Templatic morphology and indexed markedness constraints¹

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The existence of morpheme-specific markedness constraints has been debated in Optimality Theoretic work on both templatic morphology and exceptions to phonological generalizations. Generalized Template Theory (GTT; McCarthy and Prince 1995) argues that morphemes that impose prosodic templates on outputs should be accounted for by the interaction of morpheme-specific faithfulness constraints and general markedness constraints, rather than by template-enforcing markedness constraints indexed to specific morphemes (e.g. RED=FOOT), as had previously been assumed. GTT therefore claims that no markedness constraints are morpheme-specific. More recently, the indexed constraint theory of lexical exceptions has revived the possibility of morpheme-specific markedness constraints. This theory argues that constraints can be indexed to exceptional lexical items (Fukuzawa 1999; Ito and Mester 1999, 2001; Pater 2000, 2006); some proposals claim that indexed (i.e. morpheme-specific) markedness constraints are needed to account for certain exceptional patterns (Pater 2000, 2005; Ota 2004). Such proposals inherently conflict with GTT's claim that only faithfulness constraints may be morpheme-specific.

This paper finds a new source of evidence for morpheme-specific markedness

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constraints in Dinka (Nilotic, Sudan; Andersen 1995), where an exceptional prosodic template imposes a fixed mora count on vowels. An indexed-constraint analysis of this phenomenon cannot use only indexed faithfulness constraints but rather crucially depends on indexed markedness constraints. This contradicts the GTT prediction that all morphological templates can be accounted for using general, rather than morpheme-specific, markedness constraints.

1. Morphological vowel length and indexed markedness constraints in Dinka

Dinka verb forms are nearly all monosyllabic; verb roots are subject to a rich system of nonconcatenative morphology which mutates root vowels in various ways (data from Andersen 1995). Vowels contrast in voice quality (breathy V̤ or creaky V̥ ; no vowels have modal voice), tone (high, low, or falling), and length (verb roots may have one or two moras; morphologically complex verbs may have one, two, or three).

The following discussion will focus on vowel length and the ways that it can be manipulated by morphology. Dinka morphemes can affect the length of verb root vowels in two possible ways: they can add moras, or impose moraic templates. When mora-adding morphemes interact with morphological moraic templates, a template imposed by one morpheme can block lengthening that should be induced by another. Indexed markedness constraints will be crucial in explaining this blocking interaction.

1.1. Typical patterns of morphological vowel lengthening

Morphologically complex Dinka verbs may surface with trimoraic nuclei, despite the cross-linguistic rarity of such structures (Ladefoged and Maddieson 1996: 320). Verb roots themselves, however, have maximally bimoraic nuclei. This inventory restriction

can be accounted for if a markedness constraint against trimoraic vowels, *V::, is ranked above MAX-μ. This is shown in the hypothetical, richness-of-the-base tableau in (3).

- (1) *V:: A vowel cannot be linked to three moras.
 (2) MAX-μ Each mora in the input must have an output correspondent.

(3)

t̤a::k	*V::	MAX-μ
a. → t̤a:k		*
b. t̤a::k	*!	

A number of morphemes add a mora to both monomoraic and bimoraic verb roots. Third person singular agreement (3S) and centrifugal (CF, ‘movement away from’) are two such lengthening morphemes; of the sixteen verbal morphemes described by Andersen, eleven add moras to some or all roots.

- (4) w̤ɛc → w̤ɛ:c ‘kick.3S’
 t̤ɛŋ → t̤ɛ:ŋ ‘dust.3S’
 l̤ɛ:r → l̤ɛ::r ‘roll.3S’
 m̤ɿ:t → m̤ɿ::t ‘pull.3S’
- (5) w̤ɛc → w̤ɛ́:c ‘kick.CF’
 t̤ɛŋ → t̤ɛ́:ŋ ‘dust.CF’
 l̤ɛ:r → l̤ɛ́::r ‘roll.CF’
 m̤ɿ:t → m̤ɿ́::t ‘pull.CF’

Trimoraic vowels can have any combination of vowel quality, voice quality, and tone; a single verbal morpheme can trigger both lengthening and also alternations in vowel quality, voice quality, and tone. The CF morpheme, for example, can change a root vowel’s tone in addition to inducing lengthening, as in (5). Vowel properties other than length will be largely ignored here, though see section 2 for their relevance to a possible MORPHREAL analysis.

