THE MIRROR ALIGNMENT PRINCIPLE:
MORPHEME ORDERING AT THE MORPHOSYNTAX-PHONOLOGY INTERFACE*

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1 Introduction

Even before Baker's (1985) influential proposal of the "Mirror Principle" (MP), it was widely recognized that the linear order of morphemes within a morphologically complex word generally correlates with hierarchical syntactic structure (see also Muysken 1981; cf. Baker 1988). In morphologically complex words, morphemes which represent the exponents of morphosyntactic terminals that are lower in the syntactic structure (or, in Baker's terms, apply earlier in the syntactic derivation) generally surface closer to the root than those morphemes which are exponents of higher morphosyntactic terminals. In broad terms:

(1) The Mirror Principle (Baker 1985:375)
Morphological derivations must directly reflect syntactic derivations (and vice versa).

While Baker uses morphological ordering as a means of demonstrating the inseparability of syntax and morphology, he does not explore in detail the question of the formal means by which compliance with the Mirror Principle is implemented in the grammar.

Baker assumes that the MP follows from a cyclic concatenation operation which joins (the exponents of) morphosyntactic terminals which are adjacent (i.e. sisters) in the syntactic structure (1985:377-8). Embick (2007) attempts to formalize this sort of concatenation operation by proposing a framework related to Kayne's (1994) "Linear Correspondence Axiom" for syntactic linearization. However, as recognized in Embick (2015), while this approach may be able to limit the set of possible morpheme orders to those which obey the MP, it underdetermines the choice

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between multiple possible MP-obeying orders. Some language-specific property (or set of properties) must be brought to bear in order to resolve this indeterminacy. Furthermore, identifying concatenation operations as the formal mechanisms behind morpheme ordering immediately excludes nonconcatenative morphological processes (especially Semitic “root-and-pattern” morphology) from the phenomena which can be directly assessed through the lens of the Mirror Principle (Baker 1985:400-403; cf. LeTourneau 1997).

This paper develops a new framework for morpheme ordering that derives the Mirror Principle while avoiding some of the shortcomings of a concatenation-based system. The core of the proposal is an algorithm that applies at the morphology-phonology interface, called the *Mirror Alignment Principle* (MAP). The MAP is an algorithm that takes the hierarchical structure of morphosyntactic terminals generated by the syntax (and potentially operated on by the morphology) and translates it into a ranking of ALIGNMENT constraints (McCarthy & Prince 1993, Prince & Smolensky 1993/2004) in CON in the phonological component. All possible morpheme orders are generated by GEN, and the optimal surface order is selected by EVAL.

This proposal assumes a modular, feed-forward grammar with the characteristics schematized in (2) below (cf. Embick 2015). The syntax generates a hierarchical structure of morphosyntactic terminals (following Chomsky’s 1995, *et seq.* Minimalist Program). This hierarchal structure serves as input to a discrete morphological component (as in Distributed Morphology (DM); Halle & Marantz 1993) which has the ability to perform its own operations on hierarchical structure (cf. Arregi & Nevins 2012). Vocabulary Insertion endows the morphosyntactic terminals with phonological content at the end of the morphological component. These vocabulary entries serve as the input to an Optimality Theoretic (OT; Prince & Smolensky 1993/2004) phonological grammar, which generates surface forms through constraint evaluation.

(2) The modular grammar

Syntactic Component

syntactic operations: MERGE, MOVE, etc.

⇩

hierarchical structure of morphosyntactic terminals

⇩

Morphological Component

morphological operations: FISSION, DELETION, FEATURE CHANGE, etc.

⇩

vocabulary insertion

⇩

unordered set of morphemes & **ranking of ALIGNMENT constraints**

⇩

Phonological Component

Optimality Theoretic grammar: GEN, CON, EVAL

⇩

surface representations with linearly ordered morphemes

The part of this grammar which is responsible for determining the linear order of morphemes is the "ranking of ALIGNMENT constraints" produced by the morphological component. This ranking is determined by the Mirror Alignment Principle (defined below), which converts c-command relations into ranking relations. Even though morpheme order in this system is computed in the phonology, the driving force behind this order rests in the syntax/morphology. This link between grammatical components generates Mirror Principle-compliant surface morpheme orders.

Section 2 lays out the formal details of the proposal. It defines and exemplifies the Mirror Alignment Principle, and shows how the use of ALIGNMENT constraints can restrictively generate morpheme ordering when connected to the syntax. The remainder of the paper explores Mirror Principle effects, and Mirror Principle violations, in the Bantu languages. Section 3 shows that mirror-image orderings among Causative and Reciprocal in Chichewa directly follow from the formulation of the Mirror Alignment Principle. However, these sorts of mirror-image orderings are embedded within a more complicated system, as laid out in Section 4, termed by Hyman (2003) the "CARP template". In this system, some morpheme pairs have "asymmetrically compositional" (Hyman 2003) ordering properties, and other pairs have fixed orders regardless of semantic scope (cf. Ryan 2010). Both types, either in part or in whole, violate the Mirror Principle. Nonetheless, the Mirror Principle must remain in force in order to properly generate certain aspects of asymmetric compositionality. I will show that the Mirror Alignment Principle, when integrated into Ryan's (2010) framework of bigram morphotactic constraints, straightforwardly captures the distribution of order-interpretation pairs in the basic cases of both asymmetric compositionality and fixed order. Furthermore, I will flesh out Ryan's proposal for capturing the more complicated distributions which arise when three morphemes of the relevant type interact, demonstrating that this framework properly explains these distributions, as long as we assume a phonological grammar that allows variable ranking and at least some gang effects (as in Harmonic Grammar). Section 5 concludes, and discusses how the general proposal could be extended to account for ordering of constituents above the word level.

2 The Mirror Alignment Principle

In developing the theory of Generalized Alignment, McCarthy & Prince (1993) argue for the existence of ALIGNMENT constraints, a species of constraint couched within Optimality Theory which demand the coincidence in the output representation of specified edges of phonological and/or morphological constituents. As already recognized in McCarthy & Prince's original proposal, and implemented in various ways thereafter (cf. Anderson 1996, Potter 1996, Hargus & Tuttle 1997, a.o.), one possible application of the theory of Generalized Alignment is in the determination of morpheme order. Subsequently, the critique has frequently been leveled that using Generalized Alignment as the primary arbiter of morpheme order seriously overgenerates and fails to capture restrictive generalizations (cf. Paster 2006, 2009, Yu 2007, Ryan 2010, a.o.). The proposal outlined in this section takes Generalized Alignment as its starting point, but seeks to significantly constrain its power by placing principled restrictions on the ways ALIGNMENT constraints can operate in the phonology. Namely, the relative ranking of ALIGNMENT constraints is not free, contrary to the normal conception of free ranking of constraints in OT. Instead, their ranking is fixed, transmitted from the morphological component by means of the Mirror Alignment Principle. This section defines the Mirror Alignment Principle, and illustrates how it can constrain the operation of Generalized Alignment.

