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PAPER

# PHONOLOGY COUNTS[1]

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This paper reconsiders the widely accepted claim that phonological rules/constraints do not 'count' to three or more. As I discuss, there exist some phenomena that are problematic for this claim, especially in Bantu tone systems. This paper gives an overview of some phonological systems that seem to require counting. I argue that counting is more common than has been acknowledged, and that an adequate theory of phonology must account for counting.

Autosegmental, Bantu, Counting, Ternary, Tone

## INTRODUCTION

It is often said that phonological rules/constraints cannot 'count' to three or more (see, for example, Goldsmith 1976, McCarthy & Prince 1986, Myers 1987, Hewitt & Prince 1989, Rose 1999, Seidl 2001, Heinz 2009, Smith 2010, Hayes 2012, and Kiparsky to appear for various versions of the claim). We will later focus on more specific types of 'counting' and cases that relate to them, but to start, we will deal in a general way with the notion of counting and the claim that it does not exist.[2] Formally, the

1 Many thanks to Mazvita Machinga and Johnes Kitololo for providing Manyika and Kuria data, respectively. For discussion of the analysis of those languages I am also grateful to Lee Bickmore, Mattie Johnson, Mike Marlo, Chacha Mwita, Dave Odden, and the audiences at ACAL 42 and ACAL 43. Thanks to audiences at UCLA, UCSD, and the 2018 Réseau Français de Phonologie for feedback on other aspects of this work.

2 This is in line with many sources that repeat the claim in vague terms; e.g., Kiparsky's statement that 'phonology

enforcement of an anti-counting restriction follows from at least two different mechanisms. Regarding tonal and segmental rules, the prohibition against counting follows in part from locality requirements on rules, which do not allow anything to intervene between the target and trigger. In the autosegmental rule in (1a), for example, a high (H) tone associated to a mora spreads rightward onto the following mora with no other moras intervening. The ill-formed rule in (1b), on the other hand, spreads the H from the first to the third mora while skipping the second one, producing a 'gapped' structure that is generally disallowed, with association lines linking the tone to two non-adjacent items (moras) on the same tier. Reformulating the rules in SPE form yields the same result: (1c), an SPE-style version of (1a), is well-formed while (1d), like (1b), is ill-formed.[3]

(1) a. μ μ
H

b. *μ μ μ
H

c. $\mu \rightarrow [+H] / \underset{[+H]}{\mu} \_\_$

d. $*\mu \rightarrow [+H] / \underset{[+H]}{\mu}\ \mu \_\_$

(We will discuss (1b) and (1d) in more detail later on to consider whether they are indeed ill-formed and whether they should be ruled out by the grammar as is generally assumed.) In the domain of stress, the requirement that feet are (maximally?) binary rules

cannot count past two' which is made in passing without being explained, formalized, or attributed (to appear: 4).

3 To anticipate the discussion in §3, this rule would be considered ill-formed whether the mora next to the target is considered to be part of the trigger or simply intervening material. If this mora is part of the trigger, then the trigger comprises multiple elements on the same side of the target which is generally disallowed (see §3). If this mora is considered to be irrelevant intervening material between the 'real' trigger (the H-toned mora) and the target, this is still generally considered impermissible because while elements can intervene between targets and triggers, these elements need to be marked off (e.g. with parentheses) as optional and irrelevant. The irrelevant intervening material cannot be a crucial part of the environment for the rule to apply; no rule can be restricted to applying only when an element intervenes between the trigger and target. (This is true almost by definition, since if the 'irrelevant' material has to be present in order for the rule to apply, then the material is not actually 'irrelevant' and is instead part of the trigger.)

out ternary groupings.

As pointed out by e.g., Odden (2003), Marlo, Mwita & Paster (2015), there exist some phenomena that are problematic for the standard notion of locality, especially in Bantu tone systems. In this paper I give an overview of some phenomena where the grammar seemingly needs to count to three (or more), go into more detail about two particularly challenging cases and discuss ways of accommodating them, and conclude with arguments for a theory that allows counting.

## 1 ATTESTED CASES OF COUNTING AND TERNARITY

We begin with an overview of some attested cases of counting and ternarity. As will be evident, and discussed later on, many of the examples come from Bantu tone systems (Guthrie numbers are given for each Bantu language the first time it appears).

One set of examples is the ternary H tone spreading found in Zezuru (S.12) and other varieties of Shona (Myers 1987), including Manyika (S.13; Johnson & Paster 2012). Consider the Manyika infinitive forms in (2), where underlyingly toneless verbs surface with low tones (2a), while the verbs in (2b) with an underlying (lexical) H tone on their stem-initial syllable (indicated by underlined vowels) undergo H tone spreading that targets the two following moras.

(2)

| | | | | |
|---|---|---|---|---|
| a. | ku-bva | ‘to leave’ | b. ku-pá | ‘to give’ |
| | ku-bika | ‘to cook’ | ku-téngá | ‘to buy’ |
| | ku-bikira | ‘to cook for’ | ku-téngésá | ‘to sell’ |
| | ku-puruzira | ‘to rub’ | ku-téngéséra | ‘to sell to’ |

This apparently rare phenomenon is referred to as ‘ternary’ H tone spreading because it creates a span of three H-toned syllables; in contrast, many Bantu languages exhibit ‘binary’ H tone spreading or ‘H tone doubling’ that simply spreads a H onto one following

mora, yielding a two-syllable H domain (see, e.g., Odden 2015). Ternary H spreading is also found in Copperbelt Bemba (M.42; Kula & Bickmore 2013), but this is argued to follow from two separate rules – the much more commonly attested H tone doubling, plus 'secondary' H tone doubling that spreads the H to an additional mora after doubling has already applied. Hence, the ternary spreading rule reduces to two binary spreading rules. As evidence for the two separate rules, Kula & Bickmore (2013) show that secondary H doubling is sensitive to the Obligatory Contour Principle, while H tone doubling is not.

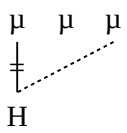
A related phenomenon, ternary H tone displacement, is found in Sukuma (F.21; Richardson 1959, Siestema 1989, Roberts 1992). In Sukuma, H tones shift two moras to the right. This is like ternary spreading, but the tone surfaces only on the third mora; the mora that underlyingly hosted the H, as well as the immediately following mora, both surface with low tone. This can be seen in (3) (Roberts 1992: 135), which gives near-minimal pairs where a lexical H tone is present vs. absent. In cases with an underlying H tone (indicated by the underlined vowels), a H tone appears on the surface, two moras to the right of its original location.

| | | | | | | |
|---|---|---|---|---|---|---|
| (3) | a. | i. | /a-ku-ku-sol-el-a/ | → | [a-ku-ku-sol-el-a] | 'he will choose for 2sg' |
| | | ii. | /bá-ku-ku-sol-el-a/ | → | [ba-ku-kú-sol-el-a] | 'they will choose for 2sg' |
| | b. | i. | /ku-sol-anij-a/ | → | [ku-sol-anij-a] | 'to choose simultaneously' |
| | | ii. | /ku-bón-anij-a/ | → | [ku-bon-aníj-a] | 'to see simultaneously' |
| | c. | i. | /akasola amahagala/ | → | [akasola amahagala] | 'he chose the tree forks' |
| | | ii. | /akabóna amahagala/ | → | [akabona ámahagala] | 'he saw the tree forks' |

This tone shifting rule could be represented by the autosegmental rule in (4), which differs minimally from the ill-formed rule in (1b) in that the output does not contain a gapped representation with association lines linked to two moras that are not adjacent

on a tier.

(4)




Although (4) is written as a single rule, spreading of the H to the third mora must occur prior to delinking from the first mora in order for the rule to 'know' which mora to target for spreading. This produces an intermediate form with a gapped representation.

Another domain in which Bantu tone systems exhibit counting and/or ternarity is in the domain of grammatical ('melodic') tone assignment. A striking example is found in Kuria (E.43; Marlo, Mwita & Paster 2014, 2015) where a H tone is assigned to mark different tense/aspect/mood (TAM) categories by targeting a specific mora of the verb stem. As shown in (5), past tense is indicated (in part) by a melodic H tone on the first mora of the stem (5a); past progressive assigns a H to the second mora of the stem (5b); remote future assigns a H to the third mora of the stem (5c); and inceptive assigns a H to the fourth mora of the stem (5d). In each case, a regular phonological rule of unbounded H tone spreading then spreads the melodic H rightward, up to and including the penultimate mora. The location of the initial assignment of the melodic tones, prior to spreading, is indicated by underlining the vowel.

| | | | | |
|---|---|---|---|---|
| (5) | a. | μ1 | n-to-o-hɔ̰́ɔ́tɔ́ɔ́t-ɛ́r-a | Past |
| | | | FOC-1PL-PAST-reassure-APPL-FV | |
| | | | 'we reassured' | |
| | b. | μ2 | n-tɔ-ɔka-hoó̱tóót-ééy-e | Past progressive |
| | | | FOC-1PL-PAST.HAB-reassure-APPL.PERF-FV | |
| | | | 'we have just been reassuring' | |
| | c. | μ3 | n-to-re-hɔɔtɔ̰́ɔ́t-ɛ́r-a | Remote future |
| | | | FOC-1PL-FUT-reassure-APPL-FV | |
| | | | 'we will reassure' | |
| | d. | μ4 | to-ra-hɔɔtɔɔ̱́t-ɛ́r-a | Inceptive |
| | | | 1PL-INCEPT-reassure-APPL-FV | |
| | | | 'we are about to reassure' | |

I will discuss Kuria in more depth in §2.2. Although Kuria is an extreme example, melodic H tone assignment in other Bantu languages has also been shown to count beyond two – e.g., there is a μ3 melodic H pattern in both Kimatuumbi (P.13; Odden 1996) and Ekoti (P.31; Odden 2003).

Outside of tone, another domain where counting and/or ternarity is observed is in stress patterns. Apparent ternary stress is found in Tripura Bangla (Das 2001), Chugach Alutiiq (Leer 1985, Idsardi 1992, Das 2001), and Cayuvava (Key 1961), among others. In Tripura Bangla, as shown in (6), in words with only light syllables, primary stress occurs on the first syllable with secondary stress on the fourth, seventh (etc.) syllable (except that final syllables are not stressed) (data adapted from Das 2001: x, 201).

| | | |
|---|---|---|
| (6) | bá.ta.ʃa | ‘type of candy’ |
| | ɔ́.na.ba.di | ‘uncultivated’ |
| | ɔ́.ʃɔ.hɔ.zù.gi | ‘non-cooperative’ |
| | ɔ́.ʃɔ.hɔ.zù.gi.ta | ‘non-cooperation’ |
| | ɔ́.no.nu.dà.βo.ni.yɔ | ‘unintelligible’ |
| | ɔ́.no.nu.grɔ̀.ho.ni.yɔ̀.ta | ‘unacceptability’ |

Such a stress pattern would result from left-to-right ternary foot construction.