When a lengthening morpheme applies to a bimoraic root, the resulting morphologically complex form has a trimoraic vowel. An input-output faithfulness constraint, e.g. MAX- μ , cannot force these marked trimoraic vowels to surface in morphologically complex words, as it was shown in (3) that *V:: must dominate MAX- μ . As explained below, these derived trimoraic vowels instead surface because of distinct faithfulness constraints banning deletion of root and affixal moras in derived forms.

Deletion of root moras in derived forms is prevented by an output-output faithfulness constraint (Benua 1997), OO-MAX- μ , which dominates *V::. OO-Faith constraints govern the relationship between output forms and morphologically complex outputs derived from those bases. In morphologically complex forms derived from bare roots (e.g. CF, 3S), OO-MAX- μ requires each mora in a root to have a correspondent in forms derived from that root. This constraint forces vowels in morphologically complex forms to be at least as long as vowels in the roots from which they were derived; vowels in derived forms will in fact be longer than root vowels if morphologically-added moras surface in addition to faithfully realized root moras, as discussed below.

(6) OO-MAX- μ Every mora in the base has a correspondent in the derived form.

(7)

$\begin{array}{c} \mu^1 \quad \mu^2 \\ \swarrow \quad \searrow \\ \text{lə:r} + \mu_{3\text{-CF}} \end{array}$	OO-MAX- μ (cf. bare root lə:r)	*V::	MAX- μ
a. $\begin{array}{c} \mu^1 \quad \mu_{3\text{-CF}} \\ \swarrow \quad \searrow \\ \text{lə:r} \end{array}$	*!		*
b. $\begin{array}{c} \mu^1 \quad \mu^2 \quad \mu_{3\text{-CF}} \\ \swarrow \quad \searrow \quad \searrow \\ \text{lə::r} \end{array} \rightarrow$		*	

Deletion of morphologically-added moras (e.g. $\mu_{3\text{-CF}}$ in tableau (7)) must also be banned in order for morphological lengthening to occur. This indicates that an affix-

specific faithfulness constraint, $\text{MAX-}\mu_{\text{Affix}}$, must also be ranked above $*V::$.²

- (8) $\text{MAX-}\mu_{\text{Affix}}$ Every input mora affiliated with an affix must have a correspondent in the output.

(9)

$\begin{array}{c} \mu^1 \mu^2 \\ \swarrow \searrow \\ \tilde{l}\hat{e}:r + \mu_{3\text{-CF}} \end{array}$	$\text{MAX-}\mu_{\text{Affix}}$	$*V::$	$\text{MAX-}\mu$
a. $\begin{array}{c} \mu^1 \mu^2 \\ \swarrow \searrow \\ \tilde{l}\hat{e}:r \end{array}$	$*!$		$*$
b. $\begin{array}{c} \mu^1 \mu^2 \mu_{3\text{-CF}} \\ \swarrow \searrow \searrow \\ \tilde{l}\hat{e}::r \end{array}$		$*$	

A final point about lengthening morphemes concerns their cooccurrence. When two lengthening morphemes are added to a single root, the two morphemes collectively add only a single mora to roots, rather than each adding one.

- (10)
$w\hat{e}c + \mu_{\text{CF}} + \mu_{3\text{S}}$	$\rightarrow w\acute{e}:c$	$*w\acute{e}::c$	‘kick.CF.3S’
$t\hat{e}\eta + \mu_{\text{CF}} + \mu_{3\text{S}}$	$\rightarrow t\hat{e}:\eta$	$*t\hat{e}::\eta$	‘dust.CF.3S’
$\tilde{l}\hat{e}:r + \mu_{\text{CF}} + \mu_{3\text{S}}$	$\rightarrow \tilde{l}\hat{e}::r$	$*\tilde{l}\hat{e}:::r$	‘roll.CF.3S’
$m\tilde{\eta}:t + \mu_{\text{CF}} + \mu_{3\text{S}}$	$\rightarrow m\hat{\eta}::t$	$*m\hat{\eta}:::t$	‘pull.CF.3S’

This property of lengthening morphemes follows if all morphologically-added moras are required to surface immediately adjacent to root moras. The adjacency requirement also correctly predicts that no derived forms surface with four-mora vowels, given that roots are maximally bimoraic.

1.2. Templatic exceptions and indexed markedness constraints

The benefactive morpheme is an exception to the general pattern of morphological lengthening: rather than simply lengthening all roots, it imposes a bimoraic template.