2.1 Generalized Alignment

McCarthy & Prince (1993:80) define *Generalized Alignment* as follows:

(3) Generalized Alignment [GA]
"Align (Cat[egory]1, Edge1, Cat[egory]2, Edge2) $=_{\text{def}}$
$\forall$ Cat1 $\exists$ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide.
Where
Cat1, Cat2 $\in$ P[rosodic]Cat $\cup$ G[rammatical]Cat
Edge1, Edge2 $\in$ {Right, Left}
…A GA requirement demands that a designated edge of each prosodic or morphological constituent of type Cat1 coincide with a designated edge of some other prosodic or morphological constituent Cat2."

ALIGNMENT constraints are constraints on the morphology-phonology interface, as they modulate the relationship between morphological categories and prosodic categories. Since morpheme ordering is about determining the (linear) relationship between morphemes in the phonological representation, these constraints can be used to enact morpheme ordering.

When a single ALIGNMENT constraint is active in a phonological derivation, it will appear as though its effect is simply to place the edge of the relevant morphological category at the edge of a particular prosodic category (or as near to it as possible, subject to higher-ranking phonological considerations). However, a different picture of ALIGNMENT constraints emerges when we examine how they can interact with one another. Consider the following schematic example.

A word contains a Root plus three affixal morphemes: X, Y, and Z. The underlying representation for this word is (by hypothesis) an *unordered* set of the four morphemes /Root, X, Y, Z/ (cf. McCarthy & Prince 1993). Each morpheme is referenced by an ALIGNMENT constraint,[1] and all three constraints are defined over the same prosodic category, the *prosodic word*, and with reference to the *right edge*, as shown in (4):

(4) Alignment constraints for the input /Root, X, Y, Z/
a. ALIGN(X, R; PWD, R)
Assign one violation mark for each segment intervening between the right edge of morpheme X and the right edge of the prosodic word.[2]
b. ALIGN(Y, R; PWD, R)
Assign one violation mark for each segment intervening between the right edge of morpheme Y and the right edge of the prosodic word.
c. ALIGN(Z, R; PWD, R)
Assign one violation mark for each segment intervening between the right edge of morpheme Z and the right edge of the prosodic word.

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[1] I omit here discussion of the alignment of the Root, and I assume that each morpheme is referenced by only one ALIGNMENT constraint.

[2] Gradient evaluation of ALIGNMENT constraints is crucial for the proposal. McCarthy (2003) argues against the use of gradient ALIGNMENT constraints (though see Yu 2007 for a critique). Insofar as the present proposal on morpheme ordering turns out to be valid and useful, it provides an argument in favor of gradient ALIGNMENT constraints.

Each ALIGNMENT constraint will be maximally satisfied when the morpheme it references is absolute rightmost within the prosodic word. However, in any candidate output, only one morpheme can successfully attain this position (assuming no coalescence).[3] This means that satisfaction of one of these ALIGNMENT constraints entails increased violation of the others. These constraints, therefore, will be in *direct competition* for a particular position in the output (here, final position in the prosodic word).

The following table shows the violation profiles for each possible combination of the three morphemes X, Y, and Z (such that each follows the Root). Violations are assigned here treating each morpheme as if it were a single segment, with one violation mark assigned for each morpheme which intervenes between the right edge of the prosodic word and (the right edge of) the morpheme being evaluated.

(5) Violation profiles

/Root, X, Y, Z/	ALIGN(X, R; PWD, R)	ALIGN(Y, R; PWD, R)	ALIGN(Z, R; PWD, R)
a. Root-X-Y-Z	**	*	
b. Root-Y-X-Z	*	**	
c. Root-X-Z-Y	**		*
d. Root-Z-X-Y	*		**
e. Root-Y-Z-X		**	*
f. Root-Z-Y-X		*	**

Each candidate order has a total of three alignment violations (the morpheme second from the right incurs one alignment violation; the morpheme third from the right incurs two), but distributed across the different constraints. The six possible permutations of the three ALIGNMENT constraints each correspond to the selection of one of the six candidate orders.

2.2 The Mirror Alignment Principle

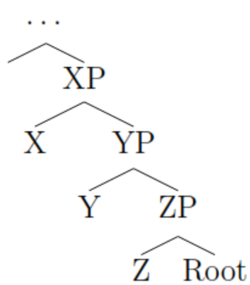
Under the principle of free ranking permutation in OT (cf. Prince & Smolensky 1993/2004), we would expect all of these rankings to be permissible, and we would have no prior expectation as to which of the six candidate orders the language should display; in other words, for the set of languages that allow morphemes X, Y, and Z to co-occur, the factorial typology expects languages of all six sorts. However, it has long been recognized that the order in which morphemes appear within a word generally reflects the relative positions that their corresponding morphosyntactic terminals occupy in the hierarchical morphosyntactic structure (Muysken 1981, Baker 1985, 1988; cf. Bybee 1985 on a diachronic interpretation, Rice 2000 on a semantic interpretation). Specifically, a morpheme that expones a terminal that appears higher in the syntactic structure will be *more external* in the word than a morpheme that expones a lower terminal. As discussed above, Baker (1985) termed this generalization the “Mirror Principle”. Given the Mirror Principle, we *do* have prior expectations about the relative order of morphemes in complex words.

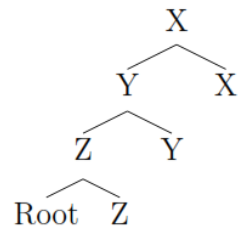
[3] If a morpheme fails to have a surface exponent, any ALIGNMENT constraint referencing it will be vacuously satisfied.