In Chugach Alutiiq, in words with only light syllables, stress falls on syllables 3*n*-1 (second, fifth, etc.) and on the final syllable. (Adapted from Leer 1985 via Das 2001: 22; note that primary vs. secondary stress is not distinguished in the source; all stress is indicated by an acute accent.)

| | | |
|---|---|---|
| (7) | mu.lú.kan | ‘if she takes a long time’ |
| | a.kú.ta.mék | ‘*akutaq* (a food; ABL SG)’ |
| | ta.qá.ma.lu.ní | ‘apparently getting done’ |
| | a.kú.tar.tu.nír.tuq | ‘he stopped eating *akutaq*’ |
| | ma.ŋár.su.qu.tá.qu.ní | ‘if he (REFL) is going to hunt porpoise’ |

This system can be analyzed as having ternary stress feet starting with the second syllable (e.g. with the initial syllable marked as extrametrical), but where if the final two syllables would end up being unstressed, then the final syllable is also stressed.

Another way in which stress systems may seem to count to three is in the context of ‘stress windows’ – regions of a word to which stress is limited in a language. A number of languages have been argued to have three-syllable stress windows. Kager’s (2012) analysis of the StressTyp database (Goedemans & Hulst 2009) indicates that three syllables is the maximum stress window size. The number of languages with two- and three-syllable stress windows in StressTyp is summarized below (Kager 2012: 1464).

(8)

| WINDOW TYPE | PHONOLOGICAL | LEXICAL | MIXED | TOTAL |
|---|---|---|---|---|
| Final two syllables | 59 | 20 | 3 | 82 |
| Final three syllables | 22 | 12 | 4 | 38 |
| Initial two syllables | 26 | 10 | 3 | 39 |
| Initial three syllables | 1 | 0 | 0 | 1 |
| TOTAL | 108 | 42 | 10 | 160 |

In total, 39 of the 160 languages represented here exhibit three-syllable stress windows. There is some evidence for four-syllable stress windows, but Kager suggests that they can be reanalyzed, commenting that 'the status of four-syllable stress windows in word-final position is too weak to constitute counterevidence to the three syllable maximum' (2012: 1466).

A final area in which we observe apparent counting to three or more is in three/four-syllable word minimality constraints.[4] For example, there is a three-mora minimum for citation forms in Mele-Fila (Biggs 1975) and Takuu (Moyle 2011) and a three-mora minimum for prosodic words in Gilbertese (Blevins & Harrison 1999). Takuu also exhibits a four-mora minimum for verbs (Moyle 2011).

This concludes our overview of apparent counting/ternarity in phonological systems. Interestingly, what seems to be missing is any example of a counting phenomenon involving segmental features (e.g., 'change the third obstruent in a11 word to [+voice]'; 'delete the fourth segment of the stem'; 'spread [+high] to the next two vowels'; etc.). This gap constitutes a discrepancy between segmental and suprasegmental phonology, which will be discussed in §3.

4 Many thanks to Kie Zuraw for making me aware of these examples. Multiple reviewers have pointed out that this is not a well-known phenomenon; I agree that these examples are unusual and deserve further attention, though I will not attempt to analyze or explain them in the present paper.

## 2 APPROACHES TO COUNTING

Given that a number of cases of counting to three or more are attested in human languages, how do we reconcile this with the accepted notion that languages do not – and cannot – count past two? One option, which unfortunately seems to prevail in the literature (in that possible counterexamples are never acknowledged when the claim is repeated), is simply to ignore the attested cases. As should be apparent, this is not an option that will be pursued here, and I will not discuss it further. Assuming we will attempt in good faith to account for the apparent cases of counting, we are left with two options: (1) explain away the attested cases (e.g., as variants on binary patterns), or (2) relax our theories of locality and foot structure to allow for counting and ternarity.

Analyses of ternary stress have tended towards option (1) – making use of extrametricality, leaving unparsed moras between feet, building trimoraic feet with nested binary branching rather than flat ternary structure, etc. For example, Tripura Bangla could be analyzed as having binary feet with unparsed (extrametrical) syllables intervening between the feet. The tone cases, however, are less amenable to reanalysis, as will be discussed below. Two examples will be presented that expose a theoretical tension. On one hand, these are robust examples that seem to call for an analysis of counting in its own right. On the other hand, relaxing our theoretical assumptions sufficiently to do this may yield a theory that drastically overgenerates with respect to attested patterns of counting. Therefore, it is worth considering carefully whether the attested patterns can be reanalyzed, and if so, at what cost. This is the subject of §§2.1-2.2.

### 2.1 TERNARY H SPREADING IN MANYIKA

In this section I consider the Manyika example in more detail. The data and analysis, except where noted, are from Johnson & Paster (2012).

### 2.1.1 H TONE TRIPLING (HTT)

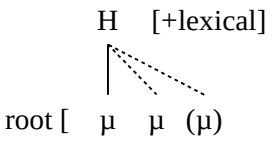
As mentioned earlier, all Manyika verb roots are underlyingly toneless (9a) or H-toned (9b) (repeated from (2)), with the initial location of the H tone underlined.

| | | | | | | |
|---|---|---|---|---|---|---|
| (9) | a. | ku-bva | 'to leave' | b. | ku-pá | 'to give' |
| | | ku-bika | 'to cook' | | ku-téngá | 'to buy' |
| | | ku-bikira | 'to cook for' | | ku-téngésá | 'to sell' |
| | | ku-puruzira | 'to rub' | | ku-téngéséra | 'to sell to' |

The infinitives in (9) exemplify a tone pattern common to many tense-aspect-mood ('TAM') categories in Manyika where H-toned stems with one, two, or three syllables have H tone from the stem-initial through the final syllable, while H-toned four-syllable stems have H tone from the stem-initial through the penult.

This pattern is analyzable via the H Tone Tripling (HTT) rule in (10), where a lexical H that is linked to the initial mora of the root/stem[5] spreads rightward to the next mora and to the mora after that (yielding sequences of three H-toned syllables, where possible).

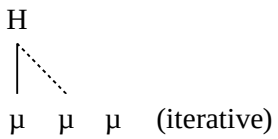
(10) H TONE TRIPLING




5 The lexical H technically belongs to the root, but in our examples the left edges of the stem and root coincide. It is not always possible to determine which of the two concepts (root or stem) is applicable; I will use the term 'stem' in most instances since the stem is an important locus for rule application in Manyika and other Bantu languages, but in some cases 'root' will be appropriate (e.g., lexical H tones are analyzed as belonging to the root).

The Manyika data are similar to what Myers (1987: 177-182) reports for the Zezuru variety of Shona, where a H tone tripling generalization is sufficient to account for stems of all sizes (though Myers rejects a tripling analysis). However, in the Manyika variety under discussion here, five-syllable H-toned stems necessitate an additional rule. In *ku-dzúngáírísa* 'to make someone confused', for example, the lexical H spreads to the penult, rather than to the antepenult. Therefore, a rule of Penultimate Spreading (PS) (11) is also needed.

(11) PÉNULTIMATE SPREADING




PS applies iteratively, spreading any H tone (whatever the source) one mora to the right if another mora follows.

In the derivation of *ku-dzúngáírísa*, H Tone Tripling applies, yielding the intermediate form *kudzúngáírisa* with a ternary H tone domain; then PS applies, spreading the H tone one mora further and yielding the surface form. It may be tempting to try to eliminate this additional step, but as seen below, Penultimate Spreading is independently needed to explain the behavior of H tones whose source is a non-stem morpheme. For instance, when a H-toned object prefix (12a) or subject prefix (12b) occurs with a toneless root, the prefix H spreads to the penult. (Habitual, like some other TAM categories, assigns H to the subject prefix.)

| | | | | | |
|---|---|---|---|---|---|
| (12) | a. | ku-pá-bva | 'to leave there' | ha-tá-í-pá-bva | 'we used to not leave there' |
| | | ku-tí-bíka | 'to cook us' | ha-tá-í-kú-bíka | 'we used to not cook you' |
| | | ku-tí-bíkíra | 'to cook for us' | ha-tá-í-kú-bíkíra | 'we used to not cook for you' |
| | | ku-tí-púrúzíra | 'to rub us' | ha-tá-í-kú-púrúzíra | 'we used to not rub you' |
| | | ku-tí-sékérérésa | 'to make us smile' | ha-tá-í-kú-sékérérésa | 'we used to not make you smile' |
| | b. | tí-ngó-bva | 'we leave (hab.)' | | |
| | | tí-ngó-bíka | 'we cook (hab.)' | | |
| | | tí-ngó-bíkíra | 'we cook for (hab.)' | | |
| | | tí-ngó-púrúzíra | 'we rub (hab.)' | | |
| | | tí-ngó-sékérérésa | 'we make smile (hab.)' | | |

The same can be seen in the past habitual (13a), recent past (13b), and negative past habitual (13c), where the source of the H tone is the TAM prefix. Thus, here again, we see the Penultimate Spreading pattern.

| | | | | | | |
|---|---|---|---|---|---|---|
| (13) | a. | a-í-bva | 'he used to leave' | b. | á-bva | 'he left' |
| | | a-í-bíka | 'he used to cook' | | á-bíka | 'he cooked' |
| | | a-í-bíkíra | 'he used to cook for' | | á-bíkíra | 'he cooked for' |
| | | a-í-púrúzíra | 'he used to rub' | | á-púrúzíra | 'he rubbed' |
| | | a-í-sékérérésa | 'he used to make smile' | | á-sékérérésa | 'he made smile' |
| | c. | ha-tá-í-bva | 'we used to not leave' | | | |
| | | ha-tá-í-bíka | 'we used to not cook' | | | |
| | | ha-tá-í-bíkíra | 'we used to not cook for' | | | |
| | | ha-tá-í-púrúzíra | 'we used to not rub' | | | |
| | | ha-tá-í-sékérérésa | 'we used to not make smile' | | | |

When a verb has a H-toned prefix and a H-toned root, the H Tone Tripling rule takes precedence: stems with one, two, or three syllables have H tone from the initial syllable through the final syllable, rather than just through the penult, as shown in (14).

| | | |
|---|---|---|
| (14) | ku-tí-pá | ‘to give us’ |
| | ku-tí-téngá | ‘to buy us’ |
| | ku-tí-téngésá | ‘to sell us’ |
| | ku-tí-téngéséra | ‘to sell to us’ |
| | ku-tí-dzúngáírísa | ‘to confuse us’ |

Looking, for example, at *ku-tí-téngésá* in (14), we can see that the spreading is indeed to the final and not the penult. This is consistent with the earlier claim that HTT applies before PS, as in the derivation in (15a). If PS applied first, as in the derivation in (15b), HTT would incorrectly fail to apply since that rule only spreads a H tone from the stem-initial mora.

