Modeling affix order

Stela Manova · Mark Aronoff

> *The real voyage of discovery consists not in seeking new landscapes, but in having new eyes.*
>
> *Marcel Proust*

1 Introduction

A language's morphology possesses a large set of meaningful elements, affixes, which combine in order to express an even larger set of semantic meanings; and affixation is the default rule for derivation of new words and word forms. However, of all possible affix combinations in a language, a relatively limited number really exist, which gives rise to the question: What principle(s) is/are responsible for the combination of affixes? This question is a central one in linguistic theory. As might be expected, there is much research on affix order, especially in particular languages. Overviews on the topic are, however, rare; and to the best of our knowledge, there is no study on affix order from a typological perspective. These facts make the writing of the following text a challenging task—easy and difficult at the same time.

S. Manova (✉)
Department of Slavic Studies, University of Vienna, Universitätscampus AAKH,
Spitalgasse 2, Hof 3, 1090 Wien, Austria
e-mail: stela.manova@univie.ac.at
URL: http://slawistik.univie.ac.at/mitarbeiter/manova-stela/;
http://homepage.univie.ac.at/stela.manova/

M. Aronoff
Department of Linguistics, SUNY at Stony Brook, Stony Brook,
NY 11794-4376, USA
e-mail: mark.aronoff@stonybrook.edu
URL: http://www.linguistics.stonybrook.edu/faculty/mark.aronoff

On the one hand, it seems easy to have an original position on something unexplored, such as the typology of affix order. On the other hand, it is difficult to offer a new and interesting perspective on an almost over-explored topic, such as affix order. Thus, since the present two-issue volume is the first ever collection of papers on affix ordering in typologically diverse languages, the objective of this introductory article is to provide an overview of research on affix ordering which situates the contributions to the volume within that research.

The present volume arises from the papers and posters presented at the Workshop on Affix Ordering in Typologically Different Languages held in conjunction with the 13th International Morphology Meeting in Vienna, Austria, on 3–4 February 2008.[1] The 10 articles included in the volume are distributed according to their topics into two issues (five in each issue). The range of the data discussed is extremely broad and covers (from east to west on the globe) the Australian languages, then Japanese, Caucasian, Slavic, Greek, Romance, Germanic, and then to indigenous languages of the Americas.

An overview of research on a given topic can be either chronological (i.e. presenting the research in chronological order) or approach-oriented (i.e. presenting the research according to the approaches followed). This paper is of the second type. Actually, the presentation strategy is borrowed from mathematics and the reasoning applied is also primarily mathematical. We will first model the task of affix ordering in order to establish its logical space (Sect. 2). The limitation of the space of the task will help us with predicting all conceivable solutions. We will then (Sect. 3) check which of the established possible solutions have been covered by linguistic research so far and discuss problematic suggestions. When summarizing the existing research on affix order, we will also refer to the papers of this volume. The content of the articles included in the first issue is briefly explained in Sect. 4. Section 5 draws conclusions.

2 The logical space of affix ordering

In mathematics, it is particularly important to establish whether the task one is confronted with is really solvable. Thus, let us try to verify the solvability of our task. If we assume that the affix system of a language represents a finite set of elements (affixes), all possible combinations of the elements of that set are a finite number. A finite number of combinations can be described in terms of relations (rules) among the elements participating in those combinations and/or as a list of existing combinations (if no rule applies). In other words, the task of describing the affix combinations in a language is solvable. It has at least one solution that is a list of all occurring combinations of affixes. However, (in mathematics) a solvable task usually has more than one solution. Therefore, we expect affix combinations to be either partly or fully governed by a set of rules. Put differently, affix ordering could be either: (1) motivated (rule-governed) and/or (2) unmotivated (rote-learned, i.e. listed).

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[1] The workshop website is available at: http://homepage.univie.ac.at/stela.manova/workshop_imm13. htm.

Before dealing with the two options, motivated and unmotivated ordering, in detail, let us clarify the following. We speak of affix ordering only if we have affixes (morphemes)[2] that combine with each other, i.e. if affix order is realized. A realized affix order is always linear.[3] This is the linear order that could be either motivated or unmotivated. If the ordering of an affix is motivated, there is a rule that explains why a particular affix is placed exactly where it is in a sequence of affixes, such as ABCDE, where A, B, C, D, and E are different affixes. In the simplest case of rule-governed affix order, all the affixes of the linear sequence ABCDE will be ordered according to one single rule, i.e. the rule that explains the placement of, let us say, B also explains the placement of A, C, D and E. In the most complicated case, the position of each affix of the sequence ABCDE is defined by a different rule. It is also conceivable that some of the affixes in the sequence ABCDE are rule-ordered whereas others are not. Such affix order would be only partially motivated.

(1) For *motivated* affix order there are the following conceivable options. It can obey either

(1.1) grammatical and/or (1.2) extra-grammatical principles.

(1.1) *Grammatical* principles are principles that reflect the organization of grammar where form and meaning play a decisive role. Therefore, grammatical principles of affix order can be either (1.1.1) formal and/or (1.1.2) semantic.

(1.1.1) *Formal* principles can be further subdivided into:

(1.1.1.1) *phonological* principles (which rely on phonological information)

(1.1.1.2) *morphological* principles (which rely on morphological information)

(1.1.1.3) *syntactic* principles (which rely on syntactic information);

and

(1.1.2) *semantic* principles (which rely on information that is semantic by nature).

(1.2) *Extra-grammatical* principles (Note that extra-grammatical principles can be also related to meaning and/or form, i.e. they, like grammatical principles, can be *formal* and *semantic*)

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[2] We assume that there are morphemes. As Manova (2010a) shows, even non-segmental morphological rules and subtractive formations, both among the crucial arguments for a-morphous morphology (Anderson 1992), operate in the way segmental affixation does.

