosyntactic features, the conclusions that should be taken from this section point to a more complicated picture. Specifically, looking beyond the category determinant, what should count as a head according to defined characteristics is very tricky, and the tests do not pick out a consistent morpheme within the word. Secondly, they show that percolation cannot be the only mechanism that is operative for determining the features of a complex word, since (a) some properties of a complex word come from the combination of the baset and the affixes; and (b) some features are introduced from neither the base nor the affix.

The question then arises, do we need there to be a head at all in a word? Bauer concludes that we do not, but if there is no head, then where do the various properties come from? Once again, whilst the category of the word does indeed appear to be determined by the rightmost morpheme of the word, and so consistent with Williams' propsal, the base still retains some ability to determine major properties of the word as a whole.

From all of this, one can conclude that morphosyntactically at least, there does not seem to be one single affix in the word that shows all of the properties that might be expected of heads. Rather, the duty of determining properties is spread over multiple elements. So, what of the original insights of the (R)RHR and the work stemming from Lieber, Kiparsky and so on? That the morphemes of a word all combine to determine

the set of features that the complex word bears should not be taken to say that all affixes play an equal role in the word. For category determination at least, there is a priviliged role for some morphemes to play.

5 Category determination in Distributed Morphology

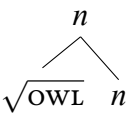
Before closing the discussion, it is worth highlighting one aspect that has been pervasive throughout. In the previous section it was shown that the tests that identify syntactic heads give a mixed picture when determining what should count as the head of a complex word. However, Bauer shows that for the issue of category determination, it is affixes that are consistently more head-like than the base. This is explicitly built into Lieber's percolation conventions: affixes will always project their features ahead of the base. This is a fairly simple observation, but by no means necessary from the perspective of Universal Grammar. It is equally possible to conceive of a world in which one can add derivational affixes to a base that contribute all the familiar features and semantic information, but that the category of the base is retained by the complex word as a whole. Put another way, why is the rule for determining the category of a complex word not the following hypothetical rule?

(40) Hypothetical Rule
For a complex word W containing a base X and derivational affixes Y (and Z etc.), the category of W is equal to the category of X.

There have been various proposals in phonology that the properties of bases win out over competing properties of affixes (cf. McCarthy and Prince, 1995; Alderete, 1999, but see Revithiadou, 1999 for a contrasting approach). In principle, one could imagine that the same pattern would cross over to morphology, at least in some cases. To the best of the authors' knowledge, this does not happen. In Lieber's feature percolation conditions, the reason is that stems and affixes are inserted differently. All items inserted into the structure percolate their features to the first node that dominates it. However, since stems are inserted first, in non-branching structures, the requirement that all morphemes percolate their features at least once will ensure that an affix will percolate its features over a stem. It is worth noting however, that Lieber's percolation conventions are not explanatory, but merely descriptive; it would be equally possible to rewrite them in some manner to give the outcome of (40). Given how strong the observation is however, and the fact that it is not a necessary feature of natural language, then it is something that warrants a principled explanation. Here we consider how this observation can be derived in Distributed Morphology (DM, Halle and Marantz, 1993). There are presumably various ways that this observation can be derived in a variety of frameworks, and the choice of DM should not be seen as a statement that DM fares better than other theories in this regard. Rather, DM serves as an illustration of the concept.

DM assumes that words are built by the combination of a category-less root and a category defining node. Roots crucially are category-less in DM, and they must obligatorily combine with a category defining node in order to receive a category and be correctly integrated into syntactic structure.[15] Category defining nodes (*n, v, a, p* etc.) assign the category to the entire form. Their combination with categoryless roots means that the root will be interpreted in that structure as having the category of the category defining node. That is, an apparently simple noun like *owl* is in actual fact a complex structure, containing the categoryless root $\sqrt{\text{OWL}}$ and the category defining node *n*.[16]

(41)

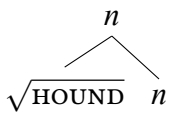


That roots are category-less is indicated by their flexibility of items to switch between different categories. For instance, the English form *hound* can be used as either a noun or a verb. Broadly speaking, the former means 'a canine creature', whilst the latter means 'to follow/pester somebody.'