(15) a.

| | |
|---|---|
| *Underlying form* | /ku-ti-tengesa/<br>H H |
| *H Tone Tripling* | ku-ti-tengesa<br>H H |
| *Penultimate Spreading* | N/A |
| *Surface form* | ku-ti-tengesa<br>H H |

b.

| | |
|---|---|
| *Underlying form* | /ku-ti-tengesa/<br>H H |
| *Penultimate Spreading* | ku-ti-tengesa<br>H H |
| *H Tone Tripling* | N/A |
| *Surface form* | * ku-ti-tengesa<br>H H |

More evidence for this ordering comes from the habitual (16a) and recent past (16b) with a H subject prefix and H root.

| | | | | | | |
|---|---|---|---|---|---|---|
| (16) | a. | tí-ngó-pá | 'we give (hab.)' | b. | á-pá | 'he gave' |
| | | tí-ngó-téngá | 'we buy (hab.)' | | á-téngá | 'he bought' |
| | | tí-ngó-téngésá | 'we sell (hab.)' | | á-téngésá | 'he sold' |
| | | tí-ngó-téngéséra | 'we sell to (hab.)' | | á-téngéséra | 'he sold to' |
| | | tí-ngó-dzúngáírísa | 'we confuse (hab.)' | | á-dzúngáírísa | 'he confused' |

One modification must be made to HTT, which is that it is limited to certain TAM categories. It does not apply in the imperative (when an object prefix (OP) is present) (17a), the hortative (17b), the hortative when an OP is present (17c), or the present subjunctive (17d) (note that (17a) and (17d) end up being homophonous since the imperative with OP is identical to the subjunctive (without a subject prefix) and the 1pl SP and OP are both *tí*-). In these categories, only PS applies. (Interestingly, the categories where HTT fails are all irrealis – but not all irrealis forms fail to undergo HTT, and it does not seem possible to describe this as a natural class of TAM categories.)

| | | | | | | |
|---|---|---|---|---|---|---|
| (17) | a. | tí-ténge | 'buy us!' | b. | ngá-tí-ténge | 'let's buy' |
| | | tí-téngése | 'sell us!' | | ngá-tí-téngése | 'let's sell' |
| | | tí-téngésére | 'sell to us!' | | ngá-tí-téngésére | 'let's sell to' |
| | | tí-dzúngáíríse | 'confuse us!' | | ngá-tí-dzúngáíríse | 'let's confuse' |
| | c. | ngá-tí-mú-ténge | 'let's buy him' | d. | tí-ténge | 'that we buy' |
| | | ngá-tí-mú-téngése | 'let's sell him' | | tí-téngése | 'that we sell' |
| | | ngá-tí-mú-téngésére | 'let's sell to him' | | tí-téngésére | 'that we sell to' |
| | | ngá-tí-mú-dzúngáíríse | 'let's confuse him' | | tí-dzúngáíríse | 'that we confuse' |

To account for these forms, the rule can be revised as in (18).[6]

6 This version of HTT indicates that the rule is blocked in particular categories rather than that it is specifically associated with the categories where it does apply; it is not clear which of these alternatives is the correct way to state the rule.

(18) H TONE TRIPLING (REVISED)

```
        H    [+lexical]
        |\
root [  μ   μ  (μ)  [-imperative/OP, -hortative, -pres. subjunctive]
```

A third type of H tone spreading is observed in the imperative (19a) and future subjunctive (19b). Here, the H tone starts on the stem-initial syllable and spreads rightward to the final (note that there is also a H tone on the 1pl prefix *tí-* in (19b), but this does not interact with the melodic H).

| | | | | | |
|---|---|---|---|---|---|
| (19) | a. í-bvá | 'leave!'[7] | b. tí-zo-bvé | 'that we leave' |
| | bíká | 'cook!' | tí-zo-bíké | 'that we cook' |
| | bíkírá | 'cook for!' | tí-zo-bíkíré | 'that we cook for' |
| | púrúzírá | 'rub!' | tí-zo-púrúzíré | 'that we rub' |
| | sékérérésá | 'make smile!' | tí-zo-sékérérésé | 'that we make smile' |

We see in (19) that in all forms the H tone spreads all the way to the final mora. These forms require an unbounded, iterative H tone spreading rule specific to these particular morphological categories, given in (20).

(20) UNBOUNDED H SPREADING

```
H    [+melodic, {imperative, fut. subj.}]
|\
μ   μ                                    (iterative)
```

7 [í] is inserted before monomoraic roots in the imperative.

It is crucial to the analysis that the H that spreads is a melodic (TAM) H, not a lexical H. This is because unbounded spreading does not apply in these same verb forms when the root has a lexical H; instead, in that instance HTT and PS apply, as shown in (21).

| | | | | | | |
|---|---|---|---|---|---|---|
| (21) | a. | í-pá | 'give!' | b. | tí-zo-pé | 'that we give' |
| | | téngá | 'buy!' | | tí-zo-téngé | 'that we buy' |
| | | téngésá | 'sell!' | | tí-zo-téngésé | 'that we sell' |
| | | téngéséra | 'sell to!' | | tí-zo-téngésére | 'that we sell to' |
| | | dzúngáírísa | 'confuse!' | | tí-zo-dzúngáíríse | 'that we confuse' |

In these cases, the stem H blocks spreading of the melodic H, so the regular pattern of stem H spreading applies.

Thus, in Manyika we have three rules that spread H tones: H Tone Tripling, Penultimate Spreading, and Unbounded H Spreading. Each rule seems to be necessarily independent, and most importanly for our discussion of counting, H Tone Tripling cannot be reduced to a combination of the other two. There is precedent for proposing multiple H spreading rules in a closely related language: see Hyman & Mathangwane's (1998) analysis of Kalanga (S.16), which, like Manyika, has three separate rightward H tone spreading rules.

### 2.1.2 ALTERNATIVES TO TRIPLING

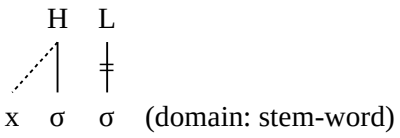
Myers (1987: 180-181) rejects a H tone tripling rule for Zezuru on theoretical grounds, in that it 'would require a capacity to count off three adjacent syllables'. He goes on to provide a rationale for rejecting a rule that counts to three: 'McCarthy and Prince (1986) have recently suggested that a rule of grammar may only involve counting ''up to two': a rule may fix on one specified element and examine a structurally adjacent element and no other'' (McCarthy and Prince 1986: 1)… In fact, though, an equally simple analysis

of the tone pattern is possible which does not violate this well-motivated constraint on phonological rules.'

#### 2.1.2.1 UNBOUNDED H SPREADING WITH SPECIFIED L TONES

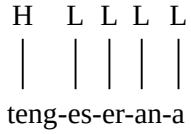
Myers' analysis of H tone tripling in Zezuru requires that all syllables be specified for tone (/H/ or /L/) at the stage when H spreading applies. The first step in the apparent tripling process is the delinking of a L tone after a singly linked H tone, shown in (22) (Myers 1987: 181).

(22) L DELINKING




The 'x' on the left edge indicates 'nothing', meaning that the H tone must be linked only to a single syllable and nothing more in order for the rule to apply. This allows iterative rightward H spread to spread a H tone two syllables to the right, since it can target a syllable that already bears a tone (but cannot go further, due to the line crossing constraint). A simplification rule then changes /HL/ on a single syllable to [H]. Myers' derivation of Zezuru *kuténgésérana* (1987: 182) is given in (23).

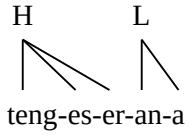
(23) a. *Input*




b. *L Delinking*


c. *Spread*


d. *Simplification, OCP Fusion*



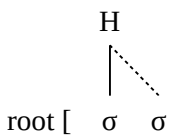

Such an analysis could be extended to Manyika, with the addition of Penultimate Spreading. But there are some problems. First, Reanalyzing all toneless syllables as having a specified L tone eliminates the distinction between /L/ and /∅/, which we need to account for some TAM categories (see Johnson & Paster 2012). Second, there is no independent evidence (in Manyika or, as we understand it, in Zezuru) for L Delinking. This suggests that L Delinking is an ad hoc rule proposed solely to avoid ternary spreading. And finally, L Delinking requires a notation (linking to ‘x’ to indicate a singly linked tone in (22)) whose status in the autosegmental model is unclear. The ‘x’ is crucial since the rule must only delink a L tone if the preceding H is associated with exactly one syllable. Assuming that the linking to ‘x’ notation is allowed, reference to an associ-

ation line on the opposite side of the trigger from the target seems to pose a locality problem unless we say that the 'trigger' is the H along with everything it is linked to (more on this possibility in §3).[8]

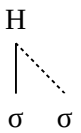
### 2.1.2.2 MULTIPLE H TONE DOUBLING RULES

Hewitt & Prince (1989) analyze tripling in another Shona variety, Northern Karanga (S.14), using two separate H spreading rules. Their rationale for the two separate rules is apparenlty not empirically based but instead invokes locality: 'Phonological rules may affect a single element (tier-) adjacent to the rule trigger' (1989: 178). The two H spreading rules are shown in (24) (Hewitt & Prince 1989: 181).

(24) ROOT TONE SPREAD (RTS)




GENERAL H-SPREAD (GHS)



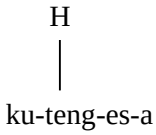

Ordering GHS after RTS yields tripling of lexical H tones on the surface. Such an analysis would not work for Manyika because the default H spreading process in Manyika is

8 Since all syllables are underlyingly associated with tones in Myers' analysis, a H tone crucially not being linked to a syllable to the left of the one it is linked to means that the H-toned syllable is preceded either by nothing or by a syllable linked to a L tone. Therefore, an SPE version of the rule in (22) would be $\sigma_L \rightarrow \sigma$ / {#, $\sigma_L$} $\sigma_H$ __. (Since curled brackets essentially collapse two rules into one line, this SPE version of (22) is technically two separate rules: $\sigma_L \rightarrow \sigma$ / # $\sigma_H$ __ and $\sigma_L \rightarrow \sigma$ / $\sigma_L$ $\sigma_H$ __.)

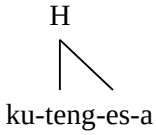
Penultimate Spreading, not binary spreading as in GTS. Also, as with Myers' L Delinking rule for Zezuru, it appears there is not independent evidence for RTS in Northern Karanga; it is proposed solely to reduce an apparent ternary rule into two binary ones.

For Manyika, we could divide HTT into Root-Initial RTS (RIRTS) as in (24), followed by a General RTS (GRTS) rule that spreads a lexical (root) H tone to the right regardless of whether it is uniquely associated to the leftmost syllable of the root, as RTS in (24) requires. This would account for the stems with up to four syllables, as shown for *ku-téngésá* 'to sell' in (25).

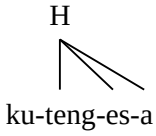
(25) *Input*




*Root-Initial Root Tone Spreading*




*General Root Tone Spreading*



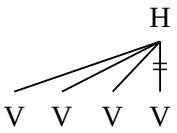

We would still need Penultimate Spreading after this to account for five-syllable stems such as *ku-dzúngáírísa* 'to make someone confused'. The problem for such an account is that there is no independent evidence for splitting High Tone Tripling into RIRTS and GRTS. We would simply be positing these two separate rules to satisfy the assumed theoretical constraint that prohibits a rule from spreading a H tone to two moras.

It is useful to contrast this situation with Roberts' (1992) analysis of Sukuma, discussed earlier, which shifts a H tone two syllables to the right. For Sukuma, Roberts provided evidence that H tone shift not only can but *must* be analyzed as two separate rules, each of them local. The evidence includes the fact that another rule, Final Lowering, must be ordered in between the two spreading rules. Such evidence is not available, as far as we are aware, for Manyika.

#### 2.1.2.3 SPREADING AND RETRACTION

Odden (1981: 197-203) discusses analytical alternatives to HTT for Karanga, including an analysis where the stem H spreads to the end of the word, and is then retracted via the rule in (26) (p. 200).

