Issues in Banawá Prosody: Onset Sensitivity, Minimal Words, and Syllable Integrity

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Three aspects of Banawá prosody (Buller, Buller, and Everett 1993, Everett 1996a,b) have been argued to present significant difficulties for metrical stress theory. First, Banawá stress is sensitive to the presence or absence of syllable onsets; second, Banawá tolerates monomoraic feet yet requires a bimoraic minimal word; and, third, it seems to employ mora-based footing that is free to ignore syllable boundaries. In this article, I argue that these issues are not nearly as problematic as they might first appear. The article demonstrates that Banawá's onset sensitivity can be produced by a constraint aligning the head syllables of feet with onsets, that its minimal word restriction can be produced with Nonfinality constraints, and that it can maintain syllable integrity simply by giving clash and lapse avoidance priority over other footing considerations.

Keywords: Banawá, stress, onset, minimality, clash, lapse

1 Introduction

Three issues in Banawá prosody (Buller, Buller, and Everett 1993, Everett 1996a,b) have been argued to present significant challenges for metrical stress theory. The first is that Banawá stress is sensitive to the presence or absence of syllable onsets. As Buller, Buller, and Everett (1993) and Everett (1996a,b) explain, Banawá strongly prefers that its syllables have onsets, restricting the occurrence of onsetless syllables to initial position. Even with this limited distribution, however, onsetless syllables have a significant effect on the stress pattern.

As illustrated in (1), when a form has an initial CV or CVV syllable,[1] its stress pattern is trochaic. Stress occurs on every odd-numbered mora counting from the left.

I would like to acknowledge the assistance of four anonymous reviewers. Their comments, questions, and suggestions have led to many improvements in the article.

[1] Long vowels in Banawá appear only in monosyllabic words, so VV sequences in longer forms are always heterorganic. (Buller, Buller, and Everett (1993) and Everett (1996a,b) offer some possible explanations for the few apparent exceptions.) Heterorganic VV sequences also have a limited distribution in Banawá, however, in that they do not appear word-initially on the surface. According to Buller, Buller, and Everett (1993) and Everett (1996a,b), when there is an initial VV sequence underlyingly, the first V is always realized on the surface as an onset glide.

Linguistic Inquiry, Volume 38, Number 2, Spring 2007
239–285

(1) a.	H	fúa	'manioc'
b.	H	fáa	'water'
c.	LL	téme	'foot'
d.	LLL	mákarì	'cloth'
e.	HHL	tìasíanì	'acquire'
f.	LLLL	báburùru	'cockroach'
g.	HLLL	kèiyárinè	'happy'
h.	LHLL	bàduébirì	'species of deer'
i.	LLLLL	mètuwásimà	'find them'
j.	LLLHL	kèrewéduàma	'turn end over end'
k.	LLLLLL	tìnarífabùne	'you are going to work'

In contrast, as illustrated in (2), when a form has an initial V syllable, its stress pattern is iambic. Stress occurs on every even-numbered mora counting from the left.

(2) a.	LL	ába	'fish'
b.	LH	uwía	'go out (as a fire)'
c.	LLL	enéki	'middle'
d.	LLH	uwárià	'one'
e.	LLLL	abébirì	'gnat'
f.	LLHLLL	atìkeíyarìne	'happy'

It is significant that onsetless syllables can provoke such a stress shift, because onsets seem never to contribute to syllable weight or to be a factor in weight-based processes.[2] Most current versions of syllable theory recognize this situation by excluding onsets from the types of elements that can have moraic status (McCarthy and Prince 1986, Hayes 1989) or, at least, independent moraic status (Hyman 1985, Zec 1988, Itô 1989). The problem presented by Banawá and similar cases, then, is to account for onset sensitivity, without abandoning the well-motivated assumptions that exclude onsets from mora count.

The second issue is most clearly illustrated in forms that contain heavy syllables. Buller, Buller, and Everett (1993) and Everett (1996a,b) describe a distinction between heavy syllables with stress on their first mora, like the first syllable in [kèiyárinè] 'happy', and heavy syllables with stress on their second mora, like the second syllable in [bàduébirì] 'species of deer'. If the description is correct, Banawá is a straightforward counterexample to the idea that the syllable is the smallest stressable unit (Jakobson 1931, Hayes 1995). Since the authors present this distinction as an observed distinction,[3] rather than a distinction made for theoretical convenience, I accept it at face value and raise no objection to the claim that individual moras can be stressed.

[2] Though several researchers have noted cases where onsets appear to play a role in stress rules (see, e.g., Everett and Everett 1984, Davis 1988), the examples are limited both in their number and in their correspondence to the full range of traditional weight-based phenomena.