[3] We assume with Manova (2010a) that: (1) addition (affixation through addition of a linear morphological segment); (2) substitution (substitution of a linear morphological segment by another morphological segment of the same type); (3) modification (morphonological and phonological modification of a morphological base); (4) conversion (no change); and (5) subtraction (subtraction of a linear segment) are all possible cognitive operations that can be performed on a morphological form (base) in order to produce a new morphological form. The five operations, termed by Manova morphological techniques, belong to the same morphological level, since they all are found to operate on roots, stems and words, and in derivation and inflection. Thus, cases, such as *to impórt → an ímport* (modification, due to the stress change) or *to cut → a cut* (conversion) in English, are not subtypes of affixation but alternative ways to express semantics that can be also expressed through affixation. This analysis means that there is no non-segmental affixation. Of the above five morphological techniques, in this article we discuss addition and substitution.

(1.2.1)   *statistical*—we have a particular order because it is the prevailing one in (a) language(s); or

(1.2.2)   *psycholinguistic*—related to the way we process and produce affix combinations;

(1.2.3)   *cognitive*—based on cognitive categorization of the world;

(1.2.4)   *pragmatic*—if the speech-act context influences affix ordering; and

(1.2.5)   *other principles* (Hypothetically, it is possible that there are also other non-grammatical principles that are relevant to affix order, such as psychological, temporal, etc. A psychological principle would be a case when the psychological condition of the speaker (rage, pleasure, etc.) influences the way (s)he orders affixes. We would have to deal with a temporal order if affix order during the day deviates from affix order during the night, etc. It is, however, not very probable that such principles could provide a full explanation of affix order in a language, i.e. if existing, they could have only a marginal role in affix ordering.)

(2)   *Unmotivated* affix order is inexplicable and of the following types:

(2.1)   inexplicable but ordered, i.e. *templatic* (A pure templatic order is related only to form. It is a list of slots and forms that occur in those slots. Note, however, that hypothetically it is also possible to have a template that is either completely or partly motivated).

and/or

(2.2)   neither ordered nor explicable, i.e. *arbitrary* (there is no system in the way an affix combines with other affixes in a given language).

This system of principles provides the logical space of affix ordering, i.e. it is hard to believe that there could be something else that can play a role in determining affix order.

As already mentioned, it may be that affix order is organized around one of the above listed principles, or that more than one principle applies. Following the already assumed mathematical logic, we expect the solution of a complex task, such as detecting the logic of affix order, to require consideration of multiple factors. Clearly, if a set of principles applies, we cannot expect that all the principles would always be equally important.

In the next section, we will see how many of the above logical predictions have been covered by research on affix order so far.

3 The research on affix order so far

Intriguingly, all of the above-predicted principles of affix ordering, except entirely arbitrary ordering (2.2), have been discussed in the linguistic literature. Thus, in what follows our goal is not to provide an exhaustive list of sources in which a

particular type of affix ordering has been tackled but to demonstrate that all mathematically conceivable types of affix order are linguistically documented. Following the list of options in Sect. 2, we will briefly comment on existing approaches to affix order, paying special attention to problematic suggestions. Before starting with the approaches, we would like to clarify a few terminological matters.

3.1 Preliminaries: templatic and layered morphology

According to the linguistic literature, there are two types of morphological organization with respect to affix order. The first type is usually referred as templatic (Simpson and Withgott 1986; Spencer 1991, 212f; Inkelas 1993, among others), though some authors speak also of position classes (cf. Stump 1992; Inkelas 1993). The second type is usually termed layered morphology, see Stump (1997, 33ff), Mithun (1999, 42f), and Rice (2000, p. 11) for illustration and discussion of both types. The following is a list of features that characterize the two types of morphology, we cite Rice (2000, p. 11):

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.'

Based on these observations, we will present templatic and layered morphology in terms of formal schemas and discuss each schema briefly.

For us, templatic affix order is form-governed, in the sense that the different slots of a template are not semantically related. A template, such as that in (1), has the realizations in (2). Note that A, B, C, D and E are usually category labels. If the slots cannot be related to particular categories, they are just numbered.

(1)   Templatic ordering

BASE   A   B   C   D   E

Realizations that are derived in terms of morphemes placed in different slots:

(2)   BASE   A1   B1   C1   D1   E1
      BASE   A2   B2   C2   D2   E2
      BASE   A3   B3   C3   D3   E3
      BASE   A4   B4   C4   D4   E4
      . . ..

A1, A2, A3, etc. are morphemes that always occupy the slot A but never co-occur. The same holds for the suffixes in slots B, C, D, and E. As Rice (2000) mentions, in a templatic realization some of the slots could be occupied by zero morphemes, i.e. could be empty. Clearly, the zero morphemes are established in analogy with forms that have an overt suffix in the same slot. Thus in order to produce a word, one should use the schema in (2) every time, fill the slots with the needed affixes, and then the empty slots with zeros. A word should be formed at once. As (2) clearly shows, template-based affix order does not allow variations, i.e. all A affixes always appear only in slot A, all B affixes always in slot B, etc.[4]

Unlike template order, layered ordering is semantics-governed. Layered morphology can produce exactly the same forms as template morphology, a layered form is, however, derived in a different way, see (3) and (4).

(3) Layered ordering

BASE   A   B   C   D   E

The realizations of (3) are derived step by step, so that every step adds some semantics to the previous one (4). This type of semantic dependence is known as scopal relationship.

(4)   [[BASE] A]
       [[[BASE] A] B]
       [[[[BASE] A] B] C]
       [[[[[BASE] A] B] C] D]
       [[[[[[BASE] A] B] C] D] E]

We would like to underline that although it is possible to make a clear distinction between templatic and layered morphology, we do not believe that a particular language must fall into of one of the two types. On the contrary, we expect, in accord with the above-assumed mathematical logic, that languages will tend to profit from a combination of both types of morphological organization. Rice (2000) exemplifies our prediction. Affix order in Athapascan languages is governed by semantic scope by default. In cases where semantics cannot order the morphemes, templatic principles intervene. Another instance of a mixed morphological type can be illustrated with the help of our example (3). If A, B, C, D and E in (3) are labels of categories that stay in scopal relations, so that B scopes over [BASE+A], C scopes over [[BASE+A]+B], etc. (see (4)), the form in (3) will also represent a template. Actually, inflectional morphology is often of this type, i.e. templatic and semantically organized at the same time. We will return to this observation in Sect. 3.3 below. It is also conceivable to have a language whose morphological organization is templatic by default but some of the neighboring slots in the template are additionally in scopal semantic relations (cf. Hyman 2003). However,

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[4] Since templatic morphology is, by definition, incompatible with variable affix order, we cannot agree with Paster (2005) that pair-wise variable affix combinations of AB—BA type are constrained by the language-specific morphological template.

layered morphology is, unlike template morphology, compatible with variable affix order, see Sect. 3.2.4 below.