(26)




This analysis could work for Manyika, but it would still require an independently unmotivated rule (retraction). Note that unbounded H spread would still have to be separate from the very similar unbounded H spreading rule in (20) since that rule crucially spreads only melodic H tones, not stem H tones. Thus we would have two rules of unbounded H tone spreading. Also, although (26) may be acceptable in terms of locality since the 'counted' vowels are all associated to the H that delinks (if we assume that locality is satisfied by a structural description where the trigger is this complex), in some sense this rule would still require the grammar to count vowels to determine whether the structural description is met (since the H must be linked to exactly four vowels in order to be retracted from the fourth one). Therefore, it would not be worthwhile to adopt an

analysis involving retraction if the sole motivation for doing so were to avoid a tripling rule on grounds that phonology doesn't count.

#### 2.1.2.4 MULTIPLE MELODIC H TONES

Another possibility[9] is that the apparent tripling might be analyzed via multiple melodic H tones rather than spreading. For example, perhaps the infinitive melodic tone is as in (27).

(27) Infinitive tone pattern
/HHH/

This tone pattern, with L-to-R association to tone-bearing units starting at the left edge of the stem, followed by Penultimate Spreading and deletion of unassociated tones, would correctly generate the infinitive forms, as shown in (28).

(28)

```
ku-pá          'to give'          ku-téngá        'to buy'
  |                                 |   |
  H [H  H] →∅                       H   H [H] →∅

ku-téngésá     'to sell'          ku-téngéséra    'to sell to'
  |   | |                           |   | |
  H   HH                            H   HH

ku-dzúngáírísa     'to make someone confused'
  |   ||/
  H   HH
```

9 Thanks to Larry Hyman for this suggestion.

However, there are a number of potential problems for such an analysis. First, it would be a strange coincidence that the melodic tone pattern for 26 different categories is /HHH/ with no categories having the simpler patterns /H/ or /HH/. The 26 categories exhibiting the ternary H pattern in Manyika are listed alphabetically in (29) (these are essentially TAM categories, but further distinguished by polarity and whether an object prefix (OP) is present).

(29) TAM CATEGORIES WITH TERNARY H PATTERN IN MANYIKA

| | |
|---|---|
| Future (w/ or without OP) | Past progressive (w/ or without OP) |
| Future subjunctive without OP | Potential 1 (w/ or without OP) |
| Habitual (w/ or without OP) | Potential 2 (w/ or without OP) |
| Inceptive (w/ or without OP) | rogressive w/OP |
| Infinitive (w/ or without OP) | Recent past (w/ or without OP) |
| Neg. infinitive (w/ or without OP) | Remote past (w/ or without OP) |
| Neg. singular imperative (w/ or without OP) | Singular imperative without OP |
| Neg. subjunctive without OP | |

A second problem is that the melody /HHH/ blatantly violates the Obligatory Contour Principle. And a third, related potential issue is that with multiple adjacent H tones, Meeussen's Rule (a tone rule found in many Bantu languages that delinks or deletes a H tone following another H tone) may delete the adjacent Hs on the surface. Johnson & Paster (2012) demonstrate that this would not be a problem for the analysis of Manyika since Meeussen's Rule in Manyika only delinks stem H tones and would not affect melodic H tones; however, this could be a problem in the analysis of other Shona varieties for which a /HHH/ tone melody might be proposed.

## 2.2 H TONE ASSIGNMENT IN KURIA

In this section we return to the case of melodic H tone assignment in Kuria, giving an analysis in terms of counting and then discussing alternatives. The key Kuria data are given in (30), repeated from (5).

(30) KURIA H TONE ASSIGNMENT

| | | | |
|---|---|---|---|
| a. | 1 | n-to-o-hɔ́ɔ́tɔ́ɔ́t-ɛ́r-a | Past |
| | | FOC-1PL-PAST-reassure-APPL-FV | |
| | | 'we reassured' | |
| b. | 2 | n-tɔ-ɔka-hoóótóót-ééy-e | Past progressive |
| | | FOC-1PL-PAST.HAB-reassure-APPL.PERF-FV | |
| | | 'we have just been reassuring' | |
| c. | 3 | n-to-re-hɔɔtɔ́ɔ́t-ɛ́r-a | Remote future |
| | | FOC-1PL-FUT-reassure-APPL-FV | |
| | | 'we will reassure' | |
| d. | 4 | to-ra-hɔɔtɔɔ́t-ɛ́r-a | Inceptive |
| | | 1PL-INCEPT-reassure-APPL-FV | |
| | | 'we are about to reassure' | |

### 2.2.1 MORA COUNTING

To account for the pattern in (30), Marlo, Mwita & Paster (2014, 2015) propose four different H Tone Association (HTA) rules. By these rules, depending on the TAM category, a H tone is assigned to the first, second, third, or fourth mora (followed by spreading of the H to the penultimate mora, where possible). Tone association is straightforward when the verb stem is long enough to support the tone pattern in question (as in (31a-b) below). Interestingly, if the verb happens to be one mora too short for a particular tone pattern (e.g., a three-mora stem in a TAM that assigns H tone to the fourth

mora), the final vowel surfaces with a rising tone, as in (31c). If the verb stem is too short by two or more moras (as in (31d-e)), the H tone is left 'floating' (unassociated to a mora, indicated by superscript $^{H}$). The evidence for a floating H tone in such cases comes from the blocking of a regular rule of word-final Superlowering that causes word-final L tones to surface as superlow (except in the presence of a floating H); see Marlo, Mwita & Paster (2014, 2015) for details.

(31) 4TH MORA HTA ON STEMS OF VARYING LENGTHS[10]

| | | |
|---|---|---|
| a. | to-ra-koondokór-a | 'we are about to uncover' |
| b. | to-ra-heetok-á | 'we are about to remember' |
| c. | to-ra-sukur-ă | 'we are about to rub' |
| d. | to-ra-rom-a$^{H}$ | 'we are about to bite' |
| e. | to-ra-ry-a$^{H}$ | 'we are about to eat' |

HTA can be formulated as in (32).

(32) 4TH MORA H TONE ASSOCIATION

```
                    H
                    ⋮
stem [   μ   μ   μ   μ
```

Another striking aspect of Kuria H tone assignment, which further demonstrates the robustness of the counting pattern, is that if the verb is too short for a particular tone pat-

10 Note that these patterns apply in Mwita's idiolect (Mwita 2008) but not in that of a different speaker. See Marlo, Mwita & Paster (2015) for discussion of these inter-speaker differences.

tern but an underlyingly toneless object follows the verb, the melodic H tone pattern continues counting moras into the object and the H tone is assigned to the relevant mora of the object (followed by spreading of the H rightward through the penultimate mora). (33a) shows a verb with four moras in the stem (*karaaŋg-a*) in a TAM category (Inceptive) that assigns a H tone to the fourth mora. In this case the H is straightforwardly assigned to the final (fourth) mora of the stem (underlined) and then spreads rightward to the penultimate mora of the toneless object (/e-ɣe-tɔɔkɛ/ 'banana'). In (33b), the verb stem has only two moras, so the counting proceeds into the object and the H is assigned to the second mora of the object (underlined) and then spreads to the penult. In (33c), the verb stem has only one mora, so the H ends up being assigned to the third mora of the object (underlined) and again is followed by spreading to the penult.

| | | | |
|---|---|---|---|
| (33) | a. | to-ra-karaaŋg-á̲ é-ɣé-tɔ́ɔ́kɛ | 'we are about to fry a banana' |
| | b. | to-ra-rom-a e-ɣé̲-tɔ́ɔ́kɛ | 'we are about to bite a banana' |
| | c. | to-ra-ry-a e-ɣe-tɔ̲́ɔ́kɛ | 'we are about to eat a banana' |

What (33) shows, as argued by Marlo, Mwita & Paster (2014, 2015), is that H Tone Association (as well as Penultimate Spreading) is a phrase-level rule.

Having offered an analysis in terms of counting, I will now consider two alternative approaches to Kuria H tone assignment that do not involve counting.

### 2.2.2 METRICAL ANALYSIS

Hyman (1989) discusses two possible ways to target the fourth mora using metrical units, based on Odden's (1987) analysis of the Nyabaasi variety of Kuria. The first, shown in (34a), is to target the head of a right-headed moraic colon at the left edge of the stem (a colon is a unit made up of two feet; the target mora is underlined). The second alternative, shown in (34b), is to designate the stem-initial foot as extrametrical, and

then to target the head of a right-headed moraic foot at the left edge of the stem.

(34) a. { (μ μ) (μ μ̲) }
b. <(μ μ)> (μ μ̲)

Both options successfully target the fourth mora, but there are a number of problems with such an approach. There is no clear evidence for stress in Kuria; stress in Bantu is typically penultimate, if present.[11] Therefore, the sole apparent function of any proposed metrical structure would be to identify the proper moras to be targeted by the H Tone Association rules. The problem is that the existence of four different HTA patterns in the language would require the ability to target not only the fourth mora, but also the first, second, and third. This would seem to require different footing/headedness/extrametricality analyses for each tone pattern (for instance, the second mora cannot be extrametrical in TAM categories where it is the target of HTA). Even more challenging is the fact (discussed by Marlo, Mwita & Paster 2014, 2015) that some TAM categories assign H tones to multiple different moras in the stem, which would require conflicting metrical parses to coexist within a single word. For example, the Inceptive with a 3pl subject has both the first and fourth mora H patterns, as in *βa-ra-kár̲aaŋg-á̲* 'they are about to fry'.

### 2.2.3 MELODIC LS AND HS

Cammenga's (2004) analysis of Kuria H tone assignment is that the different patterns are due to sequences of melodic (TAM) Ls and Hs. For example, the μ4 pattern would have the melody /LLLH/. As discussed by Marlo, Mwita & Paster (2015: 260-262), this analysis is problematic in that the stem moras preceding the H are crucially toneless and cannot be specified as L. The reason is that, as was seen earlier, H tones undergo un-

11 Bennett (2012) argues that all languages have latent metrical structure due to a cognitive bias towards foot parsing, but if there is any latent metrical structure in Kuria we would expect it to be built from the right edge, corresponding to penultimate stress/prominence.

bounded rightward spreading in the language. Previously we observed stem tones spreading, but other H tones spread as well; e.g., in (35) we see the H tone of the negative prefix /tɔ́-/ spreading rightward into the stem in a μ4 TAM category.

| | | |
|---|---|---|
| (35) | o-ɣo-tɔ̰́-kó-βéréker-á | 'to not call' |
| | o-ɣo-tɔ̰́-kó-héétok-á | 'to not bite' |

Spreading the H tone from the prefix into the stem in (35) requires the target syllables to be toneless; otherwise we are faced with the need for an iterative L tone deletion rule to sweep through the word just ahead of H spreading and to delete two of the melodic L tones. It would not help to say that the tone melody is assigned after the prefix H spreads, because the OCP effect (where the spreading of the prefix H stops one mora shy of the melodic H) shows that the melodic H has to be in place before spreading applies.

## 3 MAKING ROOM FOR COUNTING

If we accept that the 'counting' analysis of Kuria is the only viable one we have seen, and considering also the Manyika example discussed in §2.1, we can conclude that counting to three and beyond seems to be a real and robust phenomenon, at least in the domain of tone. Given this, how can we allow for it in our theory?

