# MOBILE OBJECT MARKERS IN MORO: THE ROLE OF TONE

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Object markers alternate between a prefix and a suffix position in the Thetogovela dialect of Moro, an underdocumented Kordofanian language of Sudan. Although the alternation appears to depend on the morphosyntactic category of verb forms, we show that it actually follows from the tonal properties of these verb forms. Verb stems that are usually marked with a default, phonologically predictable leftmost high tone select prefix object markers. The high-toned prefix object marker appears inside the stem, and its high tone serves as the default tone of the stem, obviating the need for inserted high tone. Verb stems that impose other tone patterns, either all high or all low, select suffix object markers, a fact that we attribute to the incompatibility of high-toned prefix object markers with all-high and all-low tone patterns. The data are analyzed as a case of phonology conditioning prefix placement and overriding standard suffix position. Although such phonologically determined mobile affixes are rare in the world's languages, the Moro case provides a new example of affix mobility based on a novel property, tone, and it underscores the need to incorporate such cases into the architecture of grammatical systems.*

*Keywords*: object marker, tone, mobile affixation, Moro, phonology-morphology interface

**1.** INTRODUCTION. The position of affixes within a word is correlated with a variety of different factors. On the one hand, morphosyntactic analyses relate affix position with syntactic derivation (Baker 1985), reflected in scope relationships (Rice 2000). On the other hand, in some languages, the positions of affixes are fixed relative to one another, sometimes violating scope relationships (Hyman 2003, Caballero 2010) and motivating the use of templates or fixed-order stipulations (Inkelas 1993, Hyman 2003, Good 2007). There are also cases in which phonological factors appear to impact affix or clitic position, often driven by syllable structure (Fulmer 1991, Noyer 1994, Hargus & Tuttle 1997, Kim 2008) or stress (Caballero 2010).

Two cases of phonologically conditioned MOBILE AFFIXATION (Noyer 1994) have been highlighted in the literature, that of Afar (Fulmer 1991, Rucart 2006) and Huave (Noyer 1994, Kim 2008, 2010). In these languages, a small set of affixes may appear as either prefixes or suffixes depending on syllable structure and whether the stem begins with a consonant or vowel. For example, in San Francisco del Mar Huave, the completive affix /t/ is a suffix in 1a, but a prefix in 1b (Kim 2008, 2010).[1]

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[1] Abbreviations used in this article are as follows: 1: 1st person, 2: 2nd person, 2I: 2nd person intransitive, 3: 3rd person, AMD: aspect/mood/deixis, APPL: applicative, ASP: aspect, CL: noun class, COMP: complementizer, CONS: consecutive, CP: completive, DIST: distal, DU: dual, EXCL: exclusive, EXT: extension marker, HUM: human, INCL: inclusive, INST: instrumental, IPFV: imperfective, ITER: iterative/durative, LOC: locative, OM: object marker, PFV: perfective, PL: plural, PROG: progressive, PROX: proximal, RTC: root clause, SB: subordinate, SG: singular, SM: subject marker, TV: theme vowel, V: suffix vowel.

(1) a. [mojk-o]-t
face.down-V-CP
's/he lay face down'

b. t-[e-mojk-o-r]
CP-2-face.down-V-2I
'you (sg.) lay face down'

Kim argues persuasively that the position of this affix and five other monoconsonantal affixes is determined by syllable structure. The affixes are prefixes if the stem begins with a vowel and ends in a consonant. Otherwise, they are suffixes. The analysis she offers depends on a conception of the phonology-morphology interface in which phonological constraints can outrank morphological constraints of affix placement, the P(honology) ≫ M(orphology) approach of McCarthy and Prince (1993). Noyer (1994) proposes a similar, but less detailed, analysis for San Mateo del Mar Huave.

However, other researchers have challenged the P ≫ M model, arguing that, for infixation (Yu 2007a,b) and phonologically conditioned suppletive allomorphy (Paster 2006, 2009), a more constrained and explanatory analysis is one in which morphology precedes phonology, and affix position is determined by GENERALIZED PHONOLOGICAL SUBCATEGORIZATION, in which affixes can subcategorize for a phonological constituent. One of the main arguments for this latter model is that while affix position may have a phonologically determined position, it is not always phonologically optimizing in the output.

Nevertheless, mobile affixes of the type in 1 pose a problem for generalized subcategorization analyses, since there is no unified subcategorization—one has to assume either a single affix with competing subcategorization frames (Stump 1993) or two segmentally identical affixes with the same meaning but different subcategorization frames (Paster 2009). See further discussion in §7. Moreover, there is some skepticism as to whether phonologically conditioned mobile affixes even exist. Paster (2005) reanalyzes several cases in terms of morphological templatic positions or local metathesis, while Wolf (2008) questions whether the Afar mobile affix case is phonologically determined. Since mobile affix examples are rare, these types of treatments are deemed preferable to the option of allowing phonological constraints to determine morphological position. Given the problematic status of phonologically conditioned mobile affixation, new cases would lend credence to this rare breed, particularly if the phonological factors conditioning the affix position were of a different variety.

In this article, we introduce a novel case of phonologically conditioned mobile affixation in which tone is the determining factor. In the Thetogovela dialect of Moro, a Kordofanian language spoken in the Nuba Mountains of Sudan, incorporated object pronouns, or OBJECT MARKERS (OMs), are positioned as either prefixes or suffixes on the verb depending on (i) the tone pattern of the verb stem and (ii) the tone of the OM itself. For example, in the aspectual forms without OMs in 2a and 2c, high tone (marked with an acute accent (*á*)) appears at the left edge of the verb root *váléð* 'pull'.[2] But in the forms in 2b and 2d, the 2nd singular OM ***-ŋá*** appears as a prefix, and when this OM is present, high tone is not realized on the root (low tone is unmarked). All data are from our fieldnotes; audio examples are available at http://moro.ucsd.edu/.

(2) a. proximal imperfective with no OM
g-a-vəléð-a
SM.CL-RTC-pull-IPFV
's/he is about to pull'

[2] The initial noun class marker /g-/ of the verb is realized as [k] in phrase-initial position. Verbs in isolation begin with [k]. We transcribe [g] here, although in other work we have used [k].

b. proximal imperfective with 2SG OM
ɡ-a-**ŋá**-vəleð-a
SM.CL-RTC-2SG.OM-pull-IPFV
's/he is about to pull you'

c. consecutive imperfective with no OM
ṯ-áŋə́-vəléð-ó
COMP-3SG.SM-pull-CONS.IPFV
'… s/he is pulling'

d. consecutive imperfective with 2SG OM
ṯ-áŋ-**ŋá**-vəleð-ó
COMP-3SG.SM-2SG.OM-pull-CONS.IPFV
'… s/he is pulling you'

In the aspectual forms in 3, by contrast, high tone appears not on the root, but on the aspectual affixes. The 2nd singular OM appears as a suffix in these forms, and causes the suffix /ó/ to be pronounced as [á] due to assimilation.

(3) a. distal imperfective with no OM
ɡ-á-vəleð-ó
SM.CL-DIST.IPFV-pull-DIST.IPFV
's/he is about to pull from there to here'

b. distal imperfective with 2SG OM
ɡ-á-vəleð-á-**ŋá**
SM.CL-DIST.IPFV-pull-DIST.IPFV-2SG.OM
's/he is about to pull you from there to here'

c. perfective with no OM
ɡ-a-vəleð-ó
SM.CL-RTC-pull-PFV
's/he pulled'

c. perfective with 2SG OM
ɡ-a-vəleð-á-**ŋá**
SM.CL-RTC-pull-PFV-2SG.OM
's/he pulled you'

The same pattern holds for other high-toned OMs, but when an OM is low-toned, as with the 3rd plural *-lo*, no variable positioning is found. Furthermore, high tone is found on the root in the forms with *-lo* in 4a–b, just as it is in the forms with no OM.

(4)

| | WITH NO OM | WITH 3PL OM |
|---|---|---|
| a. proximal imperfective | ɡ-a-vəléð-a | ɡ-a-vəléð-á-**lo** |
| b. consecutive imperfective | ṯ-áŋə́-vəléð-ó | ṯ-áŋə́-vəléð-ə́-**lo** |
| c. distal imperfective | ɡ-á-vəleð-ó | ɡ-á-vəleð-ə́-**lo** |
| d. perfective | ɡ-a-vəleð-ó | ɡ-a-vəleð-ə́-**lo** |

In addition to alternating OMs like the 2nd singular in 2 and 3, and the nonalternating 3rd plural OM in 4, the 1st plural exclusive and inclusive are expressed with both a prefix and a suffix OM; see §5.

In this article, we argue that tone provides a better synchronic explanation for the variable position of OMs than one based on morphosyntactic features of the verb. The distribution of tone on a verb stem together with the tone of the OM determines the position of the OM. Moreover, we argue that when an OM appears as a prefix, it appears in a position that is phonologically optimizing according to independently motivated constraints on high tone distribution within the stem. As such, we conclude that the

placement of Moro OMs represents an example of phonologically conditioned affix positioning, and hence that the interface between phonology, morphology, and syntax should be able to accommodate such phenomena.

The article is organized as follows. We first introduce the basic data (§2), illustrating the positions of the OMs and demonstrating how no cohesive analysis based on morphosyntactic properties can be responsible for these variable positions. We then present the tone patterns of Moro verb stems and motivate domains of tone assignment (§3). We show how the position of an OM correlates with different classes of tone patterns: prefix OMs occur with default tone, while suffix OMs occur with other tone patterns. We present a formal analysis in §4, and demonstrate in §5 that the distribution of nonmobile OMs and double OMs follows straightforwardly from the proposed analysis. We then address potential problems posed by two phonologically opaque environments (§6). Finally, we argue in §7 that several alternative analyses fail to account for the Moro pattern, including approaches based on phonologically conditioned spell-out of syntactic movement, the process of LOCAL DISLOCATION within the DISTRIBUTED MORPHOLOGY framework, and phonological subcategorization. We also briefly review other cases of phonologically conditioned affix position, arguing for the superiority of P ≫ M analyses.

**2.** THE VARIABLE POSITION OF OMs. In this section we describe the distribution of prefix and suffix OMs in Moro. We outline the full range of environments where both positions of the OMs are found, illustrating that their distribution cannot be predicted on the basis of the morphosyntactic environments in which they occur.

As examples 2 and 3 above demonstrated, Moro OMs can appear in two positions on the verb stem: preceding the root and iterative prefix, or following the verb root, extension suffixes, and the aspect/mood/deixis vowel. In 5 we illustrate the locations of OMs within the Moro verb template.

(5) Moro verb structure and position of OMs

COMP-SM-CLASS-CLAUSE-AMD-**OM**/PROG-ITER-ROOT-EXT-AMD-PL-**OM**-INST-LOC

The clause vowel (CLAUSE) occurs in finite clauses and exhibits a three-way alternation marking forms with no extraction, subject extraction, and nonsubject extraction, as well as other categories (see Rose 2013, Rose et al. 2014 for details). The extension affixes (EXT) consist of antipassive/reciprocal, causative, benefactive applicative, passive/reflexive, and locative/malfactive applicative.

OMs are incorporated pronominals rather than agreement markers; they do not cooccur with lexical noun phrases, and they bear a close affinity to free pronouns. Relevant data for this conclusion are presented in §4.1, where we outline our assumptions about the syntax-phonology interface. Their status as pronominals might lead to the conclusion that they are clitics, as has been assumed for OMs in Bantu languages by some authors, despite their linear position preceding the root but following subject and tense prefixes (Duranti 1979, Baker 2008). Yet the distinction between clitics and affixes is not clear-cut (Zwicky 1977, Spencer & Luís 2012). Furthermore, the assumption that agreement markers are affixes while incorporated pronouns are clitics does not hold crosslinguistically. See the compelling case of Sorani Kurdish (Bonami & Samvelian 2008) and analyses of Bantu OMs as incorporated pronominal affixes (Bresnan & Mchombo 1987, Zeller 2013). Moro OMs fit the profile of affixes according to several criteria. They appear only on verbs, their position is closer to the root than other affixes, and they display a fixed order when more than one OM occurs (see §5.2). They also interact phonologically with the root and other affixes in terms of vowel harmony and

tone (see §3). We thus label the OMs as affixes in this article.[3] Whether they are considered to be affixes or clitics, however, the larger point is that the phonology of the language influences the word-internal distribution of morphemes.

As we have already seen, OMs in Moro are either prefixal or suffixal. Setting aside phonological factors, the morphological categories that seem to condition the position of the OM include those marking aspect and mood, spatial deixis, and clause type. For example, the perfective verb forms in 6a require suffix OMs, but the proximal imperfective forms in 6b require prefix OMs. In each case the OMs are the same, with minor vowel differences.[4] The perfective suffix is pronounced as [ǝ́] before most OMs, and as [á] before *-ŋá*.

(6) Verb forms that take suffix OMs versus prefix OMs

| | a. perfective | b. proximal imperfective |
|---|---|---|
| NO OM | g-a-vəleð-ó | g-a-váléð-a |
| 1SG OM | g-a-vəleð-ǝ́-**ɲé** | g-a-**ɲǝ́-**vəleð-a |
| 2SG OM | g-a-vəleð-á-**ŋá** | g-a-**ŋá-**vəleð-a |
| 3SG OM | g-a-vəleð-ǝ́-**ŋó** | g-a-**ŋó**-vəleð-a |
| 1DU.INCL OM | g-a-vəleð-ǝ́-**ńda** | g-á-**ńdə**-vəleð-a |
| 2PL OM | g-a-vəleð-ǝ́-**ńda** | g-á-**ńdə**-vəleð-a |

Based on these examples alone,[5] it appears as if an OM's position should be tied to the aspectual specification of the verb.

There are two ways in which morphosyntax might condition the placement of the OM on the Moro verb. First, the position of the OM could be dependent on a particular morphosyntactic feature or category, such as perfective aspect. Alternately, the position of the OM might vary due to a requirement that it attach to a specific morpheme as a prefix or suffix, overriding its default specification in the other direction.

However, a closer examination of the morphosyntactic categories that correlate with the two OM positions reveals that neither of these proposals is tenable. To see that this is the case, consider the verb forms that condition suffix OMs, given in Table 1.

| | NO OM | WITH 3SG OM | |
|---|---|---|---|
| a. PERFECTIVE | g-a-vəleð-ó | g-a-vəleð-ǝ́-**ŋó** | 's/he pulled (him/her)' |
| b. DISTAL IMPERFECTIVE | g-á-vəleð-ó | g-á-vəleð-ǝ́-**ŋó** | 's/he is about to pull (him/her) from there to here' |
| c. PROXIMAL IMPERATIVE | váléð-ó | váléð-ǝ́-**ŋó** | 'pull (him/her)!' |
| d. DISTAL IMPERATIVE | vəleð-a | vəleð-ǝ́-**ŋó** | 'pull (him/her) from there to here!' |

TABLE 1. Verb forms that take suffix OMs.

[3] In previous descriptive work (Rose 2013), the prefix OMs were considered affixes, but the suffix OMs were labeled as enclitics, since they are less phonologically incorporated into the verb stem than the prefixes. However, phonological criteria of this type may reflect word-internal morphological domains rather than clitic/affix distinctions. Syntactically, there is no distinction between prefix and suffix OMs.