3.2 Motivated affix order

As already argued above, if affix order is systematically organized, it should be motivated at one or more linguistic levels: phonological, morphological, and syntactic; or explicable in terms of semantic or extragrammatical principles, such as statistical, psycholinguistic or cognitive ones.

3.2.1 Phonological ordering

This type of affix ordering depends on phonological information that is regular and can be thus formulated in terms of a rule. The data in (5) are an illustration. Bases terminating in coronal consonants (5a) and bases in vowels (5c) affix for causatives differently than bases ending in non-coronal consonants (5b). The examples are from the Bantu language Tiene and are borrowed from Hyman (2006).

(5)   Causative formation
a.   bases in coronal (alveolar or palatal)
     mat-a 'go away'   *maas-a* 'cause to go away'
     bót-a 'give birth'   *bóos-ɛ* 'deliver (child)'
     kɔlɔ 'become tired'   *kɔɔs-ɔ* 'tire (tr.)'
     pal-a 'arrive'   *paas-a* 'cause to arrive'
     taan-a 'get thin'   *taas-a* 'cause to get thin'
     píín-a 'be black'   *píís-a* 'blacken'
     bany-a 'be judged'   *baas-a* 'caused to be judged'
b.   bases in non-coronal (labial or velar)
     lab-a 'walk'   *lasab-a* 'cause to walk'
     lók-a 'vomit'   *lósek-ɛ* 'cause to vomit'
     bik-a 'become cured'   *bisek-ɛ* 'cure'
     kuk-a 'be sufficient'   *kusik-ɛ* 'make sufficient'
     dím-a 'become extinguished' *díseb-ɛ* 'extinguish (tr.)'
     yóm-a 'become dry'   *yóseb-ɛ* 'make dry'
     tóm-a 'send'   *tóseb-ɛ* 'cause to send'
     suɔm-ɔ 'borrow'   *sɔsɔb-ɔ* 'lend'
c.   bases in a vowel
     lɛ 'eat'   *lees-ɛ* 'feed'
     vu 'fall'   *vuus-ɛ* 'cause to fall'

Another convincing illustration of phonological ordering is Kim (2010). In order to avoid epenthesis, some affixes in Huave, depending on the phonological make-up of the base, surface as either suffixes or prefixes.

In the recent literature, see, for example, Paster (2005 and later works), it has been claimed that there is no phonologically driven affix order and that all the phonology involved in affix ordering is always morphologically driven. An

overview of the research on the problem is provided by Kim (2010). Note that in this issue, the two opposite positions, both captured within Optimality Theory, are defended: Kim (2010) argues for phonologically driven affixation (i.e. phonological ordering), whereas Caballero (2010) favors morphologically driven phonology (i.e. morphological ordering) whereby phonological constraints override all other constraints. The alternative treatments of the phonology–morphology interface in affixation seem to stem from two facts: (1) if regular phonological information serves for the ordering of affixes, this information is visible through affixation; and (2) if regular phonological information serves for the ordering of affixes, this information may be encoded in the affix entry. Unfortunately, theory-based interpretations of these two facts have led to the misleading claim that all phonology is morphologically driven. Moreover, affixes do not have only phonological form but also semantics and if we apply Paster's (2005 and later works) logic about the role of phonology in the phonology–morphology interface to semantically-motivated affixation rules, we should then claim that also semantics (and syntax, since semantic structure can be directly turned into syntactic structure, cf. Rice 2000, p. 29) is morphologically driven, which is definitely wrong. Our explanation of all interfaces in affix order follows the logic outlined in Sect. 2: the morphological phenomenon of affix order can use different types of information, phonological, morphological, semantic, etc.

A more complex case of phonology-morphology interface represents the so-called stratal approach, see Siegel (1974), Allen (1978), Selkirk (1982), Kiparsky (1982), Mohanan (1986) and Giegerich (1999). This approach identifies affixes through their phonological and morphonological specification (i.e. through the phonological and morphonological alternations they cause) and assigns them to different strata. The stratal approach argues that neutral affixes (such that leave the morpheme boundary intact) order outside non-neutral affixes (such that blur the morpheme boundary). For a short overview of the stratal approach, see Zirkel (2010).

Of course, it is also possible that affixation uses phonological and morphological information at the same time. An example would be a rule of the type: if the last suffix of a derived base (morphological information) contains a front vowel (phonological information), add the suffix X, in cases of a last suffix with a back vowel select the suffix Y.

Phonological ordering is typical of inflectional morphology, see Aronoff and Xu (next issue). Phonological inflection class assignment rules result in phonological affix ordering; cf. Aronoff (1992, p. 31) who terms inflection class 'morphological class'.

To summarize this section, affix order that relies on phonological information is phonologically ordered.

3.2.2 Morphological ordering

Morphological affix ordering, in contrast to phonological affix ordering, depends on morphological information. A selectional rule (selectional restriction in the sense of Fabb 1988; Plag 1996) where an affix requires the attachment of a particular other

affix is a manifestation of morphological ordering, e.g. the English suffix *-ization* always selects the suffix *-al*.

In the literature, combinatorial morphological restrictions are seen as either encoded in the (last affix of the) base or as encoded in the affix attached. Plag (1996, 1999), Giegerich (1999) and almost all of the papers included in the volume advocate primarily rules of the first type, though the claim is seldom stated explicitly. Fabb (1988), Gaeta (2005), Melissaropoulou and Ralli (next issue) claim that selection is encoded in the affix, the article by Melissaropoulou and Ralli (next issue) being entirely devoted to the issue. Note that the approach mentioned in the previous section of morphologically driven phonology is compatible with affix-driven rules only, whereas a phonological approach could be of both types, i.e. base-driven or affix-driven. An approach to affix order that relies on semantic information (see Sect. 3.2.4 below) means a step-by-step derivation (cf. (4)) and is compatible with a base-driven morphology only. From the literature on affix order, it seems that affixation in human languages tends to be of one of the two types, i.e. either base-driven or affix-driven, the former type being the prevailing one. It is, however, unclear whether this conclusion is not due to a theory-based analysis. Note that there is no logical (mathematical) reason why a language cannot be base-and-affix-driven at the same time.