Regarding stress, which has not been considered in depth in this paper but where there does appear to be evidence for ternary groupings (since, as we saw, there are patterns that stress every third syllable and there are three-syllable stress windows), an obvious move is to allow the grammar to build feet with more than two units (syllables or moras). In OT terms, we might say that the FOOTBINARITY constraint (or family of constraints) is violable. A possible objection is that with no established limit, we have no way to exclude languages with absurdly high, unattested numbers of units in their feet

(four, five, 23…). My assertion (here and in response to the analagous critique of counting rules) is that UG does allow such languages in principle and is not responsible for ruling them out. Rather, the reasons for the lack of (attested) languages that stress, e.g., every fifth syllable are functional ones, such as (1) most languages do not have a high enough proportion of sufficiently long words in the lexicon (or even polymorphemic words) to support a prosodic system that stresses every fifth syllable; and (2) relatedly, learners are unlikely to hear enough words of sufficient length to learn or reinforce such a pattern, so if it did emerge in some language it would probably be lost quickly due to imperfect acquisition (see also Samuels et al 2017 for discussion of the role of learning biases in stress typology).

The strategy for accommodating counting in tone rules depends more on the formalism that is assumed. In constraint-based approaches, since it is easy to model global effects, the locality-based mechanisms that one might use to exclude counting from autosegmental or SPE-style rules do not necessarily work. In the context of constraint-based frameworks, the 'no counting' restriction may operate as more of a rule of thumb for analysts than as a built-in restriction on representations. Locality restrictions must be formalized as constraints, so relaxing or eliminating locality restrictions may involve the relatively easy task of redefining or eliminating some constraints. Therefore, in the rest of this section I will focus on rules, though it should be noted that a constraint-based model that incorporates autosegmental representations will be affected by any 'hard' (inviolable) constraints on these representations – just not on the processes that give rise to them. (For example, it may be deemed impermissible in OT to have an output autosegmental representation with a 'gap' where a feature X on one tier is linked to two, nonadjacent elements Y and Z on another tier.)

If we adopt McCarthy & Prince's (1986) assumption that rules 'fix on' one element (the target, or 'focus' of the rule) and can 'examine a structurally adjacent element and no other', if we further assume that an 'element' has to be a single unit (either a segment or a unit in the prosodic hierarchy such as a syllable or mora, but not a string of multiple

segments or units), this means that for an SPE-style rule of the form A → B / X __ Y, X and Y can each only be a single segment or prosodic unit, not a 'string' as in the original SPE proposal. This is clearly too restrictive, so to start, one important exception (for handling, e.g., vowel harmony) is to stipulate that if an element intervenes between the trigger and target but is irrelevant and unnecessary to the application of the rule (indicated by parentheses or $X_0$), then the target and trigger are still considered adjacent. The considerable literature on locality can be seen as an extended debate over how to define 'adjacent' and how much/what kinds of 'irrelevant' material can intervene between the target and trigger (the autosegmental notion of 'tier adjacency' constituting one important answer to these questions post-SPE).

Despite advances in our understanding of locality, less attention seems to have been devoted to the question of how much material can be a part of the trigger itself. In the segmental domain, rules have often been proposed with multiple (non-boundary) elements on one side of the environment, but in many of these cases the rule could be restated without this. For instance, the environment for a rule that applies in an open syllable may be stated as '__CV', which looks like it contains two segments but could just as easily be written '__$\sigma_{CV}$' with only a single element to the right of the target. In other cases an element irrelevant to a rule may be written without parentheses or $X_0$ notation because it is always present (e.g., a vowel harmony rule such as 'V → [+back] / [+back] C __' where the intervening consonant is not 'optional' – perhaps the language does not have VV sequences – but is nonetheless not an essential part of the rule trigger). Setting aside cases like these, there may still exist segmental rule environments that crucially have two elements on one side of the trigger and cannot be reformulated otherwise. Regardless, there clearly are such cases in the domain of tone.

Consider again the rule of fourth mora H tone association in Kuria ((36), repeated from (32)).

(36) 4TH MORA H TONE ASSOCIATION

```
                    H
                    ⋮
stem [   μ   μ   μ   μ
```

Excluding the stem boundary and focusing on phonological material, we would have to say that the trigger of this rule is the three moras to the left of the target mora. No individual mora preceding the target can be said to be the trigger with the other elements being irrelevant, given that the rule crucially applies to the fourth mora. In SPE terms, the environment in which a mora gets a high tone is 'μμμ__'. We saw in §2.2 that there is no satisfactory way to reduce the trigger to a single element by grouping the moras (and/or marking moras as extrametrical). It seems necessary, then, to allow 'μμμ__' as a possible rule trigger. If we allow this, we are back to the SPE idea that in an environment X__Y, X and Y can be strings, not just single elements. Barring some additional stipulation that would differentiate suprasegmental elements/features/rules from segmental ones, this means that the strings may be not only strings of prosodic elements ('μμμ') but also strings of segments.

We may step back and ask at this point: irrespective of the formalism, (1) what exactly is bad about counting, and (2) why does counting to two not count as counting?

Regarding why counting is bad, one answer is that it assumes greater recruitment of nonlinguistic mental resources than otherwise seems to be needed. For instance, regarding the analysis of stress systems (binary or otherwise) in terms of foot groupings rather than counting: 'Counting appears to be a conscious activity that is not actually utilized

by other cognitive systems… It is thus attractive to not posit stress-generating algorithms that depend on the language faculty counting to arbitrarily high numbers' (Isac & Reiss 2008: 65).

If we accept this consideration, we might then ask why two is generally not considered an 'arbitrarily high number'. Part of the answer here may be that some of what we have subsumed under 'counting to two' can be interpreted differently. For instance, 'high tone doubling' suggests counting to two, but the autosegmental rule itself only inserts a single association line. The concept of 'doubling' or binarity does not apply to the rule, only to the surface form (the length of the surface 'domain' of the H tone is two moras, i.e. binary) and to the comparison of the underlying vs. surface forms (the domain length is doubled from one mora to two).[12] However, some degree of binarity seems to be required and irriducible, e.g., in rules or constraints that build or enforce binarity of feet, words, etc.

Another possible explanation, then, is simply that there is ample evidence for a need to refer to two elements but less evidence for larger numbers, so two has been deemed a hard limit in order to avoid a 'slippery slope' where our theory radically overgenerates in the domain of counting. This line of reasoning is adopted by Heinz (2009: 310), who in the service of arguing against ternary stress domains points out that 'no stress pattern places stress on every fourth or fifth syllable'.

A further argument in favor of counting to two appeals to notions of the fundamental building blocks of language – e.g., the logical operation 'and', or branching tree structures. For example, Rose (1999:51) (responding to Paradis & Lacharité's critique of the 'magic of number '2'' (1997: 385)) writes, 'In phonological representations, for exam-

12 It could even be argued that the environment for fourth mora High tone association in Kuria, 'μμμ__', does not really constitute counting since to apply the rule the grammar is looking for the exact sequence 'μμμ' and is not performing any calculations that refer to the number of identical adjacent elements in the string. (It does not care whether the elements are identical – it could just as easily be looking for the sequence 'μσk' – and it does not need to be able to compare the number of elements with any other number of elements using proto-mathematical concepts such as 'greater than/less than'). I will not address this possibility further since, if we reject the informal claim that 'phonology cannot count', as I do, then it does not matter whether a specific example involves true 'counting' or not.

ple in the Prosodic Hierarchy, the 'magic' number 2 is an artifact of the hypothesis that languages select binary versus unary constituents. Thus, the question does not bear on the absolute number of dependents a given node may dominate, but only on the branching/non-branching distinction for this given node.'

The implication is that binarity is permitted because it follows directly from branching. Why, however, is it assumed that branching can only be binary? Although strictly binary branching is widely assumed, e.g. in syntax, it is not universally accepted (see, e.g. Culicover & Jackendoff 2005). The defense of binarity and rejection of ternarity on the grounds that branching is binary runs into a circularity problem, as evident in the continued passage from Rose (1999: 51): '…when branching is possible, two and only two branches are possible. If arithmetic counting were allowed in representations, we would also expect ternary or quaternary constituents, a possibility which is arguably not required. A few languages show stress patterns that seem to require ternary feet. However… ternary feet can be avoided in the analyses of these stress systems.' The logic of such argumentation is that (1) because there are no ternary patterns, our theory disallows ternary structures; and (2) apparent ternary patterns should be analyzed in binary terms since our theory disallows ternary structures; therefore there are no true ternary patterns. (See also Raimy 2009 for discussion of how excluding ternarity by appealing to binarity begs the question.)

## CONCLUSION

Patterns that involve 'counting' in phonology seem to be rare and may be restricted to the domains of stress and tone. It is tempting to maintain a prohibition on counting and to explain away putative cases, but as I have argued, some problematic cases exist (whether we call them 'counting' or not).

My conclusion is that ternary (or *n*ary) branching structures and rule environments including multiple elements on the same side of the target (including a specific number

of multiple identical elements, which may constitute 'counting') are both allowed by UG and that the reasons why more cases are not described in the literature are extra-grammatical – functional, historical, accidental, and/or a product of analyses that presuppose the impossibility of ternarity and counting. There does seem to be a systematic gap in that we have not identified any segmental counting rules – our examples have all involved tone or stress. The permissive approach I am advocating does dramatically overgenerate in this regard. I suggest, however, that the lack of examples of segmental counting rules is not a product of restrictions on UG, but rather results from factors such as the phonetic origins of phonological rules and possibly learning biases affecting the acquisition process. The phonetic phenomena that give rise to phonological rules are almost entirely local in the physical sense – they involve coarticulatory or perceptual effects that usually affect only adjacent or nearby segments. The fact that segmental rules are overwhelmingly local is therefore no surprise, and does not necessarily need to be built into UG. There is no phonetic precursor for a rule that targets, for example, the third vowel or third segment of a word; there is also no other reason for a language to spontaneously develop such a rule. The few segmental features whose coarticulatory phonetic effects have a relatively long time course (e.g., rhoticity) are precisely the ones that participate in long-distance phonological relations (e.g., liquid dissimilation). Further, if the acquisition process disfavors counting (perhaps because a rule that counts is more complex than one that does not, or because rules requiring long words to manifest their effects will yield fewer tokens to guide and reinforce learning), then counting patterns may be more likely to be lost historically. Thus, if our theory allows both segmental and tone/stress rules to 'count' (or allows rule triggers to consist of unboundedly long strings), the lack of attested examples of segmental counting is not an unexplained gap.

The relative rarity of counting in tone/stress systems should also not be surprising in light of the extragrammatical considerations, but an additional consideration is that, as we have seen, some of the best cases of counting come from African tone systems. Most

of the 1000+ languages of sub-Saharan Africa are tonal, and only a small subset of these tone systems is well described in the literature. Therefore, maybe counting is not quite as 'rare' as we think it is.

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# DISCUSSION WITH ROBERT KENNEDY

(UNIVERSITY OF CALIFORNIA, SANTA BARBARA)

Kennedy, Robert. 2019. discussion in: Paster, Mary (auth.) "Phonology counts". *Radical: A Journal of Phonology*, 1, 41-55.

