The Wiley Blackwell Companion to Morphology

Entry title: Ordering restrictions between affixes

Author: Stela Manova
University of Vienna, Vienna, Austria
stela.manova@univie.ac.at

Word Count

15,055 words

Abstract

A language possesses a limited set of affixes and of all possible combinations of those affixes only a relatively small number exists, which gives rise to questions about the nature of the restrictions on affix combinability. In the literature, grammatical and extra-grammatical restrictions have been reported. The former refer to the levels of grammar (phonology, morphology, semantics, syntax), the latter involve statistical and/or psycholinguistic information. Phonological restrictions rely on regular phonology. Morphological restrictions use morphological information and, as a rule, produce fixed combinations of two or three affixes. Semantic restrictions are cognitive in nature and refer to scopal relationship and/or compositionality of meaning. Syntactic restrictions are due to mirroring of syntactic derivations. Two types of morphological organization, layered and template morphology, provide the canvas for affix order analyses. Layered morphology operates with hierarchically organized layers and derives morphological structure step-by-step, which implies syntactic ordering and semantic compositionality. Layered morphology may produce variable orders of the same morphemes. Template morphology is flat and the order of affixes in a template is stipulated. Templates derive fixed combinations of affixes and are incompatible with variation. Although a clear distinction between layered and template morphology is made at a theoretical level, there is hardly a language that falls under only one of the two types. All grammatical restrictions on affix ordering are compatible with both layered and template morphology and no language's affixation system can be explained with a single affix ordering principle. As regards the length of the sequences of affixes inspected in different studies, affix order analyses are usually based on combinations of two and three affixes. Bigrams and trigrams also appear to be the most appropriate sequences for learning of affix ordering patterns both by humans and machines.

Keywords

affixation, affix order, morphology, phonology, syntax, semantics, template morphology, layered morphology, psycholinguistics, statistics

Main text

1. Preliminaries

A word may consist of a root and affixes. A language has a limited set of affixes but if there is more than one affix in a word, there are severe restrictions on the order of these affixes. Such restrictions (called also constraints in the literature) are the topic of this article.

For the proper understanding of the ordering restrictions between affixes, a few general issues related to structure building in morphology should be addressed first, which is the goal of this introductory section. We differentiate between two types of morphological structure building: layered morphology and template morphology (general schemas are provided in Sections 1.1. and 1.2 respectively). We speak of structure building strategies and not of affix ordering restrictions because these two types of morphology do not order affixes, strictly speaking, but provide the canvas on which affix order happens. Layers and templates serve for orientation when composing and decomposing words, i.e. they are helping devices that ensure the proper identification of the position of an affix in the word form and thus also the proper semantic interpretation of that affix, while, as we will see later, restrictions on affix order (be they grammatical or extra-grammatical) define an affix in a specific way, so that the attachment of a particular other affix is required.

There are two types of structure building in morphology (illustration and discussion of both types in Stump 1997, 33ff, Mithun 1999, 42f, Rice 2000, 11): layered morphology and template morphology. Templates in particular are discussed in Simpson and Withgott (1986), Spencer (1991, 212f), Inkelas (1993), Good (2011), among others. Rice (2000) summarizes the characteristic features of layered and template morphology:

> i. Zero morphemes are prevalent in template morphology but not in layered morphology
> ii. Layered Morphology gives rise to headed structures, template morphology doesn't
> iii. Layered morphology is constrained by some principle of adjacency, template morphology isn't
> iv. Layered morphology doesn't permit an 'inner' morpheme to be chosen on the basis of what an 'outer' morpheme will be, template morphology permits this type of 'lookahead.'
>
> Rice (2000:11)

Below, template and layered morphology are presented in terms of formal schemas. Crucially, these two types of morphological structure building can produce exactly the same forms (the morpheme sequences in (1) and (5)) but differ in terms of organization of the derivation itself: in layered morphology, derivation takes place step by step, while in template morphology structure building happens at once.

1.1. Layered morphology

The linear sequence of morphemes in (1) where A, B, C, D are usually category labels, attach to ROOT step by step, so that every following step adds some semantics to the previous one, as demonstrated for suffixation in (2).

(1) Layered morphology (suffixation)

ROOT	A	B	C	D

(2) [[ROOT] A]
[[[ROOT] A] B]
[[[[ROOT] A] B] C]
[[[[[ROOT] A] B] C] D]

The step-by-step addition of affixes makes layered morphology compatible with scopal affix ordering. We speak of scopal ordering if two suffixes, A and B, are in a semantic relationship and B alters the semantics of A. The two suffixes then appear in the order AB and the semantics of the expression AB is, as a rule, a sum of the semantics of A and the semantics of B. Scopal order is discussed in detail under semantic restrictions on affix order in Section 5.

Derivation of layered prefixal morphological structure, (3) and (4), happens analogically to that of suffixal structure, starting with the prefix that is closest to the root.

(3) Layered morphology (prefixation)

D	C	B	A	ROOT

(4) [A[ROOT]]
[B[A[ROOT]]]
[C[B[A[ROOT]]]]
[D[C[B[A[ROOT]]]]]

1.2. Template morphology

A template is a stipulated linear sequence of morpheme slots which are not related grammatically (syntactically, semantically or phonologically). The properties of templates are outlined in Simpson and Withgott (1986) and Spencer (1991), and summarized in Good (2003, 2011). A template, such as that in (5), has the realizations in (6); A, B, C and D are usually category labels but if the slots of a template cannot be related to particular categories, they can just be numbered.

(5) Template morphology

ROOT	A	B	C	D

In the realizations of the template in (5) all suffixes attach simultaneously (6). A1, A2, A3, A4 are suffixes that always occupy the slot A but never co-occur. The same holds for the suffixes in the slots B, C and D.

(6)

ROOT	A1	B1	C1	D1
ROOT	A2	B2	C2	D2
ROOT	A3	B3	C3	D3
ROOT	A4	B4	C4	D4
…				

Templatic derivation of prefixed words, like derivation of suffixed words, happens at once.

As (6) clearly shows, template morphology does not allow variations, i.e. all A affixes always appear in slot A, all B affixes are always in slot B, etc. In template morphology slots are basic units of analysis. They are discovered by examining constraints on morpheme linearization, i.e. a template can be reduced to constraints on the relative linear order of morphemes when they happen to co-occur.

In template morphology some of the slots could be empty and some scholars speak of zero morphemes. Zeros are established in analogy with forms that have an overt morpheme in the same slot. It has to be mentioned that zero morphemes in template morphology differ from zero morphemes in layered morphology. Zeros in template morphology are meaningless and can simply be ignored, while in layered morphology, a zero affix stands for addition of meaning without an overt marker. English morphology has been described that way (Marchand 1969, among others):

(7) *to cut → a cutØ*

In this derivation, the attachment of the zero suffix Ø gives rise to a word class change. The zero suffix is thus meaningful.

Although it is possible to make a clear distinction between templatic and layered morphology, a particular language does not necessarily fall into one of the two types and most languages use a mixture of the two structure building strategies, i.e. appear templatic and layered at the same time. For example, Chichewa (Bantu) is templatic by default but its template is also compatible with layered (scopal) morphology (Hyman 2003). In Chichewa, as in many other Bantu languages, verbal affixes occur in the unmarked template: Causative-Applicative-Reciprocal-Passive, i.e. CARP. The details vary from language to language and from affix to affix, but a "templatic" ordering (the default option) such as CR (the slots A and P are empty), is ambiguous and allows two readings (8a,b): templatic and scopal (layered); whereas an "a-templatic" ordering such as RC (9) obligatorily reflects the linear order of the morphemes, that is, it is always scopal (layered).

(8) Chichewa: templatic ordering CR: *mang-**its-an-***

a.	'cause each other to tie'	[[tie] -cause-e.o.]	(templatic & scopal)
b.	'cause to tie each other'	[[tie-e.o.] -cause]	(templatic & non-scopal)

(9) Chichewa (Bantu): a-templatic ordering RC: *mang-**an-its-***
'cause to tie each other' [[tie-e.o.] -cause] (a-templatic & scopal)

As for the two readings in (8), since the slots of a template are not semantically related, different semantic connections between slots can be expressed. This is the explanation why a highly restricted templatic order appears more flexible with respect to semantics than an a-templatic (layered) order, which is the case in Chichewa. Thus, (8) and (9) are interactions of template and layered morphology with unexpected results.

Mixed scope/template systems have been characterized as either involving scope taking precedence over templates (e.g. Athabaskan, Rice 2000), or templates overriding scope (Pulaar, Paster 2005). Chichewa is of the latter type.

It has to be mentioned here that there is some debate in the literature about whether template morpheme ordering exists and has any theoretical implications (Muysken 1986). Note that templates do not represent real words and in languages for which template morphology has been assumed templates are (usually) long, while words are short; and templates are illustrated with sequences of either two or three affixes, as the discussed above CR piece from the CARP template in Chichewa. Since templates have been considered incompatible with syntactic ordering (we return to this issue in Section 6), some scholars see them as a last resort.

However, templates seem very helpful for descriptive purposes and are a popular device for documentation of lesser-studied languages, especially when linguists approach a new language for the first time. The morphological organization of a well-studied language can also be seen as a sequence of morphological slots, for example for English: prefix--root--derivational suffix--inflectional suffix. Nevertheless, nobody has come to the idea to claim that English represents template morphology. In other words, not every fixed sequence of morphemes is a case of templatic morphology. Thus, we come to terminology where one faces the following issues:

(i) In many affix order studies, a fixed sequence of (two or three) morphemes is labeled a template, even if that sequence is derived step-by-step;

(ii) No distinction is made between templates and position classes, although they differ. According to Inkelas (1993) the definition of "position" involves two dimensions (vertical hierarchical order and linear template order) while templates are one-dimensional, i.e. flat. Since vertical hierarchical order is layered morphology, position classes combine layered and template morphology. Inkelas (1993) explains the Nimboran affix ordering in terms of position classes;

(iii) Templates are sometimes labelled morphological affix ordering (which implies that languages such as, for example, English are templatic; English affixation is discussed in Section 4, *Morphological restrictions*).

Further on terminology, in the literature on affix order, the fact that two affixes, A and B, appear in both orders, AB and BA, is called: *affix permutation*, AB-BA order or mirror image combination. As for the semantic reading of AB-BA orders, there are two options labelled *variable affix order* (10) and *free affix order* (11), respectively.

(10) Variable affix order

Definition	both orders AB and BA exist in a language and give rise to different readings
Example	causative-reflexive but also reflexive-causative (CR-RC), see (8a) and (9)

(11) Free affix order

Definition	both orders AB and BA exist in a language but are associated with the same meaning
Example	both causative-reflexive and reflexive-causative (CR-RC) are read as 'cause to tie each other', i.e. as reflexive-causative, (8b) and (9)

Before closing this section, let us look at a few really impressive examples of templates from the literature. The template in (12) has been postulated for Filomeno Mata Totonac, (McFarland 2009, cited from Rice 2011) and shows an even more complex interaction of template and scope than Chichewa. According to McFarland (2009), the morphology of Filomeno Mata Totonac is overall templatic, with zones of affixation and it is the overall template that gives the order of the zones, the latter vary internally as to whether or not ordering is fixed (i.e. templatic).

(12) Filomeno Mata Totonac zones of affixation (McFarland 2009: 206)

Prefixes 19-11	Prefixes 11-5	Prefixes 5-1	0	Suffixes 1-3	Suffixes 4-10	Suffixes 11-15
fixed order	variable order	fixed/scopal order	root	fixed order	variable order	fixed order

In a zone with fixed order, the order is seen as stipulated. For example, the order of prefixes in positions 19 through 11 is considered fixed because these prefixes mark mood/tense, person agreement, counterexpectation, and person agreement, with no apparent grammatical principles to which to attribute this order. Thus, Filomeno Mata Totonac has subtemplates within an overall template.

The next template (13) represents the structure of the verb in the Athabaskan languages, a large family of indigenous languages of North America, also known as Dene. The documentation of the Athabaskan languages has a long tradition and many scholars have worked on the description of these languages: Rice (1989, 1997, and later work), Goddard (1996), Mithun (1999, 2016), among many others.

(13) A pan-Athabaskan verbal template (Hoijer 1971:125) (based on Good 2011 and Rice 2011; table version SM)

1	2	3	4	5	6	7	8	9	10
ADV	ITER	PL	OBJ PRO	DEIC SUBJ	ADV	MODE /TNS/ ASP	SBJ PRO	CS	**STEM**

POSITION	DESCRIPTION
1	Adverbial
2	Iterative (lacking in some languages)
3	Pluralizing
4	Object, only in transitive verbs and some passives
5	Deictic subject
6	Adverbial
7	Mode/tense/aspect
8	Subject pronoun
9	Classifier
10	**Stem**

With respect to (13), Rice (2000) convincingly demonstrates that significant portions of the template involve scopal ordering, which is best visible when the template is used for decomposition of real words. This situation seems to indicate that purely templatic systems are most probably due to insufficient language knowledge. Templates are just the first approximation of an unknown language and with the deepening of the research grammatical relations between the slots of the template emerge.