[4] OMs shift vowel quality depending on position, with full vowels alternating with schwa in the prefix position. The vowels /i e o u/ can reduce to schwa between consonants in Moro. We assume that the 1st dual (and 1st plural inclusive) alternation [nda] ~ [ndə] arises from underlying /nd/ being realized as [ndə] when followed by a consonant (also before another consonant-initial OM: *g-a-natʃ-ǝ́-ńdə-ŋo* 's/he gave us to him/her' or 's/he gave him/her to us'; see §5.3) and as [nda] in word-final position; [ə] does not generally appear word-finally in Moro except as part of a diphthong.

[5] We consider only the markers in 6 for now. Three other OM categories will be analyzed in §5: 1st plural inclusive, 1st plural exclusive, and 3rd plural.

While we saw in 6 that the proximal imperfective conditions prefix OMs, the distal imperfective form in Table 1(b) conditions suffix OMs, just like the perfective. Thus, while these two forms are both imperfective, they differ in terms of spatial deixis. Therefore, aspectual distinctions alone do not determine OM position.

Likewise, spatial deixis on verbs cannot be correlated with OM position.[6] Although proximal imperfective and distal imperfective take prefix and suffix OMs, respectively, both proximal and distal imperative forms take suffix OMs (Table 1(c–d)), despite differing in their deictic specification. Likewise, infinitive and consecutive verb forms condition prefix OMs regardless of whether they are in the proximal or distal form, as shown in Table 2(b–f). The list of verb forms that cooccur with OM prefixes is provided in Table 2. The final suffix is a portmanteau morpheme indicating the aspect/mood/deixis (AMD) of the verb along with the tone pattern of the stem. The different infinitive forms (labeled infinitive 1 and infinitive 2 here) are selected by different matrix verbs (Rose 2013).[7]

| | NO OM | WITH 3SG OM | |
|---|---|---|---|
| a. PROXIMAL IMPERFECTIVE | g-a-vəléð-a | g-a-**ŋó**-vəleð-a | ‘s/he is about to pull (him/her)’ |
| b. INFINITIVE 1 PROXIMAL | (n-)áŋ-vəléð-e | (n-)áŋ-**ŋó**-vəleð-e | ‘that s/he pull (him/her)’ |
| c. INF. 1 DISTAL/INF. 2 PROXIMAL | (n-)áŋ-vəléð-a | (n-)áŋ-**ŋó**-vəleð-a | ‘that s/he pull (him/her) (there)’ |
| d. CONSECUTIVE IMPERFECTIVE | ṯ-áŋə́-vəléð-ó | ṯ-áŋ-**ŋó-**vəleð-ó | ‘… s/he is pulling (him/her)’ |
| e. CONSECUTIVE PROXIMAL PERFECTIVE | n-áŋə́-vəléð-e | n-áŋ-**ŋó**-vəleð-e | ‘…. s/he pulled (him/her)’ |
| f. CONSECUTIVE DISTAL PERFECTIVE | n-áŋə́-vəléð-a | n-áŋ-**ŋó**-vəleð-a | ‘… s/he pulled (him/her) from there to here’ |
| g. NEGATIVE | g-anːá áŋ-vəléð-a | g-anːá áŋ-**ŋó**-vəleð-a | ‘s/he doesn’t/didn’t pull (him/her)’ |
| h. NEGATIVE IMPERATIVE | ánːá á-vəléð-a | ánːá á-**ŋó**-vəleð-a | ‘don’t pull (him/her)!’ |

TABLE 2. Verb forms that take prefix OMs.

These data also illustrate that mood is not responsible for OM position. Positive imperative forms take suffix OMs (Table 1(c–d)), whereas negative imperatives take prefix OMs (Table 2(h)).

Most verb forms that take prefix OMs can be categorized as dependent verbs, in that they follow an auxiliary verb (in the case of the negative *anːá*) or are dependent on a preceding clause, as in the case of the infinitive and consecutive forms. This is reflected in an alternate subject-marking paradigm particular to infinitive verbs, exemplified in Table 2 by the different realizations of the 3rd singular subject marker. While 3rd singular agreement is represented by a noun-class concord marker in main verbs (*g-* in (a)), it is realized as an invariant prefix *áŋ(á)-* or *áŋ(ə́)-* in dependent verbs (b–g). See Rose 2013 for more details. However, the main/dependent division also does not correlate perfectly with OM position, since the proximal imperfective in Table 2(a) is a basic

[6] Proximal forms involve location of the event/addressee close to the speaker, whereas distal forms involve location of the event/addressee at a distance from the speaker. Distance can also be interpreted as lack of emotional involvement in the event. In addition, proximal forms may convey movement away from the speaker (also known as *itive*), whereas distal can be used for movement toward the speaker (also known as *ventive*). The main perfective does not encode direction/location distinctions, but the consecutive perfective does. Conversely, the main imperfective does encode direction/location, whereas the consecutive imperfective does not. See Dimmendaal 2009 for discussion of similar distinctions in Tima, a related language.

[7] In Rose 2013, the term ‘subordinate’ was used instead of ‘infinitive’. Note that the distal imperfective can be used in dependent clauses as the distal version of the infinitive 2, but it is conjugated like a main clause verb and takes OM prefixes.

main verb form. In sum, while most dependent verbs take prefix OMs, not all verbs with prefix OMs are dependent verbs, so the main/dependent verb form distinction does not provide a unified explanation for the distribution of OMs.

In conclusion, no single morphosyntactic property correlates with whether a verb form will have a prefix or a suffix OM. Mood, aspect, deixis, and main/dependent status all fail to explicate the patterns. Moreover, purely morphological features of the verb, the most obvious candidate being the final vowel of the verb, fail to accurately predict the position of the OM. The inability of OM position to be predicted on regular morphosyntactic grounds gives the initial impression that OM position is random, possibly determined by an irregular indexical property of the different morphosyntactic environments. However, the following section shows that there are clear generalizations to be made across these different categories: they lie not in the morphosyntax of these different verb forms, but rather in their tonal properties. On the basis of these tonal properties, the position of Moro OMs is fully predictable.

**3.** TONE PROPERTIES OF VERB STEMS AND THE POSITION OF OMS. We demonstrate in this section that the tonal characteristics of the different verb forms correlate with OM position. Moro has two basic surface tones, high (H) and low (L). Underlyingly, Moro is an H/Ø tone system; L tone is not active (Jenks & Rose 2011). In the verbal system, verb roots do not show H versus L lexical tone contrasts. Instead, there are three distinct patterns of grammatical tone on Moro verb stems. The first pattern is termed DEFAULT tone, due to its general predictability based on the segmental and syllabic properties of verb roots (Jenks & Rose 2011). Verb forms with default tone occur with prefix OMs. The second pattern is ALL-H tone, where H occurs on every tone-bearing unit in the verb stem regardless of its segmental or syllabic properties. The third pattern is NO-H tone, where every tone-bearing unit within a particular domain in the verb stem is L-toned. Verb forms with all-H and no-H tone occur with suffix OMs.

**3.1.** DEFAULT TONE. Default tone patterns are found in all of the verb forms listed in Table 2. The default pattern is characterized by an H tone, which extends one mora to the right, positioned at the left edge of the root, as shown in 7a–b. In Jenks & Rose 2009, 2011, we attributed this pattern to a constraint ranking that constructs a left-aligned bimoraic foot with H tone aligned to both of its edges. H tone does not spread out of an initial closed or heavy syllable (7c–d). The transcribed tone pattern (e.g. H-H or H-L) indicates the tone on the root and the tone on the following affix, typically the final AMD vowel.

| (7) | ROOT SHAPE | ROOT-SUFFIX TONE | PROXIMAL IMPERFECTIVE | |
|---|---|---|---|---|
| a. | CVCVC | HH-L | ɡ-a-dógáṭ̪-a | ‘fix’ |
| b. | CVC | H-H | ɡ-a-ðə́w-á | ‘poke’ |
| c. | CVCCVC | HL-L | ɡ-a-m$^{w}$ándəð-eə | ‘ask’ |
| d. | CVCC | H-L | ɡ-a-wárð-a | ‘write’ |

If a root begins with a vowel, the default distribution of H tone is different, as seen in the forms in 8. Again, the default distribution of H in these roots is attributable to syllable structure. The generalization is that H tone avoids vowel-initial syllables unless they have a coda. Thus, the initial vowel of the root is L-toned if it occurs in a light syllable (8a–b). As predicted by the left-aligned bimoraic foot analysis, H tone will appear on the second syllable of a bisyllabic, vowel-initial root, and this H does not spread to the suffix (8a). However, monosyllabic, light, onsetless roots surface with no H tone in default forms (8b). If the initial syllable is heavy, H tone does appear but it does not spread (8c–d), again as predicted by the left-aligned bimoraic foot analysis.

(8)

| | ROOT SHAPE | ROOT-SUFFIX TONE | PROXIMAL IMPERFECTIVE | |
|---|---|---|---|---|
| a. | V.CV.C | LH-L | ɡ-ogə́t-a | ‘jump’ |
| b. | V.C | L-L | ɡ-al-a | ‘slice’ |
| c. | VC.CV.C | HL-L | ɡ-ónn̪ə̰t̪-a | ‘dry’ |
| d. | VC.C | H-L | ɡ-áff-a | ‘build, shoot’ |

These examples also demonstrate that the agreement prefix *ɡ-* does not license H tone on the initial root vowel despite the fact that it provides an onset for this syllable. In Jenks & Rose 2009, 2011, the failure of this prefix to license H is attributed to the fact that this prefix and the stem occur in different tonal domains. Further evidence for these domains is provided in §3.3 below.

While the default distribution of H on most verb roots is as described above, some exceptional roots do not obey this pattern. However, the distribution of tone on these exceptional forms is systematic: while H is still aligned at the left edge of the root, as in the general pattern, this H does not spread, for example, *ɡ-a-noán-a* ‘s/he is caring for’ or *ɡ-a-və̋dad-a* ‘s/he is sweeping’. In addition, nonspreading H tone can appear on an onsetless initial light syllable, where H tone is otherwise prohibited, for example, *ŋáwá ŋ-ól-a* ‘water is dripping’. There are no CVCVC roots with an LH tone pattern or CVC roots with L tone. Therefore, the overarching principle of default tone distribution is H tone at the left edge of the root.

Although we have given examples from the proximal imperfective verb form in this section, it is important to remember that the default tone pattern appears in a variety of other AMD forms with different AMD suffixes (*-e*, *-a*, *-ó*). Due to the independence of type of suffix and default tone, we do not include the tone of the AMD suffix as part of the default tone pattern.

In conclusion, verb forms with the default tone pattern show H-tone distribution patterns that are dependent on the syllable structure of the root (light versus heavy syllables, C-initial or V-initial roots). There are also several verbs that have an H tone positioned at the left edge that does not extend to a second tone-bearing unit regardless of syllable structure. Furthermore, the default tone pattern cooccurs with three different AMD suffixes and marks a range of different AMD categories.

**3.2.** ALL-H TONE AND NO-H TONE. In contrast to the default tone pattern, the all-H tone pattern marks one particular AMD category, the proximal imperative (9a). The no-H tone pattern appears with three different AMD categories (9b–d). In the no-H forms, the verb root is L-toned, although the AMD affix may be either H- or L-toned. Comparing 9c to 9d shows that the distal imperfective is different from the perfective only in having an H-toned prefix *á-* before the root.[8]

(9)

| | | | |
|---|---|---|---|
| a. | ALL-H | proximal imperative | vəléð-ó |
| b. | NO-H | distal imperative | vəleð-a |
| c. | NO-H | perfective | ɡ-a-vəleð-ó |
| d. | NO-H | distal imperfective | ɡ-á-vəleð-ó |

While the distribution of H tone in the default tone pattern is sensitive to the syllabic make-up of the root, the tone patterns in 9 are the same regardless of the segmental or

[8] We assume that the distal imperfective includes a separate prefix *á-* rather than an H tone that appears on the clause vowel *a-*. This is because in subject and nonsubject extraction, clauses are marked with *é-* and *ə́-*, respectively, rather than *a-*, except in distal imperfectives. In distal imperfectives, subject and nonsubject extraction are not marked overtly on the verb, but are gleaned from context. We surmise this is due to vowel hiatus of the clause prefix and the distal imperfective prefix: /ɡ-é-á-vəleð-ó/ → [gávəleðó]. Vowel hiatus in Moro is resolved in favor of the second vowel if hiatus occurs outside of the derived stem.

syllabic make-up of the root, as shown in 10 with the perfective (no-H) and proximal imperative (all-H) for a variety of different root types.

(10)

| | ROOT SHAPE | PERFECTIVE | PROXIMAL IMPERATIVE | |
|---|---|---|---|---|
| a. | CVCVC | g-a-dogaṭ-ó | dógáṭ-ó | ‘fix’ |
| b. | CVC | g-a-ðəw-ó | ðə́w-ó | ‘poke’ |
| c. | CVCCVC | g-a-m$^{w}$andəð-ó | m$^{w}$ándə́ð-ó | ‘ask’ |
| d. | CVCC | g-a-warð-ó | wáŕð-ó | ‘write’ |
| e. | VCVC | g-ogət-ó | ógə́t-ó | ‘jump’ |
| f. | VC | g-al-ó | ál-ó | ‘slice’ |
| g. | VC.CVC | g-onḍəṭ-ó | ónḍə́ṭ-ó | ‘dry’ |
| h. | VC.C | g-aff-ó | áff-ó | ‘build, shoot’ |

Although the all-H pattern occurs only with the H-toned suffix *-ó*, the no-H pattern can occur with either *-a* or *-ó* in different AMD categories. As with default tone, we do not consider the AMD suffixes part of the expression of these tone patterns, since their own tone is invariant and they can cooccur with different AMD forms. For example, the consecutive imperfective, the proximal imperative, and the perfective all occur with the final H-toned suffix *-ó*, but the consecutive imperfective has default tone (*ṭ-áŋ-ogə́t-ó* ‘… and s/he is jumping’; cf. Table 2(d), 8a), the proximal imperative has all-H tone (*ógə́t-ó* ‘jump!’), and the perfective has no-H tone (*g-ogət-ó* ‘s/he jumped’).

In summary, while the default tone pattern is sensitive to the syllabic properties of the root,[9] all-H and no-H tone patterns ignore root properties. The central empirical generalization offered by this article is that prefix OMs occur on verb forms with the default tone pattern, whereas suffix OMs occur with the all-H and no-H tone patterns regardless of the morphosyntactic features these tone patterns are associated with. Thus, the tone pattern on the verb stem precisely correlates with the position of the OM, cross-cutting various morphosyntactic categories.

**3.3.** DOMAINS OF TONE INTERACTION. In the previous section we saw that the tone pattern of the verb stem correlates with the position of the OM. In the current section we show that the tone of the OM interacts with the tone pattern of the verb stem differently depending on whether it is in prefix or suffix position, an observation with crucial implications for our analysis. The basic pattern is as follows: when prefix OMs occur, the default H tone does not appear on the verb stem. Suffix OMs, in contrast, do not impact the tone pattern of the stem.[10] This is illustrated in 11 with the proximal imperfective, which has default tone, and the proximal imperative, which has all-H tone.

(11)

| | PROXIMAL IMPERFECTIVE | WITH 3SG OM PREFIX | |
|---|---|---|---|
| a. | g-a-wə́ndaṭ-a | g-a-**ŋ́ó**-wəndaṭ-a | ‘watch’ |
| b. | g-a-və́léð-a | g-a-**ŋ́ó**-vəleð-a | ‘pull’ |
| | PROXIMAL IMPERATIVE | WITH 3SG OM SUFFIX | |
| c. | wə́ndáṭ-ó | wə́ndáṭ-ə́-**ŋ́ó** | ‘watch’ |
| d. | və́léð-ó | və́léð-ə́-**ŋ́ó** | ‘pull’ |

[9] Dependent clause forms (infinitive, consecutive, and negative) show slightly different tone patterns dependent on person/number of the subject. Most forms show the standard default tone pattern, but 1st plural exclusive and 3rd plural are L-toned regardless of root type. These forms are discussed in §6.