Taking our schematic example, let's assume that we independently (through principles of syntax) have reason to believe that the morphemes X, Y, and Z stand in the hierarchical syntactic relation shown in (6):[4]

(6) Syntax of /Root, X, Y, Z/

i. Base-generated structure → ii. Complex head





Given this structure, the Mirror Principle dictates that Z surface closest to the Root, Y surface next closest, and X surface farthest away. This is candidate order (5f) [Root-Z-Y-X]. The ranking of the three ALIGNMENT constraints in (4) which will generate candidate order (5f) is the one in (7):

(7) Generating the Mirror Principle order

i. *Ranking*: ALIGN(X, R; PWd, R) » ALIGN(Y, R; PWd, R) » ALIGN(Z, R; PWd, R)

ii. *Tableau*:

/Root, X, Y, Z/	ALIGN(X, R; PWd, R)	ALIGN(Y, R; PWd, R)	ALIGN(Z, R; PWd, R)
a. Root-X-Y-Z	*!*	*	
b. Root-Y-X-Z	*!	**	
c. Root-X-Z-Y	*!*		*
d. Root-Z-X-Y	*!		**
e. Root-Y-Z-X		**!	*
f. ☞ Root-Z-Y-X		*	**

What is important here is the relationship between the hierarchical structure in (6) and the ranking in (7). The highest terminal in the syntactic tree is X; the highest ranked constraint in the constraint ranking is ALIGN-X. The next highest terminal in the syntactic tree is Y; the next highest ranked constraint is ALIGN-Y. The lowest terminal in the syntactic tree is Z; the lowest ranked constraint is ALIGN-Z. This illustrates how mapping hierarchical syntactic relations onto ranking relations among ALIGNMENT constraints generates a Mirror Principle-compliant order of morphemes.

If we characterize hierarchical relations in the typical way using c-command, this mapping can be defined as in (8):

[4] The same results generally obtain whether the Mirror Alignment Principle (see below) is computed over the base-generated syntactic structure or the complex head resulting from head movement. One case where there may be evidence for using the complex head comes from the interaction of the Root with other functional heads in Arabic (see Zukoff 2016b, *in prep*).

(8) The Mirror Alignment Principle (The MAP)
If a terminal node α asymmetrically c-commands a terminal node β, then, in the phonological component, the ALIGNMENT *constraint referencing α dominates the* ALIGNMENT *constraint referencing β.*[5]

Shorthand: **If α c-commands β → ALIGN-α » ALIGN-β**

There are two different ways in which the resulting surface structure can be viewed as complying with the Mirror Principle. When ALIGN-α and ALIGN-β reference the same edge, applying the MAP-determined ranking will result in α being closer to the desired edge than β, i.e. the competition will be resolved in favor of α. From the reverse perspective, this results in β being closer to the Root than α is. This situation is canonically Mirror Principle-obeying. If, on the other hand, the ALIGNMENT constraints reference opposite edges, then both alignment conditions can be satisfied simultaneously. Such would be the case when one morpheme is (descriptively) a prefix and the other is (descriptively) a suffix, e.g. ALIGN-α-LEFT but ALIGN-β-RIGHT. Since the two conditions do not interact, Mirror Principle satisfaction is essentially vacuous.

2.3 Local summary

This section has demonstrated that the Mirror Principle can be implemented in a framework that handles morpheme ordering in the phonological component using ALIGNMENT constraints, as long as there is a connection which links hierarchical structure to the ranking of those ALIGNMENT constraints. This causal link between hierarchical structure and ALIGNMENT ranking is an algorithm here termed the Mirror Alignment Principle (MAP). The MAP limits the overgeneration problem typically associated with a Generalized Alignment approach to morpheme ordering, because it eliminates the possibility of free ranking of ALIGNMENT constraints, in contradistinction to other phonological constraints.

While the phonology does ultimately determine the surface order of morphemes, this determination is non-arbitrary; syntactic structure is responsible for providing this information to the phonology. Therefore, in this proposal, we can view the syntax/morphology as making the *decision* about morpheme ordering, and phonology as simply being responsible for the *implementation* of this decision. Since the final determination of order is made in the phonology, this implementation may be imperfect from the perspective of the syntax/morphology, as other phonological constraints may interact with the MAP-determined ALIGNMENT constraints in a way that obscures the underlying structures. The following sections will show how the MAP can be applied to generate a real example of Mirror Principle-determined orderings in the Bantu languages, and how deviations from the Mirror Principle can be handled in a MAP-based framework.

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[5] There are several points in the derivation where we could take the MAP to be calculated: (i) the output of the narrow syntax *before* head movement, (ii) the output of the narrow syntax *after* head movement, or (iii) the output of the morphology after morphological operations. Based on the evidence to be presented in this paper, any of these points would be sufficient. The answer hinges on several questions, which I will not attempt to adjudicate here, including: (i) does head movement take place in the narrow syntax or in the post-syntax? and (ii) are there morphological operations which feed the calculation of the MAP, such that the Alignment ranking it transmits is distinct from what we expect from the syntax?

This framework, though developed independently, bears significant resemblance to a proposal by Potter (1996), whereby morpheme order is determined in the phonology through the interaction of competing ALIGNMENT constraints whose relative ranking is non-arbitrarily determined in relation to the syntax. For Potter, the non-arbitrary link is “Hierarchy Correspondence”:

(9) Hierarchy Correspondence (Potter 1996:297)
“With respect to inflection, the dominance relationships within the syntactic functional hierarchy mirror the dominance relationships within the alignment constraint hierarchy at PF.”

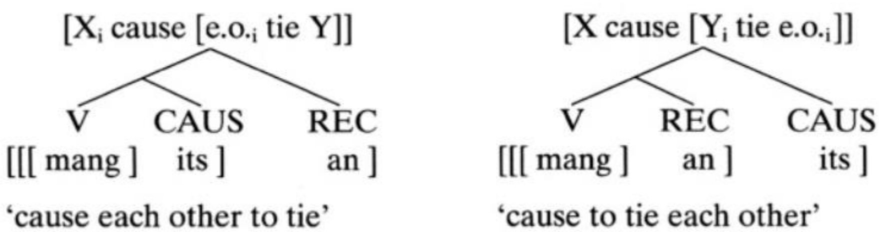
The main point of difference between the two approaches, though relatively small, is the following. Potter rejects the notion that morphologically complex words are built up through head movement/adjunction; instead, morphosyntactic feature values are present lexically and simply “checked” in the course of the derivation. As such, the “functional hierarchy” need not necessarily reflect the syntactic derivation, *per se*; this relationship is somewhat more indirect than in the MAP approach. In the following sections, using evidence from verbal derivational morphemes, rather than the purely inflectional morphemes examined by Potter, I will show that the Mirror Principle must truly be tracking syntactic derivation rather than some abstract functional hierarchy, since contrastive semantic/syntactic derivations result in contrasting ordering facts.[6]

3 Mirror-Image Morpheme Orders in Chichewa

Baker (1985) demonstrates that, in certain Bantu languages, given two meaningful elements in verbal derivation, such as Causative and Reciprocal, a reversal in semantic interpretation correlates with a reversal in the linear order of the morphemes that expone those meanings. This generalization can be seen with the following contrast from Chichewa:

(10) Orders of Causative and Reciprocal in Chichewa (Hyman 2003:247, ex. 2)

i. Reciprocalized Causative ii. Causativized Reciprocal



When the Reciprocal meaning “scopes” over that of the Causative (10a), the Reciprocal morpheme *-an-* is more external in the linear order than the Causative morpheme *-iʦ-*. On the other hand, when the Causative meaning scopes over the Reciprocal meaning (10b), that order is reversed and Causative *-iʦ-* is most external.