Maybe, the only template in the literature that has not been reanalyzed in terms of scope, partly at least, is that of Murrinh-Patha verbal morphology (14), cited from Nordlinger (2010).

(14) Murrinh-Patha verbal template (Nordlinger 2010)

1	2	3	4	5	6	7	8	9
CS.SBJ. TNS	SBJ.NUM /OBJ	REFL/ RECP	IBP/ APPL	**LEXS**	TNS	ADV	SBJ.NUM / OBJ.NUM	ADV

POSITION	DESCRIPTION
1	Portmanteau encoding classifier stem, subject agreement and tense
2	Subject number marker/Object agreement marker
3	Reflexive/Reciprocal marker
4	Incorporated body part/Applicative marker
5	**Lexical stem**

6	Tense marker
7	Morpheme with “adverbial” meaning (manner, temporal, etc.) (according to Blythe (2009) there may be more than one ADV in each position in the template)
8	Subject number marker/Object number marker
9	Adverbial

For this template, Nordlinger (2015) writes the following:

> Although its [Murrinh-Patha] verbal morphology is largely agglutinating, it is templatic and is rife with discontinuous dependencies, multiple exponence, and the interspersal of inflectional and derivational material. In addition, the verbal word is a complex predicate, built on a discontinuous stem, one part of which (the ‘classifier stem’) is taken from one of thirty eight largely fusional sub-paradigms exhibiting high degrees of suppletion, homophony, and irregularity. Furthermore, some of this verbal inflectional material is co-opted into the nominal system to derive nominal predicates raising interesting questions for the distinction between inflection and derivational morphology.
> https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199591428.001.0001/oxfordhb-9780199591428-e-21

It is hard to comment on the structure of the template in (14) since there is not much literature on Murrinh-Patha, at least not as much as on the Athabaskan languages. Nevertheless, a brief comparison of (13) and (14) seems to provide insight why the latter template (14) is incompatible with scope, while the former (13) is. In (14), there are portmanteaus in slots 1, 2, and 8; in (13) no single slot accommodates a portmanteau. Portmanteaus are clusters of two or more morphosyntactic features and it is therefore hard to judge whether they combine with other morphemes based on scope or not.

A highly insightful discussion of the templates of a large number of languages can be found in Mithun (2016). The author also addresses the arbitrariness of template morphology by providing diachronic evidence of how templates emerged.

Having illustrated the two types of morphological organization, layered and template morphology, and their interactions that can result in variable and free affix order, in the next section we provide general definitions of the restrictions on affix order reported in the literature and illustrate them with hypothetical examples. The rest of the article is organized as follows: in Sections 3 through 6, grammatical restrictions on affix order (phonological, morphological, semantic, and syntactic, each in a separate section) are discussed in more detail. Section 7 and Section 8 are devoted to extra-grammatical restrictions (statistical and psycholinguistic, respectively). In Section 9 conclusions are drawn.

2. Affix order restrictions: general definitions

In the literature on affixation, two types of restrictions on the order of affixes have been recognized: grammatical and extra grammatical (Manova and Aronoff 2010; Rice 2011; Inkelas 2016, among others). Following this logic, we define four grammatical restrictions: phonological, morphological, semantic and syntactic; and two extra

grammatical restrictions: statistical and psycholinguistic. The classification of restrictions is based on the approach adopted by Manova and Aronoff (2010), namely the type of information that defines a restriction serves as a label for that restriction. Rice's (2011) approach is different: she assumes that affix order is scopal (by default) and always first checks for scope and only if scope cannot account for the order of affixes, other explanations (either phonological or templatic) are looked for. Rice does not assume any principle difference between syntactic and semantic ordering, either. Inkelas (2016), among others, follows Rice (2011).

Below, the restrictions on affix order discussed in this chapter are first defined and then illustrated with hypothetical examples, they will be illustrated in more detail in the sections to come. For avoidance of confusion, affix order restrictions are illustrated based on suffixation but they also hold for prefixation.

In (15) through (20) and elsewhere in this article, SUFF1 and SUFF2 are two neighbouring suffixes and in the word form SUFF1 precedes SUFF2.

(15) Phonological restrictions

Definition	Involve regular phonological information: some phonological property of SUFF1 (or the language in general) requires the attachment of a specific SUFF2
Hypothetical example	If SUFF1 terminates in a consonant, attach SUFF2 that starts with a vowel (to avoid epenthesis)

(16) Morphological restrictions

Definition	Involve morphological information: SUFF1 is always followed by a particular SUFF2
Hypothetical example	If a word terminates in SUFF1, attach a particular SUFF2

(17) Semantic restrictions

Definition	Involve semantic information: the semantics of SUFF2 modifies the semantics of SUFF1, usually (but not always) SUFF2 scopes semantically over SUFF1
Hypothetical example	SUFF1 derives objects (things), SUFF2 modifies the semantics of SUFF2 by the idea of smallness, i.e. SUFF2 is a diminutivizer

(18) Syntactic restrictions

Definition	Involve syntactic information: The order SUFF1-SUFF2 mirrors order of syntactic operations, e.g. relates to argument structure
Hypothetical example	SUFF1 expresses a subject and is closer to the root than SUFF2 that marks an object

(19) Statistical restrictions

Definition	Involve statistical information: SUFF1-SUFF2 is the default order of suffixes because this order prevails in the language
Hypothetical example	In a sufficiently large corpus (or a dictionary) SUFF2 follows SUFF1 in most cases (and this is statistically significant)

(20) Psycholinguistic restrictions

Definition	Involve psycholinguistic information: the order SUFF1-SUFF2 is easier to process than *SUFF2-SUFF1
Hypothetical example	SUFF2 is more frequent and productive than SUFF1

3. Phonological restrictions

Restrictions on the order of affixes that involve phonological factors are called phonological restrictions; consequently, affix ordering that is restricted phonologically is referred to as phonological. Purely phonologically ordered affixal systems are rare. Nevertheless, Hyman (2006) and Kim (2010) are usually seen as studies providing evidence for such systems. Hyman (2006) discusses data from a Bantu language (spoken in Congo), while the data in Kim (2010) come from the language isolate Huave (spoken in San Francisco del Mar). However, Hyman's data are not really on the topic of this article but reveal a system where phonology plays a role in the placement of an affix with respect to a root, i.e. whether the added morpheme ends up as an infix or a suffix. Therefore examples from Hyman (2006) are not cited here. Kim's data are addressed in Section 3.3.

Before illustrating phonological restrictions on affix order, we would like to turn the reader's attention to the following issue. In the literature, there are two major classifications of approaches to affix order: Manova and Aronoff (2010) and Rice (2011).

These classifications could appear overlapping at first glance because they both try to define the grammatical factors (such as phonology or semantics) influencing affix order. However, they differ significantly. Rice (2011) assumes that affix order is scopal by default and refers to other ordering principles only if scope fails to explain the order of affixes. Manova and Aronoff (2010) speak of phonological ordering irrespective of scope. As we will see below, phonology and scope can indeed contradict (3.1) but can also work in tandem (3.2). Thus, for Rice only the examples in 3.1. are instances of phonological ordering, while for Manova and Aronoff all examples discussed in this section illustrate phonological restrictions on affix order.

3.1. Phonology and scope (or semantic compositionality) contradict

In the literature on affix order, the example in (21) is often cited as an instance of phonological ordering. The data come from Western Cherokee (Iroquoian; Foley 1980), the order of affixes in the first and third person forms of counterfactives and cislocatives is as expected, while the second person forms (bolded below) exhibit suffix permutation.

(21) Western Cherokee (Iroquoian): counterfactive & cislocative

counterfactive			cislocative			
yi-hi-nega	→	***hyinega***	*wi-hi-nega*	→	***hwinega***	'you'
counterfactive-2SG			cislocative-2SG			
yi-ji-nega	→	*yijinega*	*wi-ji-nega*	→	*wijinega*	'I'
counterfactive-1SG			cislocative-1SG			
yi-ga-nega	→	*yiganega*	*wi-ga-nega*	→	*wiganega*	'he'
counterfactive-3SG			cislocative-3SG			

In the boldface forms, ***hyinega*** and ***hwinega***, the vowel 'i' deletes when preceding a second singular form (i.e. a particular morphological form, 2SG, requires vowel deletion), which creates a glide-consonant sequence unallowed by the language's phonotactics (phonological constraint), and it is therefore corrected by metathesis (phonological change), yielding permutation with the next prefix. Thus, *yi-hi-* changes to *hyi-* and *wi-hi-* to *hwi-*. As for the interaction between scope and phonology, if the order of the prefixes was scopal, it should have been the same as in the first and the third singular forms.

Rice (2000) reports a case of phonological affix ordering that is of a different type: prosodically 'small' or 'incomplete' affixes (V, C, VC) appear closer to the stem than 'full' or 'complete' ones (CV, CVC, CVCV). Many languages of the Athabaskan family have more than one way of marking inception: by a complete morpheme (labeled "lexical" in the literature) that occurs near the beginning of the verb word (i.e. far away from the stem (22a)), and an incomplete (called 'functional') morpheme that occurs closer to the stem (22b). The relevant morphemes are bolded.

(22) Slave (Athabaskan): inceptive (data from Rice 1989: 711, 587)[1]

a. lexical *ti7* 'start off'
ti7-na*-neh-tɬa* 'I started off again.'

b. functional *d* inceptive
na-de*-h-tɬaah* 'I started out on a trip again.'

In these examples, the affix *na-* 'again' follows the lexical inceptive (*ti7-*) but precedes the functional inceptive (*de-*), which thus gives rise to two different orders, *inseptive-na* (lexical) and *na-inceptive* (functional), with the same meaning. Clearly, if the order of the affixes was scopal, (22a) and (22b) should have had different readings.

A similar restriction explains the combinability of Polish diminutive suffixes, data from Szymanek and Derkach (2005) and Manova & Winternitz (2011). In Polish (as in other Slavic languages), diminutive suffixes can be stacked to form second-grade (or double) diminutives (DIM2). DIM2 forms are derived from first-grade diminutives (DIM1) by the attachment of diminutive suffixes. This is illustrated in (23) where all diminutive suffixes are bolded. All DIM2 nouns in (23a) have two diminutive suffixes, while the DIM2 forms in (23b) have a single suffix.

(23) Polish (Slavic, Manova & Winternitz 2011): second-grade diminutives

a. with monosyllabic (short) DIM2 suffixes, *k* > *cz* [t͡ʂ]
DIM1 *stol****-ik*** 'small table' → DIM2 *stol****-icz-ek***
DIM1 *ram****-ka*** 'small frame' → DIM2 *ram****-ecz-ka***
DIM1 *sit****-ko*** 'small sieve' → DIM2 *sit****-ecz-ko***

b. with disyllabic (long) DIM2 suffixes, sz [ʂ]
DIM1 *kłęb****-ek*** 'small billow' → DIM2 *kłęb****-uszek***
DIM1 *kij****-ek*** 'small stick' → DIM2 *kij****-aszek***

Polish has a rich set of diminutive suffixes, some are monosyllabic, others are disyllabic. All disyllabic diminutive suffixes, including *-aszek* and *-uszek*, serve as DIM1 suffixes; *-aszek* and *-uszek* are the only disyllabic suffixes used for derivation of DIM2 nouns (23b). Clearly, these two suffixes could also be parsed as *-asz-ek* and *-usz-ek*, which has made some scholars see *-asz-* and *-usz-* as interfixes, while others treat them together with *-ek*. For the sake of completeness (and since an anonymous reviewer noticed that the examples in (23a) all have front vowels, while those in (23b) do not), there is also a DIM1 suffix *-iszek* [i] */ -yszek* [ɨ] but, as already mentioned, it does not derive DIM2 nouns. For curious readers, all Polish DIM1 and DIM2 suffixes and their combinations are listed in Manova and Winternitz (2011), Table 3. In a nutshell: Polish has 12 DIM1 suffixes, there are no diminutive interfixes in this language, all productive DIM1 suffixes are monosyllabic; of the 12 DIM1 suffixes only *-ek, -ka* and *-ko*, plus *-aszek* and *-uszek* derive DIM2 nouns. Therefore, Manova and Winternitz (2011), following Rice (1989), explain the difference between (23a) and (23b) in terms of long and short suffixes: the disyllabic

[1] In (22), (24), (32) and (33), the standard IPA symbols are used for lateral fricative, schwa and nasalisation, the other symbols are based on APA (American Phonetic Alphabet).