[10] The only exception to this pattern is the addition of an H tone on the vowel preceding a suffix OM in verbs that are all L-toned: *vəleð-a* → [vəleða] ‘pull from there to here!’ but [vəleðáŋé] ‘pull me from there to here!’. This H tone is not part of the tone melody, but appears on L-toned verbs in nonfinal phrase position. For example, it is found with L-toned VC verbs if an object follows: /g-a-p-a/ → [kapa] ‘he carried’ but [kapá gəla] ‘he carried the plate’.

As shown in 11a–b, the default H tone that normally appears at the left edge of the root in the proximal imperfective disappears in the presence of the OM prefix. In contrast, the H tone of the proximal imperative is unaffected by the OM suffix (11c–d).

Below, we demonstrate that the difference in the tone behavior of prefix versus suffix OMs is due in part to their location in different nested domains in which the distribution and interaction of H tone is distinct. We provide evidence for these morphophonological domains and show how the position of the OM fits within them. The first of these is the MACROSTEM, which includes the prefix OM, progressive and iterative prefixes, verb root, and extension markers, as shown in 12. The macrostem is familiar from Bantu languages and in Bantu normally includes the prefix OM, root, extension markers, and final vowel (e.g. Myers 1987, 1997, Mutaka & Hyman 1990, Hyman & Ngunga 1994, Odden 1996). In many Bantu languages, the macrostem is a domain for certain tonal processes. The main difference between Bantu and Moro is that the proposed Moro macrostem does not include the final vowel.

The Moro macrostem is nested inside the INFLECTIONAL STEM, which also includes the distal imperfective prefix and the AMD suffixes. While the macrostem is the domain of stem tone assignment, the inflectional stem includes the affixes that accompany and determine the type of stem tone pattern (default, all-H, or no-H tone). The Moro inflectional stem is similar to the Bantu inflectional stem, but differs from it in that the Bantu inflectional stem is smaller than the macrostem and excludes the OM prefix. Below we propose that the inflectional stem consists of the verbal projections that make up the *v*P domain in syntax.

The VERB STEM consists of the inflectional stem plus a string of prefixes: complementizer, subject marker, noun class, and clause type. Thus, the verb stem includes the syntactic *v*P in addition to syntactic heads in the TP/CP domain. Finally, at the right edge of the verb are several additional affixes, including the suffix OM. Syntactically, these markers originate within the *v*P but are not incorporated into the inflectional stem. The difference in the behavior of the prefix and suffix OMs is due to their position inside or outside of these domains. The different domains are summarized in 12.

(12) Verb domains

(COMP-SM-CLASS-CLAUSE-[AMD-{**OM**/PROG-ITER-ROOT-EXT}-AMD])-**OM-PL-**INST-LOC
(VERB STEM [I-STEM{MACROSTEM }I-STEM])

In the rest of this section we provide phonological evidence that each of these stems forms a distinct domain, and we situate the behavior of the OMs within these domains.

EVIDENCE FOR THE MACROSTEM AND INFLECTIONAL STEM. Recall from example 11 that default H on the root is absent in the presence of prefix OMs. The same pattern is observed with the iterative/durative prefix, realized by partial reduplication of the root. This prefix has the shape *CaC-*, where C indicates a copy of the first root consonant (13a–c), or *Vkk-* if the root is vowel-initial, where V copies the first vowel (13d). In default tone forms, this prefix is H-toned, and like with the prefix OM, no default H tone appears on the root when the reduplicant occurs.

(13)

| | PROXIMAL IMPERFECTIVE | ITERATIVE PROXIMAL IMPERFECTIVE | |
|---|---|---|---|
| a. | g-a-ðə́w-á | g-a-**ðáð**-ðəw-a | ‘poke’ |
| b. | g-a-lánḍa | g-a-**lál**-lanḍ-a | ‘close’ |
| c. | g-a-vəléð-a | g-a-**váf**-fərleð-a | ‘pull’[11] |
| d. | g-ogə́t-a | g-**ókk**-ogət-a | ‘jump’ |

[11] Another way of marking iterative is /r/ infixed as a coda of the first syllable of the root, often used with vowel-initial roots, for example, *gilíðʌ* ‘s/he is buying’ versus *gírliðʌ* ‘s/he is buying (iter.)’. Note that the /r/

When both the OM and the iterative prefix are present, the OM precedes the iterative prefix, and H tone appears only on the OM prefix; both the iterative prefix and the root lack H tone.

| (14) | PROXIMAL IMPERFECTIVE | **2SG OM** + ITERATIVE PROXIMAL IMPERFECTIVE | |
|---|---|---|---|
| a. | ɡ-a-ðə́w-á | ɡ-a-**ŋ́á**-ðað-ðəw-a | ‘poke’ |
| b. | ɡ-a-və́léð-a | ɡ-a-**ŋ́á**-vaf-fərleð-a | ‘pull’ |

The general pattern is therefore that only the leftmost prefix bears H tone, and that only a single autosegmental H tone can be realized inside of the macrostem.

Not all H-toned prefixes trigger this effect. H-toned prefixes that occur to the left of the OM, bolded in 15, can cooccur with default H tone on the root.

(15) **COMP-SM**-CLASS-**CLAUSE**-AMD-{OM/PROG-ITER-ROOT-EXT}-AMD

The pre-ROOT boundary between AMD and the OM represents the left edge of the macrostem. This AMD slot is realized by just one prefix, *á-*, which occurs only with the no-H tone pattern (as in 9d above). Also to the left of the macrostem are complementizers, main clause subject markers, and clause prefixes, which occur on main clauses and mark A-bar extraction (Rose et al. 2014). The H tones on these prefixes freely cooccur with the H tone on the root. If these prefixal H tones are adjacent to default H on the root, the H on the root may be downstepped (marked with ˈ).[12]

| (16) | complementizer | **t̪ə́**-ɲ-ˈáff-ó | ‘… I am building’ |
|---|---|---|---|
| | subject markers | **é**-ɡ-a-k$^{w}$ə́réð-a | ‘I am about to scratch’ |
| | | **é**-ɡ-ˈáff-a[13] | ‘I am building’ |
| | subj. extraction (clause type) | ɡ-**é**-k$^{w}$ˈə́réð-a | ‘(s/he) … who is about to scratch’ |

Downstep provides evidence for two separate autosegmental H tones (Odden 1986, Myers 1997, Bickmore 2000, 2007), indicating that the H of the prefix is distinct from the H on the root, rather than being a result of spreading. Independent H tones can also cooccur on the verb stem prefixes, and they do not trigger downstep on each other, indicating that downstep is restricted to the macrostem boundary demarcated in 15.

Just as the verb stem prefixes can cooccur with H tone on the root, they can also cooccur with the H tone of the iterative prefix or a prefix OM; if adjacent, downstep is observed.

| (17) | subject marker | **é**-ɡ-a-{ðáð-ðəw-a | ‘I am poking (iter.)’ |
|---|---|---|---|
| | subj. extraction (clause type) | ɡ-**é**-{ðˈáð-ðəw-a | ‘(s/he) … who is poking (iter.)’ |
| | subject marker | **é**-ɡ-a-{ŋ́á-k$^{w}$əreð-a | ‘I am about to scratch you’ |
| | subj. extraction (clause type) | ɡ-**é**-{ŋˈá-k$^{w}$əreð-a | ‘(s/he) … who is about to scratch you’ |

creates a heavy syllable, and so default H tone appears on the first syllable of the root rather than the second. The verb /vəleð/ preferentially uses both reduplication and /r/ infixation.

[12] As seen in 9d, the distal imperfective aspect prefix /á-/ requires a no-H tone pattern. For this independent reason, it never cooccurs with macrostem H tone. It also shows no tone interaction (downstep) with preceding H-toned prefixes: *égávəleðó* ‘I am about to pull over there’. This suggests that this prefix is not within the macrostem.

[13] This verb form features the vowel-initial, heavy-syllabled root /-áff-/. Because of vowel hiatus between the clause-marking prefix /a-/ and the root, the clause-marking prefix is not realized, resulting in adjacency between the H of the subject prefix and the H of the root, triggering downstep.

In summary, prefixes outside the macrostem boundary in 15 trigger downstep across the boundary on the following H, regardless of whether the H is associated with the root or a macrostem-internal prefix.

We conclude, therefore, that there is tonal evidence for a morphoprosodic constituent, the macrostem, delimited on the left by the OM. The leftmost tone-bearing unit in the macrostem bears H tone in the default tone pattern. This H tone is downstepped when another H-toned prefix is adjacent across the boundary.

There is a different kind of interaction between root H and suffixal H outside of the macrostem. Here we consider the H-toned AMD suffixes and suffix OMs. The perfective suffix *-ó* cooccurs with L tone on the root (the no-H pattern), whereas the proximal imperative occurs with H tone on the root (the all-H pattern). Conversely, the consecutive imperfective *-ó* cooccurs with the default tone pattern described in §3.1. Downstep occurs between the root and the *-ó* suffix only when these two H tones are adjacent (18c).

| | | | |
|---|---|---|---|
| (18) a. | perfective | é-ɡ-a-vəleð-ó | 'I pulled' |
| b. | proximal imperative | vəléð-ó | 'pull!' |
| c. | consecutive imperfective | égavárá ʈ-é-ˈvəléð-ˈó | 'I am crying and pulling' |

In example 18c, the existence of downstep indicates that the H of the root is distinct from the H on the prefix and suffix, rather than being linked to one autosegmental H. This is as expected, since default H is anchored at the left edge of the macrostem and spreads rightward; it does not always abut an H-toned AMD suffix. In contrast, downstep does not occur with the imperative (18b), suggesting an analysis of the imperative as a single autosegmental H spread across the stem, and not two juxtaposed H tones. Thus, if downstep is linked to adjacent autosegmental H tones at the border of the macrostem, AMD suffixes must be outside of the macrostem.

Turning to OM suffixes, they show no interaction with all-H tone. There is also no downstep between the all-H tone on the root and the OM suffix tone, which is reminiscent of the lack of downstep between prefixal H tones outside of the macrostem. Recall that the reduction of /o/ to schwa is a standard phonological process in Moro (n. 4).

| | | |
|---|---|---|
| (19) a. | **é-**ɡ-a-kʷəreð-ə́-**ŋ́ó** | 'I scratched him/her' |
| b. | kʷə́réð-ə́-**ŋ́ó** | 'scratch him/her!' |

The invariance of suffix OMs in the presence of adjacent H tones differs markedly from the behavior of prefix OMs, which cannot cooccur with default tone on the verb stem and undergo downstep in the presence of a preceding prefixal tone. This difference indicates that, unlike prefix OMs, suffix OMs are not part of the macrostem.

In conclusion, H tone is realized on the leftmost syllable in the macrostem in verb forms exhibiting the default tone pattern, modulo the constraints placed on default H by syllable structure described in §3.1. Evidence for the boundaries of the macrostem comes from the fact that downstep applies between adjacent H tones only at this boundary. Outside of this domain, adjacent H tones cooccur freely and do not trigger downstep.

While we have seen that the macrostem is the domain in which the default tone pattern is realized, we assume that the larger inflectional stem is the locus of the process of tone assignment. There are three reasons for this assumption. First, the morphosyntactic category of the inflectional stem is exponed by the constructional combination of one of the tone patterns with one of the AMD affixes. The default tone pattern cooccurs with one of three suffixes, *-e*, *-a*, or *-ó*, which indicate several distinct AMD categories (see Table 2); the default pattern is the same regardless of which AMD suffix it appears

with. Second, while downstep occurs between default H tone and an H-toned AMD suffix in the consecutive imperfective, no downstep occurs between the all-H tone pattern on the root and an H-toned AMD suffix in the proximal imperative. Third, stem tone patterns conditioned by AMD affixes are confined to the inflectional stem, and they do not affect the assignment of tone outside of this domain. Thus, while the macrostem is completely contained in the inflectional stem, its tonal properties are determined by the morphosyntactic category of the inflectional stem. These tonal properties are what determine whether OMs occur in the prefix or suffix position.

Evidence for the verb stem and post-verb stem affix group. The inflectional stem is nested inside a larger domain that we call the verb stem (see 12 above and 22 below). Phonological evidence for the existence of the verb stem domain comes primarily from vowel harmony. Moro exhibits vowel height harmony, which raises the lower vowels /e a o/ to [i ʌ u], respectively. For verbs in Moro, the verb stem is the domain of this vowel harmony process. Thus, every member of the inflectional stem undergoes vowel harmony, as well as all prefixes attached to the inflectional stem. However, suffixes to the right of the AMD suffix generally do not undergo harmony, though it can optionally occur on the first OM. In 20a,e, the verb root *veð* 'sleep', which has a lower vowel /e/, is shown. The affixes attached to this root are all of the lower set /e a o/. In 20b,f, the root for 'hit', which has an underlyingly high vowel /u/, causes the affixes to raise to their higher counterparts [i ʌ u]. While prefix OMs do undergo harmony (20g,h), suffix OMs do not (20c,d). This indicates that prefix OMs, but not suffix OMs, are included in the verb stem.

(20) a. é-g-a-veð-ó 'I slapped (something)'
b. í-g-ʌ-bəg-ú 'I hit (something)'
c. é-g-a-veð-á-**ŋá** 'I slapped you (sg.)'
d. í-g-ʌ-bəg$^{w}$-á-**ŋá** 'I hit you (sg.)'
e. é-g-a-véð-á 'I am about to slap (something)'
f. í-g-ʌ-bə́g$^{w}$-ʌ́ 'I am about to hit (something)'
g. é-g-a-**ŋá-**veð-a 'I am about to slap you (sg.)'
h. í-g-ʌ-**ŋ**ʌ́-bəg$^{w}$-ʌ 'I am about to hit you (sg.)'

Note that the harmony effects cannot be attributed to direction relative to the verb root, as aspectual final vowels do undergo harmony, despite the fact that they follow the root.

In addition to the suffix OMs, the instrumental *-ja* and locative *-u* follow the AMD suffix and likewise do not undergo or trigger vowel harmony. Thus, vowel harmony provides evidence for a constituent, the verb stem, whose right boundary follows the AMD suffix (and thus is the same as the right boundary of the inflectional stem). The left boundary of the verb stem corresponds with the left boundary of the verb.

The suffixes that do not undergo vowel harmony form a group, which is defined by distinct tonal effects. The instrumental and locative markers do not bear H tone, but cause an H tone to appear on a preceding tone-bearing unit. This can be the final aspect vowel (21b,c), or another affix (21d,e). If both of these markers occur, two H tones are found (21d). If two H-toned OMs occur, the second one does not bear H tone if it is phrase-final (21f).