[6] One other difference is that Potter uses opposite-edge ALIGNMENT constraints, where the affix is the first argument of the constraint and the Root is the second argument, to derive the basically parametric difference between ordering in Apache and SiSwati. This is not something that is needed for the data examined in this paper, and thus is something which would be ideally eliminated from the theory on the grounds of parsimony, but this is an empirical question.

While Hyman (2003) is cautious not to assert that these hierarchical structures are truly the *syntactic* structures associated with these derivations, I propose that we should indeed interpret them as such; these structures are the complex heads resulting from head movement. When the Mirror Alignment Principle algorithm receives these two distinct structures, it generates two distinct rankings, as shown in (11). These verbal derivational morphemes are suffixal in Chichewa (and the other Bantu languages), so they have right-oriented ALIGNMENT constraints.

(11) Mirror Alignment Principle Rankings for the structures in (10)

i. *Reciprocalized Causative* ((10)i):
Rec c-commands Caus → ALIGN-REC-R » ALIGN-CAUS-R

ii. *Causativized Reciprocal* ((10)ii):
Caus c-commands Rec → ALIGN-CAUS-R » ALIGN-REC-R

When these rankings are submitted to CON and run through EVAL in the phonological component, they will generate mirror-image orders, as demonstrated in (12). In the input, the morphemes are unordered; therefore, the order in which they are listed graphically is purely arbitrary. Each morpheme is notated with the morphosyntactic category it is exponing.

(12) Phonological derivations of mirror-image orders

i. *Reciprocalized Causative* (10i): ALIGN-REC-R » ALIGN-CAUS-R

/maŋ$_{ROOT}$, its$_{CAUS}$, an$_{REC}$/	ALIGN-REC-R	ALIGN-CAUS-R
a. ☞ maŋ-its-an		** (an)
b. maŋ-an-its	*!* (its)	
c. its-maŋ-an		***!** (an, maŋ)
d. an-maŋ-its	*!**** (its, maŋ)	

ii. *Causativized Reciprocal* (10ii): ALIGN-CAUS-R » ALIGN-REC-R

/maŋ$_{ROOT}$, its$_{CAUS}$, an$_{REC}$/	ALIGN-CAUS-R	ALIGN-REC-R
a. maŋ-its-an	*!* (an)	
b. ☞ maŋ-an-its		** (its)
c. its-maŋ-an	*!**** (an, maŋ)	
d. an-maŋ-its		***!** (its, maŋ)

In the derivation of the Reciprocalized Causative in (12i), the highest ranked constraint is ALIGN-REC-R. This constraint eliminates all candidate orders which do not place the right edge of the Reciprocal morpheme (the /n/ of *an*) at the right edge of the word, i.e. (b) and (d). The next highest ranked constraint is ALIGN-CAUS-R. This constraint selects from among the remaining candidate orders the one where the right edge of the Causative morpheme (the /ts/ of *its*) is as far to the right as possible, i.e. interior to the Reciprocal morpheme but no farther – candidate (a) over candidate (c). When the MAP produces the opposite ranking for the Causativized Reciprocal in (12ii), the candidate set and violation profiles are identical, but the constraint ranking instead selects candidate (b).

This demonstrates that ALIGNMENT constraints can place morphemes in the correct order in the phonological component *without* the application of declarative concatenation operations at any point within the grammar, as in the standard approaches represented by Baker (1985, 1988) and Embick (2007, 2015). All that is required is that hierarchical relations in the syntax/morphology are transmitted to the phonology as a set of pairwise ordered rankings of ALIGNMENT constraints, via the MAP.

We can see from this example that the ranking between these ALIGNMENT constraints differs across different syntactic derivations; this is, in fact, the very nature of the proposal. This is somewhat unusual from the perspective of Optimality Theory, in which the constraint ranking is taken to be internally consistent within a language. But note that these are not purely phonological constraints; they crucially depend on morphosyntactic information. Therefore, it seems appropriate that higher-level morphosyntactic differences could alter their ranking. This would not be the case for purely phonological constraints, which are not sensitive to differences in morphosyntactic structure, so we should not expect their ranking to change in this way (though one could adduce similarities in the operation of lexically-indexed constraints (e.g. Pater 2009), or cophonology theory (cf. Inkelas & Zoll 2007)).

4 The CARP Template in Bantu

While a number of Bantu languages do indeed display behaviors like those outlined above for Chichewa, the full picture is a great deal more complicated. Hyman (2003:247-8) shows that there are at least two major problems for assuming that the Mirror Principle operates without exception in Bantu. First, not all Bantu languages permit the sorts of mirror-image order reversals illustrated above for the Causative and Reciprocal in Chichewa; for example, Chimwiini shows no mirror-image orders with elements of this type (Hyman 2003:258). And, among those languages that do show this behavior, including Chichewa, it is generally only permitted with certain pairs of suffixes rather than as a whole throughout the system; for example, Chichewa does not show mirror-image orders for Causative and Applicative or Applicative and Reciprocal (Hyman 2003). Second, there is an interpretive asymmetry, which Hyman (2003:250) terms “asymmetric compositionality”: in languages which do permit mirror-image orderings, one type of ordering permits *both scopal interpretations* while the other permits only the one correlated with the surface order (Hyman 2003:248, Good 2005:30-41), i.e. the one which is directly compositional via the Mirror Principle.

Both of these problems point to the existence of the “CARP template”, as proposed by Hyman (2003) (cf. Good 2005, McPherson & Paster 2009). The Bantu languages permit verbal formations involving multiple affixes from the set of Causative (C), Applicative (A), Reciprocal (R), and Passive (P). In these languages, it is always permissible for those affixes to surface in that linear order, i.e. Causative before Applicative before Reciprocal before Passive, regardless of the relative scopal interpretation of those affixes. However, only a subset of the languages allow any orderings between these elements which does not comply with this “template”.