Closing suffixes (Aronoff and Fuhrhop 2002; Manova 2008, 2009a) represent another clear example of morphological ordering. As the term implies, morphological information, the fact that a suffix cannot be followed by another suffix of the same type (i.e. a closing derivational suffix cannot be followed by another derivational suffix, whereas a closing inflectional suffix cannot be followed by another inflectional suffix), is encoded in the suffix itself. The feature +/− closing is, however, relevant to affixation only if the suffix is part of a base. In other words, a closing suffix does not allow attachment of further suffixes but may attach to many suffixes. Thus, closing suffixes are an example of morphological information (morphological selectional rule) encoded in the base, more precisely in the last suffix of the base. Closing suffixes are mentioned in Manova (2010b), as well as in Melissaropoulou and Ralli (next issue).

3.2.3 Syntactic ordering: the Mirror Principle

Syntactic affix ordering is based on the assumption that morphology mirrors syntax and vice versa, that syntax mirrors morphology. This claim is known as the Mirror Principle (Baker 1985, p. 375):

(6)   *The Mirror Principle*
      Morphological derivations must directly reflect syntactic derivations (and vice versa).

Baker defends the two claims the Mirror Principle contains as an if-and-only-if rule. In what follows, we will, however, demonstrate that the way syntax relates to morphology is not the same as the way morphology relates to syntax, as well as that

it is not always clear what the exact role of the syntax in the syntax–morphology–syntax interface is.

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. This claim implies that at least the values of morphosyntactic features with markers (affixes) of their own (i.e. morphologically derived forms) arose from syntactic structure, which in turn means that realized morphosyntactic values should be derived uniformly in the way the Mirror Principle predicts. Let us exemplify the point with the morphosyntactic category of tense. Following the Mirror Principle, it is logical to expect that the different values of tense, such as past, perfect, future, etc., all should have something to do with syntax, at least due to being a result of grammaticalization. Moreover, since across languages the morphological marker of the category of tense is usually placed far away from the verb root (Bybee 1985, see also the next section), it is not very probable that in a cyclic derivation of the Mirror Principle type marked tense forms are taken from the lexicon, i.e. again, tense forms should be derived syntactically. Let us see now whether this is the case with all realized values of tense. Our data come from the Slavic family, specifically from Old Bulgarian (Old Church Slavonic in some sources) where the diachronic development of the aorist and of the future tense forms is well documented. The historical development of the aorist paradigm is summarized in Table 1, the listed forms are from Mirčev (2000, 103ff).

As can be seen from table 1, Old Bulgarian possessed four different aorist patterns for verbs with consonant-final infinitive stems (see the infinitives in table 1 where -*ti* is the infinitive ending). Of all forms, the productive aorist is the newest pattern. Crucially, none of the four patterns is an obvious product of syntax-morphology mapping. The last consonant of the verb root served as an aorist marker in paradigm 2 and paradigm 3, therefore the labels sigmatic and asigmatic aorist respectively. In paradigm 4, however, the aorist marker was added after amplification of the verb root with the vowel -*o*-, which thus makes this paradigm morphologically derived. The status of -*x*- (the last consonant of the verb root in paradigm 3) as an aorist marker is visible through a comparison of the paradigms of the asigmatic (paradigm 3) and the productive aorist (paradigm 4), as well as through a comparison of all four Old Bulgarian paradigms with their corresponding Modern Bulgarian paradigms. On the diachronic development of the Bulgarian aorist, see Ivanova-Mirčeva and Haralampiev (1999) and Mirčev (2000). Intriguingly, in the same language, the future tense, that is another marked value of tense, was expressed in two ways: (1) the oldest forms labeled simple future were synthetic and used the present tense of a perfective-aspect verb (i.e. as in the present-day Russian); and (2) compound future forms that were periphrastic, i.e. syntactic constrictions with the verbs *iměti* 'have'*, hotěti* 'want' and *načęnti* 'begin' conjugated in the present tense and the infinitive of the verb. For example, *imamъ pisati* 'I will write', *imaši pisati* 'you will write', etc. The respective Modern Bulgarian forms consist of a particle and the present tense of the verb: *šte piša* 'I will write', *šte pišeš* 'you will write'. The particle *šte* comes from the verb *hotěti*. Modern Bulgarian (unlike Russian) does not have simple future. Thus in one and the same language (Bulgarian), morphologically derived forms (aorist and

Table 1 Old and Modern Bulgarian aorist inflection

	(1) Root Aorist	(2) Sigmatic Aorist	(3) Asigmatic Aorist	(4) Productive Aorist
Old Bulgarian				
Infinitive	*pas-ti* 'to fall'	*ves-ti* / **vedti* 'to lead'	*reš-ti* 'to say'	*reš-ti* 'to say'
1SG	*pad-ъ*	*věs-ъ*	*rěx-ъ*	*rek-ox-ъ*
2SG	*pad-e*	*ved-e*	*reč-e*	*reč-ø-e*
3SG	*pad-e*	*ved-e*	*reč-e*	*reč-ø-e*
1PL	*pad-o-mъ*	*věs-o-mъ*	*rěx-o-mъ*	*rek-oxo-mъ*
2PL	*pad-e-te*	*věs-ø-te*	*rěs-ø-te*	*rek-os-te*
3PL	*pad-ę*	*věs-ę*	*rěš-ę*	*rek-oš-ę*
1DU[a]	*pad-o-vě*	*věs-o-vě*	*rěx-o-vě*	*rek-oxo-vě*
2DU	*pad-e-ta*	*věs-ø-ta*	*rěs-ø-ta*	*rek-os-ta*
3DU	*pad-e-ta*	*věs-ø-te*	*rěs-ø-te*	*rek-os-te*
Modern Bulgarian				
1SG[b]	*pad-a-x*	*vod-i-x*	*rek-o-x*	*rek-o-x*
2SG	*pad-a*	*vod-i*	*reč-e*	*reč-e*
3SG	*pad-a*	*vod-i*	*reč-e*	*reč-e*
1PL	*pad-a-xme*	*vod-i-xme*	*rek-o-xme*	*rek-o-xme*
2PL	*pad-a-xte*	*vod-i-xte*	*rek-o-xte*	*rek-o-xte*
3PL	*pad-a-xa*	*vod-i-xa*	*rek-o-xa*	*rek-o-xa*