(long) DIM2 suffixes, *-aszek* and *-uszek* (23b), attach by replacement, while the monosyllabic (short) DIM2 suffixes, *-ek, -ka* and *-ko* (23a), attach by addition. Note that semantic compositionality would require a second diminutive suffix in the DIM2 forms in (23b).

(23a) is unusual in a different way: in the second and the third example, two phonologically identical suffixes, *-ka* and *-ko*, are in adjacent positions (giving *-ka-ka* and *-ko-ko*) but the k > cz alternation camouflages the suffix repetition (Szymanek and Derkach 2005). By contrast, in Witsuwit'en (Athabaskan; Hargus 2007) under conditions of identity, suffix suppression (due to haplology) takes place (24). The example is cited from Rice (2011): the first line shows the basic verb form; the second line shows a verb form based on this lexical entry, with the prefix that is part of the lexical entry in bold; the third line shows that when a productive affix of the same form as the prefix that occurs in the basic lexical entry is added (*t-* future), only a single one of the identical consonants (prefixes) is found in the surface form, i.e. **t-t* > *t.*

(24) Witsuwit'en (Athabaskan, Hargus 2007): *t-* future + *t-* lexical

lexical entry	*nən t-zuh*	'spit'	
	nən ***t*****ə***zuh*	'He's spitting.'	
	nən ***t****azuh*	'He will spit.'	****t-t*** (*nən* ***t****ətazuh*)

According to Rice (2011), in this case phonology disallows two identical consonants (phonologically identical affixes) adjacent to one another.

3.2. Phonology and scope work in tandem

In the examples in the previous section, scope and phonology contradict, in the sense that scope cannot explain the order of the prefixes: in (21) scope would block the prefix permutation; in (22) scope would place the two morphemes with the same meaning at the same distance from the root; in (24) scope would require the preservation of the repeated morpheme. Thus, one could get the impression that phonological ordering holds only if phonology and scope contradict. However, Bulgarian (Slavic) offers an example of phonological ordering when both phonology and scope work in tandem.

Bulgarian has a suffixed definite article (a set of suffixes (allomorphs) serves for this purpose). In nouns, the definite article, *-ta* and *-to* in (25a), always follows the number suffix, if the latter is overt; and the definite article follows the suffix for gender and number in adjectives (25b) (Manova & Dressler 2001, Manova 2010). Nouns and adjectives terminating in *-a*, irrespective of gender and number values, require the definite article *-ta*; likewise, nouns and adjectives terminating in *-o* require *-to*. In (25), there are three different *-a* suffixes (indexed for convenience) and three different *-o* suffixes (also indexed).

(25) Bulgarian (Slavic): definiteness

a. Nouns
singular feminine: žen-***a*****$_1$** 'woman' → *zen-****a-ta*** 'the woman'
singular neuter: *sel-o*$_1$ 'village' → *sel-o-to* 'the village'
plural neuter: *sel-****a*****$_2$** 'villages' → *sel-****a-ta*** 'the villages'

singular masculine: *djad-o*$_2$ 'grandfather' → *djad-<u>o-to</u>* 'the grandfather'

b. Adjectives
singular feminine: *mil-**ɑ**$_3$* 'dear' → *mil-**ɑ-tɑ*** 'dear-the'
singular neuter: *mil-o*$_3$ 'dear' → *mil-<u>o-to</u>* 'dear-the'

The order of the suffixes can easily be explained in terms of semantic scope (number-definiteness in nouns and gender.number-definiteness in adjectives) but scope cannot account for the fact that the vowel in the definite article mirrors the final vowel of the base, giving in the definite forms *-a-ta* and *-o-to*. The only plausible explanation is that in such cases the selection of the definite article is phonologically driven.

3.3. Phonological restrictions, template and layered morphology

In Huave (isolate) phonological restrictions on affixation interact with templatic order (26). However, the template is defined in terms of symmetrical "layers" (Klm 2010; 2015), i.e. morphology is templatic and layered at the same time. Crucially, Huave has fixed and mobile prefixes and suffixes. A mobile affix can surface on either side of the stem, i.e. it can be both a prefix and a suffix. However, regardless of whether a mobile affix is a prefix or a suffix, it still appears at its fixed distance from the stem, which serves for a definition of the Huave verb template and makes the latter hierarchically organized, cf. the definition of position class in Section 1. The Huave verb template "layers" are numbered L1 through L4 expanding from either side of the stem, as in (26); Layer 0 is unproductive. Layers 1 and 3 accommodate mobile affixes. In the gloss of (26a), "TV" stands for a theme vowel, i.e. the stem is vowel-initial; in (26b), "V" is the gloss for a stem vowel and the stem is vowel-final. The placement of the vowel is the property that defines the position of the affixes to be considered.

(26)	[L4	[L3	[L2	[L1	[[Stem] L0]	L1]	L2]	L3]	L4]
a.		*ʃ-*	*i-*	*n-*	*a-mut*				
		1	FUT	1SUB	TV-write				
b.					*ndil-i*	*-t*	*-ej*	*-as*	
					turn-V	CPL	RFL	1	

Since Huave does not allow consonant clusters, in *ʃ-i-n-a-mut* 'I will write (it)', the L1 mobile affix *n-* surfaces in prefixal position adjacent to the stem *a-mut*, while the first-person mobile affix *s-* (allophonically realized as *ʃ-*) occurs in L3. By contrast, in *ndil-i-t-ej-as* 'I turned around; I came back', the L1 mobile affix *-t* surfaces in suffixal position next to the stem *ndil-i*, while the first-person *s* is realized suffixally but again in L3. Note the presence of a preceding vowel, which is epenthetic. Kim (2010) explains the positioning of the mobile affixes in terms of default and epenthesis-avoidance: affixes surface by default as suffixes but are placed in prefixal position wherever this would obviate the need for epenthesis. In *ndil-i-t-ej-as*, epenthesis is tolerated, i.e. the first-person suffix *-s* is realized as *-as*, since the base *ndil-i* begins with a consonant and

prefixation would have required epenthesis, too; so the default preference for suffixes emerges. However, the base *i-n-a-mut* is vowel-initial (but ends with a consonant), thus placing the first-person affix *ʃ-* in a prefixal position avoids epenthesis.

In sum, affix order can be subject to phonological restrictions. Phonological factors are of importance in both lesser-studied and well-studied languages and work irrespective of other ordering factors: if semantics (scope or compositionality) requires a specific order of affixes or the addition of an affix and phonology intervenes, in cases where semantics and phonology clash, phonological restrictions supersede. While there are arguments in the literature against phonological control of affix order (see Paster 2009 and the response in Kim 2015), the examples in this section clearly show that phonology determines the order of at least some of the affixes in a language. Nevertheless, languages with affix order systems based entirely on phonology are rare.

4. Morphological restrictions

Morphological affix ordering depends on morphological information: the mere occurrence of an affix (or a combination of affixes) requires the attachment of another specific affix, e.g. the English suffix combination *-ization* (*-ize* + *-ation*) always selects the suffix *-al*. English word-formation has been traditionally discussed in terms of morphological affix ordering (Marchand 1969; Kiparsky 1982; Aronoff 1976; Plag 1996, 1999; Giegerich 1999, among many others).

In the literature, combinatorial morphological restrictions are seen as either encoded in the (last affix of the) base (i.e. it is SUFF1 that selects SUFF2) or as encoded in the affix attached (i.e. it is SUFF2 that selects SUFF1). Plag (1996, 1999), Giegerich (1999) and many others advocate primarily rules of the first type, though the claim is seldom stated explicitly. Fabb (1988), however, sees selection information as encoded in the affix to follow; the same claim in Gaeta (2005) for Italian and in Melissaropoulou and Ralli (2010) for Greek.

4.1. Closing suffixes

A clear case of a morphological restriction on affix order are closing suffixes (Aronoff and Fuhrhop 2002; Manova 2008, 2009, 2015b). Morphological information, the fact that a suffix (SUFF1) cannot be followed by another suffix (SUFF2) is encoded in the suffix (SUFF1) itself. If a language differentiates between derivational and inflectional affixes, a closing derivational suffix carries the information that it cannot be followed by another derivational suffix, whereas a closing inflectional suffix that it cannot be followed by another inflectional suffix. Closing suffixes has been reported in various languages: Szymanek (2000) is on closing morphemes in English and Polish; Aronoff and Fuhrhop (2002) report a phenomenon that bans the further derivation in German and explain it in terms of closing suffixes; Manova (2008, 2010) provides evidence for closing suffixes in Bulgarian and Russian; Sitchinava (2015) speaks of closing suffixes in Russian; Melissaropoulou and Ralli (2010) acknowledge the existence of closing suffixes in Greek derivational morphology; and Manova and Winternitz (2011) discuss closing diminutive

suffixes in Bulgarian and Polish. Manova (2015b) is an overview of research on closing suffixation and discusses data from different languages.

There is much research on affix order in English and two of the approaches explaining the order of English affixes illustrate morphological ordering, generally speaking. The first approach assigns affixes to different strata and is termed Stratal Ordering, while the second approach relies on Selectional Restrictions.

4.2. Stratal Ordering

English affixes are distributed into two classes—Class I and Class II affixes (classes are also called levels or strata); and class II affixes are outside class I affixes in the word form. The stratal approach assigns specific properties to the two classes (27). For the sake of completeness, Siegel (1974) uses phonology to differentiate between the two types of strata; Selkirk (1982) defines levels in terms of word structure such as roots and words; Kiparsky (1982) employs levels in terms of cyclic application of phonological rules and possible ordering of morphological processes. Thus with respect to stratal ordering, in the different studies we find the following claims:

(27) English: Stratal Ordering
- Class I affixes tend to be phonologically less transparent than Class II affixes
- Class I affixes cause stress shifts, resyllabification, and other morphophonological alternations, whereas Class II affixes do not
- Class I affixes frequently attach to bound roots
- Class I affixes are less productive and less semantically transparent than Class II affixes
- Class I affixes do not occur outside Class II affixes

The last claim is a prototypical instance of morphological ordering, all other claims rely not only on morphological information. But let us illustrate how Stratal Ordering works and why morphological restrictions are at its core.

English affixes belong to the following classes or strata (from Spencer 1991:79):

Class I suffixes: *+ion, +ity, +y, +al, +ic, +ate, +ous, +ive, +able, +ize*
Class I prefixes: *re+, con+, de+, sub+, pre+, in+, en+, be+*

Class II suffixes: *#ness, #less, #hood, #ful, #ly, #y, #like, #ist, #able, #ize*
Class II prefixes: *re#, sub#, un#, non#, de#, semi#, anti#*

An example of a stratal derivation is *atom+ic+ity*. Since affixes can only attach to affixes of the same or lower stratum, *atom+ic+ity* is fine, while combinations in which a class II suffix occurs inside a class I suffix, e.g. **atom#less+ity*, are ruled out on principled grounds.

Of all possible combinations of English suffixes allowed by the Stratal Approach (or Level Ordering), only a few exist, which made Fabb (1988) reject the Stratal Ordering and propose affix-driven ordering based on selectional restrictions encoded in the suffix to follow. This approach distributes English suffixes into four groups:

(28) English: affix-driven selectional restrictions (Fabb 1988)
Group 1: suffixes that do not attach to already suffixed words
Group 2: suffixes that attach outside one other suffix
Group3: suffixes that attach freely
Group 4: problematic suffixes

These groups are all morphologically defined. Fabb (1988) maintains that it is not the relation of a suffix with a particular stratum (27) but selectional restrictions of individual suffixes (28) that are responsible for the combinatorial properties of suffixes. Plag (1996) provides a critical review of Fabb's proposal, establishes numerous counterexamples and argues for base-driven affix ordering and that sectional restrictions in terms of phonological, morphological, semantic, and syntactic (i.e. word-class-specification) properties are responsible for the possible and impossible combinations of an affix.

As can be seen from the distribution of affixes into levels (27) and from Plag's proposal, morphological ordering often interacts with other factors. In such interactions, morphological restrictions supersede all other factors, that is, morphology orders (fixes the combination of affixes), while the other factors explain the order.

4.3. Fixed two-suffix combinations

An even stronger morphological restriction on the order of English derivational suffixes is reported in Manova (2011b) and Manova and Knell (2021). Manova (2011b) sees derivational suffix combinations as binary structures of the type SUFF1-SUFF2, where SUFF1 has three valency positions for further suffixation: $SUFF2_{Noun}$, $SUFF2_{Adjective}$ and $SUFF2_{Verb}$. The idea of this distribution of outputs according to the syntactic-category specification of SUFF2 is based on a mathematical method, Gauss-Jordan elimination. This elimination serves for solving systems of linear equations (systems with a large number of variables) numerically, i.e. only by the help of elementary operations (e.g. substitution, addition, multiplication). The goal is to come to a single option for a variable, because if there is only one option for a variable, this option is the variable's value, i.e. the solution to the problem. In our case, one value for a variable means one combination of a kind, see Table 58.1 where indeed, there is a single SUFF2 of the syntactic categories N and V (N: *-dom* and V: *-ize*).