Paster's work provides a persuasive account of two cases in which a language's phonological patterning needs an appeal to phonological representations that admit numeric counting of components. As such, this work offers a compelling look at what may or must be considered as plausible components of phonological statements.

Both crucial test cases are drawn from the morphophonemic tone systems of Bantu languages, specifically Kuria and Manyika. Her account is compelling and perhaps the simplest and most elegant solution available to handle the phenomena, but at the cost of introducing into the formalisms of rules and constraints a sensitivity to counting, despite long standing traditions to the contrary in linear and non-linear approaches to representation and in rule-based and constraint-based approaches to derivation.

In this review I first summarize the main thrust of Paster's argument; highlighting its strengths, and rephrasing where I can the main issues with respect to the patterns in Kuria and Manyika (both in terms of their language-internal morphophonemic mechanisms and their theoretical import for phonology). I then entertain some alternative approaches which may obviate the need for counting, but the fitness of these alternatives is not certain.

**1. Locality.** Paster begins by acknowledging the gist of the theoretical issue: that phonological theories have gravitated toward a conception of representation in which rules and constraints are strictly local, and as such can only operate on adjacent elements, or in such a way that a target and its trigger are adjacent. In other words, a rule operating on some element should encode in its structural description a sequence of 2 or more ele-

ments of the same type before or after the target. The schemata below demonstrate Locality; (1a), which matches Paster's (1a), has a H tone spreading from one mora to an adjacent mora, as such respecting Locality. In contrast, (1b) has a H tone spreading from one mora to a non-adjacent mora; the skipping of the intermediate mora is a violation of Locality.

(1) a. μ μ
H

b. *μ μ μ
H

I leave aside Paster's inclusion of linear analogs to (1a) and (1b), but I do think it would help to enrich this initial theoretical basis with a few additional points, because these formalisms suggest that *skipping* is central to a non-local operation. I would add that spreading the H tone to two or more (of some exact number of) subsequent units is as much a non-local description. The representation in (1b') demonstrates this: here the rule spreads H to two subsequent moras, and the second of these is a non-local environment.

(1) b'. μ μ μ
H

Locality in this discussion is not a constraint on representations themselves, but a fundamental limit on the stuff of rules and constraints. Tone may indeed spread over three sequential units, but not at the behest of a process that invokes that precise number. Instead, its spread may result from exhaustive or iterative association to every element

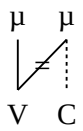
within some domain (such as a foot or stem).

A consequence or corollary of Locality is that rules and representations ought to be able to encode binary but not ternary phenomena – thus, grouping 3 segments together as a target of featural spreading or 3 syllables together as a foot is not possible given the demands of Locality.

**2.1 Binary accounts for ternary phenomena.** As background, the first part of her paper then presents a range of known phenomena in which such ternarity of representation is observed, but which can be reduced to simpler binary representations or to adjacency on a specific phonological tier. Many such examples come from tonal phonology or from metrical phonology – domains in which non-linear representation is widely adopted in theoretical notation.

Non-linear representation is a crucial step in the consolidation of Locality – without it, representations comprise linear strings of segments, subject to rules that may need to refer to sequences of two or more nearby segments in the same string. With non-linear representations, instead of shortening a vowel before two consonants (an adjacent one and a non-adjacent one), as in (2a), a rule may instead shorten vowel just within a local domain of a closed syllable by reassociating a mora (2b).

(2) a. [Vowel] → [-long] / ___ [Cons][Cons]  b.




Likewise, a harmonic pattern within the confines of Locality may spread a feature from one vowel to the next because they are adjacent on a vowel-specific tier (while a linear model requires harmony to skip over adjacent segments). As such, vowel harmony may have a vowel affect a subsequent vowel (intervening consonant features being on differ-

ent tiers thus do not preclude the vowels being adjacent) or may allow a harmonic feature to spread iteratively from one vowel to the next within some domain, but will not spread to exactly two or three subsequent vowels irrespective of domain.

**2.1.1. Tone.** Non-linear representations offer a similar elegance for tonal phonology, where tonal features may spread from one vowel or tone-bearing unit to another over intervening segments – but the tone-bearing units are adjacent on their own tier, as are the tones. Our understanding of tonal phonology, then, allows a characterization of widespread if not universal strict Locality.

Even so, some patterns are known to tempt a counting or non-local analysis even within nonlinear approaches, as Paster points out. The basic issue appears in any case where a tonal pattern invokes two or more sequential tone-bearing units. Paster's first example then is from Zezuru (3) (this appears as (2) in Paster), a Shona variety (Myers 1987), where a H tone spreads rightward to no more than exactly two following tone bearing units, reflecting the process schematized in (1b') above.

| | | | | | | |
|---|---|---|---|---|---|---|
| (3) | a. | ku-bva | 'to leave' | b. | ku-pá | 'to give' |
| | | ku-bika | 'to cook' | | ku-téngá | 'to buy' |
| | | ku-bikira | 'to cook for' | | ku-téngésá | 'to sell' |
| | | ku-puruzira | 'to rub' | | ku-téngéséra | 'to sell to' |

At first glance, a rule to yield this result would need to encode a sequence of elements in its structural description, foregoing the goal of Locality. A constraint-based analysis would presumably face the same choice.

Nevetheless, the Zezuru ultimately data provide a helpful example of distilling ternary patterns to more nuanced layers of adjacent phenomena. Paster cites Kula & Bickmore (2013), who argue that in a similar pattern in Bemba, ternarity can be attrib-

uted to 2 sequential applications of adjacent (local) H spreading to a single following unit. That there are 2 applications of the process is supported by the fact that the two applications occur under different conditions. A similar approach could apply to the more problematic scenario Paster describes for Sukuma (Richardson 1959, Siestema 1989, Roberts 1992), where H is displaced rightward by two moras, another reflection of the schema in (1b').

While some non-local phenomena can nevertheless be explained as products of a sequence of truly local effects, others offer more of a challenge. Paster thus introduces the more problematic case of Kuria, in which the position of melodic H tone within a sequence of four moras differentiates four different categories of Tense/Aspect/Mood.

**2.1.2. Meter.** Analogous to the emergence of apparent ternarity in tonal phonology is the existence of apparent ternary meter. In the more traditional approaches to metrics, the known types of feet include binary iambs and trochees as well as the ternary structures of dactyls, amphibrachs, and anapests. These, of course, are more suitable to the analysis of strict scansion rather than of word stress.[13] Metrics in non-linear phonology (focusing on natural language word stress rather than poetic convention) are reducible to binary structures, which group adjacent elements, and as such only iambs and trochees are invoked, distinguishable from each other only by the initial or final position of their strong element (see, for example, Liberman & Prince 1977, Hayes 1985)

Yet surface ternary patterns do exist in natural language – strong elements separated by two weak ones as in Tripura Bangla (Das 2002), Chugach Alutiiq (Leer 1985, Idsardi 1992, Das 2002), and Cayuvava (Key 1961). Typically such apparent ternarity is still reducible to binary, local structures. For example, other pressures may force binary trochees to be separated by intervening unfooted syllables, giving the appearance of

13 We should acknowledge the equivocal nature of the concept of the foot; in traditional metrics, it is a repeated grouping which may include more than one strong component; for example there is also the strong-strong spondee and the strong-strong-weak antibacchius. In contrast, in metrical phonology the foot is a unit that contains exactly one strong element plus additional weak ones.

three-syllable groupings. Paster also cites a few examples of apparent trimoraic minima, for example in Mele-Fila (Biggs 1975), Takuu (Moyle 2011), and Gilbertese (Blevins & Harrison 1999), and binary approaches may preserve Locality here as well, for example through requiring the head of a binary foot to also be branching.

Paster's inclusion of ternary metrical phenomena here is a helpful contribution to demonstrate the import of the issue – that in other areas of non-linear phonology aside from tone, there may be a small but crucial number of cases in which non-local descriptions are motivated within the content of phonological statements. Thus Paster provides on Page 8 a succinct layout of choices: either we can approach any case by attempting to explain it away as extensions of binarity (as can be done for Zezuru tone and Gilbertese word minima), or treat it by expanding the set of descriptions to allow non-local statements.

**2. Phonological counting in Kuria and Manyika.** The second and more central part of Paster's paper more closely addresses the tonal phonology of Kuria and Manyika. Both languages provide evidence that the distribution of tone seems to require non-local information within the rules or constraints that one would need to model the pattern at hand.

**2.1 Manyika.** In Manyika, a ternary tone-spreading is evident where a lexical H tone spreads rightward up to two following moras, as shown in (4), drawn from (9) in Paster. The forms in (4a) have no lexical tone, while those in (4b) have a lexical H tone that spreads as far as two moras from the initial vowel. The process is salient enough to call it H Tone Tripling.

| | | | | | |
|---|---|---|---|---|---|
| (4) | a. ku-bva | ‘to leave’ | b. | ku-pá | ‘to give’ |
| | ku-bika | ‘to cook’ | | ku-téngá | ‘to buy’ |
| | ku-bikira | ‘to cook for’ | | ku-téngésá | ‘to sell’ |
| | ku-puruzira | ‘to rub’ | | ku-téngéséra | ‘to sell to’ |

Some of the evidence for this phenomenon being a non-local rule comes from the interaction with independently motivated tone spreading rules, notably Penultimate Spreading, which spreads any H tone (lexical or not) rightward up to the penultimate mora. In the forms in (5) (drawn from Paster’s (12)), non-lexical H spreads to the penult in every case, irrespective of the length of the word.

| | | |
|---|---|---|
| (5) | a. ku-pá-bva | ‘to leave there’ |
| | ku-tí-bíka | ‘to cook us’ |
| | ku-tí-bíkíra | ‘to cook for us’ |
| | ku-tí-púrúzíra | ‘to rub us’ |
| | ku-tí-sékérérésa | ‘to make us smile’ |

Paster demonstrates that this process must follow H Tone Tripling, since shorter forms (trimoraic or less) with lexical tone have H spreading via H Tone Tripling to their right edge, as demonstrated in (6) (drawn from Paster’s (14)), while the forms without lexical tone in (5) above have H spreading only to the penult.

| | | |
|---|---|---|
| (6) | ku-tí-pá | ‘to give us’ |
| | ku-tí-téngá | ‘to buy us’ |
| | ku-tí-téngésá | ‘to sell us’ |
| | ku-tí-téngéséra | ‘to sell to us’ |
| | ku-tí-dzúngáírísa | ‘to confuse us’ |

While an apparent analog to H Tone Tripling can plausibly be reduced to a series of local effects in Zezuru , the same is not true for Manyika. Paster argues that there is no independent evidence for there being two sequential local processes independently of Penultimate Spreading.

Other alternative accounts are possible, but each with its own weakness. Paster cites treatments by Myers (1987) and Odden (1981); Myers relies on positing L specifications for some vowels and using these to establish triggers for spreading H no more than two moras rightward, but Paster points out that underlying L behaves differently from the lexically toneless vowels through which H tripling spreads. I should add that in a more modern perspective, an appeal to such input specification is a problem in terms of Richness of the Base – precluding toneless vowels amounts to a constraint on the input, and the absence of such forms is left unexplained.