[a] The Old Bulgarian dual was lost in the diachronic development of Bulgarian. Therefore there are no dual forms in the Modern Bulgarian part of the table

[b] The Modern Bulgarian verb does not have infinitive and 1 SG PRES serves as a citation form of the verb. This explains why the Old Bulgarian part of the table starts with a row for infinitives whereas the Modern Bulgarian part does not have this row

future) of the same morphosyntactic category are and are not products of syntactic derivations. This makes the syntax–morphology mapping an obscure process and gives rise to the logical question with respect to the Mirror Principle: Does the Mirror Principle reflect something that is linguistically real, such as diachronic development of linguistic structure, or does it work because of making things abstract?

Let us see now how the second mirror, that of morphology-to-syntax contributes to the results of the first mirror, the syntax-to-morphology one. As we observed, it is possible that in a language (Bulgarian) a synthetic form (the Old Bulgarian simple future) was replaced by a periphrastic construction (the Old Bulgarian compound future is the only type of future tense forms that exists in Modern Bulgarian). Generally, it appears that synthetic (i.e. morphological) forms easily developed into periphrastic (i.e. syntactic) forms. Just to mention a few instances from Slavic and Germanic: synthetic past tense has been replaced by periphrastic perfect (e.g. in Bosnian, Croatian, Serbian, and in Austrian German), synthetic Genitive has been replaced by a periphrastic construction with a preposition (e.g. in Bulgarian, English, and German). This development can be explained by the greater iconicity of a syntactic construction in comparison to a morphological construction, i.e. the syntax–morphology mapping and the morphology–syntax mapping appear to differ

cognitively. Thus we have in one and the same language morphological forms that are purely morphological (non-derived and derived), morphological forms that are syntactic by origin (i.e. grammaticalized syntax) and morphological forms that developed into or are periphrastic constructions. Whereas morphology readily accommodates all these types of forms in a morphological paradigm, it is unclear how syntax accesses the purely morphological derivations, such as the Bulgarian aorist. If non-derived morphology is listed in the lexicon, and grammaticalized and periphrastic morphology is accessed syntactically, what happens with affixed morphological forms that are not syntactically derived? As was mentioned, purely morphological forms may disappear through replacement by more iconic periphrastic constructions, but there is always a stage in the development of a language where a purely morphological form and its corresponding periphrastic construction coexist and provide the same semantics, which requires syntax to read (mirror) the two types of forms in the same way. Indeed, it is true that any non-simple morphological form, even one that has nothing to do with syntactic derivation, can be always turned into a tree structure. A corresponding tree structure, however, does not make something syntactic. A tree structure is one of the many technical ways for representing information structure. Additionally, the classical example of a tree structure in informatics is the family tree, which is related neither to syntax in particular not to language in general. Thus it seems that the syntactic play with the morphology–syntax mirror is, like the syntax–morphology mirror, possible only at an abstract level where any morphological form that is composed of meaningful elements (morphemes) can be always turned into information structure, the latter misleadingly called by some linguists syntactic structure. Related to our observation is Alsina (1999) who claims that the Mirror Principle does not reflect syntactic derivations but lexical operations.

An additional problem with syntactic ordering arises if one considers that syntactic information, unlike phonological, morphological and semantic information, is not directly available when affix ordering takes place. Compare phonological ordering, e.g. 'if a vowel-final base, attach affix X', morphological ordering, e.g. 'if a base terminates in a suffix X, select the suffix Y', and semantic ordering 'if a base with semantics X, attach affix Y' with syntactic ordering, e.g. 'if grammaticalization of Verb + Auxiliary pattern, then BASE+Suffix morphological order' or 'if SOV word order, then XY affix order'. While phonological, morphological and semantic information is available and directly accessible when affix order takes place, syntactic information is not available. The speaker should, in the course of word-production, first check the diachronic development of a syntactic construction, or do syntactic analysis of existing sentences to establish whether the word-order pattern of a language is (predominantly) SOV. Therefore, it is hard to believe that purely syntactic information, whether involving a Mirror Principle mapping or not, could be the (only) factor responsible for affix ordering. Another argument against any universal principle of affix ordering based exclusively on syntactic information is provided by template morphology, (1) and (2) above. Baker himself (1985, 401f) confessed that Mirror Principle can't adequately account for template morphology, if the latter exists.

Of the articles included in this volume, syntactic ordering in terms of grammaticalization is discussed in detail by Mykhaylyk (next issue) with relation to

Ukrainian synthetic future tense; Korotkova and Lander (next issue) relate syntactic ordering to semantics in one Caucasian language; as also Caballero (2010) does for a Mexican language; and Nordlinger (next issue) sees syntax as a factor in the formation of the language-specific template of an Australian language.

In the literature, syntactic affix ordering is usually discussed in relation to semantic ordering (cf. Rice 2009) and illustrated with data from polysynthetic languages where arguments such as subjects and objects are part of the verb form (see Korotkova and Lander, next issue) and words can be thus seen as phrases (Rice 2000). Since syntactic relations between arguments can be defined semantically, it is assumed that there is a direct correspondence between semantic and syntactic structure (Rice 2000, p. 29, 2009). Recall, however, our observation on the relation between information structure (semantics) and syntax above. The following subsection is devoted to semantic ordering.