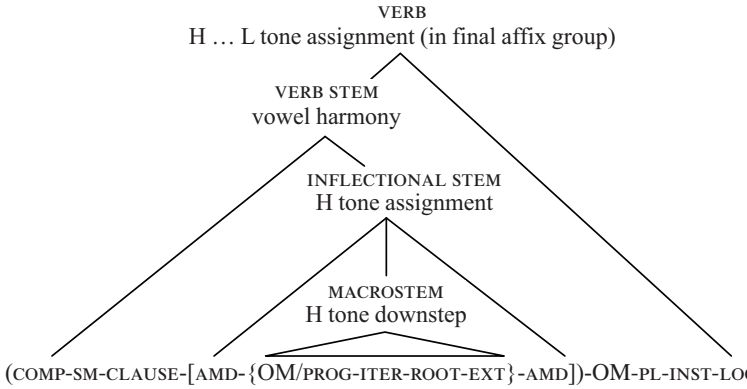
(21) a. g-a-və́dað-a] 's/he is sweeping'
b. g-a-və́dað-á]-ja 's/he is sweeping with it'
c. g-a-və́dað-á]-u 's/he is sweeping in it'
d. g-a-və́dað-á]-já-u 's/he is sweeping with it in it'
e. g-ʌ-dʌr-ə́]-lə́-ja 's/he covered them with it'

f. ɡ-a-natʃ-á]-ńdə-ŋo ‘s/he gave us to him/him to us’ (/ńdə/ + /ŋó/)
g. ɡ-ʌ-dʌr-t̪-á]-ɲá-ŋó-ja ‘s/he covered me with it for him/him with it for me’

These affixes require an H tone at the left edge (which can appear just inside the verb stem if the affix is L-toned) and an L tone at the phrasal right edge, presumably an L% boundary tone. These two requirements compete when there is a single H-toned OM, however, and the H tone of the OM is maintained: *ɡ-ʌ-dʌr-á-ŋó* ‘s/he covered him/her’. The ban on a final H tone is evident only if there is more than one final affix within this domain.[14]

The structure of the Moro verb is summarized in 22, with indications of the phonological processes marking each level.[15]

(22) Moro verb structure




To recap, the boundaries of the macrostem are marked by tonal downstep, indicating that it includes OM prefixes but not OM suffixes. Only one H autosegment occurs within the macrostem in default tone patterns; it is this H that undergoes or triggers downstep across its boundaries. The inflectional stem is the domain for the assignment and distribution of default, all-H, and no-H tone patterns. The inflectional stem includes the macrostem as well as the AMD prefix and suffixes. The verb stem includes the inflectional stem and all prefixes, and it is the domain of vowel harmony. Finally, suffix OMs and the locative and instrumental markers are adjoined to the right edge of the verb stem, a domain that is marked by distinct tonal properties. These markers do not interact with the tone on the verb stem, other than to place an H tone on the final L-toned syllable of the verb stem. The first suffix OM optionally participates in vowel harmony.

Two main observations about the interaction between tone and OMs have been established. First, OMs occur in prefix position in the morphosyntactically diverse group of verb forms exhibiting DEFAULT TONE, characterized by a left-aligned H tone in the macrostem that spreads one mora to the right. In contrast, suffix OMs occur in verb forms that exhibit either ALL-H TONE or NO-H TONE. Second, the OM interacts differ-

[14] There is evidence that the H tone of the final OM can be recuperated on a preceding OM. Compare the form *ganatʃá*]-*ńdr-lo* ‘s/he gave them to us’ with *ganatʃá*]-*ńdŕ-ŋo* ‘s/he gave her/him to us’ in which the H tone of the OM *-ŋó* is displaced onto the preceding L-toned /r/. See §5 for discussion of the 1st plural inclusive OM *-ndr*.

[15] In Jenks & Rose 2011, the macrostem was proposed to include the final aspect/mood vowel. However, that analysis did not consider the downstep evidence or the tonal behavior of the consecutive imperfective. That article also postulates a smaller domain called the derived stem, consisting only of the root and extension suffixes. Evidence is provided from finer details of the distribution of default H tone in Jenks & Rose 2011.

ently with the tone of the stem depending on whether it is in prefix or suffix position. Prefix OMs have H tone, while the rest of the macrostem is L-toned, failing to exhibit the characteristic default tone. When suffixal, the H tone of the OM does not interact with the tone pattern of the rest of the verb stem, as expected based on the position of suffix OMs outside the verb stem.

In the following section, we pursue a formal analysis of the variable position of OMs in Moro as driven by the tonal properties of the verb forms with which they occur.

**4.** ANALYSIS OF THE DISTRIBUTION OF OMS. The goal of this section is to demonstrate how the variable OM position in Moro fits into an analysis of the distribution of tone. We provide a formal optimality-theoretic analysis of the tone interaction patterns from §3 and derive from this analysis the two different positions of Moro OMs. Section 4.1 provides an overview of the process by which OMs are incorporated into the verb, which we take to be largely prosodic. In §4.2, we introduce constraints and rankings to derive the tone patterns of default, all-H, and no-H tone. In §4.3 we show how these constraints and rankings, combined with the default suffix OM position, derive the prefix OM in default tone constructions, but the suffix OM with the other two patterns.

**4.1.** SYNTACTIC POSITION OF OMS AND PROSODIC INCORPORATION. We begin by laying out our assumptions about the syntactic, morphological, and phonological status of OMs in Moro. We take OMs to be pronouns that enter the syntactic structure in the position typical of objects, following the verb. OMs then combine with the verb stem for prosodic reasons. There are two pieces of evidence for the claim that Moro OMs are pronouns rather than agreement markers.

First, Moro OMs occur in complementary distribution with full noun phrases.

(23) a. Kúku ɡ-a-ləvəʧ-ó ummiə/ ŋeɾá
CLg.Kuku SM.CLg-RTC-hide-PFV CLg.boy/CLŋ.girl
'Kuku hid the boy/girl'

b. Kúku ɡ-a-ləvəʧ-ə-**ŋó**
CLg.Kuku SM.CLg-RTC-hide-PFV-3SG.OM
'Kuku hid him/her'

OMs and nominal objects do not cooccur in elicited forms or texts, and speakers reject forms where they cooccur. If OMs occur in the same syntactic position as full noun phrase objects, the complementarity of OMs and full nominals follows directly.

Second, there is a distinct set of free pronouns in Moro that occur in emphatic environments in both subject and object position. Systematic formal and semantic similarities between free emphatic pronouns and OMs indicate a close relationship between the two classes. For example, while subject agreement reflects Moro's noun class system (Gibbard et al. 2009), neither pronouns nor OMs mark noun class. Thus, the OM in 23b could refer to either object in 23a (*ummiə* 'boy', class *ɡ-*, or *ŋeɾá* 'girl', class *ŋ-*). The general similarity between independent pronouns and OMs is further illustrated in 24.

(24)

| | PRONOUN | OM | | PRONOUN | OM |
|---|---|---|---|---|---|
| 1SG | ə́ɲɲí | ɲé | 1PL.EXCL | ɲ́ɲandá | lánda |
| 1DU.INCL | (ńdə́)líŋ | ńdə/ńda | 1PL.INCL | ńdr | ńdr |
| 2SG | ŋ́ŋá | ŋá | 2PL | ɲáŋə́ndá | ńda |
| 3SG.HUM | ŋ́ŋúŋ | ŋó | 3PL | ŋúlʷɔ́/ŋúlandá | lo |

Nonhuman 3rd singular object pronouns and OMs are unmarked or zero forms. In contrast, the 3rd plural forms in 24 can refer to human or nonhuman plural objects.

The forms in 24 also show that while OMs are predominantly monomoraic, the free pronouns are minimally bimoraic. Compare the 2nd singular free pronoun *ŋ́.ŋá* to the

OM *ŋá*. This alternation between free and bound pronominal forms in Moro is an instance of the observation that many functional words occur in both weak (= bound) and strong (= free) forms (Zwicky 1970, Selkirk 1995). We conclude that Moro OMs are the normal realization of nonfocused pronouns. We attribute their phonological dependence on the verb to prosodic deficiency (see below), forcing them to attach to the verb. We assume prosodic deficiency for both monomoraic OMs and longer forms such as 1st plural exclusive *-lánda*, discussed further in §5 below.

Following Selkirk (1995), we interpret prosodic deficiency to mean that, as functional items, OMs do not project to the level of phonological word. Thus, while OMs are syntactically distinct from the verb, they become phonologically dependent on the verb through a process of STRAY ADJUNCTION (Anderson 2005:13, 75–85), which incorporates the OM into the prosodic constituent projected by the verb. Stray adjunction has no effect on the linear relationship between the pronoun and the verb (if such a linear relationship even exists at this point in the derivation), an analysis that successfully predicts that the suffix position of the OM is the default one (see §5). We further adopt the MINIMALIST framework, where prosodic structure is realized and interpreted during spell-out, triggered by the phase head *v* (Chomsky 2000).

(25) a. g-a-[$_{vP}$ [$_{v}$ ləvəʧ-ə́] [$_{D}$ **ŋó**]] SYNTAX ‘S/he hid him/her.’ (cf. 25b)
b. [[$_{\omega}$ ləvəʧə́] **ŋó** ] SPELL-OUT

The inflectional stem (= $_{\omega}$) is the prosodic realization of the verb. We assume that the equivalent of the *v* phase head in Moro at some level of abstraction is the AMD suffix on the verb, which hosts a functional projection to which the verb and other intervening projections move. Because the OM does not project its own prosodic structure, when the *v*P is spelled out, the OM is stranded to the right of the inflectional stem without prosodic structure and must stray-adjoin to the phonological word projected by the phonological content of the *v* phase head. At this point, the *v* phase realizes its particular, lexically stored phonology (see below).

In summary, OMs are structural objects of the verb, and we attribute their default position to the right of the verb to the observation that objects follow verbs in Moro. This preference is modeled below with the constraint RIGHTMOST, which aligns stray morphemes with the right edge of the inflectional stem (Legendre 2000). This constraint could also be formulated with reference to the right edge of the *v*P, or as a faithfulness constraint requiring the OM to be realized in its merge position. Either way, the morphosyntactically preferred position may be overridden by phonological constraints, which push the OM to attach within the macrostem.

**4.2.** ANALYSIS OF AMD TONE PATTERNS. We now present a formal analysis of the three main tone patterns described in §§3.1 and 3.2. A summary of these tone patterns is given below. The morphosyntactic features particular to each class are expressed constructionally, through a combination of tone, a final suffix (and in one case, a prefix), and a select subject-agreement paradigm. The macrostem tone patterns and the corresponding AMD affixes are summarized in 26.

(26)

| TONE PATTERN | AMD AFFIX | ASPECT/MOOD/DEIXIS |
|---|---|---|
| No H | -ó | perfective |
| No H | á- -ó | distal imperfective |
| No H | -a | proximal imperative |
| All H | -ó | proximal imperative |
| Default H at left edge | -ó | consecutive imperfective |
| Default H at left edge | -a | proximal imperfective, negative, infinitive 2 proximal, infinitive 1 distal, consec. distal perfective |

| | | |
|---|---|---|
| Default H at left edge | -e | infinitive 1 proximal, consec. proximal perfective |

The phenomenon of tone patterns being assigned to particular tense/aspect/mood categories is also attested in some Bantu languages. For example, in Makua, Yao, and Kimatuumbi (Odden 1989), Makonde (Odden 1990), and Nyala (Ebarb & Marlo 2009), there are no lexical tone contrasts in verb roots, but H tone is assigned somewhere in the verb stem in most tenses; the exact position of the H is morphologically conditioned by the tense/aspect. For example, Odden (1990) proposes a basic rule 'Stem H insertion' in the Chimaraba dialect of Makonde. A series of morphologically conditioned rules then account for the precise position of the H tone. 'Stem mapping H' assigns H tone to the penultimate syllable in conditional subordinate tenses, while 'Future negative docking' assigns H to the penultimate root syllable in the negative future, and 'Stem initial H' maps H tone to the initial stem mora in the infinitive. This discussion highlights the fact that whether a rule-based or constraint-based framework is used to model the distribution of tone, some degree of morphological specificity of this kind is required.

We model our analysis in OPTIMALITY THEORY (OT). A rule-based framework could also be used, but we show in §4.3 that the OT framework is well suited to the optimizing character of the output with respect to tone, capturing the interplay between the tone of the OM and the overall tone pattern of the macrostem. First, we assume that each AMD suffix is lexically specified for tone: /-a/ and /-e/ are L-toned (lack an H autosegmental tone), and /-ó/ is H-toned. This assumption is based on the fact that regardless of AMD construction, these affixes bear the same tone. Second, we assume that roots are not specified underlyingly for tone; the tone patterns are assigned at the inflectional stem level where AMD affixes are attached.

We derive the distribution of the H tone with three faithfulness constraints and four markedness constraints (TBU = tone-bearing unit).

(27) a. MAX-IO(H): Do not delete H tone.
b. DEP-IO(H): Do not insert H tone.
c. INTEGRITY-IO(H): No input H can be linked to more than one output TBU.
d. *H: Assign one violation for every autosegmental H tone.
e. HAVE-H: Assign one violation mark for every TBU that is NOT associated with an H tone autosegment.
f. MACROSTEM-H: Macrostem (MSTEM) must contain an H tone.
g. ALIGN(H, L; MSTEM, L): Align left edge of H with left edge of the macrostem.

These constraints are quite general. Their only language-specific component is the reference to the macrostem domain as the locus of tone realization. Any analysis, however, must make reference to this domain to achieve descriptive adequacy.[16]

We adopt an analysis whereby each AMD construction listed in 26 is lexically associated with one of three rankings of these constraints corresponding to the three tone patterns. Alternate rankings for different morphological constructions are sanctioned in approaches to OT with morphological levels, such as STRATAL OT (Bermúdez-Otero 2006, 2016) or closely aligned LEXICAL PHONOLOGY & MORPHOLOGY (LPM) OT (Kiparsky 2000). However, in stratal OT/LPM OT, rankings are associated with general

[16] We do not employ the term PROSODIC WORD here, as suggested by a referee, since macrostems with short roots can be smaller than a single mora, whereas Moro prosodic words are minimally bimoraic. The term PROSODIC STEM (Downing 1999) could be substituted for macrostem, but this is a terminology difference, and does not change the basic analysis.

stem-level and word-level categories, whereas the forms under consideration here are all of the same general inflectional category and assign tone at the same morphological level. COPHONOLOGY theory, by contrast, builds words constructionally (Inkelas 1998, Anttila 2002, 2009, Inkelas & Zoll 2005, 2007, Inkelas & Caballero 2013). Each construction is associated with semantic features and a particular ranking of phonological constraints. These constructions can be general (i.e. stem-level) or specific. Cophonology theory is therefore better suited for this kind of morphologically specific tone assignment. While we are adopting the incremental nature of cophonology approaches, our approach assumes a syntactic word-building mechanism. Thus, while we still identify distinct constraint rankings with distinct levels of structure, we take these distinct levels of structure to be underlyingly syntactic rather than purely morphological.

The widespread default tone pattern is characterized by H at the left edge. To simplify our tableaux, we combine the last two constraints in 27, MACROSTEM-H and ALIGN(H, L; MSTEM, L) into a single constraint, ALIGN(H,L). Together, these constraints require the macrostem to have a single H positioned at the left edge (Jenks & Rose 2009, 2011),[17] deriving a prosodic maximality effect. This constraint is ranked above the faithfulness constraint DEP-IO(H), which prevents tone insertion. In addition, the ranking of the faithfulness constraints INT(EGRITY)-IO(H) ≫ DEP-IO(H) ensures that a tone is inserted rather than spread from the AMD suffix. To illustrate, we use the 3rd singular consecutive imperfective *ṯ-áŋ-ˈvə́léð-ˈó*, which bears the complementizer prefix *ṯ-*, the subject marker *áŋ-*, and the AMD suffix *-ó*. The linking of H tone on the first two vowels arises due to constraints on H tone extension within a foot structure that are not relevant here (see Jenks & Rose 2011). We do not incorporate an analysis of the downstep pattern in this article.