4.1 Asymmetric Compositionality in Chichewa

Chichewa’s Causativized Reciprocal in (10ii), with the order *Root-Rec-Caus* (R→C), is thus not typical within the family. Many Bantu languages do not permit this surface order, and instead express the semantic equivalent using the CARP-obeying order *Root-Caus-Rec* (C→R). The interpretation of this surface form, *Root-Caus-Rec,* is ambiguous, since it can also be used to express the Reciprocalized Causative, as expected. Such a situation can be characterized as a fixed order (cf. Ryan 2010).

Even in languages where both orders are permitted, the CARP-obeying order has the potential to express both meanings. Yet, the CARP-violating orders have only one possible interpretation, the one which is properly correlated with the surface morpheme order via the Mirror Principle. This distribution is Hyman's "asymmetric compositionality", since one underlying scope can only surface compositionally (i.e. MP-obeying), but the other can surface in either order.

The asymmetric compositionality illustrated by Chichewa's Causative and Reciprocal is summarized in table (13). In the discussion below, a semantic interpretation which is "CARP-violating" is one where an element farther to the right in the CARP acronym semantically scopes below an element farther to the left in the acronym. (Under the assumption that syntax and semantics are essentially isomorphic in this regard, semantic CARP-violation is equivalent to syntactic CARP-violation.) A "✓" indicates an order-interpretation (O-I) pair which is licit in Chichewa; a "✗" indicates an O-I pair which is illicit in Chichewa.

(13) Asymmetric compositionality with Chichewa's Causative and Reciprocal

<table>
<tr><td colspan="2" rowspan="3"></td><td colspan="2">Surface Morpheme Order</td></tr>
<tr><td>CARP-obeying</td><td>CARP-violating</td></tr>
<tr><td>ROOT-CAUS-REC
maŋ-iʦ-an</td><td>ROOT-REC-CAUS
maŋ-an-iʦ</td></tr>
<tr><td rowspan="4">Semantic Interpretation</td><td>CARP-obeying</td><td rowspan="2">a. ✓ (MP-obeying)</td><td rowspan="2">b. ✗ (MP-violating)</td></tr>
<tr><td>[[[ROOT] CAUS] REC]</td></tr>
<tr><td>CARP-violating</td><td rowspan="2">c. ✓ (MP-violating)</td><td rowspan="2">d. ✓ (MP-obeying)</td></tr>
<tr><td>[[[ROOT] REC] CAUS]</td></tr>
</table>

From this table, we can draw two generalizations about the nature of asymmetric compositionality. First, O-I pairs that *obey the Mirror Principle*, whether order and interpretation are both CARP-obeying (13a) or both CARP-violating (13d), are licit.[7] Thus, any verbal form can be interpreted as having the outer affix take semantic scope over the inner affix. Second, O-I pairs where the *linear order* is CARP-obeying, whether semantically CARP-obeying (13a) or semantically CARP-violating (13c), are licit. Linearly CARP-obeying orders are thus semantically ambiguous.

Taken together, this shows that there are two conditions which license an O-I pair in such cases: (i) Mirror Principle satisfaction, or (ii) linear CARP satisfaction. The only illicit O-I pair is (13b), the one which satisfies neither of these conditions: it is not Mirror Principle-obeying, nor is it linearly CARP-obeying. The way to distinguish a language like Chimwiini (which permits no mirror-image orders) from a language like Chichewa (which does permit certain mirror-image orders), is whether or not Mirror Principle satisfaction is a sufficient condition for licensing an O-I pair. If this is not sufficient, an O-I pair like (13d) will not be licensed, and the system will map to a Chimwiini-type language, where only CARP-obeying orders are allowed.

[7] Note that the O-I pair which is MP-obeying but linearly CARP-violating (13d) is *not* licit in languages like Chimwiini, or for subparts of other languages that display fixed order, like Causative-Applicative combinations in Chichewa.

4.2 Where's CARP?

Since CARP effects involve in some way all aspects of the grammar – semantics, syntax, morphology, and phonology – one could seek to locate the explanation of the CARP template in any component(s) of the grammar. To begin narrowing down the possibilities, we can consider a piece of syntactic evidence adduced by Hyman (2003:260): there are extraction asymmetries between CARP-obeying orders which represent distinct scopal relations.

As mentioned above, in Chichewa, Causative and Applicative always surface in that order (linearly CARP-obeying). When this order corresponds to an Applicativized Causative interpretation (C < A), and gets passivized, only the Applicative argument can be promoted to subject, as shown in (14). On the other hand, when this order corresponds to a Causativized Applicative interpretation (C > A), and gets passivized, only the Causee can be promoted to subject, as shown in (15).

(14) Applicativized Causatives in Chichewa (Hyman 2003:260, ex. 22)
(Caus *-its*, Appl *-il*, Pass *-idw*, 'children' *aná*, 'stick' *ndodo*)

a. *Mchómbó a-ná-líl-its-il-a* [CAUSEE *aná*] [APPL *ndodo*]
'Mchombo made the children cry with a stick'

b. [APPL *ndodo*] *i-ná-líl-its-il-idw-á* [CAUSEE *aná*]
'a stick was used to make the children cry'

c. ?* [CAUSEE *aná*] *a-ná-líl-its-il-idw-á* [APPL *ndodo*]
'the children were made to cry with a stick'

(15) Causativized Applicatives in Chichewa (Hyman 2003:260, ex. 23) ('hoes' *makásu*)

a. *Mchómbó a-ná-lím-its-il-a* [CAUSEE *aná*] [APPL *makásu*]
'Mchombo made the children cultivate with hoes'

b. [CAUSEE *aná*] *á-ná-lím-its-il-idw-á* [APPL *makásu*]
'the children were made to cultivate with hoes'

c. ?* [APPL *makásu*] *a-ná-lím-its-il-idw-á* [CAUSEE *aná*]
'hoes were used to make the children cultivate'

These facts indicate that only the argument that is syntactically highest is available for movement to subject. This requires that the arguments, and (presumably) the heads that introduce them, be merged in different syntactic orders for the two different scopal interpretations. Thus, there must be distinct syntactic structures underlying the ambiguous surface form of the verb word.

Since this is a language that does not allow linearly CARP-violating order-interpretation pairs (for these particular CARP affixes), we know that being Mirror Principle-obeying is not a sufficient licensing condition. This means that the Mirror Principle itself cannot be implicated in the explanation of CARP effects. Rather, the explanation for CARP must lie somewhere in the (imperfect) mapping between syntactic structure and the surface order of morphemes.