² $\text{FAITH}_{\text{Affix}} \gg \text{FAITH}_{\text{Root}}$ rankings similar to $\text{MAX-}\mu_{\text{Affix}} \gg *V:: \gg \text{MAX-}\mu$, $\text{MAX-}\mu_{\text{Root}}$ are proposed by Bowerman (2002), Noske (2000), Revithiadou (1999), Ussishkin (2000), and Ussishkin and Wedel (2002), cf. McCarthy and Prince (1995) and Beckman (1998).

While the benefactive adds a mora to monomoraic verb roots, which surface as bimoraic as in (11a), it fails to induce lengthening in stems that are already bimoraic, as in (11b).

- (11) a. w̥ɛc → w̥ɛ:c ‘kick.BEN’
 t̥ɛŋ → t̥ɛ:ŋ ‘dust.BEN’
- b. l̥ɛ:r → l̥ɛ:r *l̥ɛ::r ‘roll.BEN’
 m̥ɿ:t → m̥ɿ:t *m̥ɿ::t ‘pull.BEN’

The bimoraic template also affects the realization of cooccurring lengthening morphemes. While 3S generally adds a mora to bimoraic roots, this 3S mora does not surface when it cooccurs with the benefactive morpheme on a bimoraic verb, as in (12).³ The benefactive template therefore affects the realization of the root and any morphemes associated with it; BEN is unique in that it is the only Dinka morpheme to impose an inviolable moraic template on surface forms.

- (12) a. l̥ɛ:r → l̥ɛ::r ‘roll.3S’
 l̥ɛ:r → l̥ɛ:r ‘roll.BEN’
 l̥ɛ:r → l̥ɛ:r *l̥ɛ::r ‘roll.BEN.3S’
- b. m̥ɿ:t → m̥ɿ::t ‘pull.3S’
 m̥ɿ:t → m̥ɿ:t ‘pull.BEN’
 m̥ɿ:t → m̥ɿ:t *m̥ɿ::t ‘pull.BEN.3S’

The bimoraic template imposed on vowels by the benefactive can be captured

³ It was noted above that some morphologically-added moras also fail to surface whenever normal lengthening morphemes cooccur. While this is similar to the BEN pattern, there is a crucial difference: BEN does not itself lengthen bimoraic roots. The condition on moraic root-affix adjacency, which explains the typical behavior of cooccurring lengthening morphemes, therefore cannot account for the exceptional templatic behavior of BEN forms of bimoraic roots.

using an indexed markedness constraint: an undominated version of the markedness constraint $*V::$ is indexed to the benefactive morpheme, as in (14).

(13) $*V::_{BEN}$ A vowel in a benefactive verb may not be linked to three moras.

(14)

$*V::_{BEN}$	$MAX-\mu_{Affix}$	$*V::$
a.		*	
b.	*!		*

The trimoraic candidate (14b) would ordinarily win, as it satisfies $MAX-\mu_{Affix}$.⁴ This candidate loses, however, due to the higher-ranked indexed markedness constraint $*V::_{BEN}$ which bans trimoraic vowels specifically in benefactive verbs. The bimoraic form in (14a) thus wins despite its violation of $MAX-\mu_{Affix}$. The choice of which mora to delete in these BEN forms with bimoraic roots depends on the ranking of $MAX-\mu_{Affix}$ relative to $OO-MAX-\mu$; without evidence to distinguish between these rankings, I assume that $OO-MAX-\mu \gg MAX-\mu_{Affix}$ motivates deletion of the mora added by BEN.

High-ranking $*V::_{BEN}$ also accounts for the fact that morphemes that typically add a mora to roots, e.g. 3S, cannot add a mora to a bimoraic benefactive stem and produce a trimoraic surface form. This is because $*V::_{BEN}$ is violated by any trimoraic vowel that surfaces in a benefactive verb, regardless of the morphological source of the three moras.

⁴ The ranking from (9), $MAX-\mu_{Affix} \gg *V:: \gg MAX-\mu$, is obeyed in benefactive forms of monomoraic roots, which surface as bimoraic.