(28) Default: INT-IO(H), ALIGN(H,L) ≫ DEP-IO(H)

| / ṯ-áŋ-vəleð-ó/ | INT-IO(H) | AL(H,L) | DEP-IO(H) |
|---|---|---|---|
| a. ṯ-áŋ-[{və́léð}-ó] | **! | | |
| ☞ b. ṯ-áŋ-[{və́léð}-ˈó] | | | * |
| c. ṯ-áŋ-[{vəleð}-ó] | | *! | |

In this example, the boundaries of the macrostem are demarcated with curly brackets { } and the inflectional stem with square brackets [ ] in the candidate forms, as in 15 and 22 above. Recall that only material in the inflectional stem/*v*P is assessed here, though we show the whole word form. Candidate 28a has a single H tone spread onto both syllables of the macrostem from the final suffix, violating INT-IO(H), which penalizes spreading. Candidate 28c does not have an H tone at the left edge of the macrostem, violating ALIGN(H,L). The winning candidate 28b satisfies INT-IO(H) and ALIGN(H,L), though it violates the lower-ranked DEP-IO(H), the constraint penalizing insertion. Note that tones cannot shift from input hosts in order to satisfy ALIGN(H,L)—for example, the H tone on the suffix *-ó* does not move to the left edge of the macrostem. Tone shift is ruled out by high-ranking IDENT-IO(H)/OI(H) (Jenks & Rose 2011), which we do not include here. In summary, the constraint ranking in 28 produces the effect of a single H tone aligned at the left edge, a type of prosodic maximality effect. The same ranking will also compel H insertion if the AMD suffix is L-toned, as in, for example, the proximal imperfective form *g-a-vəléð-a*.

[17] Note that in Jenks & Rose 2011, the constraint requiring an H tone referenced the derived stem rather than the larger macrostem (see n. 15). In this article we have added the inflectional stem level and adjusted our analysis of the macrostem to exclude the AMD suffixes.

We turn now to a derivation of the no-H pattern, found in the all L-toned distal imperative (e.g. *vəleð-a*), the perfective (e.g. *g-a-vəleð-ó*), and distal imperfective (e.g. *g-á-vəleð-ó*). In this pattern, no H tones can appear in the macrostem. DEP-IO(H) prevents inserted Hs, and INT-IO(H) prevents spreading tone from a suffix. H tones may also shift into the macrostem, so we employ a general *H, which penalizes each autosegmental H tone no matter its source. This is ranked above ALIGN(H,L) and HAVE-H, though we only show the former. The ranking of MAX-IO(H) ≫ *H, INT-IO(H) prevents deletion of underlying affixal H tones where relevant. This ranking is illustrated by the example in 29, a perfective verb form.

(29) No-H: MAX-IO(H) ≫ *H, INT-IO(H), DEP-IO(H) ≫ ALIGN(H,L)

| /g-a-vəleð-ó/ | MAX-IO(H) | *H | INT-IO(H) | DEP-IO(H) | AL(H,L) |
|---|---|---|---|---|---|
| a. g-a-[{vəleð}-o] | *! | | | | * |
| ☞ b. g-a-[{vəleð}-ó] | | * | | | * |
| c. g-a-[{váléð}-ó] | | * | **! | | |
| d. g-a-[{váléð}-ˈó] | | **! | | * | |

Candidate 29a has no H tone, but violates MAX-IO(H), which preserves the H tone on the suffix. Candidate 29c spreads tone from the suffix to the left edge of the macrostem, satisfying ALIGN(H,L) but violating the higher-ranked INT-IO(H). Candidate 29d inserts a tone, likewise satisfying ALIGN(H,L) but violating DEP-IO(H) and also incurring an extra *H violation. Candidate 29b, with no H inside the macrostem, is therefore the winner. Because this ranking is associated with the inflectional stem, *H violations outside the inflectional stem are not counted.

We turn last to the all-H tone pattern, attested only in the proximal imperative (ex. *vəléð-ó*). Because the all-H pattern lacks downstep, we analyze H tone as spread from the suffix *-ó* to the left edge of the inflectional stem. The constraint that favors the occurrence of this exhaustive spreading is HAVE-H (McCarthy et al. 2012), which requires every TBU to bear H tone.[18] Because spreading from *-ó* violates INT-IO(H) and *H, these constraints must be ranked below HAVE-H. DEP-IO(H), which penalizes H insertion, must also be ranked above INT-IO(H). Together, these candidates prefer exhaustive spreading of the suffixal H to every TBU in the inflectional stem, as in candidate 30a.

(30) All-H: DEP-IO(H), HAVE-H ≫ *H, INT-IO(H)

| /vəleð-ó/ | DEP-IO(H) | HAVE-H | *H | INT-IO(H) |
|---|---|---|---|---|
| ☞ a. [{váléð}-ó] | | | * | ** |
| b. [{váléð}-ˈó] | *! | | ** | |
| c. [{vəleð}-ó] | | **! | * | |

We do not show MAX-IO(H) here but assume that it maintains its high ranking. ALIGN(H,L) is not crucially ranked in the all-H pattern, given the independent high ranking of HAVE-H.

In summary, each AMD construction is associated with one of three rankings, which generate the three basic stem tone patterns.

[18] The ALIGN(H,L) constraint already employed for default tone could be used to derive the all-H pattern as well. If ALIGN(H,L) replaced HAVE-H in 30, spreading from the final vowel to the left edge of the macrostem would be optimal. However, the all-H pattern differs from the default pattern in ignoring syllable structure, so the ALIGN(H,L) approach would incorrectly predict that H would not spread to the first vowel of a vowel-initial root. We therefore opt for the more encompassing HAVE-H constraint.

(31) a. Default—H tone at left edge:
MAX-IO(H), INT-IO(H), ALIGN(H,L) ≫ DEP-IO(H), *H; HAVE-H
b. No H tone:
MAX-IO(H) ≫ *H, INT-IO(H), DEP-IO(H) ≫ ALIGN(H,L), HAVE-H
c. All H tone:
MAX-IO(H), DEP-IO(H), HAVE-H ≫ *H, INT-IO(H); ALIGN(H,L)

Equivalent characterizations of these constructions can also be formulated in a rule-based framework. The all-H-toned forms would be generated by a rule spreading H leftward, and the default H-stem would be generated by a rule inserting H tone and positioning it at the left edge of the macrostem. No rule of H insertion or spreading is required for the L-toned forms. However, we demonstrate in the following section that when these constraint rankings interact with a constraint requiring the OM to be situated at the right edge of the verb stem, the position of the OM relative to the verb root and its tonal interaction with the root follow straightforwardly.

**4.3.** ANALYSIS OF OM POSITION. Recall that in §4.1 we equated the inflectional stem with the *v*P in syntactic structure, a constituent that includes the verb, voice and valence heads, aspect, and internal arguments of the verb. We argued in §4.1 that OMs prosodically adjoin to the right edge of the phonological word projected by the *v* head, forming their own prosodic domain outside of the inflectional stem.[19] We take the prosodic adjunction of the OM to the inflectional stem to follow from the following constraint, which has the effect of enforcing stray adjunction.

(32) RIGHTMOST(AFFIX, L; INFLSTEM, R): Align the left edge of prosodically deficient material with the right edge of the inflectional stem.

Because OMs are not lexically specified for prefix or suffix status, we take their position in the verb to follow from a combination of prosodic incorporation, namely the effect of RIGHTMOST, in addition to the tone requirements of the stem. We crucially assume that RIGHTMOST is ranked relative to the constraint rankings introduced in the previous section. We illustrate below that the constraint ranking responsible for producing default tone also favors the prefix realization of OMs, where their H tone satisfies the initial tone requirement characteristic of this pattern. For this analysis, we must assume that OMs bear H tone underlyingly, an assumption for which there are three pieces of evidence: (i) alternating OMs appear with an H tone regardless of their position; (ii) their corresponding free pronouns also have H tone (24); and (iii) not all OMs have H tone, so there must be a lexical distinction between these two groups. Since OMs are uniquely mobile within the Moro verb, we assume that the other H-toned affixes are lexically specified for position, whereas the other final nonmobile affixes (3rd plural OM, instrumental, locative) are L-toned and cannot be displaced (see §5 for an analysis).

We turn now to the tableau illustrating why H-toned OMs emerge in the prefix position. The basic claim is that OMs in this position are phonologically optimizing, as they provide the macrostem with an H tone. They satisfy ALIGN(H,L) without violating DEP-IO(H), the constraint against inserting an H tone, and obviate the need for an H tone to be inserted on the stem. Taking the ranking proposed for the default tone pattern

[19] Constraints besides RIGHTMOST may be necessary to account for the incorporation of the final affix group into prosodic structure. For example, an additional constraint requiring phonological material to be prosodically parsed may be needed; cf. the EXHAUSTIVITY constraint of Selkirk (1995). Since this constraint is not relevant to our main concern, we omit it but assume it is active.

in 28, we slot RIGHTMOST in below DEP-IO(H) and illustrate with the proximal imperfective form. We leave out the constraints MAX-IO(H) and HAVE-H for reasons of space, and because they do not affect the selection of the winning candidate.

(33) INT-IO(H), ALIGN(H,L) ≫ DEP-IO(H) ≫ RIGHTMOST

| /g-a-vəleð-a ɲé/ | INT-IO(H) | AL(H,L) | DEP-IO(H) | RIGHTMOST |
|---|---|---|---|---|
| ☞ a. g-a-[{ɲə́-vəleð}-a] | | | | * |
| b. g-a-[{vəléð}-a]-ɲé | | | *! | |
| c. g-a-[{vəleð}-a]-ɲé | | *! | | |
| d. g-a-[{vəléð}-á]-ɲé | ***! | | | |

Thus, the ranking favors a prefix OM over a suffix OM due to the avoidance of a DEP-IO(H) violation, which default tone forms normally incur. While H tones cannot be displaced from one segment to another, an affix bearing an H tone can be realized in different positions.

In the other tone patterns, the prefixal realization of the OM is not optimal. Consider first the ranking for the no-H pattern. Positioning an H-toned OM at the left edge of the macrostem leads to violations of both *H and RIGHTMOST (34c). Deleting the H tone from a prefix OM (34a) is prevented by high-ranked MAX-IO(H), previously motivated to account for the basic forms. The candidate with the suffix OM (34b) is therefore preferred.

(34) MAX-IO(H) ≫ *H, INT-IO(H), DEP-IO(H), RIGHTMOST ≫ ALIGN(H,L)

| /g-a-vəleð-ó ɲé/ | MAX-IO(H) | *H | INT-IO(H) | DEP-IO(H) | RIGHT-MOST | AL(H,L) |
|---|---|---|---|---|---|---|
| a. g-a-[{ɲə-vəleð}-ó] | *! | * | | | * | * |
| ☞ b. g-a-[{vəleð}-ə́]-ɲé | | * | | | | * |
| c. g-a-[{ɲə́-vəleð}-ó] | | **! | | | *(!) | |

RIGHTMOST is crucial, however, in determining the position of the OM in the all-H tone pattern, to which we turn last. In the all-H pattern, HAVE-H ensures that every TBU has an H tone, so outputs without the all-H pattern (e.g. 35a) are ruled out. (Subscripts refer to H tone autosegments.) The choice comes down to candidates 35b and 35c, both of which satisfy HAVE-H equally. However, incorporation of the OM into the macrostem in 35b incurs a RIGHTMOST and a *H violation, so suffixation outside the inflectional stem is preferred. Thus, the suffixal position of the OM in these forms follows from RIGHTMOST since there are no tonal preference constraints favoring other options.

(35) MAX-IO(H), DEP-IO(H), HAVE-H ≫ *H, INT-IO(H), RIGHTMOST

| /vəleð-ó$_2$ ɲé$_1$/ | MAX-IO(H) | DEP-IO(H) | HAVE-H | *H | INT-IO(H) | RIGHT-MOST |
|---|---|---|---|---|---|---|
| a. [{ɲə́$_1$-vəleð}-ó$_2$] | | | **! | * | | * |
| b. [{ɲə́$_1$-və$_2$lé$_2$ð}-ó$_2$] | | | | **! | ** | *(!) |
| ☞ c. [{və$_2$lé$_2$ð-ə́$_2$}]-ɲé$_1$ | | | | * | ** | |
| d. [{ɲə́$_2$-və$_2$lé$_2$ð}-ó$_2$] | *! | | | * | *** | * |

To summarize, prefix OMs occur in the default tone pattern because the H tone of the OM satisfies the requirement of this pattern that an H tone occur at the left edge of the macrostem. As long as RIGHTMOST is ranked below DEP-IO in the default pattern, H-toned OMs are optimal in the prefix position. In contrast, the constraint rankings mo-

tivated in §4.2 rule out a prefixal OM in the other two tone patterns; the position of RIGHTMOST is not crucial in these patterns, but it does favor a suffix OM. In these cases the OM is realized as a suffix outside the inflectional stem. We conclude that the prefix realization of the OM is phonologically determined, both by the tonal properties of the OM, and by the tonal requirements of the stem to which it attaches.

Before proceeding to further predictions of our analysis, we first compare it to an alternative suggested by a referee that explicitly restricts the number of autosegmental tones allowed within the macrostem, either an OBLIGATORY CONTOUR PRINCIPLE (OCP) or anti-clash constraint, or a prosodic maximality constraint restricting the macrostem to only one H tone. Note that the domain for such constraints must be the macrostem rather than the inflectional stem since both prefix and suffix OMs can cooccur with H-toned AMD suffixes, and suffix OMs can cooccur with all-H stem tone. The point of these constraints is to penalize more than one autosegmental H tone within the macrostem. Since the H tone that does appear is leftmost in the macrostem, an additional rule or constraint (such as ALIGN(H,L) or 'delete second H tone') would need to favor the leftmost tone. This analysis would work whether the default tone is lexically present on the root or inserted.

The question this alternative does not answer, however, is why the H-toned prefix OM should occur at all in the default pattern, since a suffix OM would not violate the OCP. If default H tone is inserted, then the analysis could rely on a preference for non-inserted tones over inserted tones to derive the prefix position by ranking INT-IO(H) ≫ DEP-IO(H), just as in our analysis. The OCP analysis also does not account for the suffix position of the OM with the all-H and no-H verb forms. Thus, the OM is suffix in the all-H pattern, despite the fact that H tone appears at the left edge of the macrostem in both the all-H and default patterns (default *ʦáŋˈvə́léðˈó* versus all-H *və́léðó*). These forms clearly illustrate that the position of the OM is not determined by the surface tone properties of the stem but by the ranking that produces them. Thus, analyzing the all-H pattern with the OCP adds no additional insights about the distribution of the OM and says nothing about the tonal differences between different verb forms. Likewise, in the no-H forms, the OCP offers no explanation for why the OM can occur in the prefix position in the macrostem, so some other explanation is still required, such as the high ranking of *H we adopt. In summary, an analysis incorporating the OCP would need to be supplemented with the constraint rankings we employ to account for all of the tone patterns and the position of the OM. Therefore, there is no advantage to adding an OCP constraint banning two H tones within the macrostem, already captured in the statement of ALIGN(H,L). If the position of the OM is determined by factors besides tone, and tone patterns merely accommodate its position, then those factors are yet to be identified. See §7 for further critical discussion of alternative analyses that could be used to derive the OM position.

**5.** MORE EVIDENCE FOR THE ROLE OF TONE: NONMOBILE AND SPLIT OMS. In this section we examine cases of nonmobile and split OMs, as well as the distribution of multiple OMs with ditransitive verbs. All of these cases fall out from our analysis with few additional stipulations.