Given the syntactic effects outlined above, we can eliminate a (purely) semantic explanation for CARP. Similarly, the narrow syntax is unlikely to provide a complete explanation; however, as Myler (2015) demonstrates for similar phenomena in Quechua, careful syntactic investigation could reduce certain aspects of the "template" to syntactic selectional restrictions. We could explore an analysis whereby CARP effects are located in the morphological component (i.e. the "post-syntax"). If some morphological operation(s) neutralized the syntactic structures in a particular way, the MAP could generate a CARP order in either case (cf. Zukoff 2016a). However, explanations of this sort are largely *ad hoc*, and are likely to make unappealing typological predictions (cf. Ryan 2010:778-9). This leaves as the most promising explanation an analysis which locates CARP effects in the phonological component. If some CARP constraint(s) were present in the phonological constraint set and ranked in the proper position, they could override the ALIGNMENT ranking transmitted by the MAP and generate templatic ordering conditions. This will be the approach pursued in the following section, implemented using Ryan's (2010) bigram morphotactic constraints.

4.3 Generating CARP in the Phonology: MAP + Bigrams

To account for the CARP facts, Hyman (2003) posits a set of output-oriented constraints whose interaction derives the possible orders of CARP elements. (This approach is followed also by McPherson & Paster 2009.) Hyman seems to intend this computation to take place in an autonomous morphological component, or perhaps in some lexical component. Viewed from a Distributed Morphology perspective, though, the most reasonable place to locate this computation is in the phonological component proper. Since the phonology is where ALIGNMENT constraints are evaluated, if this approach is to be reconciled with the Mirror Alignment Principle, then this is where this analysis must be located anyway.

In Hyman's analysis, a CARP constraint ("TEMPLATE") competes with a Mirror Principle constraint ("MIRROR") to determine morpheme order. In the present proposal, Mirror Principle effects are a byproduct of the operation of the Mirror Alignment Principle and its consequent ranking of ALIGNMENT constraints. Therefore, the most direct translation of Hyman's analysis into the current framework would replace MIRROR with the MAP-generated ALIGNMENT ranking, but retain a constraint equivalent to TEMPLATE that outranks the Alignment constraints (in the appropriate circumstances). In order to account for the differences in behavior between different pairs of CARP morphemes, Hyman decomposes MIRROR into a set of pairwise constraints on particular morpheme combinations. Since the MAP already decomposes the Mirror Principle into separate constraints, but in a different way, there does not seem to be a straightforward means of applying this strategy.[8] Instead, one might try to achieve these results by decomposing the CARP constraint in a parallel way. To do this, I will adopt Ryan's (2010) approach of using bigram morphotactic constraints.

The asymmetric compositionality involved in the CARP affixes represents the confluence of arbitrary and non-arbitrary ordering properties. The ability of linearly CARP-obeying orders to indicate either scopal relationship reflects a (synchronically) arbitrary preference of the system for that particular order.[9] The inability of linearly CARP-violating orders, when they are permitted at all, to have ambiguous scope reflects the non-arbitrary preference encapsulated by the Mirror Principle (or by equivalent theories that indirectly encode the generalization with reference to semantic scope, e.g. Rice's 2000 SCOPE constraint). Ryan (2010) demonstrates that the most effective means of capturing arbitrary ordering properties is through the use of bigram

[8] Furthermore, Hyman's analysis uses positive licensing constraints (and also constraint conjunction), which is not consistent with the assumptions of the present proposal.

[9] See Bybee (1985), Good (2005), Ryan (2010), for suggestions regarding a possible diachronic origin for such apparently arbitrary ordering restrictions.

morphotactic constraints. These are constraints that prefer immediate precedence relations between particular morpheme pairs. For example, (one aspect of) the requirement that Applicative follow Causative in the CARP template would be instantiated by a constraint CAUS-APPL (Ryan 2010:778), which assigns violations for every instance of Causative which is not immediately followed by Applicative.

Ryan (2010) identifies four ordering scenarios which can arise based on the interaction between bigram constraints and a constraint advocating for the Mirror Principle (for which he uses SCOPE). These are enumerated in (16). (">>" indicates strict ranking domination; "~" indicates variable ranking.)

(16) Ordering typology (Ryan 2010:761, table 1)

	SCENARIO	RANKING	OUTPUT(S) FOR /[[[root]X]Y]/	OUTPUT(S) FOR /[[[root]Y]X]/
i.	compositional	SCOPE >> X-Y ~ Y-X	root-X-Y	root-Y-X
ii.	fixed (a)	X-Y >> SCOPE ~ Y-X	root-X-Y	root-X-Y
	fixed (b)	Y-X >> SCOPE ~ X-Y	root-Y-X	root-Y-X
iii.	asymmetric (a)	X-Y ~ SCOPE >> Y-X	root-X-Y	root-X-Y, root-Y-X
	asymmetric (b)	Y-X ~ SCOPE >> X-Y	root-X-Y, root-Y-X	root-Y-X
iv.	free	X-Y ~ Y-X >> SCOPE	root-X-Y, root-Y-X	root-X-Y, root-Y-X

Chichewa's Causative and Reciprocal reflects a type (iii) asymmetric ordering scenario. Elsewhere in Chichewa, Causative and Applicative, and Applicative and Reciprocal, always surface in the CARP order (Hyman 2003) (though things become more complicated when all three morphemes co-occur; see below). This means that they each represent a type (ii) fixed ordering scenario. In the MAP framework, the function of SCOPE is handled by the MAP-driven ranking of ALIGNMENT constraints. Replacing SCOPE with the MAP-driven ALIGNMENT ranking within Ryan's ranking schema, and substituting the specific morphemes involved in Chichewa, we arrive at the following rankings for the constraints determining the relative order of Causative, Applicative, and Reciprocal:

(17) Chichewa bigram rankings

i. *Asymmetric*: CAUS-REC ~ [MAP-driven ALIGNMENT ranking] » REC-CAUS
ii. *Fixed*: CAUS-APPL » [MAP-driven ALIGNMENT ranking] ~ APPL-CAUS
iii. *Fixed*: APPL-REC » [MAP-driven ALIGNMENT ranking] ~ REC-APPL

In the case of the fixed ordering scenario, we cannot glean any information about how the bigram constraints might interact with individual ALIGNMENT constraints; that is to say, there is nothing to distinguish an analysis where the "MAP-driven ALIGNMENT ranking" acts as a single 'monolithic' constraint from an analysis where it is comprised of individual ALIGNMENT constraints which can potentially have other constraints ranked between them. This is because the high-ranked bigram constraint is decisive, rendering the ALIGNMENT constraints inert. This situation is illustrated in (18) for Causative and Applicative.