3.2.4 Semantic ordering: relevance and scope

The fact that an affix, by definition, has form and semantics makes any combination of affixes describable in terms of semantics. Put differently, semantic ordering seems a much better candidate for being a universal principal of affix ordering than any syntactic principle. Two concepts, relevance and scope, are related to affix order based on semantic information. Bybee (1985) suggested the relevance principle. "A meaning element is *relevant* to another meaning element *if the semantic content of the first directly affects or modifies the content of the latter*" (Bybee 1985, p. 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, p. 211) and postulates the following order of verb categories: Verb STEM–VOICE–ASPECT–TENSE–MOOD. Spencer (2006) provides good illustrations of this order but unfortunately with examples that do not involve morpheme order in synthetic forms. Consider the following periphrastic verb forms from English in which the verb stem is on the right: *has been seen* TENSE/ASPECT-VOICE/Verb STEM, *has been walking* TENSE/ASPECT—ASPECT/Verb STEM, and *might have been seen* MOOD–ASPECT–VOICE/Verb STEM (Spencer 2006, p. 125).

Many studies on affix order explore the principle of semantic scope, the most profound of all being undoubtedly Rice (2000). Semantic scope implies semantic compositionality. Of two suffixes that appear in the order AB and are in a scopal semantic relation, 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 usually means that the meaning of A is modified by the meaning of B, as demonstrated with the following two examples that show AB and BA order of morphemes:

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

(Mithun 1999, p. 43)

Recall that step-by-step semantic derivation means layered morphology, (3) and (4) above. Thus (7) explains why layered morphology is compatible with variable order.

Based on the semantic, i.e. cognitive, content of the different morphological categories, Rice (2000, p. 79) discusses the order of markers: (1) of categories that are in a fixed scopal relationship, which occur in a fixed order with respect to each other; (2) of categories that are in reversed scopal relationship (as those in (7)), which may occur in variable order and the interpretation depends on the order); and (3) of categories that do not enter into a scopal relationship with each other, which may occur in different orders.

Semantic relevance can be seen as the opposite of semantic scope. The suffix with the broadest scope is most general (i.e. least relevant) and is thus placed farthest away from the base, whereas the most relevant suffix has the narrowest scope and is thus the closest to the base.

The principle of semantic scope is explained in detail and illustrated with copious examples in Caballero (2010). Narrog (2010) and most of the papers included in the next issue provide analyses based on semantic scope, Aronoff and Xu (next issue), Korotkova and Lander (next issue), and Nordlinger (next issue).

3.2.5 Statistically motivated ordering: typological universals and corpora

Clear examples of statistically motivated typological observations, called universals, provide studies based on numerous usually genealogically unrelated languages. Perhaps the most popular typological 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, p. 93).

Recently, with the growth of electronic corpora, statistics has also entered affix order. Unlike typological studies that consider a number of languages and are often imprecise, corpus-based studies of affix order are usually devoted to one single language for which an appropriate corpus is available. An appropriate electronic corpus (cf. Baayen et al. 1995) allows meticulous counting of occurrence of forms. The largest part of the research on affix order that relies on statistical information has been carried out in relation to productivity (see Baayen and Lieber 1991; Baayen 1992 and later work) and productivity and parsability (cf. Hay and Baayen 2002; Plag and Baayen 2009). Baayen (2008) is an introduction to statistical analysis for linguists.

In the current issue, Linda Zirkel applies a statistical method to establish the way English prefixes combine.

We will finish this section with a reference to syntactic ordering, since purely statistical information is, like syntactic information, not available to the speaker in the course of word production. While producing a word, a speaker can neither compare languages nor count forms in a corpus. We therefore conclude that purely statistical information can provide some explanation of existing affix order patterns when a set of languages is concerned but is not directly involved in affix ordering, assuming that the real ordering of affixes always takes place as a concrete act

performed by a single speaker in a single language. However, if universal principles may be rephrased as semantic-cognitive or psycholinguistic principles, they can be made directly relevant to affix ordering; see Aronoff and Xu (next issue) for some such strategy.

The role of universals in affix ordering is discussed in two of the papers included in the next issue, the already mentioned paper by Aronoff and Xu and in Nordlinger's paper. Aronoff and Xu argue that morphological theory should profit from universal claims about scopal relationships. Nordlinger, however, doubts the existence of universal principles that underline semantic scope.

3.2.6 Psycholinguistically motivated ordering: parsability and complexity-based ordering

Issues related to perception and production of morphological forms could in principle impose restrictions on affix ordering. This type of affix ordering is best illustrated with Jennifer Hay's work on parsability in English word formation, Hay (2001, 2002, 2003). Hay postulates a set of factors responsible for parsing, such as phonology, productivity, regularity, semantic transparency, and relative frequency. 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. Thus a parsability hierarchy of suffixes ABCDE, where A is the least parsable suffix and E is the most parsable one, predicts that the combinations ACD or BDE should occur in a language, whereas the combination *CAD and *EDB should be impossible. Since a parsable affix adds (morphological) structure to a base, making the latter more complex morphologically, Plag (2002) labeled affix ordering that depends on parsability *Complexity-Based Ordering*. Plag (2002) and Hay and Plag (2004) also demonstrated that parsability works in conjunction with selectional restrictions on affix order. The most recent contribution to this approach, Plag and Baayen (2009), has shown that not only parsability and selectional restrictions but also other factors related to perceptions and production of morphologically complex forms are relevant to affix order.

Complexity-Based Ordering and parsability are discussed by Zirkel (2010) in relation to English prefixes, and by Manova (2010b) in relation to Bulgarian suffixes.

3.2.7 Cognitively motivated ordering: prototypes and other cognitive categories

Some linguists (cf. Dressler 1989; Manova 2005, 2010a) use cognitive concepts, such as prototypes, in order to explain the organization of morphology, in particular the order of derivational and inflectional affixes. Derivation and inflection are seen as situated between the poles of prototypical inflection and prototypical derivation, with an in-between zone of non-prototypicality where non-prototypical derivation 'meets' non-prototypical inflection and derivation and inflection are difficult to differentiate. In the word-form, affixes expressing prototypical derivation (roughly, word-class changing affixes) are internal to the affixes expressing non-prototypical

derivation; the reverse relation holds for inflection—the affixes of prototypical inflection (more general semantically) are external to less prototypical inflectional affixes (more relevant to the base semantically), cf. Dressler et al. (2009).