Table 58.1: Combinability of the suffix *-ist* (data from Aronoff & Fuhrhop 2002, based on OED , CD 1994)

SUFF1	Syntactic category of SUFF1	SUFF2 according to syntactic category

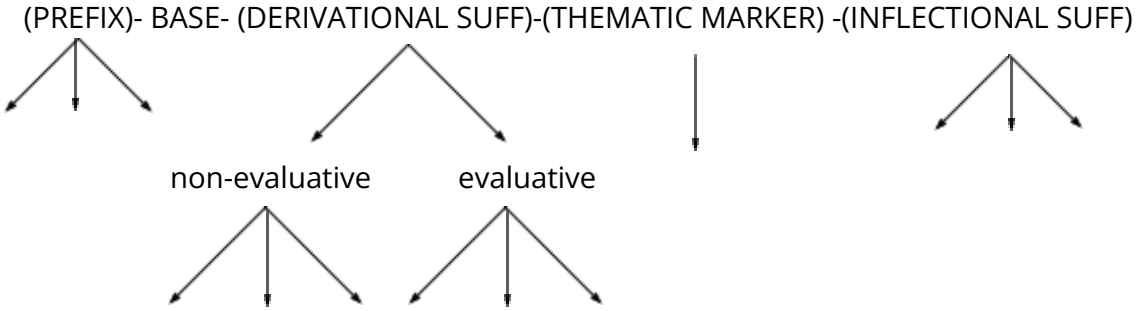
-ist	N	N: *-dom* (2) A: *-ic* (631), *-y* (5) V: *-ize* (3)

If more than one SUFF2 of the same syntactic category is available, which is the case for $SUFF2_A$ (*-ic* and *-y* in Table 58.1), there is one SUFF2 that attaches by default: *-ic* in our case, because *-ist-ic* derives 631 types (words) in comparison to *-ist-y*, with only 5 types. In other instances of more than one SUFF2 suffix, the available SUFF2 options express completely different semantics (e.g. an abstract noun and an object) and thus do not really compete for the SUFF1. Regarding the default suffixes, having counted suffix combinations in large dictionaries and corpora for different languages, Manova (2011b) also observes that in cases in which more than one SUFF2 of the same syntactic category is available, one of the SUFF2 suffixes derives more than 10 types (the suffix *-ic* in Table 58.1). The SUFF2 suffixes that compete with the default suffix always derive ten types or fewer each (the suffix *-y* in Table 58.1). Importantly, the number of types does not depend on the corpus size, and a dictionary of about 70–100K words and a large corpus of millions of tokens give the same results (Manova and Talamo 2015), which is the case because at some point the suffix combinations start repeating.[2]

4.4. Morphological restrictions, template and layered morphology

In this section we demonstrate that morphological restrictions on affixation are compatible with both template and layered morphology. The discussion will be illustrated with the structure of the Slavic word. Manova (2015a) explains the structure of the Slavic word with the help of the template in (29) that she calls a generalized form of the Slavic word.

(29) Generalized form of the Slavic word (Manova 2015a)



The BASE in (29) can be a root, a stem, or a word, see the explanations in Manova (2011a). As indicated by the brackets, the slot BASE is always occupied, whereas the

[2] Manova's approach is defined to make possible research on affix combinability in languages of the inflecting-fusional type where derivational suffixes are followed by inflection and for which the resources available for English do not exist, including corpora with annotated derivational suffixes such as for e.g. CELEX for English (Baayen et al. 1995).

other slots may be empty. Prototypically, derivation takes place in the derivational slot of the word, whereas inflection operates in the inflectional slot. Thematic markers are assumed only in verbal morphology, where they have inflectional status (cf. Manova 2005, 2011a). Crucially, the different word slots (except the thematic marker slot) can be occupied by more than one affix. Slots that can host more than one affix are associated with more than one arrow, i.e. a single arrow means that within a word, only one single affix can occur in that slot; two arrows stand for two (types of) affixes; and three arrows mean that more than two affixes can co-occur in a particular slot. Slots that can host more than one affix form word domains. There are: prefixational domain and suffixational domain, the latter with derivational and inflectional domains; and non-evaluative and evaluative subdomains within the derivational domain. Each (sub)domain has its own affix order peculiarities and closing affixes. We will illustrate this observation with the order of the diminutive suffixes in the evaluative subdomain (Table 58.2).

Table 58.2: Combinability of the DIM suffixes in Bulgarian (based on Manova and Winternitz 2011, Manova 2015a)

Nouns in	Slot 1: DIM1 suffixes	Slot 2: DIM2 suffixes	Slot 3: DIM3 suffixes
in *-C*	*-ec* (unproductive)		
	-le (unproductive) *-če*	*-ence*	*-ence*
	-čica (unproductive)		
in *-a*	*-ica*	*-ka*	
	-ka	*-ica*	*-ica*
	-ička (unproductive)		
in *-o*	*-ce*	*-ence*	*-ence*
in *-e*	*-ence* *-ice* (unproductive)		

The order of DIM1-DIM2-DIM3 suffixes in Table 58.2 is fixed two-dimensionally: 1) vertically (templatically), in terms of slots: DIM1, DIM2, and DIM3 suffixes are each placed in different slots; and 2) horizontally (morphologically), in terms of specific combinations of suffixes.

The examples in (30) illustrate the morpheme order restrictions defined in Table 58.2, i.e. how this table can be used for derivation of DIM2 and DIM3 nouns in Bulgarian:

(30) noun in *-C*: *nos* 'nose' → DIM1 *nos-le* → DIM2 *nos-l-ence* → DIM3 *nos-**l-enc-ence***
vlak 'train' → DIM1 *vlak-če* → DIM2 *vlak-č-ence* → DIM3 *vlak-**č-enc-ence***

nouns in *-a*: *răka* 'hand' → DIM1 *răč-ica* → DIM2 *răč-ič-ka* → DIM3 *răč-**ič-ič-ica***
bluza 'blouse' → DIM1 *bluz-ka* → DIM2 *bluz-č-ica* → DIM3 *bluz-**č-ič-ica***

noun in *-o*: selo 'village' → DIM1 *sel-ce* → DIM2 *sel-c-ence* → DIM3 *sel-c-**enc-ence***
noun in -e: *kepe* 'cap' → DIM1 *kep-ence* → DIM2 *kep-enc-ence* →
DIM3 *kep-**enc-enc-ence***

Not every noun allows a DIM3 derivation. The constraints (mostly semantic in nature) on the formation of DIM2 and DIM3 nouns in Bulgarian are discussed in Manova and Winternitz (2011). As for affix order restrictions, the suffix combinations listed in Table 58.1 define the suffix *-ence* as a closing diminutive suffix, i.e. no other diminutive suffix is allowed to follow the suffix *-ence*. By contrast, the suffix *-ica* can be followed by the suffix *-ka* and vice versa, the suffix *-ka* can be followed by *-ica*, which makes both suffixes, *-ka* and *-ica*, non-closing.

5. Semantic restrictions

5.1. Scope

Semantic restrictions on affixation are closely related to the principle of semantic scope. The most profound study on morpheme order and scope is undoubtedly Rice (2000). Semantic scope is related to concepts such as compositionality, generality, and specificity, and is formally expressed through layering of structure, i.e. of two suffixes that appear in the order AB and are in a scopal relationship, B scopes over A and the semantics of the expression AB is a sum of the semantics of A and the semantics of B, which actually means that the meaning of A is modified by the meaning of B. (Noncompositional scopal morphology is discussed in Gerner 2014). In the literature, scopal ordering is often demonstrated with the following two examples that show variable AB and BA order of morphemes, each ordering with different meaning:

(31) *yug-**pag-cuar***
person-big-little
'little giant'

*yug-**cuar-pag***
person-little-big
'big midget'
(Yup'ik, Mithun 1999: 43)

Since morphological categories can be defined in terms of cognitive content, Rice (2000:79) speaks of markers: (i) of categories that are in a fixed scopal relationship and thus occur in a fixed order with respect to each other (32) and (33); (ii) of categories that are in a reverse scopal relationship (as those in (31) and (34)), which may occur in variable order and the interpretation depends on the order); and (iii) of categories that do not enter into a scopal relationship with each other, which may occur in different orders (35). In the examples below, the raised comma is a glottal stop, after a consonant it signals that the sound is a glottalized consonant.

(32) Scopal: Slavey (Athabaskan, Rice 2000: 86): preverbs of location and relation
***te-ká**-yĩ-ya* 's/he got out of water'

water-out of
teh-k'e*-ts'e-ne-tah* 'look around, feel around in water'
water-around

(33) Scopal: Slavey (Athabaskan, Rice 2000: 88): preverbs with a modificational relationship

ɬé-ní*-ts'-ĩ-'a* 'fold'
half-complete
séé-ní*-eni-ts'-ĩ-h-thi* 'think over, get straight in mind'
good-complete

Paster (2005, 2006) discusses scopal ordering in the Fuuta Tooro dialect of Pulaar (West Atlantic), contrasting the order of several morphemes.

(34) Scopal, Pulaar, Fuuta Tooro dialect (Paster 2005: 176f)

causative - repetitive
o *jaNNg-**in-it**-ii* *kam*
3sg learn-CAUS-REP-past 1sg
'He taught me again.' (taught me before)
[[he taught me] again]
repetitive - causative
o *jaNNg-**it-in**-ii* *kam*
3sg learn-REP-CAUS-past 1sg
'He made me learn again.'
[[he made me [learn again]]

(34) is an instance of reverse scopal order: causative and repetitive are in a scopal relationship and the different orders of their markers are associated with different readings. Thus, (34) significantly differs from (35), the latter illustrates compositional but non-scopal *applicative - causative* semantics:

(35) Non-scopal, Pulaar, Fuuta Tooro dialect (Paster 2005:182)

applicative - causative

a.	*o*	*irt-**ir-in**-ii~*	*irt-**in-ir**-ii*	*kam*	*supu*	*o*	*kuddu*
	3SG	stir-APPL-CAUS-PAST	stir-CAUS-APPL-PAST	1SG	soup	DET	spoon
	'he made me stir the soup with a spoon' (I used a spoon)						
b.	*o*	*irt-**ir-in**-ii~*	*irt-**in-ir**-ii*	*kam*	*supu*	*o*	*laɓi*
	3SG	stir-APPL-CAUS-PAST	stir-CAUS-APPL-PAST	1SG	soup	DET k	nife
	'he made me stir the soup with a knife' (he used a knife)						

5.2. Relevance principle

Closely related to scope is the so-called relevance principle suggested by Bybee (1985): "A meaning element is *relevant* to another meaning element *if the semantics content of the first directly affects or modifies the content of the latter*" (Bybee 1985: 13). On the basis of a comparative investigation of the verb morphology of 50 languages, Bybee established that the formal exponents of categories the semantics of which is more

relevant to the content of the verb occur closer to the verb stem (Bybee 1985: 211) and postulates the following order of verb categories:

(36) Verb STEM-VOICE-ASPECT-TENSE-MOOD

Spencer (2006, 215) provides an illustrations of this order, (37) through (39), with periphrastic verb forms from English in which the verb stem is on the right:

(37) TENSE/ASPECT-VOICE/Verb STEM
has been seen

(38) TENSE/ASPECT–ASPECT/Verb STEM
has been walking

(39) MOOD-ASPECT-VOICE/Verb STEM
might have been seen

Thus, relevance appears the opposite of scope, in the sense that the affix with the broadest scope is most general (i.e. least relevant) and is thus placed farthest away from the base, whereas the most relevant affix has the narrowest scope and is thus the closest to the base.

5.3. Semantic compositionality without scope: Suffix repetition

Scope is assumed to operate between two different affixes (one with broader and one with narrower scope) and suffix repetition has not been discussed in relation to scopal ordering. And indeed can an affix scope semantically over itself? We therefore see double (40) and triple (41) diminutives as cases of semantic restrictions on affixation without scope. Double diminutives are quite common in some well-studied languages such as Romance (Talamo 2015 and Merlini Barbaresi 2012) and Slavic (Szymanek and Derkach 2005; Manova 2010; Manova and Winternitz 2011; Manova, Ptáček, and Gregová 2017).