(15)

$\begin{array}{c} \mu^1 \quad \mu^2 \\ \swarrow \quad \searrow \\ \text{lê:r} + \mu_{3\text{-BEN}} + \mu_{4\text{-3S}} \end{array}$	$*V::_{\text{BEN}}$	$\text{MAX-}\mu_{\text{Affix}}$	$*V::$
a. $\rightarrow \begin{array}{c} \mu^1 \quad \mu^2 \\ \swarrow \quad \searrow \\ \text{lê:r} \end{array}$		**	
b. $\begin{array}{c} \mu^1 \quad \mu^2 \quad \mu_{3\text{-BEN}} \\ \swarrow \quad \searrow \quad \nearrow \\ \text{lê::r} \end{array}$	*!	*	*
c. $\begin{array}{c} \mu^1 \quad \mu^2 \quad \mu_{4\text{-3S}} \\ \swarrow \quad \searrow \quad \nearrow \\ \text{lê::r} \end{array}$	*!	*	*

This highlights a crucial difference between indexed markedness and faithfulness constraints: while indexed faithfulness constraints protect the output correspondents of input features associated with the indexing morpheme, indexed markedness constraints are generally understood to apply to entire outputs in which the indexing morpheme occurs.⁵ This property of indexed markedness constraints will be crucial in the following discussion of why indexed faithfulness constraints cannot account for this phenomenon.

2. Alternative analyses

The previous section demonstrated that the indexed markedness constraint $*V::_{\text{BEN}}$ can account for the templatic behavior of the Dinka benefactive. This section will show that neither indexed faithfulness constraints nor other alternatives can explain this pattern.⁶

First, the exceptional moraic template must be enforced by an indexed markedness constraint like $*V::_{\text{BEN}}$ rather than an indexed faithfulness constraint. Evidence for this comes from the fact that the benefactive morpheme blocks lengthening

⁵ See Pater (2006) for a more restrictive locality condition for indexed markedness constraints, which would also be effective here.

⁶ I am grateful to comments from anonymous reviewers which led me to consider some of the following alternatives.

from other morphological sources; indexed faithfulness constraints cannot capture this sort of morphological interaction. The interaction of the general markedness constraint *V:: with morphologically indexed faithfulness constraints could account for the Dinka data in (16), where 3S adds a mora but BEN does not.

- (16) a. MAX- μ_{3S} » *V:: $\text{l}\ddot{\text{e}}\text{:r} + \mu_{3S} \rightarrow \text{l}\ddot{\text{e}}\text{:r}$ ‘roll.3S’
b. *V:: » MAX- μ_{BEN} $\text{l}\ddot{\text{e}}\text{:r} + \mu_{\text{BEN}} \rightarrow \text{l}\ddot{\text{e}}\text{:r}$ * $\text{l}\ddot{\text{e}}\text{:r}$ ‘roll.BEN’

These constraints predict the wrong winner in cases where BEN and 3S cooccur, however, as in (17), as they cannot capture the interaction between the benefactive and other cooccurring lengthening morphemes.

(17)

$\begin{array}{c} \mu_1 \mu_2 \\ \swarrow \searrow \\ \text{l}\ddot{\text{e}}\text{:r} + \mu_{3\text{-BEN}} + \mu_{4\text{-3S}} \end{array}$	MAX- μ_{3S}	*V::	MAX- μ_{BEN}
a. $\rightarrow$ $\begin{array}{c} \mu_1 \mu_2 \mu_{4\text{-3S}} \\ \swarrow \searrow \nearrow \\ * \text{l}\ddot{\text{e}}\text{:r} \end{array}$		*	*
b. $\begin{array}{c} \mu_1 \mu_2 \\ \swarrow \searrow \\ \text{l}\ddot{\text{e}}\text{:r} \end{array}$	*!		*

As noted above, indexed faithfulness constraints do not allow the presence of one morpheme in an input to determine the output realizations of other morphemes. An exceptional morpheme (like BEN) can only trigger indexed faithfulness constraints governing the realization of its own features. It is crucial in this case that the presence of one morpheme (BEN) block the moraic realization of another (3S). An indexed markedness constraint works in this case precisely because it evaluates the overall shape of the output containing BEN, rather than solely the realization of BEN itself.

A second possibility is that the interaction of *V:: and MORPHREAL, which demands that morphemes have some non-null surface realization (Kurusu 2001), might

explain the absence of trimoraic benefactive forms. This would be possible if all trimoraic surface forms contained a morpheme whose only exponent is length, as follows. In the examples above, BEN lengthens only monomoraic roots, and also changes root vowels from creaky to breathy. It could be argued that the ranking MORPHREAL » *V:: » MAX- μ_{Affix} bans trimoraic vowels in BEN forms because BEN is already marked by a change in voice quality, so both MORPHREAL and *V:: are satisfied in bimoraic BEN forms from bimoraic roots.