Odden's account spreads H more generally and retracts it from the right word edge under certain circumstances. While a directed process of retraction is otherwise unmotivated by the data, this approach is driven by the fact that H spreads rightward throughout the data, with one important distinction: lexical H tone spreads to a word edge in trimoraic forms, while all other forms (ie, all longer forms, as well as shorter forms without lexical tone) have a final mora with a surface L tone.

Rephrasing this account in output-oriented terms, it is conceivable that an Align constraint spreads lexical tone rightward within some abstract (and trimoraic) domain, while a separate more general Align constraint spreads it fully rightward (but in conflict with some other constraint that requires final vowels to be L). While this takes away the stance of retraction in the process, the other issue is how to bring about a trimoraic domain in which lexical tone may spread. I return to this question in Section 4 below.

**2.2 Kuria.** Of the two patterns handled in this section, Kuria's is clearly more challenging. In this case, a range of verbal morphological functions is expressed in tandem with a set of distinct tonological sequences distributed over sequences of four tone-bearing

units. Specifically, the past prefix occurs alongside H tone associated to the initial mora of the root; the past progressive co-occurs with H associated to the second mora; future co-occurs with H on the third mora, and the inceptive occurs with H on the fourth. H spreads rightward from its basic position. These patterns are demonstrated in (7) below, drawn from Paster's (30).

(7) KURIA H TONE ASSIGNMENT

| | | | |
|---|---|---|---|
| a. | 1 | n-to-o-hɔ̍ɔ̍tɔ̍ɔ̍t-ɛ́r-a | Past |
| | | FOC-1PL-PAST-reassure-APPL-FV | |
| | | 'we reassured' | |
| b. | 2 | n-tɔ-ɔka-hoo̱tóót-éey-e | Past progressive |
| | | FOC-1PL-PAST.HAB-reassure-APPL.PERF-FV | |
| | | 'we have just been reassuring' | |
| c. | 3 | n-to-re-hɔɔtɔ̍ɔ̍t-ɛ́r-a | Remote future |
| | | FOC-1PL-FUT-reassure-APPL-FV | |
| | | 'we will reassure' | |
| d. | 4 | to-ra-hɔɔtɔɔ̍t-ɛ́r-a | Inceptive |
| | | 1PL-INCEPT-reassure-APPL-FV | |
| | | 'we are about to reassure' | |

At play here is the locus of the anchoring of a H tone to any of the first, second, third, or fourth mora. The latter two are especially problematic; it is as if the expression of FUT in the language requires H to follow two L toned units (while INCEPT invokes a sequence of 3 such units). Paster's account (adapted from Marlo, Mwita & Paster 2014, 2015) is to attribute the position of the tense/aspect H tone to rules that count moras from the left edge of the stem.

As with her discussion of Manyika, Paster duly considers alternative accounts in

which the phonological statements encode only adjacent components, and carefully addresses the shortcomings of each. One alternative is found in Hyman (1989), where the positioning of the H tone is established by targeting binary metrical structure – thus, for example, the fourth mora is identified as the right mora of the second of two binary feet. The abstractness of this approach is of course notable; in addition, its handling of the other positions is problematic, but I return to this hurdle in Section 4 below.

A second alternative (Cammenga 2004) involves positing the TAM tones as melodies of tone sequences rather than of anchored H tones that differ only by their anchored position. This approach suffers from some of the same pitfalls as Myers (1987) for Manyika: relying on specified L tones runs afoul of phenomena which otherwise motivate underlying toneless vowels, and leaves unanswered the question as to why other conceivable melodies are missing.

**3. Counting in phonology.** Paster concludes in her Section 3 with a thoughtful discussion of the implications of her analysis – foremost, that the appeal to counting in her accounts opens up the possibility of a greatly more powerful phonological mechanism, far more than what natural language typology typically motivates. To mitigate, she reasonably demonstrates that most phonological systems, for a variety of functional reasons, would gravitate towards patterns in which the appearance of Locality would emerge as a robust nearly universal trait of representation, even without expressing it as a foundational limit on the content of structural descriptions in rules and constraints.

And indeed, this notion of relaxing phonological theory and relegating its typological predictiveness to functional pressures transcends the spectrum of rule- and constraint-based models of derivation. Either model of derivation has a most stringent interpretation in which its symbolic objects are universal, as well as less stringent applications in wich the content of some objects (be they rules, constraints, features, or representaions) emerge as categories on the basis of what can be learned from ambient data (yet still within the confines defined by metaconstraints such as Locality or Richness of the

Base).

To relinquish even Locality leaves a great deal more typological observations to be explained by phenomena outside the limits of what the phonological component may express. To wit, if so few (if any) languages provide evidence of truly non-local processes, then we infer that non-local processes are simply not possible mechanisms within the power and scope of phonological models. In addition, the building blocks of phonological representations and structural descriptions have more explanatory appeal (especially when it comes to explanations of robust cross-linguistic trends) when they are held to a standard of maintaining simplicity and succinctness in their formulation. Clearly, then, there is a tension between achieving a maintenance of this more restrictive (Locality-inclusive) model and data that challenges these limits.

Probably Paster's most thought-provoking contribution is that while tone is perhaps the most likely domain in which non-local representations are to be seen, the specifics and nuances of tonal morpho-phonology in Bantu languages are underdocumented and underdescribed. It is thus a solemn implication that phonological typology of the kind that asserts certain phenomena to be unattested is sometimes formulated on the basis of a very limited and underanalyzed sample.

To add to this argument, we may admit that given the infinite scope of the input and candidate set, constraints and rules ought to be able to choose between two representations where only the count of elements in some tier is enough to distinguish them.

**4. Binary accounts for Kuria and Manyika.** On the other hand, the gravity of foregoing locality behooves us to consider alternatives which could allow these languages to exist in a binary world. It is the simple nature of phonological representations and the rules that limit their configuration that highlight their fundamental abstraction as symbolic entities distilled out of far more infinitely incremental phonetic spectra. Thus I present here a few ideas to consider for preserving a locality-oriented solution to the problems in Manyika and Kuria. In short, this would be analogous to demonstrating the

emergence of ternarity surface phenomena from more fundamental binary basics in Zezuru and Gilbertese.

For Manyika, the alternative I propose follows Odden (1981), but instead of appealing to a direct step of retraction, I suggest an output-oriented approach to have H tone spread rightward except under particular circumstances. The process identified as Penultimate Spreading can be modeled with a general Align constraint that spreads H fully rightward, but in conflict with some other constraint that requires final vowels to be L.

Meanwhile, the process of H Tone Tripling can be modeled with a more specific Align constraint that spreads lexical tone rightward within some abstract (and trimoraic) domain. While this takes away the stance of retraction in the process, the other issue is how to bring about a trimoraic domain in which lexical tone may spread. To manage this, we can appeal to the projection of some delimiting domain in which H-spreading may apply iteratively, adjacently, and exhaustively. Thus a rule or constraint could require spreading of H to the right edge of this domain, irrespective of the number of tone-bearing units within it, and apparent ternarity of the H-spreading could result from felicitous ternarity of the domain. Perhaps, for example, it is an abstract foot which achieves ternarity as feet do in Gilbertese or as stress windows do (Kager 2012).

For Kuria, the alternative I propose follows Hyman (1989) in its use of foot structure, but with the additional mechanisms of Anchor and Align afforded to us in Optimality Theory. While Paster points out that Hyman's representations may readiy target the fourth mora but not earlier ones, the two abstract feet associated with the verb stem actually allows morphophemic H to anchor to any of four moras in sequence.

These four moras are groupable as two binary feet, where each foot position can be invoked with Align, and its component moras with Anchor. We can use these tools to derive the first-mora HHHH pattern from a left-anchored (H) foot, aligned to the left edge of the root, while the second-mora LHHH pattern follows from from a right anchored foot aligned similarly to the left edge of the root.

Likewise, the third-mora LLHH and fourth-mora LLLH patterns use the same constrast of left and right Anchoring, but with the foot aligned to the right edge of the stem. An attractive aspect to this approach is that the past and past progressive patterns both invoke an H tone anchored within an initial foot, while the future and inceptive invoke an H tone anchored to a final foot.

As Paster notes while discussing the proposals that provide the basis for what I spell out here, both of these alternatives require some degree of abstraction, making use of prosodic structure that is not otherwise motivated in these languages. Indeed, independent motivation for these representations would make for a more compelling case, but the absence of such independent motivation should not sink the argument (after all, the data at hand themselves motivate the representation). Meanwhile these abstractions have precedent elsewhere in the form of otherwise imperceptible foot structure providing the domain for some pattern to extend. The alternatives I present here (as well as those acknowledged by Paster, such as Hyman 1989, Myers 1987, and Odden 1981) can truly only by dismissed if they yield some kind of contradictory result elsewhere in the distribution of tone in the languages.

More to the point, while the abstracted foot structure is not independently motivated by other data in these languages, neither is an appeal to counting. As a result, we can conclude that a constraint based system may yet have the power to choose appropriate tone sequences (including those that appear to require counting) using only binary feet and constraints that hold over their anchoring and alignment.

**5. Discussion.** The concept of Locality is an imposition held upon the stuff of rules and constraints themselves – as long as no data motivate otherwise, there is no need to posit complex non-local rules to account for natural language data. In contrast, admitting such structural representation yields a phonological model far more powerful than needed. Locality as a general trait of phonological descriptions is much more attainable in non-linear representations, which allow us to model apparent long-distance phenomena like

tonal spreading or vowel harmony as operations that hold between elements that actually are autosegmentally adjacent.

Moreover, Locality can be considered a profoundly explanatory trait in the way it limits the extent of phonological description: it greatly reduces the scope of possible phonological expressions in a way that seems to capture a similar narrowness in the range of observed phonological patterns.

In contrast, Paster provides a compelling argument that there may yet be patterns which are better modeled outside the confines of Locality. It is notable that these cases come from tonal spreading, where the tone autosegment and its spread presents exactly the scenario to test the limits of locality as a meta-constraint.

Her treatment of Manyika and Kuria is perhaps the simplest approach in how it eschews otherwise unmotivated absractions – yet it does so by relying on non-local structural descriptions in its expressions. The avoidance of non-locality comes instead at the price of appealing to foot projections which are otherwise undetectable within the phonology of the languages, and also at the risk of unintended predictions beyond the distribution of tones in the specific circumstances of interest. In short, there is no easy choice between these perspectives, though the goal of achieving simple Locality-compliant expressions cannot be attained with simple, transparent representations.

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## DISCUSSION WITH CÉDRIC PATIN

(UNIVERSITY OF LILLE)

Patin, Cédric. 2019. discussion in: Paster, Mary (auth.) "Phonology counts". *Radical: A Journal of Phonology*, 1, 56-60.

In a (very) well-written and thoroughly researched thought-provoking paper, Mary (Paster) advocates in favor of a phonological component that has the ability to count (e.g. moras), and against alternative perspectives that deny this ability. While the analysis partly builds upon data from ternary stress patterns, it mostly focuses on Eastern and Southern Bantu tone patterns.

Both the claim and the analysis that sustains it are highly convincing, and so is the data that the latter is based on. Melodic tones of Kuria [E40], in particular, strongly support the idea that "*phonology counts*" (cf. the striking example (33), p.27).