(40) Czeck (Manova, Ptáček, and Gregová 2017): diminutive suffix repetition (2x)

	Noun	→	DIM1 'small N'	→	DIM2 'very small N'
-ek + -ek:	*rám* 'frame'	→	*rám-ek*	→	*rám-**eč-ek***
-ka + -ka:	*hlava* 'head'	→	*hláv-ka*	→	*hlav-**ič-ka***
-ko + -ko:	*slovo* 'word'	→	*slov-ko*	→	*slov-**íč-ko***

Bulgarian has even triple diminutives, see also the examples in (30).

(41) Bulgarian (Manova 2010): diminutive suffix repetition (3x)

-enc-enc-ence: dete 'child'	→	DIM1 *det-ence*
	→	DIM2 *det-enc-ence*
	→	DIM3 *det-**enc-enc-ence***

In (40) and (41), semantics is compositional: noun → DIM1 small noun → DIM2 very small noun → DIM3 very very small noun. However, semantic compositionality is achieved through suffix repetition. Since the definition of a scopal relationship, namely that the affix with a broader scope is outside the affix with a narrower scope, presupposes different affixes, suffix repetition proves the existence of semantic affix ordering (compositional semantics) without scopal relationship of the affixes involved. Note also that in Slavic languages non-diminutive derivational suffixes (i.e. suffixes that usually illustrate scopal relationship) cannot be repeated on adjacent cycles, see (49) and (50).

Based on what has been reported in the literature, the ordering of the prefixes seems less restricted than the ordering of the suffixes and prefixes are often repeated, for example, the English *re-refinance* meaning refinance multiple times. For additional examples of prefix repetition, see Zirkel (2010) and Manova (2015a).

6. Syntactic restrictions

Most of the research on affix ordering in understudied languages explores the mirror principle (Baker 1985) and thus provides a syntactic explanation of the order of affixes. The mirror principle argues that morphological derivations directly reflect syntactic derivations and vice versa. Some scholars who explain affix ordering semantically also assume that semantic derivation directly maps syntactic derivation as both syntax and semantics mean compositionality (Rice 2000); Dixon and Aikhenvald (2002) and Bickel and Nichols (2007) also argue that affix order is controlled by scope and other aspects of semantic and syntactic structure. In other words, in the literature syntactic affix ordering is usually discussed in relation to semantic ordering (cf. Rice 2011) and illustrated primarily with data from polysynthetic and agglutinating languages where arguments such as subjects and objects are part of the verb form (Mithun 1999; Korotkova and Lander 2010; Nordlinger 2010, among many others). Since syntactic relations between arguments can be defined semantically (this is addressed in *6.1, Syntactic Hierarchical Structure All the Way Down*), a direct correspondence between semantic and syntactic structure is assumed (Rice 2000: 29).

By contrast, Manova and Aronoff (2010) and Manova (2014) make a clear distinction between syntactic and semantic affix ordering, as the former relies on syntactic information such as e.g. subject and object, whereas the latter depends on information that involves semantic categories such as 'human', 'non-human', 'material', 'abstract', and so on. Semantic ordering by itself does not refer to syntax but looks for scopal relations between affixes, since if affix X scopes semantically over affix Y, X is outside Y in the word form. Semantic ordering also ensures iconicity and semantic compositionality (transparency).

The claim that 'morphological derivations must directly reflect syntactic derivations' can be seen as following from grammaticalization: since morphological derivations are grammaticalized syntax (Givón 1971), the former mirror the latter. In a similar fashion, Bybee (1985) argues that the order of morphemes within a word reflects

an earlier ordering of words within a sentence; and since words that function together in a sentence tend to occur together there are implications for affix ordering.

6.1. Syntactic Hierarchical Structure All the Way Down

One of the reasons why it is difficult to tease apart syntactic and semantic restrictions on affixation and why even involvement of argument structure seems not always a reliable criterion for establishing syntactically restricted affix order could be due to the fact that argument structure is accounted for in terms of thematic (theta) roles which are actually semantically defined, i.e. a thematic role is the semantic relationship of an argument with the predicate. Theta roles (θ-roles) are the formal device for representing syntactic argument structure. Some of the major theta roles of the verb include: Agent (an entity (willfully) doing something), Experiencer (an entity that undergoes an emotion, a state of being, or a perception expressed by the verb), Patient/Theme (an (animate) entity undergoing something), Instrument (the entity by which the action of the verb is carried out), Recipient/Goal (an (animate) entity receiving something), etc. In unmarked situations agents map onto subject positions, themes onto object positions, and goals onto indirect objects. We therefore assume that restrictions on affix placement based on labels such as (syntactic) subject and object are syntactic in nature. Now, in generative grammar Distributed Morphology (Halle and Marantz 1993, Embick and Noyer 2007, Bobaljik 20017) derives word structure. Theta roles are, however, problematic in DM (Harley and Noyer 1999), which is actually due to the status of roots. In DM roots are a-categorical and thus incompatible with theta role assignment. In sum, in syntax the verb has a central role and relates to its arguments by theta roles; in DM the root has the central role but since a-categorical, it cannot assign theta roles, which thus makes the syntax-morphology mapping an issue, although one of DM's major claims is that elements within syntax and within morphology enter into the same types of constituent structures (such that can be diagrammed in terms of binary branching trees). Nevertheless, following DM, restrictions on affix order, at least at an abstract level of derivation, are always and only syntactic in nature. We re-address DM's building blocks in 6.3, *Cartographic syntax: Syntacticization of semantics.*

6.2. Argument structure versus scope

Koyukon (Athabaskan; Jetté and Jones 2000) offers a good example of syntactic ordering: affixal pronominal subjects and objects occur in the fixed order shown in (42), i.e. all subjects, including passive ones, are in 'subject position' rather than 'object position':

(42) object – aspect – (participant) subject – classifier – verb stem

Actually, (42) is a piece of the pan-Athabaskan verbal template (Hoijer 1971) in (13). As can be seen from (42), in Koyukon subjects occur close to the verb stem and only a classifier can intervene between the subject and the stem. The examples in (43) all contain second person singular arguments, with the argument given in bold.

(43) Koyukon (Athabaskan)[3]

(a) transitive subject
*no-tegh-**ee**-ʔoɬ*
down-future-**2sg.subject**-handle compact object.future
'you will take it (compact object) down' (Jetté and Jones 2000: 780)

(b) intransitive subject
*ee-**n**-de-dzaah*
change, become-**2sg.subject**-classifier-dirty.imperfective
'you sg. become dirty' (Jette and Jones 2000: 795)

(c) transitive object
***ne**-he-nee-ɬ-ʔaanh*
2sg.obj-3human pl.-classifier-see.imperfective
'they are looking at you sg.' (Jetté and Jones 2000: 469)

(d) passive subject
*ee-tegh-**ee**-l-dzes*
once-future-**2sg.subject**-classifier-hit with fist
'You will be hit once.' (Thompson 1996: 360)

The subject precedes the verb stem (and classifier, 43b, d) and the object is further to the left (43c). The passive subject in (43d) has the form *ee-* and appears before the stem (and the classifier), which is evidence for a fixed order of grammatical relations in terms of argument structure such as subject and object.

Likewise, Paster (2005) in work on affix ordering in Pulaar (West Atlantic) takes argument structure to be syntactic. If argument structure is not involved, the ordering of the affixes is defined as scopal.

In Manova (2015c), there is a discussion of why argument structure is not used for explanation of word-formation in well-studied languages (at least not to the degree it is used for explanation of word structure in lesser-studied languages; recall also the discussion of English word-formation in Sections 4.2 and 4.3, as well as Section 4.1, *Closing Suffixes*). One of the reasons pointed out in this discussion is that word-formation in well-studied languages is word-class changing and derives mostly nouns, while word-formation in lesser-studied languages is verb-cented and word-class preserving. For example, the attachment of a suffix to a verb in English usually results in a derivation of a noun, which is almost never the case in the data from understudied languages where irrespective of what is attached to a verb stem, the final result always seems to be a verb. Significantly, Rice's (2011) article on principles of affix ordering starts with the clarification that she speaks of "factors involved in the ordering of affixes that are word-class preserving in languages with complex morphology." (p. 169).

[3] I thank Keren Rice for her help with the glosses and the analysis of these examples.

6.3. Cartographic syntax: Syntacticization of semantics

The goal of this section is, among other things, to clarify why some analyses of the syntax-semantics interface are semantical (section 5), while others are syntactic.

In generative grammar, certain aspects of meaning are recognized as grammatical semantics, i.e. belong to the grammar proper (syntax), while other aspects of meaning such as extralinguistic or conceptual semantics fall outside of grammar. For example, features encoding number, case, tense, aspect, and so on are grammatical semantics, while aspects of meaning arising from social, cultural, or historical contexts are extralinguistic semantics. In other words, concepts observed to have morphosyntactic encoding across languages are grammatical(ized) semantics and should be syntacticized, i.e. modeled in terms of syntactic maps, therefore the term cartography or cartographic syntax. Rizzi's (1997) work on a fine-grained left periphery, i.e. expanding the CP, and Cinque's (1999) research expanding the functional domain of IP are usually seen as the foundations of cartography. Rizzi and Cinque (2016) is a recent overview of the model; Baunaz and Lander (2018) provide a very helpful comparison between DM, cartography and nanosyntax, although their ultimate goal is an introduction to nanosyntax.

Cartography maintains that the units of syntax are much smaller and syntactic representations much more articulated than previously thought. Therefore, each syntactico-semantic feature is assumed to be an independent head that projects, one-feature-one-head principle. As for how heads project (i.e. how language structure is built): (i) structures are strictly binary-branching and right-branching, (ii) there is only one specifier per head, and (iii) only leftward movement is permitted. In what follows, we illustrate the cartographic approach with Cinque's (2014) analysis of *Mood-Tense-Aspect-Verb / Verb-Aspect-Tense-Mood* orders across the languages of the world (in 5.2, *Relevance principle,* we discussed a semantic approach to the order of these elements, see (36)-(39)). It is well-known from mathematics that all possible combinations of four elements (*Mood, Tns, Asp, V* in our case) are 4! = 1*2*3*4 = 24, see (44). Thus, Cinque (2014) lists all 24 patterns and based on impressive cross-linguistic evidence establishes existing "√", non-existing "*" and spurious "(*)" patterns.

(44) Cross-linguistic TAM orders (Cinque 2014)

a. √ Mood Tns Asp **V**
b. √ Mood Tns **V** Asp
c. √ Mood **V** Tns Asp
d. √ **V** Mood Tns Asp

e. (*) Tns Mood Asp **V**
f. (*) Tns Mood **V** Asp
g. * Tns **V** Mood Asp
h. * **V** Tns Mood Asp

i. (*) Asp Mood Tns **V**
l. (*) Asp Mood **V** Tns

m. √ Asp **V** Mood Tns
n. √ **V** Asp Mood Tns

o. * Mood Asp Tns **V**
p. √ Mood Asp **V** Tns
q. √ Mood **V** Asp Tns
r. * **V** Mood Asp Tns

s. * Tns Asp Mood **V**
t. √ Tns Asp **V** Mood
u. √ Tns **V** Asp Mood
v √ **V** Tns Asp Mood

w. (*) Asp Tns Mood **V**
x. * Asp Tns **V** Mood
y. √ Asp **V** Tns Mood
z. √ **V** Asp Tns Mood

There is no "j" because this letter is missing in the original text.

Two of the orders in (44), namely *Mood-Tense-Aspect-Verb* (a.) and *Verb-Aspect-Tense-Mood* (z.), are default patterns for pre- and post-positioning cross-linguistically. That is, (a.) and (z.) serve as basic templates and all attested deviations from them are language-specific templates. In section 1.2, *Template morphology*, we mentioned that some scholars consider templates incompatible with syntactic ordering, Cinque's analysis in (44) and (45) proves the opposite. Of the 24 possible patterns listed in (44) only 13 exist. Cinque (2014) derives the 13 attested combinations as restrictions on merge and move:

(45) *Derivation of the existing Mood Tns Asp V / V Tns Asp Mood patterns* (adopted from Cinque 2014, emphasis SM)

a. Order of **merge**: [...[MoodP(speech act) Mood...[TensePTense...[AspPAspect [VPV]]]]]
b. Parameters of **movement**:
i) No movement, or
ii) VP movement without pied-piping, or
iii) VP movement plus pied-piping of the *whose pictures*-type, or
iv) VP movement plus pied-piping of the *pictures of who*-type
v) total vs. partial movement of the VP with or without pied-piping
vi) obligatory vs. optional application of movement.
vii) No movement of a phrase not containing the VP is possible (except for (focus) movements to the left of a second-position element).