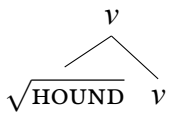
(42) a. He's such an ugly hound, but we love him anyway.
b. Are you going to hound me all day until I give you what you want?

Within DM, one need not assume a process of zero-conversion from noun to verb or verb to noun in the examples in (42). Rather, the root $\sqrt{\text{HOUND}}$ is able to combine with either *n* or *v*, and can therefore be either a noun or a verb:

(43) a.

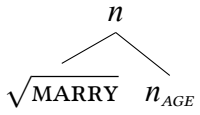


b.



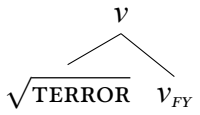
In the examples discussed so far, there is no overt evidence for the existence of a category defining node. However, derivational affixes are taken to also instantiate category defining nodes, and then their presence becomes clear. Suffixes like *-age, -ity, -ism* are all variants of *n*, *-al,- able* variants of *adj* and *-ise, -fy* are instances of *v*.

(44) a.



= *marriage*

b.



= *terrify*

From this system, of categoryless roots and category defining nodes, emerges something of an explanation for why the cateogory of the base is never projected, but it is always the affix that determines the category. Since roots have no category, then it is impossible to formulate a rule that would allow their category to consistently project. There is of course far more that could be said surrounding the issue of categoryless roots both in DM (see for instance Marantz, 1997; Embick, 2010; Embick and Marantz, 2008; Alexiadou and Lohndal, 2017, and references therein) and more generally (see Borer, 2005a; Borer, 2005b; Borer, 2013, for a series of work not written in DM, but assumes that roots do not bear category specifications), but, what the discussion given here suffices for the current purposes.

The category defining node has a somewhat priveleged status within DM. It is an element that allows roots to legitimately enter into and be interpreted within the wider syntactic structure. Furthermore, it is the same category defining nodes that determine the functional projections that are merged above the root. Category defining nodes have other properties that set them apart from other elements in the structure. As discussed in Embick (2010), Moskal (2015a), and Moskal (2015b), category-defining nodes are cyclic, in the sense that they delimit locality domains for allomorphy (Newell, 2008; Embick, 2010; Moskal, 2015a; Moskal, 2015b), as well as allosemy (Marantz, 2000; Marantz, 2013). This idea has been formulated in various guises (see Moskal, 2015a, for a comparison among various approaches), however, the general idea is that category defining nodes are *cyclic* in that they cause the spell-out of structure that they combine with, and hence freezing the elements of that structure from any interaction with higher elements. Interestingly, Moskal (2015a) argues that not all category defining nodes have this property, but rather all category defining nodes are *potentially* cyclic. Whether they are cyclic or not depends on whether they are the highest caetgory defining node in the structure. We do not press this issue any further, but there is a clear parallel to Lieber (1990) where not all affixes are heads, but all affixes can be a head assuming that they are the highest in the structure.

6 An ultimately complex notion without a clear resolution

As has been seen throughout this paper, the discussion of what constitutes a head in morphology is an issue that has attracted a lot of attention in the literature. It is also a very complex issue, with no easy answer. On the one hand, there is strong evidence from category determination that there is some morpheme in a complex word that is more prominent than all others. However, for other tests, there are mixed results. Furthermore, there appears to be both inter- and intra-language variation in the headedness of compounds that complicates the picture further.

At the heart of the notion of headedness is an asymetry between elements, such that one element is superordinate over the others. We have seen that asymmetries are

pervasive throughout morphology, however it turns out that it is difficult to define a single locus for this asymmetry between items. Ultimately then, the question of whether there is a head in morphology depends on how tightly or loosely one wishes to define the notion head in terms of what the head should be responsible for.

List of abbreviations

Throughout this article the following abbreviations have been used:

ACC = accusative, Adj = adjective, DAT = dative, DIM = diminutive, DM = Distributed Morphology, F = feminine, LF = Logical Form, M = masculine, NT = neuter, N = noun, PERF = perfect, PERS = person, PF = Phonetic Form, PL = plural, PRES = present, RHR = Right-hand Head Rule, RRHR = Relativised right-hand Head Rule, V = verb

Notes

[1]The plural of *person* is famously most often the suppletive *people*, however, the non-suppletive plural form *persons* is well attested in various contexts of English such as search and rescue operations (Harley, 2014, footnote 17, citing personal communication from Peter Svenonius). See Arregi and Nevins (2014) for further discussion.