Then, why is it necessary to advocate in favor of counting, as Mary does in this paper? She does not mince her words when she explains that "*[o]ne option, which unfortunately seems to prevail in the literature [...], is simply to ignore the attested cases" (p.10), or that "the reasons why more cases are not described in the literature are extragrammatical – functional, historical, accidental, and/or a product of analyses that presuppose the impossibility of ternarity and counting*" (p.35). While it has to be reminded that it is not always the case,[14] there is undoubtedly some truth in these statements.

However, the claim is also, in my opinion, a bit unfair, since there are some good arguments supporting the fact that many – *most?* – of the ternary patterns in Bantu tonology result from the succession of two distinct rules. Mary acknowledges for

14 Discussing Creissels' (1998) account of the ternary H spreading rule of Tswana [S31], Bickmore & Kula (2013: 125 sqq.) wrote: "*It is difficult to see an alternative (non-ternary) account to these data* [...]." (Bickmore & Kula 2013: 126).

instance, with honesty, that "*Roberts provided evidence that H tone [ternary] shift [in Sukuma] not only can but must be analyzed as two separate rules, each of them local*" (p.18),[15] or that the ternary H spreading of Copperbelt Bemba "*is argued to follow from two separate rules*" (p.3), but additional examples can be provided. In the Dembwa dialect of the Bantu language Daβida (E74a – Odden 2001), binary and ternary spreading coexist, indicating that the latter may be an extension of the former, an idea supported by the fact that ternary patterns does not occur in all the dialects of the language (Philippson 2014), and the ternary pattern that characterizes Saghala [E74b], a closely-related language I worked on (Patin 2009), clearly involves two rules, since a H spreads after shifting.[16] Thus, clear-cut counting cases may well be rare among the rare cases of ternary patterns.[17] This may even be true in the S zone of Bantu languages where, in addition to Manyinka and other Shona dialects, or the Tswana example discussed in footnote 14, other cases of ternary H spreading are reported (e.g. Venda [S20] – Westphal 1962, Cassimjee 1986): according to Hyman & Mathangwane (1998), the ternary pattern of Ikalanga [S16] results from two successive H spreading rules, $HTS_2$ (a phrase-level rule) and $HTS_3$ (a utterance-level rule) – support for this analysis is provided in Hyman & Mathangwane (1998: 203;214ff).

As a consequence, ruling out an account of ternary patterns that is built upon a two-rules analysis is crucial for the claim that is made in the paper. In several occasions throughout the paper, Mary advocates against alternative analyses to ternary H spreading using the following argument: there is no independent evidence in favor of the unit (e.g. foot) or the rule (e.g. high-tone doubling) that is postulated. However, the absence of evidence is not the evidence of absence, and a doubt can arise that a rule

15 As for Sukuma, according to Philippson (1991: 134ff), additional evidence comes from the comparison with the closely-related language Nyamwezi (Sukuma and Nyamwezi form a dialectal continuum), where binary H shifting occurs.

16 A similar pattern occurs in Holoholo, a Bantu D28 language from the Democratic Republic of the Congo: /kutégelela/ > [kutegéléla] 'listen' (Coupez 1955, quoted by Kisseberth & Odden 2003:64).

17 Outside of Bantu, a case of ternary H spreading not discussed in Mary's paper is the Gur language Dagbani (Hyman 1993, Hyman & Olawsky 2004). The ternary spreading pattern is presented as a single rule by Hyman & Olawsky (2004).

remains hidden. When Mary writes p.20-21 that "*Such an analysis would not work for Manyika because the default H spreading process in Manyika is Penultimate Spreading, not binary spreading* [...].", for instance, the possibility remains that Penultimate spreading results from a high-tone doubling rule followed by another tone-spreading rule. Such a hypothesis can surely and legitimately be considered as an ad hoc trick to save the HTD hypothesis, but it is not absurd. In the Bantu language Shambaa [G23], for instance, Nonfinality prevents an unbounded spreading rule to target the final syllable of a phrase (1b), but a tone that is associated to the penult at the underlying level spreads on the final syllable (1c), indicating that the unbounded spreading rule may result from the combination of various spreading subrules.

(1) SHAMBAA[18]

| | | | |
|---|---|---|---|
| a. | | ŋombe na mboɣ<u>ó</u> | 'cow and buffalo' |
| b. | i. | mb<u>ú</u>zí ná ŋómbe | 'goat and cow' |
| | ii. | boɣ<u>ó</u> ná ŋómbe | 'buffalo and cow' |
| c. | | ŋombe na mb<u>ú</u>zí | 'cow and goat' |

In order to strengthen the claim that ternary H spreading exists, it may thus be interesting to build upon the analysis that lead Bickmore & Kula (2013) to support a two-rule account of the ternary spreading pattern of Bemba. Let us consider a hypothetical language with a ternary spreading pattern similar to that of Manyika. If this pattern results from a single spreading rule, one expect the underlying patterns in (2)...

(2) a. /...σ́ σ σ́.../ b. /...σ́ σ σ σ́.../

18 The data for Sambaa comes from Philippson (1991: 113).

...to surface either as (3i) or as (3ii).

(3) i. a [...σ́ σ σ́...] b. [...σ́ σ́ σ σ́...] [Pattern A]
ii. a. [...σ́ σ́ ˈσ́...] b. [...σ́ σ́ σ́ ˈσ́...] [Pattern B]

The surface configuration in (4), however, may indicate that the ternary pattern results from two underlying rules, the first being high-tone doubling.

(4) a [...σ́ σ́ ˈσ́...] b. [...σ́ σ́ σ σ́...] [Pattern C]

Of course, the absence of this latter pattern C in Manyika, and/or the presence of one of the two alternative configurations, would not be considered as a proof of the existence of a counting rule in the language (patterns A and B are compatible with a two successive-rules analysis). However, any weakening of such an alternative to counting is an enhancement of the claim that is made.

Thus, I think it may be interesting to explore the impact tone contacts in Manyinka may have on the analysis.[19]

**Bickmore**, L. S. & N. C. **Kula**. 2013. 'Ternary spreading and the OCP in copperbelt bemba'. *Studies in African Linguistics* 42.2 : 101–132 **Cassimjee**, Farida. 1986. *An autosegmental analysis of Venda tonology*. Ph.D. Dissertation, University of Illinois. **Coupez**, André. 1955. *Esquisse de la langue holoholo*. Tervuren: Annalen van het koninklijk museum van Belgisch-Kongo vol. 12. **Creissels**, Denis. 1998. 'Expansion and Retraction of High Tone Domains in Setswana'. In Larry M. Hyman & Charles W. Kisseberth (dir.), *Theoretical aspects of Bantu Tone*. Stanford, CSLI Publications : 133–194. **Hyman**, Larry M. & Joyce T. **Mathangwane**. 1998. 'Tonal domains and depressor consonants in Ikalanga'. In Larry M. Hyman & Charles W. Kisseberth (dir.), *Theoretical aspects of Bantu Tone*. Stanford, CSLI : 195–230. **Kisseberth**, Charles W. & David **Odden**. 2003. 'Tone'. In Derek Nurse & Gérard Philippson (dir.), *The Bantu languages*. London and New York, Routledge : 59–70. **Odden**, D. 2001. 'Tone shift and

19 However, it seems that tone contact configurations in this language are quite complicated to deal with (Sedefian 2014).

spread in Taita I'. *Studies in African linguistics* 30: 75 110. **Patin**, C. 2009. 'Tone Shift and Tone Spread in the Saghala Nominal Phrase'. *Faits de Langue - Les Cahiers* 1, pp. 230-247. **Philippson** G. 1991. *Tons et accent dans les langues bantu d'Afrique orientale : étude comparative, typologique et diachronique*. Thèse d'état, Université Paris V. **Philippson**, Gérard. 2014. 'Verb stem tone patterns in Dawida (E74a)'. *Africana Linguistica* 20 : 349–365. **Sedefian**, Z. B. 2014. *Morphologically driven tonology and the OCP in Manyika verbs*. Ms., University of Albany. Retrieved from https://www.academia.edu/9970940/Manyika_Verbal_Tonology. **Westphal** E. 1962. 'Venda: Tonal structure and intonation'. *African Studies* 21.2: 50–69 ; 123–173.

## DISCUSSION WITH OLLIE SAYEED

(UNIVERSITY OF PENNSYLVANIA)

Sayeed, Ollie. 2019. discussion in: Paster, Mary (auth.) "Phonology counts". *Radical: A Journal of Phonology*, 1, 61-62.

The author argues that the phonological component can 'count' higher than two, based on examples of tone and stress systems that seem to involve counting to three or more. If any of the world's languages involve counting, then counting must be allowed by UG. The reason that counting higher than two seems to be rare is that phonetic phenomena that would become phonologized into counting rules are rare, not because the grammar is biased against them. The paper is detailed, carefully reasoned, and adds some important data points to the foundational debate over what the phonology should and shouldn't be allowed to do.

The most important conceptual problem hinted at the paper is what it actually means for a grammar to 'count'. Myer's (1987) quoted definition is the intuition the paper is based on (and fits my intuition). As the paper points out, whether or not a process involves 'counting' depends on what representations we use.

For example: if we allow multiple rules that can each count to two (like tone doubling), can't the grammar as a whole now count up to N? This would get us grammars that can count, even if individual rules can't count. We have the same problem with explaining away counting with an /HHH/ analysis (on top of the problems with that analysis described in the paper): we could imagine languages with tone patterns like /HHHH/, /HHHHH/, /HHHHHH/… This would also give the grammar unbounded counting abilities, which the analysis was meant to avoid. (And if this isn't 'really' counting, then what is counting?)

The discussion of why exactly counting is bad in the first place makes a good point. I've never understood why storing hundreds of thousands of strings in the lexicon

(which can 'count' in the sense that /aaaaaa/ and /aaaaaaaaaa/ could be different words) is fine, but storing a string in the description of a rule is too costly.

Some of these arguments are about differences in intuition, where different analysts could reasonably have different views on which analysis is neater. On whether "L Delinking is an ad hoc rule proposed solely to avoid ternary spreading": a critic might have the opposite thought, and wonder why we need to propose ternary spreading when we can account for the surface patterns using existing machinery. One person's "ad hoc" is another's "parsimonious"…

I think the distinction between short-time-course vs long-time-course coarticulation in the final part of the paper is different to the distinction between non-counting and counting rules. Rhoticity shows long-time-course coarticulation, but never (for example) skipping intermediate liquids; so this gradient coarticulation is still 'local' in the phonological sense and doesn't involve counting anything. In the other direction, tone spreading that stops after two moras has a shorter time course than unbounded tone spreading, but the former involves counting and the latter doesn't. The time course of a coarticulatory process seems separate to the computational power we need to generate that process.

I also wasn't completely convinced by the argument for a difference between segmental and suprasegmental processes with respect to counting. It seems plausible that there are no phonetic precursors to segmental counting rules, but what's the phonetic precursor of e.g. the tone-counting rules we've seen in this paper? It's not obvious to me how ternary H tone spreading could have appeared in a single sound change; and in the case of morphologically conditioned counting rules like in Kuria, the origin of the system will have to involve something more than pure phonetics.

**Myers**, S. P. (1987) *Tone and the Structure of Words in Shona*. PhD dissertation. University of Massachusetts, Amherst.