Why doesn't a cartography analysis face DM's derivational problems? As can be seen from (44) and (45), in cartography, unlike in DM, the derivational base (root in DM) is not a-categorical but categorized. In the case under scrutiny the base is verbal but the same holds for functional sequences in the nominal domain. For example, Cinque (2005) derives the attested and unattested orders of the so-called Greenberg's *Universal 20*

(Greenberg 1963): Dem-Num-A-N (e.g. *these five young ladies*) / N-A-Num-Dem. Of course, it should also be considered that the elements of these sequences are, similar to the elements of Mood-Tns-Asp-V / V-Asp-Tns-Mood, not always (bound) morphemes, strictly speaking; while DM operates only with (abstract) morphemes. We return to this issue in the next paragraph where we address the derivational architecture of nanosyntax.

Closely related to cartography is nanosyntax (Starke 2009, Caha 2009): the two frameworks assume a strict mapping between syntax and semantics and obey the principle of one-feature-one-head, i.e. not feature bundles but separate features are the building blocks of syntax. By contrast, feature bundles are allowed in DM. Thus, nanosyntax, like cartography, derives word structure feature-based, while derivation in DM is (abstract) morpheme-based. Consequently, if a DM abstract morpheme is made up of syntactico-semantic features such as X, Y, and Z, in nanosyntax these features form a span, i.e. they are heads merged in a binary- and right-branching tree. In other words, a nanosyntax analysis of word structure is not morpheme-based but sub-morphemic, which we see as being outside the scope of this chapter. For the sake of completeness, the cartography analysis of TAM orders in (45) is one-feature-one-head and thus compatible with nanosyntax; if every feature corresponds to a morpheme (which seems to be the case for TAM morphemes), the cartography / nanosyntax analysis is compatible with the DM architecture as well.

7. Statistical restrictions

Perhaps the most popular claim about affix order is Greenberg's "*Universal 28*: If both the derivation and the inflection follow the root, or they both precede the root, the derivation is always between the root and the inflection" (Greenberg 1963: 93). This claim can be explained in terms of either scope or relevance, can be seen as being either morphological or syntactic in nature, in the sense that both morphology and syntax can easily derive the suffix order "derivation-inflection" , "inflection-derivation" for prefixation. Nevertheless, Universal 28 was established statistically, based on data from numerous languages. However, statistics predicts probability of occurrence (i.e. the label "universal" is misleading) and, as can be expected, there are exceptions to Universal 28. Manova and Aronoff (2010) label claims such as Universal 28 statistical affix ordering.

Another example of statistical affix order is Trommer (2003) who, based on 58 languages with subject agreement, observes that the affixes that mark person and number usually attach in the order Person >> Number, i.e., person before number. In the literature, constraints such as Person >> Number are seen as hierarchical ordering as in an Optimality theory analysis Person >> Number reads "rank Person over Number." Hierarchies such as Person >> Number combined with alignment constraints allow for formulation of generalizations even in cases when the affixes that mark the respective features are not on the same side of the root. Thus Trommer (2003) also observes that in the majority of the languages he scrutinizes Person markers are usually prefixes while Number markers are usually suffixes. He maintains that the order is Person >> Number as fused person/number markers share the position of the Person marker.

With the growth of electronic corpora, statistics requiring meticulous countings and calculations of probabilities entered affix order research. Unlike typological studies such as the above-cited Greenberg (1963) and Trommer (2003) that consider a number of languages, corpus-based studies of affix order are, as a rule, devoted to a single language for which an appropriate corpus is available. An appropriate electronic corpus for research on affixation should allow effortless counting of occurrence of affixes. Unfortunately, such corpora are not easy to produce and are currently available only for some well-studied languages such as Dutch, English, German, Italian, or Russian. Thus, unsurprisingly the largest part of the research on affix order that relies on statistical information has been carried out in relation to productivity in English (Baayen and Lieber 1991; Baayen 1993 and later work) and to productivity and parsability again in English (Hay 2001, 2002, 2003 and later work; Hay and Baayen 2002; Plag and Baayen 2009).

As already explained, statistical affix ordering does not depend on grammatical information in the sense that it is available even if there is no grammatical explanation of it. In other words, statistics does not order affixes but only helps us establish a prevailing affix order pattern. We illustrate this issue with affix order in Chintang (Sino-Tibetan). According to Bickel et al. (2007), Chintang is a case of free ordering of inflectional prefixes (bolded in the examples below). The prefixes of interest are: *u-* 3rd person nonsingular actor; *kha-* 1st person nonsingular primary object; *ma-* negative. The abbreviations used are as follows: NS nonsingular, A actor, P primary object, NEG negative, PST past.

(46) Chintang (Mulgãu) dialect; Bickel et. al (2007: 44)

(a) ***u-kha-ma-****cop-yokt-e*
3NS.ACTOR-1NS.P-NEG-see-NEG-PAST

(b) ***u-ma-kha****-cop-yokt-e*
3NS.A- NEG-1NS.P-see- NEG-PST

(c) ***kha-u-ma-****cop-yokt-e*
1NS.P-3NS.A-NEG-see- NEG-PST

(d) ***ma-u-kha-****cop-yokt-e*
NEG-3NS.A-1NS.P-see-NEG-PST

(e) ***kha-ma-u-****cop-yokt-e*
1NS.P-NEG-3NS.A-see-NEG-PST

(f) ***ma-kha-u-****cop-yokt-e*
NEG-1NS.P-3NS.A-see-NEG-PST

All meaning: 'They didn't see us.'

Bickel et al. (2007) argue that prefix permutability in Chintang is a consequence of phonological subcategorization properties of prefixes: prefixes take a phonological word as host, and, since there are several phonological words, variable ordering results. This observation makes Manova and Aronoff (2010) and Rice (2011) classify affix order in Chintang as phonological (phonological restrictions were discussed in Section 3). Bickel et al. (2007) speak of "free prefix ordering". However, a recent statistical investigation based on distribution of bigrams (two-morpheme combinations) has shown that prefix order in Chintag is not as free as previously claimed (Mansfield, Stoll,

and Bickel 2020). The authors explain their new finding with the following morphological observations: 1) markers of the same category tend to be expressed in the same morphological position (Crysmann & Bonami 2016, in relation to paradigmatic alignment), and 2) morphological positions tend to be filled by markers of the same category (Stump 2001, in relation to featural coherence).[4] The scholars propose the observed statistical tendency for category clustering as a cognitive bias found in various aspects of grammar (Mansfield, Stoll, and Bickel 2020 and references therein). They see category clustering as "a good candidate for a universal force shaping the structure and use of language, potentially due to benefits in processing and learning.", cf. Ryan (2010) who also relies on bigrams (local morphotactic restrictions encoded as weighted bigram constraints) for machine learning of variable affix order. This leads us to the next section where psycholinguistics restrictions on affixation are also discussed in relation to learning but by humans. However, before turning to the role of psycholinguistics, in order to conclude this section we would like to remind the reader that statistical restrictions on affix order do not order affixes, they only establish tendencies in a data set.[5]

8. Psycholinguistic ordering

Jennifer Hay's work on parsability in English word formation, Hay (2001, 2002, 2003), seems to provide the best illustration of this type of restrictions on affix order. Hay postulates a set of factors responsible for parsing, such as phonology, productivity, regularity, semantic transparency, and relative frequency. The Parsabilty hypothesis assumes a double route access of morphologically complex words: a derived word can be accessed either as a whole unit (whole-word route) or as a decomposable unit (decomposition route). Which route is preferred depends on relative frequency. If the derivative is more frequent than its base, the relative frequency is high and the whole-word route is more probable, e.g. as in *government* versus *govern*. If the base is more frequent than the derivative, the relative frequency is low and the decomposition route is more probable, as in *green* versus *greenness*. Since parsability depends on a number of factors, it is a gradual notion and allows affixes to be ordered hierarchically according to their degree of parsability. Parsability determines affix order in the sense that a more parsable affix should occur outside a less parsable affix, since this order is easier to process. A parsable affix adds morphological structure to a base, making the latter more complex morphologically, therefore Plag (2002) labels affix ordering that depends on parsability *Complexity-Based Ordering* (CBO). A CBO parsability ordering demands a parsability hierarchy of suffixes, e.g. ABCDE (Table 58.3), where A is the least

[4] Stump, Bonani and Crysmann are major proponents of word-based morphology that does nor operate with morphemes but with markings without semantics, it is thus really interesting that meaningless markers express categories and look for semantically defined positions in order to cluster (see the discussion on the relation of meaning and form in PFM in Manova et al. 2020); it is also unclear why template morphology (as discussed in Section 1) is not an instance of category clustering, especially giving the fact that rule blocks in Stump (2001) are template-like.

[5] Based on the fate of statistical universals in linguistics and the route of previous research on affix order (from variable and free order to statistically established templates to scopal reanalyses and allowance for other grammatical restrictions when scope cannot account for the order of affixes, e.g. affix order research on Athabaskan), it would be interesting to review the Category Clustering Universal and affix order in Chintang in about ten years from now.

parsable suffix and E is the most parsable one. Such hierarchies are established following Hay's definition of parsability. In other words, all affixes of a language constitute a parsability hierarchy and the latter predicts their combinability. The diagonal in Table 58.3 is marked by "X" because a suffix is not expected to combine with itself, at least such combinations violates CBO; and since the suffixes are ordered hierarchically according to their degree of parsability, all existing suffix combinations (marked by "+" in Table 58.3) should be above the diagonal. Thus, CBO, based on the hierarchy in Table 58.3, predicts that the combinations ACD or BDE, should occur in a language, whereas the combinations *CAD and *EDB should be impossible.

Table 58.3: Complexity-base ordering: a hypothetical parsability hierarchy (A is the least parasble suffix, E is the most parsable one)

Suffix	A	B	C	D	E
A	X		+		
B		X		+	
C			X	+	
D				X	+
E					X

There has been much research on affix ordering in CBO, see Plag (2002), Hay and Plag (2004), Plag and Baayen (2009), Zirkel (2010), Manova (2010), Talamo (2015). Manova (2010) applies CBO to data from Bulgarian and shows that it cannot account for the order of the derivational suffixes in this language: 12 out of the 22 derivational suffixes discussed in this study are incompatible with CBO. Permutations and repetitions of suffixes pose a major problem to CBO. Some examples from another Slavic language, Russian, follow:

(47) Russian (Manova 2015a)

AB - BA order

-ost' & -(l)ivyj

a. *mil-ost'* 'mercy' → *mil-**ost-ivyj*** 'merciful'

b. *son-livyj* 'sleepy' → *son-**liv-ost'*** 'sleepiness'

(48)

***-ota** & -nyj*

a. *dobr-ota* 'goodness' → *dobr-**ot-nyj*** 'good'

b. *tem-n-y* 'dark' *tem-**n-ota*** 'darkness'

(49)

ABA order

a. *revn-iv-yj* 'jealous' → *revn-ost'* 'jealousy' → *revn-ost-n-yj* 'devoted' → *revn-**ost-n-ost'*** 'devotedness'

b. *verojatn-yj* 'probable' → *verojatn-ost'* 'probability' → *verojatn-ost-n-yj* 'related to probability' → *verojatn**-ost-n-ost'*** '(greater) probability'

(50) **ABAB order**
lico 'face' → *lič-n-yj* 'personal' → *lič-n-ost'* 'person, personality' → *lič-n-ost-n-yj* 'related to personality' → *lič**-n-ost-n-ost'*** '(greater) personality'

Examples such as these in (47)-(50) present a real challenge to CBO because on the CBO hierarchy (Table 58.3) a suffix has a fixed position and can either precede or follow another suffix, but not both. Additionally, CBO allows a suffix to be accessed only once in the derivation of a word. Problems with CBO due to affix permutations have also been reported for English prefixes (Zirkel 2010) and for Italian derivational suffixes (Talamo 2015), as well as for German derivational suffixes (Zirkel-Hilkenbach 2011). Clearly, all examples of affix permutations discussed in the different sections of this chapter also challenge CBO. Actually, a few years ago the major proponents of CBO stopped publishing on the topic.