(18) Fixed ordering of Causative and Applicative (consistent CARP order)

i. *Applicativized Causative*: *maŋ-iʦ-il-* (Mirror Principle-obeying)
MAP ranking: Align-Appl-R » Align-Caus-R

[[[Root]Caus]Appl]		MAP-ranking		
/maŋ$_{\text{ROOT}}$, iʦ$_{\text{CAUS}}$, il$_{\text{APPL}}$/	caus-appl	Align-Appl-R	Align-Caus-R	appl-caus
a. ☞ maŋ-iʦ-il			** (il)	*
b. maŋ-il-iʦ	*!	** (iʦ)		

ii. *Causativized Applicative*: *maŋ-iʦ-il-* (Mirror Principle-violating)
MAP ranking: Align-Caus-R » Align-Appl-R

[[[Root]Appl]Caus]		MAP-ranking		
/maŋ$_{\text{ROOT}}$, iʦ$_{\text{CAUS}}$, il$_{\text{APPL}}$/	caus-appl	Align-Caus-R	Align-Appl-R	appl-caus
a. ☞ maŋ-iʦ-il		** (il)		*
b. maŋ-il-iʦ	*!		** (iʦ)	

Unlike the fixed ordering scenarios, the asymmetric scenario represented by Causative and Reciprocal is one where the alignment constraints are active. In this case, we might expect there to be a significant difference between the two analyses alluded to above – an inseparable, monolithic MAP constraint or separable alignment constraints – since the asymmetric scenario requires, according to Ryan's typology, variable ranking of the highest-ranked bigram constraint and the Scope constraint, which here is reinterpreted as the MAP ranking. The two analyses diverge in how they would handle the ranking variability. If the MAP ranking were actually a monolithic constraint, then the variability would consist of the bigram constraint ranking either over or under the entire MAP ranking, i.e. over the *highest*-ranked alignment constraint or under the *lowest*-ranked alignment constraint. If the MAP ranking were not monolithic, but rather separable alignment constraints, the ranking variability should consist of the bigram constraint ranking either over or under the *highest*-ranked alignment constraint in the MAP ranking. In the basic case at least, it turns out that either type of variability produces the same result, as shown in (19) for the asymmetrically compositional Causative and Reciprocal.

(19) Variable ranking between bigram constraint and MAP in the Causativized Reciprocal
Consistent MAP ranking: Align-Caus-R » Align-Rec-R

i. caus-rec outranks MAP: *maŋ-an-iʦ-* (CARP-obeying order)

[[[Root]Rec]Caus]	**Bigram**	MAP 1	MAP 2	
/maŋ$_{\text{ROOT}}$, iʦ$_{\text{CAUS}}$, an$_{\text{REC}}$/	caus-rec	Align-Caus-R	Align-Rec-R	rec-caus
a. ☞ maŋ-iʦ-an		** (an)		*
b. maŋ-an-iʦ	*!		** (iʦ)	

ii. MAP outranks CAUS-REC, separable MAP: *maŋ-its-an* (CARP-violating order)

[[[Root]Rec]Caus] /maŋ$_{ROOT}$, its$_{CAUS}$, an$_{REC}$/	MAP 1: ALIGN-CAUS-R	Bigram: CAUS-REC	MAP 2: ALIGN-REC-R	REC-CAUS
a. maŋ-its-an	*!* (an)			*
b. ☞ maŋ-an-its		*	** (its)	

iii. MAP outranks CAUS-REC, monolithic MAP: *maŋ-its-an* (CARP-violating order)

[[[Root]Rec]Caus] /maŋ$_{ROOT}$, its$_{CAUS}$, an$_{REC}$/	MAP 1: ALIGN-CAUS-R	MAP 2: ALIGN-REC-R	Bigram: CAUS-REC	REC-CAUS
a. maŋ-its-an	*!* (an)			*
b. ☞ maŋ-an-its		** (its)	*	

The basic asymmetrically compositional cases thus do not disambiguate between the two conceptions of the MAP ranking. Nonetheless, both properly generate the data according to Ryan's (2010) typological ranking schema.

We now have an analysis using bigram morphotactic constraints and MAP-driven ALIGNMENT constraints which can generate the distribution of pairs of CARP elements in Chichewa. This analysis is largely sufficient to account for the combination of three CARP suffixes, e.g. Causative and Applicative and Reciprocal (Hyman 2003:272-5; cf. Ryan 2010), but not completely.

When all three elements are combined, exactly two orders are permitted (excepting those with suffix doubling, which I will not discuss here). Any scopal order can map onto the fully CARP-obeying order *Root-Caus-Appl-Rec* (*-its-il-an*); but all cases where Causative scopes over Reciprocal (the situation where asymmetric compositionality occurs in the basic case) also permit the partially CARP-violating order *Root-Appl-Rec-Caus* (*-il-an-its*). At first glance, it might appear that bigram constraints alone would best capture the data: APPL-REC » CAUS-APPL ~ REC-CAUS. This is illustrated in (20). (We know from (19) that CAUS-REC » REC-CAUS. As long as APPL-REC » CAUS-REC, then CAUS-REC must always be violated when all three morphemes are present, and thus it will be essentially inactive in the derivation.)

(20) Using bigrams for Causative, Applicative, and Reciprocal

/maŋ$_{ROOT}$, its$_{CAUS}$, il$_{APPL}$, an$_{REC}$/	APPL-REC	CAUS-APPL	REC-CAUS
a. ☞ maŋ-its-il-an			*
b. maŋ-its-an-il	*!	*	*
c. maŋ-il-its-an	*!	*	*
d. ☞ maŋ-il-an-its		*	
e. maŋ-an-its-il	*!		
f. maŋ-an-il-its	*!	*	*

This bigram ranking indeed generates the two attested variants to the exclusion of all others. However, the CARP-violating order (20d) is available only for a subset of scopal orders: this situation is asymmetrically compositional, just like the more basic case of Causative and Reciprocal (and it is asymmetrically compositional in exactly the same way). The Mirror Principle, therefore, must still be at work; if the Mirror Principle played no role, as implied by just using bigram constraints, we would expect that order to be available for all underlying scopes. The way to generate asymmetric compositionality is not through the variable ranking of two bigram constraints (this generates totally free variation, type (iv) in Ryan's (2010) typology; cf. (16) above), but rather through the variable ranking of a bigram constraint and the constraint which implements the Mirror Principle – SCOPE for Ryan, the MAP-driven ALIGNMENT ranking here. Therefore, it cannot be REC-CAUS that is driving the selection of the CARP-violating order, but rather it must be the MAP – specifically, the high-ranking of ALIGN-CAUS-R as dictated by the MAP. This is shown in (21). (Candidates that violate APPL-REC are omitted.)