The forms in 36 illustrate the nonmobile and split OMs. The 3rd plural marker *-lo* is L-toned and consistently appears as a suffix (36c).[20] In addition, the 1st plural exclusive[21]

[20] This is true for Thetogovela Moro. The Werria/Um Dorein dialect of Moro reported in Black & Black 1971 allows prefixal 3rd plural OM, though they do not report any tonal facts in that description.

[21] In Jenks & Rose 2011, this prefix was assumed to be *-álánda*. Discussions with a second consultant, Angelo Naser, prompted a reanalysis as *-lánda*. The [a] is analyzed as the AMD suffix of the previous stem. When the stem ends in *-ó*, it harmonizes with the following vowel and becomes [á]. See also Rose 2013.

and inclusive OMs split into two morphemes in the default tone pattern that normally conditions prefix OMs (36a–b).

(36)

| | PERFECTIVE (suffix OM) | PROXIMAL IMPERFECTIVE (prefix OM) |
|---|---|---|
| a. 1PL.EXCL | g-a-vəleð-á-**lánda** | g-a-**ɲə́**-vəleð-a-**lánda** |
| b. 1PL.INCL | g-a-vəleð-ə́-**ńd-r** | g-á-**ńdə**-vəleð-a-**r** |
| c. 3PL | g-a-vəleð-ə́-**lo** | g-a-váléð-a-**lo** |

While the 1st plural forms bear H tone, they possess properties distinct from other OMs. In the case of the 1st plural exclusive, the nonmobile suffix OM *-lánda* is disyllabic. An accompanying prefix *ɲə́-* appears only in the default tone verb forms. In the case of the 1st plural inclusive, the nonmobile suffix OM *-r* is L-toned, and the *-ńd(ə)* alternates. In addition to the nonalternating and split OMs in 36, we also examine ditransitive verbs with two OMs in this section. When two OMs occur, only one can appear in the prefix position, and the other appears in the final position. This section shows that the tonal analysis of mobile OMs presented in the previous section not only can accommodate these affixes, but in most cases also predicts the patterns of their distribution. We take this result to be a strong argument for the analysis of OM mobility based on the distribution of tone within the verb.

**5.1.** NONALTERNATING 3RD PLURAL. Unlike all of the other OMs, the 3rd plural does not bear H tone. It is also the only OM that always occurs as a suffix, a fact that is predicted by our analysis. Because the L-toned OM is not specified with an H tone that satisfies ALIGN(H,L), it would incur a phonological faithfulness violation of DEP-IO(H) if it occurred as a prefix, since an H tone would need to be inserted at the left edge of the macrostem. In addition, the prefix realization of OMs incurs a violation of RIGHTMOST. This is illustrated in 37 for the proximal imperfective form.

(37) INT-IO(H), ALIGN(H,L) ≫ DEP-IO(H) ≫ RIGHTMOST, *H

| /g-a-vəleð-a lo/ | INT-IO(H) | AL(H,L) | DEP-IO(H) | RIGHTMOST | *H |
|---|---|---|---|---|---|
| a. g-a-[{ló-vəleð}-a] | | | * | *! | * |
| ☞ b. g-a-[{váléð}-a]-lo | | | * | | * |
| c. g-a-[{lo-váléð}-a] | | *! | * | * | * |

There is no phonological benefit to *-lo* being realized as a prefix, so it is realized as a suffix.

As for the no-H pattern, one might expect that the 3rd plural L-toned OM *-lo* could appear as a prefix in such forms. Because it would not bear an H tone in the macrostem, it would not violate *H, which is high ranked in the no-H pattern. But there is no benefit to the prefix position for this OM, and it is ruled out by RIGHTMOST, like prefix OMs are in all-H forms.

(38) MAX-IO(H) ≫ *H, INT-IO(H), RIGHTMOST ≫ HAVE-H, ALIGN(H,L)

| /g-a-vəleð-ó/ | MAX-IO(H) | *H | INT-IO(H) | RIGHT-MOST | HAVE-H | AL(H,L) |
|---|---|---|---|---|---|---|
| a. g-a-[{lo-vəleð}-ó] | | * | | *! | *** | * |
| ☞ b. g-a-[{vəleð}-ə́]-lo | | * | | | ** | * |
| c. g-a-[{ló-vəleð}-ó] | | **! | | *(!) | ** | |
| d. g-a-[{ló-váléð}-ó] | | * | ***! | | | |

Nor does the 3rd plural *-lo* stand any chance of appearing as a prefix in the all H-toned proximal imperative form. It would either acquire H tone or fail to realize H tone in the inflectional stem, either way violating a higher-ranked constraint as well as RIGHTMOST.

(39) MAX-IO(H), DEP-IO(H), HAVE-H ≫ *H, INT-IO(H), RIGHTMOST; ALIGN(H,L)

| /vəleð-ó$_2$ lo$_1$/ | MAX-IO(H) | DEP-IO(H) | HAVE-H | *H | INT-IO(H) | RIGHT-MOST |
|---|---|---|---|---|---|---|
| a. [{lo-vəleð}-ó] | | | ***! | | | * |
| b. [{ló$_1$-və́$_2$lé$_2$ð}-ó$_2$] | | *! | | ** | ** | * |
| ☞ c. [{və́$_2$lé$_2$ð-ə́$_2$}]-lo$_1$ | | | | * | ** | |
| d. [{ló$_2$-və́$_2$lé$_2$ð}-ó$_2$] | | | | * | ***! | *(!) |

Although *-lo* does differ from other OMs in that it can refer to objects and animals as well as humans, it is hard to see how this property prevents its realization as a prefix. Requiring that prefix OMs be specified as [+human] but suffix OMs not be seems like an ad hoc stipulation. In contrast, the phonological analysis connects the immobility of *-lo* directly to its tone specification, the same factor that explains the alternating position of H-toned OMs.

**5.2.** SPLIT OMs. We turn now to the 1st plural OMs, beginning with the inclusive, *ńd-r*, multiply exponed in the prefix-inducing verb forms (36b). There is evidence that *ńd-r* is composed of two morphemes. The suffix *-r* appears in other verb forms in Moro to mark plurality, and never appears as a prefix. It can be added to 1st dual to create 1st plural (40b) and to imperative singulars to create imperative plurals (40d).

(40) a. álə́-ɡ-a-vəléð-a ‘we (du.incl.) are pulling’
b. álə́-ɡ-a-vəléð-a-**r** ‘we (pl.incl.) are pulling’
c. vəléð-ó ‘pull (sg.)!’
d. vəléð-ó-**r** ‘pull (pl.)!’

We therefore conclude that 1st plural is marked by *ńd*, the same marker found in 1st dual, and a plural marker *-r*, in a similar fashion to the way subjects are marked in 40. The *ńd* appears with no vowel when preceding [r], with epenthetic [ə] before other consonants, and with [a] when word-final, as schwa cannot appear word-finally. The fact that only one marker is prefixed follows from the analysis developed so far. There is no benefit to having *-r* in the macrostem since it is not H-toned, and the *ńd* satisfies the macrostem H requirement.

Next we turn to the 1st plural exclusive form *-lánda*, which is consistently a suffix. In default tone forms, this cooccurs with a prefix *ɲə́-*, homophonous with the 1st singular OM prefix. Given this similarity, we interpret the ***ɲə́-*** as a general 1st person prefix, rather than 1st singular. With default tone verb forms, it appears in the prefix position and *-lánda* is used in addition to differentiate it from 1st singular. The use of both OMs is prohibited in all-H and no-H tone forms, and only *-lánda* appears. Most prefixes in Moro are monomoraic (C-, V-, CV-) or maximally bimoraic (CVC-, VCV-). A trimoraic prefix of this size (CVCCV) is otherwise unattested. We therefore speculate that *-lánda* is too long to occur as a prefix. The H-tone-bearing monomoraic *ɲə́-* may be used as a prefix in these forms, as in the 1st singular forms. Alternately, the prefix emergence of *ɲə́-* might provide evidence that spell-out remains sensitive to the morphological featural content of the OM, choosing the closest morphological candidate that also satisfies the phonological needs of the macrostem. There is little evidence with which to decide between these or other possible analyses, but the emergence of an H-toned OM in these forms is compatible with our proposal.

This completes the analysis of the OMs marking all eight person/number combinations in Moro. In the following section, we turn to verbs with two OMs. We demonstrate how the analysis developed so far naturally extends to these cases, too.

**5.3.** DITRANSITIVE VERBS. In Moro, ditransitive verbs, including those that are ditransitive due to applicativization or causativization, can occur with two OMs. These OMs do not distinguish the primary/direct and secondary/indirect object, and are thus identical. Double object constructions show two relevant properties: (i) only one OM at a time may occur in prefix position, and (ii) OMs are linearly ordered according to a person/number hierarchy. The first property follows from the phonological analysis so far developed. The second property is independent of that analysis, and is a surface ordering effect due to the person hierarchy.

With all-H and no-H tone forms, double OMs appear on the verb with both in the suffix position. For double OMs, the order is 1SG > {2SG ~ 1DU/PL} > 3SG > 3PL. This requirement overrides any ordering with respect to semantic role, resulting in ambiguity.

(41) a. 1SG > 3SG
g-a-natʃ-ə́-**ɲə́-ŋo**
SM.CL-RTC-give-PFV-1SG.OM-3SG.OM
's/he gave me to her/him' *or* 's/he gave her/him to me'

b. 1SG > 2SG
g-a-natʃ-ə́-**ɲə́-ŋá**-ŋo
SM.CL-RTC-give-PFV-1SG.OM-2SG.OM-ŋo[22]
's/he gave me to you' *or* 's/he gave you to me'

The order 1 > 2 > 3 is in accordance with the PERSON HIERARCHY, where 1, 2 > 3 (Silverstein 1976), although it also imposes a 1 > 2 order. The person hierarchy is active in a variety of languages and phenomena. Clitic order in Romance (Perlmutter 1971, Bonet 1995, Heap 2005, Nevins 2007) and Arabic (Fassi Fehri 1993:104) rely on the person hierarchy, although for these languages, clitic order interacts with the person-case constraint. African languages such as Kera (Ebert 1979), Shambala (Duranti 1979), and Haya (Hyman & Duranti 1982) show evidence for ordering between 1st and 3rd OMs, where the 1st person marker is closer to the verb stem, but the ordering is also connected to semantic role.

In the default tone pattern, the order of the OMs is also determined by the person hierarchy, but only ONE prefix OM is allowed, the one highest on the person hierarchy. The other OM appears as a suffix, respecting the same linear order. Compare the no-H tone sequences in 42a,b with those with default tone in 42c,d.

(42) PERFECTIVE

a. g-a-natʃ-ə́-**ɲə́-ŋo**
SM.CL-RTC-give-PFV-1SG.OM-3SG.OM
's/he gave me to her/him' *or* 's/he gave her/him to me'

b. g-a-natʃ-ə́-**ńd**-r-**ŋo**
SM.CL-RTC-give-PFV-1PL.INCL-PL-3SG.OM
's/he gave us all to her/him' *or* 's/he gave her/him to us all'

PROXIMAL IMPERFECTIVE

c. g-a-**ɲə́**-natʃ-a-**ŋó**
SM.CL-RTC-1SG.OM-give-IPFV-3SG.OM
's/he is about to give me to her/him' *or* 's/he is about to give her/him to me'

[22] The suffix *-ŋó* unexpectedly appears in some constructions with 2nd singular or 2nd plural. This suffix has the form of the 3rd singular ([+human]) OM, but it does not contribute any 3rd singular meaning. Recall that the OM in word-final position loses H tone after a preceding H-toned OM.

d. g-a-**ɲ́də**-natʃ-a-ɾ́-**ŋo**
SM.CL-RTC-1PL.INCL-give-IPFV-PL-3SG.OM
's/he is about to give us all to her/him' *or* 's/he is about to give her/him to us all'

The fact that only one OM appears as a prefix follows from the analysis of default tone in §4. Only one H-toned OM is required to satisfy ALIGN(H,L). Fronting two would violate RIGHTMOST (and *H) unnecessarily.

(43) MAX-IO(H), INT-IO(H), ALIGN(H,L) ≫ DEP-IO(H) ≫ RIGHTMOST

| /g-a-natʃ-a ɲə́ ŋó/ | MAX-IO(H) | INT-IO(H) | AL(H,L) | DEP-IO(H) | RIGHTMOST |
|---|---|---|---|---|---|
| ☞ a. g-a-[{ɲə́-natʃ}-a]-ŋó | | | | | * |
| b. g-a-[{ɲə́-ŋó-natʃ}-a] | | | | | **! |
| c. g-a-[{ɲə́-ŋo-natʃ}-a] | *! | | | | ** |
| d. g-a-[{nátʃ}-a]-ɲə́-ŋó | | | | *! | |

It is also predicted that two 3rd plural *-lo* markers should always appear as suffixes. In fact, for reasons not well understood, two 3rd plural markers are disallowed in any configuration on the verb for the two speakers consulted for this article. Another speaker we recently consulted, however, reports that two 3rd plural OMs can cooccur on the verb as suffixes, so this restriction is subject to variation.

The person hierarchy constrains the linear order of OMs regardless of whether they are prefixes or suffixes: those OMs that are higher on the person hierarchy must occur closer to the verb stem. Given the structure of the Moro verb, the prefixal OM position is hierarchically closer to the verb than an OM suffix. We do not develop here an analysis of how the person hierarchy is incorporated formally. Various proposals have been offered in the literature, ranging from alignment constraints (Curnow 1999) to particular feature geometry effects on person/number feature combinations (Harley & Ritter 2002, Heap 2005, Nevins 2007). These accounts provide formal methods of describing the restriction, but our goal here is simply to show that the phonological account predicts a single OM prefix with double object constructions.

In conclusion, double object constructions introduce ordering of OMs based on the person hierarchy. Independently of this restriction, only one prefix OM is allowed in default tone constructions. While the restriction to a single prefix OM could be attributed to a verbal template that allows only a single prefix, the restriction also follows from our tone-based analysis: only a single H-toned OM is needed to satisfy the prosodic default tone requirement; an additional OM incurs further constraint violations.

**6.** TONE DISTRIBUTION DETERMINED BY VERB STEM. So far we have only analyzed tone assignment within the inflectional stem domain. Nevertheless, there are two cases that we have not yet introduced in which tone assigned within the inflectional stem can be affected by the larger verb stem. The first case concerns vowel-initial verb roots, which are subject to vowel hiatus that eliminates the OM's tone-bearing unit and shifts H tone leftward. The second case concerns two subordinate subject constructions that impose their own tone restrictions on macrostem tone. These complications can be accounted for by assuming that the verb is built up incrementally with different cophonologies at each stem level. A different cophonology is associated with the verb stem from that of the inflectional stem.

**6.1.** VOWEL-INITIAL VERB STEMS WITH OMS. In Moro, vowel hiatus typically results in the deletion of the first vowel. Thus, when a vowel-final OM is attached as a prefix

before a vowel-initial root or macrostem prefix, the vowel of the OM is deleted. The H tone that would have appeared on the vowel of the OM is 'orphaned' and forced to appear elsewhere. According to the STRANDED TONE PRINCIPLE (Clements & Ford 1979), tone should be recuperated on the vowel that triggered deletion. In Moro, however, it appears on the vowel in the preceding syllable. Consider the examples in 44. In 44a, the H tone of the OM appears on the preceding main clause marker *a-*, and in 44b it appears on the subordinate subject marker *ɲa-* (raised to [ ɲʌ] due to vowel harmony in the surface form).