Establishing that CBO cannot account for the order of the suffixes in the Slavic word, Manova (2011b) suggests an alternative analysis that is based on theoretical observations about the uniqueness of suffix combinations (the motivation of this claim was explained in Section *4.3. Fixed two suffix combinations*). Manova hypothesized that if affix combinations are unique (fixed) pieces of morphological structure, they should be listed in the mental lexicon, i.e. native speakers should know them by heart. To test this hypothesis, Manova and Knell (2021) ran two psycholinguistic experiments as part of a series of experiments on the processing of morphological structure in languages from different families such as Slavic, Germanic and Romance. The experiments consisted of an identification task similar to the lexical decision task (Meyer and Schvaneveldt 1971); however, the participants did not see whole words but two-suffix combinations such as *-mentary* (formed from *-ment* + *-ary*), *-ageous* (from *-age* + *-ous*), etc. In the first experiment only native speakers of English (n=45, 34 female) were tested, while the second experiment was with advanced (C1 and C2 level) non-native speakers of English (n=30, 18 female). In both experiments, 60 suffix combinations were presented to the participants as stimuli, 30 of the combinations exist in English and 30 do not. Of the existing combinations, 15 were productive and 15 unproductive. Of the non-existing combinations, 15 were created from a permutation of an existing combination (reversing the order of the two suffixes such that the combination was not possible in English), and 15 were created through a spelling manipulation of an existing combination (changing one letter from an existing combination such that the new form does not exist in English). No non-existing combinations included any phonological and/or orthographical impossibilities in English. Although knowledge of suffix combinability is not systematically acquired at school, and linguistic theories recognize only derivations that start from lexical bases (roots/stems/words), in the experimental trials, native and advanced non-native speakers did not need to see lexical bases to differentiate between existing and non-existing suffix combinations. The results of the experiments are summarized in Figure 58.1.

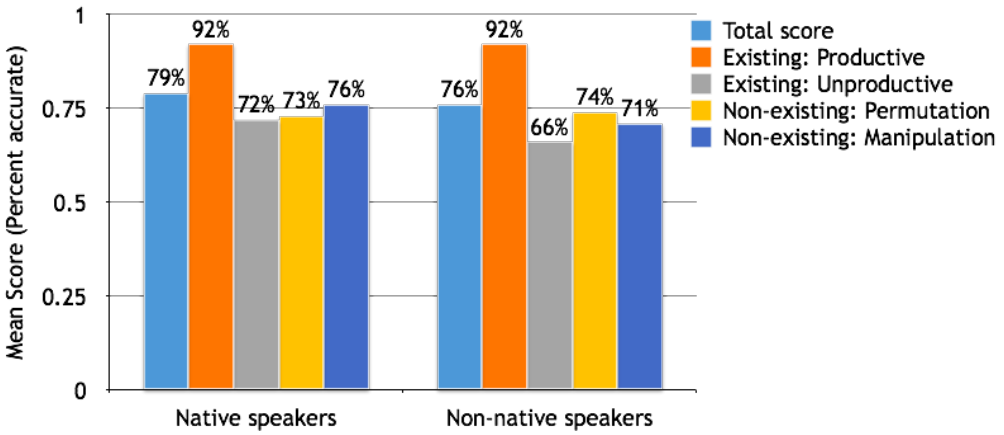


Figure 58.1: Accuracy of recognition of two-suffix combinations in English: Mean scores for native and advanced non-native speakers (from Manova and Knell 2021)

Native and non-native speaker groups showed a strong ability to recognize existing two-suffix combinations and differentiate them from non-existing two-suffix combinations, with an overall mean score of 46.29 (79%) for the native speaker group and 44.73 (76%) for the non-native speaker group; no significant difference was found between the native and non-native speaker groups (p-value = 0.19). Similar to other iterations of this study with other test languages (Polish, Slovene, Italian, and Spanish), productive combinations were the most accurately recognized of the four types (Figure 58.1), with both groups showing a mean score of 92% for identifying this type of stimulus. A significant difference in the processing of productive and unproductive combinations was found (p-value < 0.001).

The results of Manova and Knell (2021) indicate that high language competence (i.e. native and native-like) correlates with listedness of morphological structure in term of fixed two-suffix combinations in the mental lexicon, which is in accord with Rayn (2010) and Mansfield, Stoll, and Bickel (2020) who model the analysis and learning of variable and free affix order in terms of bigrams (two-suffix combinations).

Theoretical and diachronic morphology provide further support to the idea of bigramic processing and learning of morphological structure, Table 58.4.

Table 58.4: Rule conflation versus suffix combination (data from Stump 2019, table from Manova and Knell 2021)

Base	Rule conflation	Suffix combination
whimsy, nonsense	**whimsic*, **nonsensic* *whims-ical, nonsens-ical*	*cycle → cycl-ic* *cycl-ic-al*
probable, simple	**probabilist*, **simplist* *probabil-istic, simpl-istic*	*national → national-ist* *national-ist-ic*
beauty, mort	**beautic*, **mortic*	*academy → academ-ic*

	beaut-ician, mort-ician	*academ-ic-ian*

As can be seen from this table, in English some two-suffix combinations "merged" into single pieces of structure.

9. Conclusion

We discussed restrictions on affix order in well-studied and lesser-studied languages. We started with the definition of the strategies for structure building in morphology, namely layered and template morphology, and then tackled grammatical (phonological, morphological, semantic, and syntactic) and extra-grammatical (statistical and psycholinguistic) restrictions on affix order, with examples from the literature. All types of grammatical restrictions on affix ordering are compatible with both layered and template morphology and no language's affixation system can be explained with a single affix ordering principle. However, the major issue the data selected for discussion in this article uncovered is that heavy descriptive devices such as complex templates and hierarchies are often problematic for affix order research, most probably because they are not really word structure: no word in a language is as long as a template, and no word in a language has all combinations of affixes allowed by a CBO parcability hierarchy. By contrast, analyses in terms of small pieces of word structure such as two- and three-affix combinations (be they of traditional or abstract morphemes; abstract morphemes are category labels) are more appropriate for affix order accounts because they: 1) make languages of different morphological types comparable; 2) reflect the ways morphological structure is stored in the mental lexicon; and 3) seem to facilitate learning of morphology, both in humans and machines.

Related Articles (See Also)

Article ID
morphcom002
morphcom028
morphcom050
morphcom051
morphcom057
morphcom070
morphcom073

References

Aronoff, Mark. 1976. *Word Formation in Generative Grammar*. Cambridge, MAa: MIT Press.

Aronoff, M., and N. Fuhrhop. 2002. "Restricting Suffix Combinations in German and English: Closing Suffixes and the Monosuffix Constraint." *Natural Language and Linguistic Theory* 20: 451-490.

Baayen H. 1993. "On frequency, transparency and productivity." *Yearbook of Morphology* 1992, edited by G. E. Booij and J. van Marle, 181-208. Dordrecht. Kluwer. https://doi.org/10.1007/978-94-017-3710-4_7

Baayen, R.H., and Lieber, R. 1991. "Productivity and English Derivation: A Corpus Based Study." *Linguistics* 29: 801-843.

Baayen, R.H., R. Piepenbrock, and L. Gullikers. 1995. *The CELEX lexical database* (CD-ROM). Linguistic Data Consortium, University of Pennsylvania, Philadelphia, PA.

Baker, M. 1985. "The Mirror Principle and morphosyntactic explanation." *Linguistic Inquiry* 16: 373-415.

Baunaz, L., & E. Lander. 2018. "Nanosyntax: The Basics." In *Exploring Nanosyntax*, edited by Lena Baunaz, Liliane Haegeman, Karen De Clercq, and Eric Lander, 3-56. New york: Oxford University Press.

Bickel, B., G. Banjade, M. Gaenszle, E. Lieven, N. Paudyal, I. Purna Rai, M. Rai, N. Kishor Rai, and S. Stoll. 2007. "Free prefix ordering in Chintang." *Language* 83: 1-31.

Bickel, Balthasar, and Johanna Nichols. 2007. "Inflectional morphology." In *Language typology and syntactic description*, 2nd ed., edited by Timothy Shopen,169-240. Cambridge: Cambridge University Press.

Blythe, J. (2009). *Doing referring in Murrinh-Patha conversation*. Ph.D. thesis, University of Sydney.

Bobaljik, Jonathan. 2017. "Distributed Morphology". *Oxford Research Encyclopedia of Linguistics.* Retrieved 15 Jun. 2020, from https://oxfordre.com/linguistics/view/10.1093/acrefore/9780199384655.001.0001/acrefore-9780199384655-e-131.

Bybee, J. L. 1985. *Morphology: a study of the relation between meaning and form*. Amsterdam: John Benjamins.

Caha, Pavel. 2009. *The Nanosyntax of Case*. Doctoral dissertation, University of Tromsø.

Cinque, Guglielmo. 1999. *Adverbs and Inflectional Heads*. Oxford: Oxford University Press.

Cinque, Guglielmo. 2005. "Deriving Greenberg's Universal 20 and its Exceptions." *Linguistic Inquiry* 36 (3): pp. 315-332.

Cinque G. 2014. "Again on tense, aspect, mood morpheme order and the "mirror principle"." In The Cartography of Syntactic Structures, vol. 9, Functional Structure from Top to Toe, edited by P Svenonius, pp. 232–65. New York: Oxford Univ. Press.

Crysmann, Berthold, and Olivier Bonami. 2016. "Variable morphotactics in information-based morphology." *Journal of Linguistics* 52: 311–74.

Dixon, R.M.W. and Alexandra Y. Aikhenvald. 2002. “Word: A typological framework.” In *Word: A cross-linguistic typology*, edited by R.M.W. Dixon and Alexandra Y. Aikhenvald, 1-41. Cambridge: Cambridge University Press.

Embick, David and Rolf Noyer. 2007. “Distributed Morphology and the Syntax-Morphology Interface.” In The Oxford Handbook of Linguistic Interfaces, edited by Gillian Ramchand and Charles Reiss, pp. 289-324. Oxford: Oxford University Press.

Fabb, N. 1988. “English Suffixation is Constrained only by Selectional Restrictions.” *Natural Language and Linguistic Theory,* 6, 527-539.

Foley, Lawrence. 1980. *Phonological Variation in Western Cherokee.* Outstanding Dissertations in Linguistics. Garland Publishing: New York & London.

Gaeta, L. 2005. “Combinazioni di suffissi in Italiano.” In *La Formazione delle Parole*, *Atti del XXXVII Congresso internazionale di Studi della Societa di Linguistica Italiana* (SLI), edited by M. Grossmann & A. Thornton. Roma: Bulzoni.

Gerner, M. 2014. “Noncompositional scopal morphology in Yi.” *Morphology* 24, 1–24. https://doi.org/10.1007/s11525-014-9231-2

Giegerich, H. J. 1999. *Lexical Strata in English. Morphological Causes, Phonological Effects*. Cambridge: Cambridge University Press.

Givón, T. 1971. “Historical syntax and synchronic morphology: An archaeologist’s field trip”. C*hicago Linguistics Society 7*. Chicago: University of Chicago.

Goddard, Ives. 1996. 'Introduction.' In Languages, ed. by Ives Goddard. Washington D.C.: Smithsonian Institution. 1-16.

Good, Jeffrey Craig. 2003. *Strong linearity: Three case studies towards a theory of morphosyntactic templatic constructions*. PhD. dissertation. University of California, Berkeley.

Good, Jeff. 2011. “The typology of templates.” *Language and Linguistics Compass* 5:731–747.

Greenberg, J. 1963. “Some universals of grammar with particular reference to the order of meaningful elements.” In. *Universals of Language*, edited by J. Greenberg, Cambridge: MIT Press.

Halle, M., & Marantz, A. 1993. “Distributed Morphology and the Pieces of Inflection.” In *The View from Building 20*, edited by K. Hale and S. J. Keyser, 111–176). MIT Press.

Harley, H. & R. Noyer. 1999. “Distributed Morphology.” *Glot International*, Volume 4, Issue 4.

Hargus, Sharon. 2007. *Witsuwit’en grammar. Phonetics. Phonology. Morphology*. Vancouver: UBC Press.

Hay, J. 2001. “Lexical frequency in morphology: Is everything relative?” *Linguistics* 39: 1041-1070.

Hay, J. 2002. “From Speech Perception to Morphology: Affix-ordering Revisited.” *Language* 78: 527-555.

Hay, J. 2003. *Causes and Consequences of Word Structure*. London: Routledge.

Hay, J., and Baayen, H. 2002. “Parsing and Productivity”. In *Yearbook of Morphology 2001,* edited by G. E. Booij, and J. van Marle, 203-255. Dordrecht: Kluwer.

Hay, J., and Plag, I. 2004. “What constrains possible suffix combinations? On the interaction of grammatical and processing restrictions in derivational morphology.” *Natural Language and Linguistic Theory* 22: 565-596.

Hoijer, Harry. 1971. “Athapaskan morphology.” In *Studies in American Indian languages. University of California Papers in Linguistics* 65, edited by Jesse Sawyer, 113-147. Berkeley: University of California Press.

Hyman, L. 2003. “Suffix ordering in Bantu: a morphocentric approach.” In *Yearbook of Morphology 2002*, edited by G. Booij, and J. van Marle, 245-281. Dordrecht: Kluwer.