Other morphemes which give rise to trimoraic surface forms, however, show that this analysis is incorrect. As shown in (5), above, CF can change roots' tone and also add a mora to even bimoraic roots. Further, as shown in (18), the centripetal (CP, 'movement towards') and first person singular (1S) morphemes each add a mora to bimoraic roots while also inducing other changes. In (18a), CP changes roots' voice quality from creaky to breathy and can change tone from low to falling, while also (like BEN) lengthening bimoraic roots to trimoraic surface forms. In (18b), 1S lengthens bimoraic roots and also lowers and occasionally diphthongizes vowels. MORPHREAL therefore cannot explain all trimoraic surface forms.⁷

- (18) a. $m\check{\text{ɰ}}:t \rightarrow m\hat{\text{ɰ}}::t$ 'pull.CP'
 $l\check{\text{e}}:r \rightarrow l\hat{\text{e}}::r$ 'roll.CP'
- b. $m\check{\text{ɰ}}:t \rightarrow mj\grave{\text{e}}::t$ 'pull.1S'
 $l\check{\text{e}}:r \rightarrow l\grave{\text{e}}::r$ 'roll.1S'

⁷ Kurisu accounts for cases of double morpheme exponence using Sympathy Theory (McCarthy 1999); see Kiparsky (2001) and McCarthy (2006) for arguments against Sympathy Theory.

A final alternative stems from consideration of morpheme ordering. It could be the case that only affixes added directly to roots can cause lengthening, explaining both the failure of 3S to induce lengthening in benefactive verbs and also the fact that monomoraic roots can never become trimoraic. That is, it could be that the presence of any derivational morpheme, whether it adds a mora to roots (like CF) or not (like BEN on bimoraic roots), prevents any inflectional morphemes added later from adding a mora. This is not the case, as shown in (19).

- (19) $\text{lə:r} \rightarrow \text{lə::r}$ ‘roll.3S’
 $\text{lə:r} \rightarrow \text{lə:r}$ ‘roll.AP’
 $\text{lə:r} \rightarrow \text{lə::r}$ ‘roll.AP.3S’

AP behaves like BEN in that it does not add a mora to roots.⁸ But in AP.3S forms, unlike BEN.3S forms, 3S lengthens roots despite the presence of AP. The failure of 3S to induce lengthening when it cooccurs with BEN is therefore a property of the exceptional BEN morpheme, rather than a general property of nonlengthening derivational morphemes.

This section has shown that only indexed markedness constraints are capable of capturing the exceptional behavior of the BEN morpheme and its interactions with other verbal morphemes. It must therefore be possible for markedness constraints to be indexed to particular morphemes, contra GTT’s claim that morpheme-specific markedness constraints are unnecessary.

3. Conclusion

This paper has provided evidence for the morpheme-specific markedness constraint

⁸ Dinka has various AP allomorphs; the pattern shown in (19) holds for bimoraic verb roots with particular tone patterns.

*V::_{BEN} based on an exceptional prosodic template in Dinka. This result demonstrates that markedness constraints must be able to be indexed to specific, exceptional morphemes. It also disconfirms the GTT claim that all templatic morphology follows from the interaction of general markedness constraints and morpheme-specific faithfulness constraints.

Given the evidence presented here for such constraints, it is appropriate to briefly revisit GTT's arguments against them. The first argument is conceptual: morphologically induced templates are typically unmarked prosodic shapes; this is explained if morphological "templates" are the result of general markedness constraints. A theory of indexed markedness constraints inherits from GTT the idea that templates follow from (indexed) markedness constraints. Thus like GTT, and unlike the pre-GTT theory of indexed templatic constraints (e.g. RED=FOOT), the indexed-constraint approach inherently allows only unmarked prosodic templates.

The second argument against such constraints is empirical: if prosodic markedness constraints can be indexed to reduplicative morphemes, the prosodic template should be 'back-copied' onto the base when BR-Faithfulness outranks IO-Faithfulness. The absence of this apparently unattested pattern prompted the elimination of indexed markedness constraints within GTT, thus eliminating the prediction of back-copying. Given the evidence in favor of such constraints presented here, this resolution must be reconsidered: either the claim that back-copying does not exist is wrong (see Gouskova (2006) for a potential example from Tonkawa), or else a new theoretical explanation for its absence is required.

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