(44) a. /g-a-**ɲé**-abatʃ-a/ → [káɲabatʃa]
SM.CL-RTC-1SG.OM-lift-IPFV 's/he is about to lift me'

b. /nə-ɲa-**ŋó**-aləŋ-ə̰t-e/ → [nəɲʌ́ŋʷʌləŋə̰ti]
COMP-2PL.SM-3SG.OM-sing-APPL-CONS.PFV '… you all sang to her/him'

The H of the OM prefix is associated outside of the macrostem in these cases, in seeming violation of MSTEM-H/ALIGN(H,L).

One reason for the shift leftward could be the avoidance of H tone on a root-initial onsetless light syllable, as described in §3.1. Yet there is evidence against this analysis: heavy vowel-initial syllables, which generally can bear H tone, also cause leftward shift, for example, *g-áff-a* 's/he is about to shoot' versus *g-á-ɲ-aff-a* 's/he is about to shoot me.'

Therefore, the leftward shift of the H tone of the OM occurs due to different pressure from phonotactic avoidance of an H tone on the initial syllable of the root. Jenks & Rose 2011 attributes the leftward shift to a constraint, MORPHEME DEPENDENCY, that restricts tone that originated on one morpheme from shifting onto a different morpheme within the macrostem. Another interpretation of this restriction is that tone cannot appear on a morpheme that is closer to the root than its point of origin, a restriction on countercyclicity.

Support for a constraint-based analysis of these data comes from the fact that the leftward shift of H does not always occur. The H tone of the OM will appear within the macrostem if there is no available morpheme to its left, such as when the prefix to the left already bears H tone. In 45a, hiatus occurs between the OM *ɲé-* and the verb root *-aləŋ-* in the subordinate verb. The vowel of the OM is deleted, and the H tone appears to the left on the subject marker *a-*, which is L-toned. Note that the applicative marker *-ə̰t* raises all vowels. In 45b, the subject marker is H-toned, and so in this case, the H tone of the OM cannot appear to the left on the subject marker. It appears instead on the first vowel of the root, and downstep occurs between the H tone of the subject marker, which is in the verb stem, and the H tone of the OM, which is in the macrostem.

(45) a. /á-g-a-toð-ó n-a-**ɲé**-aləŋ-ə̰t-e/ → [ágatoðó nʌ́ɲʌləŋə̰ti]
2SG.SM-CL-RTC-get.up-PFV COMP-2SG.SM-1SG.OM-sing-APPL-CONS.PFV
'you got up and sang to me'

b. /g-a-toð-ó n-əŋə́-**ɲé**-aləŋ-ə̰t-e/ → [katoðó nə́ŋɲ꜒áləŋə̰ti]
SM.CL-RTC-get.up-PFV COMP-3SG.SM-1SG.OM-sing-APPL-CONS.PFV
's/he got up and sang to me'

These examples illustrate that H tone is not deleted, but will appear on the macrostem if there are no positions to the left. Therefore, we maintain that the OM is fronted internal to the macrostem, even though the final position of its tone may depend on availability in the larger verb stem.

The ability of H tone to shift leftward from the OM confirms that the position of the OM must be fixed at the level of the inflectional stem, even if this H ends up outside the

macrostem in its surface form. The addition of other prefixes interacts with the tone of the inflectional stem in predictable ways. If the adjacent prefix is H-toned, it triggers downstep on the orphaned OM tone. If the adjacent prefix does not bear H tone, it can then provide a new host syllable for orphaned OM tones. This leftward movement is motivated by morpheme dependency, which prohibits orphaned tones from attaching inside the macrostem. When the prefix preceding the OM is H-toned, this constraint is overridden due to the unavailability of a new host for the orphaned H tone. This analysis assumes that at the verb-stem level, the constraints MSTEM-H/ALIGN(H,L) are ranked lower than MORPHEME DEPENDENCY, and H tone shifts to the left if there is an available position, but will not delete due to high-ranked MAX-IO(H).

**6.2.** SUBJECT MARKER-CONDITIONED TONE PATTERNS. The behavior of subject markers in subordinate verb forms provides another example of how tone requirements at the level of the verb stem can override the requirements of the inflectional stem, but do not alter the position of the OMs. Consider the following consecutive perfective paradigm, with the structure 'COMP-SM-leave-CONS.PFV'. The verb *ʈað* is an H-H verb, and so spreads its H tone onto the aspect suffix /-e/.

| | | | | |
|---|---|---|---|---|
| (46) | 1SG | ígʌʧánó | n-e-ʈáð-é | 'I got mad and left it' |
| | 2SG | ágʌʧánó | n-a-ʈáð-é | 'you got mad and left it' |
| | 3SG | gʌʧánó | n-əŋə́-ʈʰáð-é | 's/he got mad and left it' |
| | 1DU | áləgʌʧánó | n-al-ʈáð-é | 'we two got mad and left it' |
| | 1PL.INCL | áləgʌʧʌránó | n-al-ʈáð-ə-r | 'we all got mad and left it' |
| | 1PL.EXCL | ɲágʌʧánó | **nə-ɲa-ʈað-e** | 'we (not you) got mad and left it' |
| | 2PL | ɲágʌʧánó | nə-ɲa-ʈáð-é | 'you all got mad and left it' |
| | 3PL | lʌʧánó | **lə-ʈað-e** | 'they got mad and left it' |

The 1st plural exclusive and the 3rd plural (in bold) both have L-toned macrostems in the subordinate verb. The 1st plural exclusive subordinate form differs from the 2nd plural only by the tone pattern on the inflectional stem. This is consistent across all subordinate verb stems. This indicates that these particular subject constructions require a specific tone pattern: no H tone in the macrostem.

However, this requirement affects neither the position of the OM nor its H tone; the OM is still a prefix in these forms, and still bears H tone. In fact, the presence of an OM renders the 1st plural exclusive and 2nd plural homophonous, since the 3rd singular OM *ŋó-* carries the macrostem H tone instead of the verb root in the case of 2nd plural in 47.

| | | | | | |
|---|---|---|---|---|---|
| (47) | a. | 1PL.EXCL | ɲágʌʧánó | nə-ɲa-ŋó-ʈað-e | 'we (not you) got mad and left him' |
| | b. | 2PL | ɲágʌʧánó | nə-ɲa-ŋó-ʈað-e | 'you all got mad and left him' |
| | c. | 3PL | lʌʧánó | lə-ŋó-ʈað-e | 'they got mad and left him' |

In other words, the OM replaces the regular default H of the macrostem in 47b, as in other instances of prefix OMs with the default verb pattern. The prefix OM does not affect the H tones of other verb stem affixes, such as the complementizer prefix or aspect suffixes, suggesting again that these affixes are not macrostem-internal. Consider the distinction between consecutive imperfective 2nd plural *ʈə́-ɲá-wʰáʈ-ʰó* '… and then you all are sewing' versus 1st plural exclusive *ʈə́-ɲa-waʈ-ó* '… and then we (not you) are sewing'. The underlying H tones of the complementizer and aspect suffix are not deleted in the latter form. Only the macrostem default H fails to appear.

As above, we do not present a formal analysis of these data due to lack of space. The basic idea is that the 1st plural exclusive and 3rd plural subject markers are associated

with morpheme-specific cophonologies that ban H tone within the verb stem. Specifically, the same ranking is assumed as for other default verb forms, with the exception that DEP-IO(H) ≫ MSTEM-H/ALIGN(H,L). This ranking suppresses default tone because it is inserted, but allows underlying H tones to surface. Since candidates with prefixal OMs do not require H tone insertion, they satisfy MSTEM-H in addition to ALIGN(H,L), and thus still optimize the tonal shape of the macrostem.

In summary, these two cases show that there can be additional tone effects at the level of the verb stem that can conceal the tonal properties of the inflectional stem, further motivating a domain distinction that was already established on independent grounds in §3. In both cases, the position of the OM as a prefix or suffix was shown to be solely dependent on the tonal properties of the inflectional stem.

**7.** ALTERNATIVE APPROACHES TO MORO OM ORDERING AND THEIR PROBLEMS. In this section we outline three alternative analyses of the mobility of the OMs in Moro. The first approach is syntactic: the prefix OM position is generated by movement, viewed as a copying operation (Chomsky 1993). The choice of whether the prefix or suffix OM is pronounced is determined by phonology. The second and third approaches are more directly morphological. The second approach, which assumes distributed morphology, analyzes the prefix position of the OM as an instance of local dislocation, a morphology-specific movement rule (Embick & Noyer 2001, Embick 2007). The third approach analyzes the difference as arising from subcategorization (Paster 2009). All three alternatives can be shown to overgenerate, the syntactic approach by assuming the prefixal position to be generally available, if not a default position, and the latter two approaches by incorrectly predicting that OMs front in all H-initial macrostems. Additionally, no alternative captures the observation that OM-prefixation is phonologically optimizing, and must stipulate its existence with some additional operation.

**7.1.** MOVEMENT + DELETION. The first alternative to a phonological analysis of OM placement in Moro would be to analyze the prefix position as arising from movement, as is standard in analyses of object clitics in Romance (Kayne 1991, Uriagereka 1995), Slavic (Lema & Rivero 1990), Greek (Terzi 1999), and Bantu (Zeller 2013). Following Zeller's analysis of Bantu, we could analyze the prefix position of Moro OMs as arising due to head movement of the OM through V to *v* via successive cyclic left-adjunction to the immediately superjacent head.

(48) $[_{vP}\,[_{v}\,[_{V}\,\text{OM V}]\,v]\,[_{VP}\,\sout{\text{V}}\,\sout{\text{OM}}]]$

The nested structure in 48 accurately predicts not only the wordhood of the inflectional stem but also the subconstituency of the macrostem within the inflectional stem.

Under the copy theory of movement (Chomsky 1993), one copy of a movement chain must be deleted at spell-out, a process called CHAIN REDUCTION (Nunes 2004). This requirement arises because movement creates a linearization paradox by placing a single syntactic element at two places in the tree. Deletion of the lower copy results in overt movement, while deletion of the higher copy results in movement being covert (Bobaljik 2002). Under this view, the variable position of the OM in Moro could be analyzed as pronunciation of the high or low copy. The phonological observations about the distribution of tone could be derived by subordinating chain reduction to the phonological constraints associated with *v*.

The problem with this syntactic account is that it predicts that the default position of OMs should be the prefix one, since the leftmost copy generated by movement is typically preferred (Nunes 2004 and references). In fact, there is good evidence that leftmost copies of movement chains are pronounced by default in Moro. For example,

passivization is reliably overt (Ackerman & Moore 2013), WH-question formation can make use of an ex-situ strategy that might be analyzable as overt movement and that is obligatory for subject WH-questions (Rose et al. 2014), and nominal heads obligatorily move to the left edge of the DP and PP (Jenks 2014). Together, these examples demonstrate that movement is typically overt in Moro, corresponding to the pronunciation of the leftmost copy generated by movement.

However, in §5 we showed that when OMs fail to alternate, they reliably appear to the right of the verb. For example, the L-toned 3rd plural OM *-lo* is incorrectly predicted by a spell-out-based approach to appear at the left edge of the macrostem wherever an L tone is allowed, such as in perfective verb forms. More generally, the syntactic analysis incorrectly predicts that the OMs should be pronounced on the right only when they violate some phonological constraint in the macrostem. Instead, the OMs occur to the left only when they are tonally optimizing. These facts would thus force the view that overt movement of OMs would be restricted to cases where it was phonologically optimizing. While not impossible, this analysis would go against standard assumptions and language-internal evidence about how copies are pronounced.

While this syntactic account makes the wrong predictions, at least to the extent that the leftmost copy is predicted to be the default case, certain patterns that our analysis accounts for might also be explicable on syntactic grounds. The most likely candidate for a syntactic explanation is the positive imperative forms in Moro, which have all-H or no-H tone and suffix OMs. Like Moro, many European languages with otherwise regular clitic fronting do not front pronominal clitics in positive imperative forms, a fact that is usually attributed to a higher position of the verb in imperatives (Rivero 1994, Terzi 1999). But even if suffix OMs in imperatives was attributed to the movement of imperative verbs, a purely movement-based analysis of OMs still suffers from the arguments presented above, namely, that nonalternating OMs reliably appear to the right of the verb in nonimperative forms, indicating that the rightward position is their default one.

**7.2.** DISTRIBUTED MORPHOLOGY AND LOCAL DISLOCATION. A second alternative to our approach is to analyze the variable position of Moro OMs as arising from a morphology-specific head movement rule, such as local dislocation (LD) in the theory of distributed morphology (Embick & Noyer 2001, Embick 2007, 2010). Under such a view, the variable position of Moro OMs would amount to a case of phonologically conditioned allomorphy (Carstairs 1988). Like the phonologically driven analysis we argued for in §§4–6, an LD-based approach could take the suffix position of the OM as basic, avoiding the problems with the syntactic account outlined above.

By definition, LD is able to apply within two morphological domains. These domains are derived from syntactic constructs such as head: a maximal syntactic head, whether complex or simple, defines a morphological unit called an M-WORD. If the head is complex (branching) due to head movement, then each head within the maximal head qualifies as a SUBWORD. LD is constrained by these domains: it can manipulate the order of subwords within an M-word, or invert the order of M-words, but cannot place an M-word inside another M-word.

By hypothesis, LD has two effects. The first effect, which is optional but still realized with Moro OMs, is to reorder the elements that it applies to. The second effect, a necessary component of LD that is also realized in the Moro case, is that the moving element is subordinated or 'pushed one step down in the ontology (i.e., what was an M-Word becomes a Subword)' (Embick 2007:320). Applying this approach to Moro, we can take the macrostem to be a complex head, an M-word, while the OM is a simple head, a trivial M-word. The subordination component of LD is realized in Moro in that the OM be-

comes incorporated into the macrostem, participating in its phonological processes, namely the distribution of tone in the macrostem, as described earlier.

This application of LD is illustrated in 49 for Moro; '+' connects linearized subwords, and '^' connects linearized M-words (see Embick 2007 for details).

(49) [[V + *v*] ^ OM] → [OM + V + *v*]

Because it is a rule, the fact that LD is restricted to a subset of OMs is not problematic; the rule can simply list the OMs it applies to, or their features.

Yet providing a single phonological structural description for the environments where the rule in 49 applies is problematic, since default tone patterns are realized in several different ways depending on the syllable structure of the root. The most likely environment for LD is H-initial macrostems, given that the default tone pattern that corresponds to the prefix positions of OMs contains a left-aligned H tone. However, positing this environment as the structural description for 49 overgenerates. First, it faces difficulty in distinguishing between the initial H of the default pattern versus the all-H pattern. For example, whereas all-H tone extends from the AMD suffix across the whole word for all roots, some short CVC roots also extend H tone onto the final suffix, resulting in the same surface tone distribution in the inflectional stem: for example, *g-a-*[*lág-á*] 's/he is about to weed' (proximal imperfective, default pattern) versus [*lág-ó*] 'weed!' (proximal imperative, all-H pattern). Given the criterion of initial H, the all-H proximal imperative should trigger LD, but these imperatives occur only with suffixal OMs (18b). It might seem that this approach could be saved by supplementing the phonological structural description with reference to the type of AMD that triggered the prefix form. Yet syntactic differences between imperatives and declarative verb forms should be irrelevant for LD, since LD is sensitive only to adjacency, a criterion that is clearly met even in these imperative forms. Perhaps the LD analysis could be rescued by establishing the phonological selection for OM position PRIOR to H-tone spreading, so that all-H proximal imperative has no H tone in the macrostem, but the default tone pattern does. But here another problem emerges: positing an initial H as the environment for LD faces even more serious difficulties in accounting for L-tone-initial macrostems that still have the default tone pattern, namely consonant-only or VC roots, such as *g-al-a* 's/he is about to slice' (§§3.1, 6.1). These roots require prefix OMs despite lacking an H tone at the left edge. The alternative would be to assign default H tone to all roots before LD applies, and then later delete the H tone from the VC roots.