Manova (2009b) also argues that categories such as nouns, adjectives and verbs that can be seen as having cognitive nature are relevant to suffix order in particular. The cognitive nature of nouns, adjectives and verbs is due to their semantics: nouns denote objects and persons, verbs—states and events, etc. With data from Bulgarian and English, Manova demonstrates that of all suffixes that attach to a derived base, there is usually only one suffix that belongs to a particular word-class, most of the suffixes being word-class-changing with respect to the word-class of the base. In cases where two or more suffixes with the same word-class specification attach, the suffixes are either semantically opposite, e.g. -*less*$_{ADJ}$ and -*ful*$_{ADJ}$ in English, or one of the suffixes applies by default, i.e. most of the derivations exhibit that suffix. Manova (2009b) assigns derivational status to diminutive and augmentative suffixes but treats them separately from the other derivational suffixes in Bulgarian.

As mentioned in the subsection on semantic ordering above, cognitive concepts underline semantic ordering and make possible postulation of scopal relationships between categories. Both cognitive and semantic principles should be seen much more as tendencies than as fixed unbreakable rules.

Some prototypical properties of derivation and inflection and their relevance to affix order are discussed in Manova (2010b).

3.2.8 Affix order motivated by other factors

As regards the other factors that can conceivably influence affix order (pragmatic, psychological, etc., see Sect. 2), there is no research on them, to the best of our knowledge. However, it is hard to believe that such functional factors can provide a complete explanation of affix order in the way psycholinguistic and cognitive parameters do.

The role of priming effects in affix ordering, as discussed by Caballero (this issue), can be seen as related to pragmatic ordering.

3.3 Unmotivated affix order

In Sect. 2, we predicted for unmotivated affix order two options: (1) unmotivated but ordered, i.e. templatic and (2) neither motivated nor ordered, i.e. arbitrary. We have already discussed the first option, templatic morphology, in Sect. 3.1 above. What we would like to underline here is that it has happened in the literature that a language or even a language family that had been considered a case of template morphology received an alternative analysis when a sufficiently profound description of that language (family) was made available. The best example of such reanalysis is Rice (2000) who convincingly shows that the affix order in the Athapascan family, considered for a long time templatically organized, is also describable in terms of semantic scope. Korotkova and Lander (next issue) also provide an alternative semantic–syntactic analysis of a language that has been considered templatic. This gives rise to questions such as: How many of the

affix-order patterns reported in the literature are a mere product of insufficient language documentation? How many patterns are due to the fact that the logic of the part is usually not the logic of the whole? How many of the documented patterns really exist? We will leave these questions open. It suffices to say that to the best of our knowledge there is no scientific field where the well-known is explained through the unknown. It is always the well-known that serves for the understanding and classification of the unknown.

As regards the second option of unmotivated ordering, entirely arbitrary ordering, i.e. neither ordered nor motivated, this is the only instance of a mathematically conceivable option with respect to affix order that has not been linguistically documented. Despite the great interest in endangered languages recently, no linguist has found a language whose affix order is entirely arbitrary.[5] This fact, however, has a logical explanation: if language is a system, entirely arbitrary affix order should not exist.

In sum, except entirely arbitrary ordering, all mathematically predicted principles of affix order formulated in Sect. 2 in terms of type of information relevant to affix order have been explored in the literature so far. A linguistic scrutiny of the mathematically possible affix order principles has, however, revealed that some of those principles are not directly relevant to the morphological phenomenon of affix order. From a linguistic point of view, there are two types of information involved in affix ordering, information that orders affixes and information that explains their order. Phonological, morphological, semantic, psycholinguistic and cognitive factors order whereas purely syntactic and statistical factors explain.

Finally, we have mentioned but have not discussed the interaction of different ordering principles (information). If different principles interact, they are expected to make the same, or at least non-conflicting, predictions. Different principles making non-conflicting predictions can be illustrated with the morpheme order in the verb postulated by Bybee (1985). Bybee's observation is semantic and cognitive, and since the order of the verbal categories is fixed, it is also templatic. All three types of ordering converge and regardless which principle is operative the final result will be the same.

4 The articles in the current issue

The following is a brief account of the articles included in the current issue. In order to make both issues of this two-issue volume equally accessible to the readers, the editors will introduce the articles of the second issues in the beginning of the next issue. The present issue includes five articles that all tackle hierarchical ordering of affixes. The articles were also selected to present affix order patterns in well described and underdecribed languages.

Yuni Kim's article entitled *Phonological and morphological conditions on affix order in Huave* analyses Huave, a language isolate of Mexico, that has "mobile"

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[5] Bickel et al. (2007) present data from the language Chintang suggesting the possibility of free permutation of prefixes. This may be similar to what Zirkel (2010) has found for English prefixation or it may be that prefix order is not subject to the same factors as suffix order.

affixes, which surface as prefixes or suffixes depending on phonological properties of the base to which they attach. Intriguingly, despite affix mobility, the hierarchical structure of affixes is morphologically fixed. Thus the account provided is layered and templatic at the same time. The linearization of the mobile affixes is analyzed with an Optimality-Theoretic schema, which assumes phonologically driven affixation, i.e. phonological well-formedness constraints outrank morphological alignment constraints.

Gabriella Caballero in *Scope, phonology and morphology in an agglutinating language: Choguita Rarámuri (Tarahumara) variable suffix ordering* discusses the interaction between scope, phonological conditions and language-specific morphotactic structure in determining affix combinatorics in a morphologically complex language, Choguita Rarámuri. This article makes an empirical contribution by documenting a previously unstudied language that features affix permutation. Caballero provides an Optimality-Theoretic analysis of affix order in Choguita Rarámuri and claims that scope and language-specific morphotactic constraints are freely ranked in this particular language, with phonological subcategorization overriding all other constraints. This article also argues that semantically arbitrary suffix sequences can arise through priming effects and morphophonologically-conditioned multiple exponence.

Heiko Narrog's article *The order of meaningful elements in the Japanese verbal complex* defines a scopal hierarchy of the meaningful elements in the Japanese verbal complex. Under 'verbal complex' Narrog understands the verbal predicate extended both by affixes and by morphologically independent items in periphrastic constructions, corresponding to auxiliaries in other languages. Narrog shows that the order of meaningful elements overwhelmingly obeys semantic scope. Exceptions to the semantically based ordering involve cases with scope ambiguity as well as cases where surface order is irrelevant because categories do not interact with each other semantically. Morphosyntactic restrictions on the combination of meaningful elements mostly conform to semantic scope.