[2]Arguably, *two personals* is possible, if one takes the meaning of *personal* to be 'a personal advertisement', as one would find in newspapers. However, this is clearly not the intended meaning in (1c).

[3]We restrict our attention to morphosyntactic properties, and do not divert much attention to phonological issues. Lexical Phonology and Morphology (Kiparsky, 1982a; Kiparsky, 1982b) plausibly offers a division between head-like and non-head-like affixes, notably Level 1 versus Level 2 affixes. We do not investigate these further, since in Lexical Phonology and Morphology the evaluation metrics that determine the type of morpheme are overwhelmingly phonological and as such they are informative of phonological rather than morphological effects of morphological structures. Probably the best known morphological criterion is affix ordering, where Level 1 affixes are closer to the stem than Level 2 affixes; however, this last claim is contentious with some clear counter-examples (Aronoff, 1976, p. 85), and so we will not focus further on this in this paper.

[4]Whether the exact representation of gender should be [+Neuter], [−Common] or some other variant, we leave open as it is orthogonal to the point at hand.

[5]These examples come from a teaching handout of Fabian Heck, which the second author found online some years ago, but can't find anymore. We gratefully credit him with the examples. It should be borne in mind by the reader that German, like Dutch above, does not mark gender on the compound itself, but rather it can be seen by which determiner the compound combines with.

[6]In the following, the *-en* suffix is a verbal infinitival marker, not a derivational suffix.

[7]The category of *ont-* is unindicated, as it is irrelevant since the head of the word is the zero-suffix. We also leave the infinitival marker out of the structure.

[8]This is similar to the notion of *Relativised Minimality* in syntactic locality, see Rizzi (1990) and Rizzi (2000).

[9]Lieber (1990) is a revised version of her dissertation, Lieber (1980).

[10]Note that Lieber's system does not predict that the highest affix in the structure will be the head. Thus, it is not a structural variant of the RHR. For instance, a word like *reintensify*, where the prefix seems to be

the highest affix on semantic grounds, does not determine the category of the word as a whole, but rather *-ify* does. This is because *re-* lacks a specification for a category, and as such, the category comes from *-ity*. We thank an anonymous reviewer for pushing us to be clearer about this point.

[11]Note that since both of the compounds in (27) are nominals, and the rightmost member of both is a nominal, it is not immediately obvious that the head is not the rightmost member. Hoeksema determines the head through the semantics of the compounds: in (27) a professor is more a type of master than a type of study. Similarly, an 8-cylinder engine is a machine, rather than an 8-cylinder.

[12]The subjects are the internal arguments of the verb, but raised into the subject position.

[13]As discussed at length by Bauer, for some of the criteria, it is difficult, if not impossible to translate the tests so that they are applicable to morphology.

[14] It should be pointed out however, that although these examples do seem to argue in favour of the prefix having some bearing on at least some of the properties of the word as a whole, and hence, behaving like a head, they do not argue in favour of the prefix *being* the head. To see this, consider further the following examples, which involve derivation of the verbal base through use of the prefix *dis-*.

(i.) a. The respect for me is incredible.
b. The respect towards me is incredible.
c. The respect from me is incredible.
d. The disrespect for me is incredible.
e. The disrespect towards me is incredible.
f. The disrespect from me is incredible.

What is shown is that the same set of prepositions are licensed whether the prefix *dis-* is there or not. Thus, *dis-* in this instance has seemingly no effect on the preposition, which is determined by the base.

[15]Attention is restricted here to lexical items, and not functional items, which have been argued (Moskal, 2015a; Moskal, 2015b) to involve less structure (notably, not having category defining nodes) than lexical items.

[16]In DM roots are written in small-caps underneath the square-root symbol. This convention stems from the fact that in the syntax, roots do not have any phonological information, which is later inserted post-syntactically. $\sqrt{\text{OWL}}$ then, is effectively a placeholder within the syntax, with the instruction to insert [aʊl] in the PF branch, and assign the meaning 'nocturnal bird of prey' in the LF branch, see Marantz (1997), Harley (2014), and Embick (2015) and references therein for more detailed discussion on roots within DM.

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