Hyman, L. 2006. “Affixation by Place of Articulation: Rare and Mysterious.” *UC Berkeley Phonology Lab Annual Report 2006*. Available at: http://linguistics.berkeley.edu/phonlab/annual_report/documents/2006/Hyman_Tiene.pdf

Inkelas, S. 1993. “Nimboran position class morphology.” *Natural Language and Linguistic Theory* 11: 559-624.

Inkelas, S. 2016. "Affix ordering in Optimal Construction Morphology." In *Morphological Metatheory*, edited by Daniel Siddiqi and Heidi Harley, 479-511. John Benjamins.

Jetté, Jules and Eliza Jones. 2000. *Koyukon Athabaskan dictionary*. Fairbanks: Alaska Native Language Centre, University of Alaska.

Kim, Yuni. 2010. “Phonological and morphological conditions on affix order in Huave.” *Morphology* 20:133-–163.

Kim, Yuni. 2015. “Mobile affixation within a modular approach to the morphology-phonology interface.” In *Affix Ordering Across Languages and Frameworks*, edited by S. Manova, 111- 123. New York: Oxford University Press.

Kiparsky, P. 1982. “Lexical Morphology and Phonology.” In *The Linguistic Society of Korea, Linguistics in the Morning Calm*, 1-91. Seoul: Hanshin Publishing Co.

Korotkova, Natalia, and Yury Lander. 2010. “Deriving Affix Ordering in Polysynthesis: Evidence from Adyghe.” *Morphology* 20: 299–319.

Manova, Stela 2005. “Derivation versus inflection in three inflecting languages.” In *Morphology and its Demarcations,* edited by WU Dressler, D. Kastovsky, O. Pfeiffer, and Franz Rainer, 233-253. Amsterdam: Benjamins.

Manova, S. 2008. “Closing suffixes and the structure of the Slavic word: *Movierung*.” *Austrian Contributions to the 14th International Congress of Slavists, Ohrid, Macedonia, September 2008*. *Wiener Slavistisches Jahrbuch* 54: 21-34.

Manova, S. 2009. “Closing suffixes in Bulgarian, Russian and German: the role of semantics.” In *Bulgarian Language and Literature in Slavic and Non-Slavic Contexts*, edited by Mónika Farkas Baráthi, and Henrietta Majoros, 286-292. Szeged: JATE Press.

Manova, S. 2010. “Suffix Combinations in Bulgarian: Parsability and Hierarchy-based Ordering.” *Morphology* 20: 267–296.

Manova, S. 2011a. *Understanding morphological rules*. Dordrecht: Springer.

Manova, Stela. 2011b. “A cognitive approach to SUFF1-SUFF2 combinations: A tribute to Carl Friedrich Gauss.” *Word Structure* 4: 272–300.

Manova, Stela. 2014. “Affixation.” In *Oxford Bibliographies in Linguistics*, edited by Mark Aronoff. New York: Oxford University Press.

Manova, S. 2015a. “Affix order and the structure of the Slavic word.” In *Affix Ordering Across Languages and Frameworks*, edited by S. Manova, 205-230. New York: Oxford University Press.

Manova, S. 2015b. “54. Closing suffixes.” In *Word-Formation in the European Languages*. Vol. 2, edited by P. Müller, I. Ohnheiser, S. Olsen, and F. Rainer. Handbooks of Linguistics and Communication Science (HSK) 40/2, 956-971. Berlin: de Gruyter Mouton.

Manova, S. 2015c. “Introduction: Affix order among languages and frameworks.” In *Affix Ordering Across Languages and Frameworks*, edited by S. Manova, 1-15. New York: Oxford University Press.

Manova, S., and WU Dressler. 2001. “Gender and Declensional Class in Bulgarian.” *Wiener Linguistische Gazette* 67-69: 45-81.

Manova, S., and M. Aronoff. 2010. “Modeling affix order.” *Morphology* 20: 109-131.

Manova, S., and K. Winternitz. 2011. “Suffix Order in Double and Multiple Diminutives: With Data from Polish and Bulgarian.” *Studies in Polish Linguistics* 6: 115–138.

Manova, S., and L. Talamo. 2015. “On the Significance of the Corpus Size in Affix-Order Research.” *SKASE Journal of theoretical linguistics* 12, 369-397.

Manova, S, D. Ptáček, and R. Gregová. 2017. Second-grade diminutives in Czech and Slovak: A contrastive study with data from corpora. In *12. letno srečanje Združenja za slovansko jezikoslovje / 12th Slavic Linguistics Society Annual Meeting / XII ежегодная конференция Общества славянского языкознания*, edited by Luka Repanšek, Matej Šekli,121-122. Ljubljana: Založba ZRC, Inštitut za slovenski jezik Frana Ramovša.

Manova, S., H. Hammarström, I. Kastner, I., and Y. Nie. 2020. “What is in a morpheme? Theoretical, experimental and computational approaches to the relation of meaning and form in morphology.” *Word Structure* 13: 1-21.

Manova, S., and G. Knell. 2021. “Two-suffix combinations in native and non-native English: Novel evidence for morphomic structures.” In *All things morphology: Its independence and its interfaces,* edited by Sedigheh Moradi, Marcia Haag, Janie Rees-Miller, and Andrija Petrovic, 305-323. Amsterdam: Benjamins.

Mansfield, John, Sabine Stoll, and Balthasar Bickel. 2020. “Category clustering: A probabilistic bias in the morphology of verbal agreement marking.” *Language* 96: 255-293.

Marchand, Hans. 1969. *The categories and types of present-day English word-formation*, 2nd ed. München: Beck.

McCarthy, John J., and Alan Prince. 1993. Generalized alignment. In *Yearbook of morphology* 1993, edited by G. Booj, and J. van Marle, 79-153. Dordrecht: Kluwer.

McFarland, Theresa. 2009. *The phonology and morphology of Filomeno Mata Totonac.* Ph.D. dissertation, University of California, Berkeley.

Melissaropoulou, Dimitra, and Angela Ralli. 2010. “Greek derivational structures: restrictions and constraints.” *Morphology* 20: 343–357.

Merlini Barbaresi, Lavinia. 2012. “Combinatorial patterns among Italian evaluative affixes.” *SKASE Journal of Theoretical Linguistics* 9: 2-14.

Meyer, David and Roger Schvaneveldt. 1971. Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology* 90. 227-234.

Mithun, M. 1999. *The languages of Native North America*. Cambridge: Cambridge University Press.

Mithun, M. 2016. “Affix Ordering: Motivation and Interpretation.” In *The Cambridge Handbook of Morphology*, edited by A. Hippisley & G. Stump, 149-185. Cambridge: Cambridge University Press. doi:10.1017/9781139814720.007

Muysken, Pieter. 1986. “Approaches to Affix Order.” *Linguistics* 24: 629–643.

Nordlinger, R. 2010. “Verbal morphology in Murrinh-Patha: evidence for templates.” *Morphology* 20: 321-341.

Nordlinger, Rachel. 2015. “Inflection in Murrinh-Patha.” In *The Oxford handbook of inflection*, edited by Matthew Baerman, 491–519. Oxford: Oxford University Press.

Paster, M. 2005. “Pulaar verbal extensions and phonologically driven affix order.” In *Yearbook of Morphology 2005*, edited by G. Booij, and J. van Marle, 155-199. Dordrecht: Springer.

Paster, Mary. 2006. *Phonological conditions on affixation*. Ph.D. dissertation, University of California, Berkeley.

Paster, Mary. 2009. “Explaining phonological conditions on affixation: Evidence from suppletive allomorphy and affix ordering.” *Word Structure* 2: 18–37.

Plag, I. 1996. “Selectional restrictions in English suffixation revisited. A reply to Fabb. (1988).” *Linguistics* 34: 769-798.

Plag, I. 1999. *Morphological Productivity. Structural Constraints in English Derivation*. Berlin: Mouton de Gruyter.

Plag, I. 2002. “The role of selectional restrictions, phonotactics and parsing in constraining suffix ordering in English.” In B *Yearbook of Morphology 2001*, edited by G. Booij, and J. van Marle, 285-314. Dordrecht: Kluwer.

Plag, I., and H. Baayen. 2009. “Suffix ordering and morphological processing.” *Language* 85, 109-152.

Rice, Keren. 1989. *A grammar of Slave*. Berlin: Mouton de Gruyter.

Rice, Keren. 1997. "A reexamination of Proto-Athabaskan y". *Anthropological Linguistics* 39(3). 423–26.

Rice, K. 2000. *Morpheme Order and Semantic Scope*. Cambridge: Cambridge University Press.

Rice, K. 2011. “Principles of affix ordering: an overview.” *Word Structure* 4: 169-200.

Rizzi, Luigi. 1997. “The Fine Structure of the Left Periphery.” In *Elements of Grammar*, edited by Liliane Haegeman, pp. 281-337. Dordrecht: Kluwer.

Rizzi, Luigi and Guglielmo Cinque. 2016. Functional categories and syntactic theory. *Annual Review of Linguistics*. 2016. 2:139–63, doi: 10.1146/annurev-linguistics-011415-040827

Ryan, Kevin M. 2010. “Variable affix order: Grammar and learning.” Language 86: 758–91.

Selkirk, E. 1982. *The Syntax of Words*. Cambridge: MIT Press.

Siegel, D. 1974. *Topics in English Morphology*. Cambridge: MIT.

Simpson, J., and Withgott, M. 1986. “Pronominal Clitic Clusters and Templates.” In *The Syntax of Pronominal Clitics. Syntax and Semantics 19*, edited by H. Borer, 149-174. New York: Academic Press.

Sitchinava, D. 2015. “55. Closing suffixes in Russian.” In *Word-Formation in the European Languages*. Vol. 2, edited by P. Müller, I. Ohnheiser, S. Olsen, and F. Rainer.

Handbooks of Linguistics and Communication Science (HSK) 40/2. Berlin: de Gruyter Mouton.
Spencer, A. 1991. *Morphological Theory*. Oxford: Blackwell Publishers.
Spencer, A. 2006. "Morphological universals" In *On Linguistic Universals*, edited by Ricardo Mairal and Juana Gil. 101-129. Cambridge: Cambridge University Press.
Starke, Michal. 2009. "Nanosyntax: A Short Primer to a New Approach to Language." *Nordlyd* 36 (1): 1-6. [online] Available at: http://septentrio.uit.no/index.php/nordlyd/index.
Stump, G. T. 1997. "Template morphology and inflectional morphology". In *Yearbook of Morphology 1996*, edited by G. Booij, and J. van Marle, 217-241. Dordrecht: Kluwer.
Stump, G. T. 2001. *Inflectional Morphology*. Cambridge University Press.
Stump, G. T. 2019. "Evidence for rule conflation." Talk at *AIMM4*. Stony Brook, NY. Abstract at: https://www.stonybrook.edu/commcms/aimm/_includes/documents/TalkAbstracts/Stump_AIMM4.pdf
Szymanek, Bogdan. 2000. "On morphotactics: Closing morphemes in English." In: PASE Papers in Language Studies, edited by Bożena Rozwadowska, 311−320. Wrocław: Aksel.
Szymanek, Bogdan, and Tetyana Derkach. 2005. "Constraints on the derivation of double diminutives in Polish and Ukrainian." *Studies in Polish Linguistics* 2: 93−112.
Talamo, L. 2015. "Suffix Combinations in Italian: Selectional Restrictions and Processing Constraints." In *Affix Ordering Across Languages and Frameworks,* edited by S. Manova, 175–204. New York: Oxford University Press.
Thompson, Chad. 1996. "The Na-Dene middle voice: An impersonal source of the D-element." *International Journal of American Linguistics* 62: 351-378.
Trommer, Jochen. 2003. The interaction of morphology and syntax in affix order. In *Yearbook of Morphology* 2002, edited by G. Booj, and J. van Marle, 283–324. Dordrecht: Springer.
Zirkel, Linda. 2010 "Prefix combinations in English: structural and processing factors." *Morphology* 20: 239−266.
Zirkel-Hinkelbach. 2011. "Can Complexity-Based Ordering be extended from English to German?" 3rd Vienna *Workshop on Affix Order: Advances in Affix Order Research*, University of Vienna, 15-16 January 2011.

Figure captions

Figure 58.1: Accuracy of recognition of two-suffix combinations in English: Mean scores for native and advanced non-native speakers (from Manova and Knell 2021)

Tables

Table 58.1: Combinability of the suffix *-ist* (data from Aronoff & Fuhrhop 2002, based on OED, CD 1994)

Table 58.2: Combinability of the DIM suffixes in Bulgarian (Manova and Winternitz 2011, Manova 2015a)
Table 58.3: Complexity-base ordering: a hypothetical parsability hierarchy (A is the least parasble suffix, E is the most parsable one)
Table 58.4: Rule conflation versus suffix combination (data from Stump 2019, table from Manova and Knell 2021)