Linda Zirkel in *Prefix combinations in English: structural and processing factors* tests whether English prefixes are constrained by the same structural and processing factors as the English suffixes. Two suffixes can only combine if their grammatical and semantic characteristics allow them to do so, and if the resulting combination is well processable (Hay and Plag 2004; Plag and Baayen 2009). With the help of electronic corpora, Zirkel investigates the combinatorial properties of 15 English prefixes and shows that prefixes are less heavily constrained by selectional restrictions than suffixes and that structural factors alone cannot explain the distribution of attested vs. unattested prefix combinations. The article provides evidence that prefix combinations are constrained by processing factors in the sense that prefixes can be ordered in a hierarchy organised in approximate order of increasing productivity.

Stela Manova's article *Suffix combinations in Bulgarian: parsability and hierarchy-based ordering* makes an empirical contribution to the most recent approach to affix ordering, the Parsability Hypothesis/Complexity-Based Ordering (CBO) (Hay and Plag 2004; Plag and Baayen 2009) testing the latter against data from the inflecting-fusional language Bulgarian. Manova distinguishes between suffixes that

are in the derivational slot and suffixes that are in the inflectional slot and shows that in Bulgarian inflectional suffix combinations are more easily parsable than derivational suffix combinations. Derivational suffixes exhibit variable order (in combinations of AB–BA type) and can also attach recursively. The order of 12 out of the 22 derivational suffixes under scrutiny in this article is incompatible with CBO. Manova shows that with respect to recursiveness and productivity the Bulgarian word has three domains of suffixation (in order of increasing productivity): (1) a non-diminutive derivational domain, where a suffix may attach recursively on non-adjacent cycles; (2) a diminutive domain, where a suffix may attach recursively on adjacent cycles; and (3) an inflectional domain, where a suffix never attaches recursively. Manova, however, concludes that the results of her study conform to the last revision of the Parsability Hypothesis (Baayen et al. 2009): if the derivational suffix slot and the inflectional suffix slot of the Bulgarian word are seen as parallel to the non-native stratum and the Germanic stratum respectively in English word-formation, suffixes that are closer to the root tend to exhibit idiosyncrasies and appear less parsable in both languages.

Overall, the articles in the current issue make a number of contributions to morphological theory. Variable affix order in mirror image combinations of the type AB–BA is illustrated with numerous examples from prefixation (Zirkel) and suffixation (Manova) in well-described languages (English and Bulgarian respectively). Both Zirkel and Manova demonstrate that English and Bulgarian derivational morphologies also tolerate repetition of the same affix on adjacent cycles. Additionally, Manova exemplifies recursive derivation on non-adjacent cycles. Caballero contributes examples of variable suffix order and recursive suffixation on adjacent and non-adjacent cycles from an endangered language. Caballero and Manova establish that the suffixes of different word domains may exhibit domain-specific peculiarities in combinability. Zirkel confirms this observation with respect to the distinction between prefixes and suffixes. As already mentioned, hierarchy-based ordering plays a significant role in all the articles. Unfortunately, the hierarchies in the different articles follow different principles: phonological in Kim's article, semantic in Narrog's article, domains in the verb form and morphologically conditioned phonology determine Caballero's hierarchy, psycholinguistic principles are relevant to Zirkel's hierarchy, prototypical properties of derivation and inflection defined in terms of word-domains are relevant to the hierarchical order in the paper by Manova. This makes it difficult to generalize about the exact role of hierarchy-based analysis in affix order. However, since all the articles demonstrate hierarchy-based ordering and any linear sequence of morphemes can be also seen as a hierarchy stricture (even a template is compatible with a hierarchical ordering, see Manova's article), the importance of hierarchy-based ordering seems undoubted.

5 Conclusions

Since this introductory article is about 'having new eyes', let us change our perspective once again. Imagine for a moment that what we are looking for is not an

optimal theory of affix order but the principles that are involved in affix order. These principles seem surprisingly the same in the various languages investigated in this volume. Such an approach has at least one obvious advantage: the fact that the importance of a particular principle can vary from language to language is no longer a problem. Note that also in biology, the different living organisms differ in appearance and genome but the principles on which their genomes are organized are the same. In biology, nobody tries to establish the optimal genome; there are no 'better' or 'worse' genomes neither can one relegate all living organisms to a single genome. The facts that all existing genomes have genes and that these genes are based on RNA transcripts of DNA segments and organized in spirals seem sufficient to explain the features all living organisms have in common. Now substitute 'gene' with 'affix', RNA with 'meaning (interpretation)', DNA with 'form' and 'spiral' with 'hierarchy' in the last sentence, add the necessary amount of atheoretical open-mindedness (just recall the non-linguistic logic of Sect. 2 of this introduction), and you will see how many important facts about affix ordering you already know:

- All languages have affixes.
- Affixes have form and meaning (and are thus describable on the basis of their form and meaning).
- Principes relevant to affix order can be form-related and meaning-related.
- Principles relevant to affix order can be grammatical and extra-grammatical.
- Grammatical principles related to form are phonological and morphological (recall that morphology does not always mirror syntax).
- Affix order is (usually) based on a set of principles.
- Affix order may be domain-specifically realized.
- Affix order, whether layered or templatic, is hierarchical, as affixes always appear in a linear order which is a hierarchy by itself.
- If we cannot establish the principle(s) that account(s) for the affix order in a particular language, it does not mean that the order of affixes in that language is arbitrary.

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Aronoff, M., & Xu, Z. (to appear). A realization OT approach to affix order.

Korotkova, N., & Lander, Y. (to appear). Deriving affix ordering in polysynthesis: Evidence from Adyghe.

Melissaropoulou, D., & Ralli, A. (to appear). Structural combinatorial properties of Greek derivational suffixes.

Mykhaylyk, R. (to appear). Diachronic universal and morpheme order in the Ukrainian synthetic imperfective future.

Nordlinger, R. (to appear). Verbal morphology in Murrinh-Patha: Evidence for templates.