(21) Reintroducing MAP

[[[[Root]Rec]Appl]Caus] /maŋ$_{ROOT}$, iʦ$_{CAUS}$, il$_{APPL}$, an$_{REC}$/	APPL-REC	CAUS-APPL	MAP (ALIGN-CAUS-R)	REC-CAUS
a. ☞ maŋ-iʦ-il-an			**** (il, an)	*
b. ☞ maŋ-il-an-iʦ		*		

But this cannot be the right solution. Reintroducing the MAP-driven ALIGNMENT ranking, or indeed any implementation of the Mirror Principle, creates a bona fide ranking paradox. In order to ensure fixed ordering between Causative and Applicative, as shown in (18), there must be a fixed ranking of CAUS-APPL » MAP (or CAUS-APPL » ALIGN-CAUS-R in the non-monolithic analysis).[10] This is inconsistent with the ranking required to generate asymmetric compositionality in (21), which requires variable ranking between these two constraints. It is possible, however, that a Harmonic Grammar weighted constraint approach – which is indeed how the bigram analysis is implemented in Ryan (2010) – might mitigate these problems: if enough weight were assigned to MAP and REC-CAUS, they could together "gang up" to override CAUS-APPL. This is illustrated with toy weights in (22):

(22) Generating asymmetric compositionality through constraint weighting

[[[[Root]Rec]Appl]Caus] /maŋ$_{ROOT}$, iʦ$_{CAUS}$, il$_{APPL}$, an$_{REC}$/	CAUS-APPL 13	ALIGN-CAUS-R 3	REC-CAUS 1	**HARMONY**
a. ☞ maŋ-iʦ-il-an		**** (il, an)	*	13
b. ☞ maŋ-il-an-iʦ	*			13

Using a Harmonic Grammar approach to variability allows (and, really, requires) that constraint weighting capture not only the permissibility of variants, but also the relative frequency of variants. Ryan (2010) demonstrates how the weighted bigram model robustly captures frequency effects in Tagalog morpheme ordering. This endeavor was supported by the availability of a large scale corpus. To my knowledge, no one has yet performed this sort of corpus analysis on Chichewa (or another Bantu language that displays equivalent properties), nor are relative acceptability judgments, which could stand in for corpus frequencies, reported for the variants (in, for example, Hyman 2003). Such an analysis could prove the utility and necessity of a Harmonic Grammar weighted constraint approach to CARP.

[10] For the semantic input [[[[Root]Rec]Caus]Appl] – which, according to Hyman (2003), allows for the same CARP-violating output – the highest-ranked MAP ALIGNMENT constraint would be ALIGN-APPL-R. This would not favor the desired CARP-violating candidate (d), but rather other CARP-violating candidates, namely (b) and (e).

5 Conclusion

This paper has introduced and developed a new proposal regarding the nature of morpheme ordering, based on the operation of the Mirror Alignment Principle (MAP) at the morphology-phonology interface. The MAP is an algorithm that translates hierarchical structural relations (asymmetric c-command) between morphosyntactic terminals into ranking domination relations between ALIGNMENT constraints on the exponents of those morphosyntactic terminals in the phonological component of the grammar (namely in CON). This algorithm provides a principled means of capturing so-called "Mirror Principle" effects (Baker 1985, 1988), whereby the order of morphemes in a complex word mirrors the order of syntactic derivation and hierarchical morphosyntactic structure.

This framework is straightforwardly able to capture mirror-image morpheme orderings seen in Chichewa and other Bantu languages. Differences in syntactic structure map directly onto differences in ALIGNMENT rankings, which generate different surface orders. These mirror-image ordering properties are embedded within a larger, more complex system of asymmetric compositionality and fixed ordering, collectively referred to as the "CARP template" (Hyman 2003). While other approaches to the explanation of CARP may be possible, this paper has shown that an account which integrates the MAP with bigram morphotactic constraints (following Ryan 2010) can directly capture the more basic aspects of the system, and, when framed within a Harmonic Grammar model that allows gang effects, can also capture the more complicated distributions found in combinations of three CARP elements.

The bigram approach itself is inconsistent with the traditional implementation of the Mirror Principle, by which Mirror Principle effects emerge through cyclic concatenation: if order were created cyclically, bigram constraints could not have the large scale ordering effects discussed here and in Ryan (2010). This supports the alternative, non-concatenation-based approach inherent in the Mirror Alignment Principle. Furthermore, dispensing with concatenation allows for the possibility of bringing nonconcatenative morphological processes back into the fold of Mirror Principle-related phenomena. As demonstrated in Zukoff (2016b, *in prep*), complex patterns involved in "root-and-pattern" morphology in Arabic can be accounted for through interactions of ALIGNMENT constraints and phonotactics. The ALIGNMENT rankings which are necessary for the phonological analysis, when viewed through the lens of the Mirror Alignment Principle, point to morphosyntactic representations which look completely sensible from a cross-linguistic perspective, and may even reveal mirror-image ordering properties similar to those seen in Bantu.

Additionally, the use of ALIGNMENT constraints in the implementation of morpheme ordering furnishes two other desiderata. First, concatenation algorithms (such as the one proposed in Embick 2007, 2015) have no built-in means of resolving the linear indeterminacy between concatenated elements. That is to say, a morphosyntactic structure [x[yz]] could be linearized as *x*-[*y*-*z*], *x*-[*z*-*y*], [*y*-*z*]-*x*, or [*z*-*y*]-*x* and still obey the concatenation algorithm (and thus the Mirror Principle), which itself has no left/right ordering instructions. By implementing the entire procedure using ALIGNMENT constraints, we avail ourselves of the inherent directionality of Generalized Alignment: the possible orders are weeded out according to the language particular choice of direction of ALIGNMENT for a particular (class of) morpheme.

While this paper has limited the application of the MAP to word-level phenomena, the MAP is in principle capable of contributing to the ordering properties of higher-level constituents, as well. The syntactic structure obviously furnishes phrases in addition to heads, and the prosody/phonology furnishes constituents above the level of the word. If Generalized Alignment were extended to relate these sorts of categories to one another, then the MAP could determine the ranking of these ALIGNMENT constraints according to the phrase/sentence-level syntax, as opposed to just complex heads. These alignment-based ordering properties might assert themselves only in cases of indeterminacy in syntactic linearization (cf. Kayne 1994), or perhaps they could play an even more central role in syntactic linearization itself. Therefore, the Mirror Alignment Principle provides us a number of directions for future investigation across multiple domains of the (morpho)syntax-phonology interface.

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