Finally, even if an environment could be described to trigger LD in Moro, such an analysis would need to propose that the H of the initial OM deletes the macrostem H that conditioned its prefix position, producing counterfeeding opacity. This requirement underscores another disadvantage of the LD-based approach: not only does it need to stipulate the repositioning of the OM in Moro, but it also fails to capture the generalization that the fronting of the OM is phonologically optimizing. Instead, the LD approach requires the postulation of an additional rule that creates non-surface-true forms. In contrast, the OT approach advocated above not only successfully describes the facts, but also does so in an explanatory model where OMs are prefixal due to their role in optimizing macrostem-specific phonology. It does not need to list the specific OMs that can occur as prefixes; rather, this follows from the tonal properties of the OMs themselves.

**7.3.** SUBCATEGORIZATION. A third alternative would be to use subcategorization, including phonological subcategorization. As mentioned in the introduction, the notion that phonology can determine morphological order is familiar from some approaches to infixation. In the standard OT analysis of infixation, phonological constraints such as

No Coda dictate the position of affixes, pushing prefixes or suffixes within a stem. Yu (2007a,b) argues against this P ≫ M 'displacement theory' of infixes (McCarthy & Prince 1993) and in favor of generalized phonological subcategorization, in which infixes subcategorize for prosodic constituents. Such a theory is argued to constrain the interaction between phonology and morphology and maintains a 'morphology precedes phonology' approach. Paster also adopts this model for the behavior of phonologically conditioned suppletive allomorphy (2006, 2009) and apparent cases of phonologically conditioned affix order (2005).

With respect to variable or mobile affixes that shift between prefix and suffix, there are also two distinct analytical approaches. Kim (2008, 2010) argues that phonological constraints outrank morphological constraints for Huave mobile affixes, and Wolf (2008) also argues for a P ≫ M approach for mobile affixes, although he rejects Afar, one of the key examples, as a possible case. In contrast, Stump (1993) and Paster (2006, 2009) favor subcategorization approaches to morphological position and suggest that mobile affixes have allomorphs with distinct subcategorization frames.

Under a subcategorization analysis, affixes subcategorize for syntactic, semantic, and phonological features within the morphological component. Phonological elements include members of the prosodic hierarchy (mora, syllable, foot) as well as consonants and vowels (Paster 2009 further proposes consonants and vowels specified with particular phonological features). The subcategorization frame may also specify the location of an affix relative to the stem and other elements. Affix ordering under this approach is assumed to follow from scope, the mirror principle (Baker 1985), or specific templates. A subcategorization approach to 'mobile affixation' requires positing either two distinct subcategorization frames for a single affix (see discussion in Stump 1993), or two affixes that subcategorize for different locations (Paster 2009) but that must be stipulated to be in complementary distribution. For Moro, an H-toned OM would subcategorize for particular tone properties of the stem (a single H tone within the macrostem) or be realized elsewhere at the right edge of the verb stem. Alternatively, there could be two separate affixes with the same morphosyntactic features, but with different subcategorization frames, as shown in 50.

(50)

| Single affix | Two affixes |
|---|---|
| ŋó SYNSEM: 3SG.OM | ŋó SYNSEM: 3SG.OM |
| [$_{\text{m-stem}}$ ___ [$_{\text{dstem}}$H]] | [$_{\text{m-stem}}$ ___ [$_{\text{dstem}}$H]] |
| [$_{\text{verbstem}}$] ___ elsewhere | ŋó SYNSEM: 3SG.OM |
| | [$_{\text{verbstem}}$] ___ |

Both analyses prove to be problematic empirically and theoretically. On the empirical side, there is no clear way to reference the default H tone and clearly distinguish it from the all-H tone pattern, as discussed above for LD. Furthermore, the same problem of VC roots that lack H tone in default tone cases arises. In the cophonology analysis, default and all-H forms that have identical tone patterns on the surface are distinguished through constraint rankings associated with each morphological category; the position of the OM follows from these overall rankings, not from the way tone is specifically realized in a particular stem without an OM.

From a theoretical point of view, positing two separate, identical OMs that appear in different environments would be a suspicious coincidence, as Kim (2008, 2010) argues. Positing a single affix with different phonological subcategorization environments avoids the coincidence problem, but misses the generalization that affix mobility is phonologically optimizing, and, like the distributed morphology LD analysis, further

requires deletion of the H tone on the stem in default tone cases. The cophonology analysis further predicts that nonalternating forms such as 3rd plural *-lo* should not alternate based on their tonal properties, a fact that would simply be listed alongside the other subcategorization frames in the subcategorization approach. We take these issues to conclusively favor the phonologically driven approach to OM placement.

**7.4.** OTHER CASES OF PHONOLOGICALLY CONDITIONED MOBILE AFFIXES. Besides Moro, two cases of phonology dictating prefix or suffix position have been reported in the literature: Huave (isolate: Mexico), illustrated in §1, and Afar (Cushitic: Djibouti, Ethiopia, Eritrea). Both languages feature mobile affixes whose position is conditioned by syllable structure and initial segments of the stem. We provide a brief outline of Huave and Afar here, and discuss why they constitute legitimate cases. We conclude by arguing that mobile affixation can be determined by phonology, and, by extension, the Moro case of OM placement according to tone. We then speculate on the rarity of such cases.

HUAVE. Kim (2008, 2010) presents an analysis of San Francisco del Mar Huave mobile affixes. Huave has six consonantal mobile affixes (stative *-n-*, completive *-t-*, subordinate 1st *-n-*, subordinate *-m-*, 2nd intransitive *-r-*, and 1st *-s-*) that are positioned as prefixes or suffixes for phonological reasons: to avoid consonant clusters and epenthesis, regardless of the morphosyntactic properties of the stem. Similar cases were also discussed by Noyer (1994) for San Mateo del Mar Huave. Consider the position of the mobile affixes *-s-* and *-m-* in 51.

(51)

| VOWEL-FINAL STEMS | CONSONANT-FINAL STEMS |
|---|---|
| a. [uy-u]-m | c. s-[a-rang] |
| [circle-V]-SB | 1-[TV-do] |
| '(that) it spins' | 'I do it' |
| b. [pajk-a-u]-s | d. [t-a-rang]-*a*s |
| [face.up-V-ITER]-1 | [CP-TV-do]-1 |
| 'I lie face up' | 'I did it' |

Kim argues that suffixation is the default pattern (produced by a constraint ALIGN-R), but that the affixes will be shifted to prefix position to avoid consonant sequences and the creation of a complex coda. In 51a and 51b, the stems end in a vowel, and therefore a suffix is found. In 51c, the stem ends in a consonant, so to avoid a consonant cluster, the *-s-* appears as a prefix. This is sanctioned since the stem is vowel-initial. If the prefix position does not improve syllable structure, as with consonant-initial stems, epenthesis of [a] occurs, as in 51d. Kim argues that this analysis is preferable to one that relies on subcategorization. For Huave, a prefix would subcategorize for a vowel-initial stem, whereas the suffix would be the elsewhere case (Kim 2010). The fact that both affixes are segmentally identical, have the same meaning, and appear in complementary environments is a coincidence in the subcategorization analysis. Kim further argues that this approach also misses the generalization that affix mobility optimizes syllable structure.

Paster's (2009) solution to Huave is to propose that it has fixed C and V positions, but segments are allowed to 'float' and associate from left to right within subscribed levels. There is no independent motivation for such a proposal except to avoid a phonological analysis of affix ordering. Kim notes that her analysis directly specifies the morphological location of the affixes within subscribed morphological levels. It is only within these levels that there is phonologically determined prefix or suffix positioning. By constraining the creation of these positions morphologically, such an analysis avoids criticisms of overgeneration leveled against P ≫ M.

AFAR. Afar presents another example of mobile affixes, as analyzed by Fulmer (1991) and Rucart (2006). Afar has two main verb types, labeled class I and class II (Parker & Hayward 1985), and several 'mobile affixes' that appear as either prefixes or suffixes. Class I verbs, which condition prefixes, begin with a vowel /e o i u/, for example, *eɖeg-e* 'I knew', while class II verbs, which condition suffixes, begin with a consonant or /a/, for example, *fak-e* 'I opened' or *alif-e* 'I closed'. Mobile affixes include subject markers (/t- j- n-/) and the causative (/s/), benefactive (/t/), and passive (/m/) markers. The subject marker *-t-* appears as a prefix with class I, for example, *t-eɖeg-e* 'you/she knew', but as a suffix with class II: *fak-t-e* 'you/she opened' or *alif-t-e* 'you/she closed'. The phonological aspect of their distribution resembles that of Huave in that prefixes appear with stems that are vowel-initial, but unlike Huave, in Afar stems that begin with the vowel [a] do not trigger prefixation. With consonant-initial and [a]-initial stems, suffixes occur. Bliese (1973) argues that the *a*-initial stems were historically [ʔ]-initial, in which case the division would have been based on a strict consonant-initial versus vowel-initial division. Today, however, the system is not so clear-cut. In fact, Afar is undergoing further change. Class I and class II are no longer perfectly divided based on initial vowel. In addition to the *a*-initial verbs, all of which are suffixing, other vowel-initial verbs are suffixing as well, as a verb count based on the Parker and Hayward (1985) dictionary reveals.

(52)

| INITIAL ROOT V | *a* | *e* | *o* | *i* | *u* |
|---|---|---|---|---|---|
| class I | 0 | 76 | 27 | 126 | 77 |
| class II | 119 | 6 | 16 | 22 | 21 |

There is also dialectal evidence (Bliese 1973) that suggests that Afar is undergoing a shift toward using suffixes, even with verbs that are vowel-initial.

Although Afar has the historical hallmarks of a phonologically dependent mobile affix system, language change has caused a breakdown in the consonant versus vowel conditioning distinction. The shift toward suffixation has further caused the class I/II distinction to be morphologized. Synchronically, then, Wolf (2008) is right that there are issues with treating Afar mobile affixes as phonologically conditioned. Diachronically, however, it appears to have been driven by syllable structure constraints similar to those found in Huave.

**7.5.** RARE BUT ATTESTED. The Moro mobile affix case shares certain similarities with those found in Huave and Afar. First, they all appear to favor suffixation as the default case. Prefixation occurs for phonological reasons: to satisfy H tone requirements in Moro and to satisfy syllable structure requirements in Huave and Afar. Second, the mobile affixes constitute only a subset of verbal affixes that share a common phonological make-up (a single consonant for Huave and Afar (with epenthetic vowels); a single CV syllable with H tone for Moro). Moreover, their phonological make-up connects directly with the phonological constraints on their realization. Third, they are constrained morphologically. The Afar morphemes are subject markers and 'extension' markers, appearing closest to the verb root. In Huave, Kim shows how the morphemes are restricted to two inner morphological levels. In Moro, the mobile affixes are object markers that attach to the inner macrostem. Their positions do not break up morphemes, as in the case of infixation or metathesis. They do not 'float' in the sense of featural morphemes, being able to attach to different segments. Rather, their basic position adjacent to the verb is determined by morphosyntax, while their realization in the prefixal position is due to the phonology of a morphologically delimited domain. In fact, such an analysis may not be at odds with Paster's (2009) claim that affix placement can be affected by phonology via subcatego-

rization for phonological elements, but this will produce only local effects (e.g. infix placement) rather than radical 'reshuffling' of multiple morphemes for phonological well-formedness. While mobile affixes are not strictly local in terms of adjacency, they are hierarchically local in the context of the morphological structure of the verb stem. That is, whether an affix associates as a prefix or suffix, it is still positioned at the edge of a particular domain, and ordered linearly in the same fashion with respect to the root and other affixes. For example, the Afar extension markers suffix to the verb root, followed by the subject markers. When they are prefixes, the subject markers precede them. In Huave, Kim shows how the verb is structured in layers, like the Moro verb, and the mobile affixes attach within prescribed layers.

As to the reliance on tone as a phonological condition, this is more unexpected, since tone systems tend to be variable in lexical specification and distribution. But note that default H tone in the Moro verb system, which conditions prefixation, is predictable in position and appearance, in a manner more common in stress systems. Since infixes can depend on stress for their position, it is not inconceivable that consistent tone in a predictable position could also motivate infixation. However, a language must have all of the necessary conditions in place in order for affix mobility to optimize prosodic structure in this way.

Although rare, mobile affixes are attested in the world's languages and are observed in languages belonging to different language families. Analyses seeking to explain them in their own right highlight the role of phonology. Analyses that seek to explain them away because they do not fit a unified theory of phonology-morphology interaction prove unexplanatory. Our position is that it is possible for phonology to constrain morpheme position, and we have attempted to construct the best possible analysis of this interaction, using a P ≫ M analysis, where M constraints are construed as morphosyntactic, formulated with reference to morphosyntactic (verb stem/verb phrase) domains. This is in line with other approaches to rare phenomena in language, as outlined in Harris 2010. Harris argues that many examples of rare morphosyntactic structures are the result of a complex combination of changes and conditions. Although uncommon, such structures are attested, and often endure, and grammatical analyses need to accommodate them.

Affixes generally appear in particular positions on a consistent basis. While it is possible that the prefix OM position in Moro may have historically arisen for morphosyntactic reasons, such as an auxiliary that may have eroded with the one nondependent verb form (proximal imperfective), the current motivation for alternate positions appears to be phonological. The different OM positions now serve to demarcate the boundaries of morphological domains within the verb. Related Kordofanian languages such as Tira (Stevenson 2009), Otoro (Stevenson 2009), and Cwaya (Guest 1998) also show mobile positioning of person/number markers, but allow more than one affix to be prefixed. However, little is known about the tone systems of these languages. In Cwaya, suffixes do cooccur with the L-toned verb form (present), whereas prefixes cooccur with verb forms with lexical H tone (past and future), a similar type of distribution to Moro, but the available data list only three verb form types. If these systems evolved from a different conditioning strategy, but the tone and the position of OMs are now used to mark prosodic constituents, we expect such cases to arise only under particular circumstances, and to be far from common.

**8.** CONCLUSION. In this article we have presented novel data on the position of object markers in the Thetogovela dialect of Moro, an underdocumented Kordofanian lan-

guage of Sudan. While we have shown that the prefix versus suffix positions of object markers in Moro correlate with certain aspect/mood/deixis specifications of verb forms, we argued that the positions do not follow from clearly generalizable morphosyntactic characteristics of the verb forms. The positions do, however, neatly follow from the tonal properties of these particular verb forms. We analyze the OM positions as following from restrictions on the distribution of tone. If a verb form requires either an all-H or a no-H tone pattern, OMs occur as suffixes on the verb. But if a verb form adopts a default, phonologically predictable pattern that has H tone aligned at the left edge and is sensitive to syllable structure, then OMs appear as prefixes, internal to the verb stem itself. The tone property of the OMs also dictates their ability to appear as prefixes. Only a single H-toned OM is allowed as a prefix, whereas L-toned and additional OMs appear as suffixes. Although such phonologically determined patterns of affix position are rare in the world's languages, the Moro case underscores the need to accept them as real and incorporate them into the architecture of linguistic theory.

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