[3] If the distinction is inferred, rather than observed, the authors fail to present the evidence and supporting arguments, a part of the description that I would take to be obligatory in this situation. Certainly, in cases where the authors do acknowledge an inference, as in some of their claims about syllable structure, they are careful to present their evidence and provide appropriate arguments.

Buller, Buller, and Everett (1993) and Everett (1996a,b) also take this situation, however, as evidence for a stronger claim: namely, that Banawá footing violates syllable integrity (Prince 1976, Hayes 1995). Although heavy syllables are always stressed, they never perturb the basic moraic alternations. Stress simply shifts to the position within a heavy syllable—appearing on either the first or second mora—that maintains the appropriate distribution. Since the distribution of stress is mora-based, the authors conclude that foot construction must also be mora-based: Banawá feet are maximally bimoraic and free to ignore syllable boundaries.

(3) a. (b à d u)(é b i)(r ì)   b. (k è r e)(w é d u)(à m a)
σ σ σ σ   σ σ σ σ σ

While structures like those in (3) do produce the correct stress patterns, abandoning syllable integrity opens the door to syllable-internal stress distinctions that are not actually attested. For example, as illustrated in (4), it allows multimoraic syllables that have stress on more than one mora.

(4) a. (μ́ μ)(μ́ μ)   b. (μ́)(μ́ μ)
σ σ   σ σ

The problem presented by Banawá forms with heavy syllables, then, is to produce the attested syllable-internal stress distinctions without abandoning syllable integrity. In other words, the problem is to produce mora-based alternations using syllable-based feet.

The third issue concerns the minimal word in Banawá. As Buller, Buller, and Everett (1993) and Everett (1996a,b) explain, two phenomena help to demonstrate the nature of Banawá's minimal word. The first is the distribution of long vowels, which seem only to occur in monosyllabic forms (see footnote 1).

(5) a. fáa 'water'
b. bíi 'fan'
c. búu 'beat'

Such a distribution suggests that long vowels are derived to support a bimoraic minimality requirement rather than being specified underlyingly. The second phenomenon occurs in vowel-initial forms consisting of two light syllables.

(6) a. ába 'fish'
b. áwa 'wood'
c. áwi 'tapir'

Such forms exhibit a trochaic pattern rather than the iambic pattern of their longer counterparts. This suggests that Banawá does not simply require that its minimal word be bimoraic; it also requires that the minimal word have a strong-weak contour.

As Everett (1996a,b) observes, Banawá's minimal word cannot be explained in terms of a bimoraic minimal foot requirement, the primary mechanism that theories like those of McCarthy and Prince (1986) and Hayes (1995) use to establish minimal words. Since the final stress in forms like [mákarì] 'cloth' and [mètuwásimà] 'find them' must seemingly be associated with a monomoraic foot, Banawá must tolerate monomoraic feet and should also tolerate monomoraic words. The problem, then, is to produce a bimoraic minimal word in the absence of a minimal foot restriction.

Although each of the issues discussed above has been presented as a significant challenge for metrical stress theory,[4] they are not so problematic as they might first appear. We can account for all of them using familiar devices, such as Alignment, clash avoidance, lapse avoidance, and Nonfinality. In the remainder of this section, I will briefly introduce the core components of the analysis. Subsequent sections will explore the analysis in fuller detail.

To produce Banawá's onset sensitivity, without the mediation of moras, the proposed account modifies an earlier proposal by Goedemans (1996), which established a direct alignment relationship between feet and consonants. Rather than requiring the left edges of feet to coincide with consonants, the proposed account requires the left edges of head syllables to coincide with consonants. The requirement is implemented using ALIGN(F-HD, L, C, L), given in (7).

(7) *ALIGN(F-HD, L, C, L)*
The left edge of the head syllable of every foot is aligned with the left edge of some consonant.

The effect of the constraint is to ensure that stressed syllables have onsets.[5] When syllables have onsets, like the medial and final syllables in tableau (8), they can be stressed, because their left edge coincides with a consonant.

(8) [abébirì] 'gnat'

a.be.bi.ri	ALIGN(F-HD, L, C, L)
☞ a. (a . b é)(b i . r ì)	
b. (á . b e)(b ì . r i)	*!

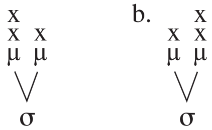
[4] Everett (2002) has argued that Paumari, a language closely related to Banawá, poses similar challenges for maintaining syllable integrity and deriving minimal words. I do not address Paumari here for two reasons. First, as Everett acknowledges, several relevant facts are in dispute. (Compare Everett's description with those of Chapman and Derbyshire (1991) and Chapman and Salzer (1999).) Second, even if we were to grant Everett's description, the arguments from Paumari are much less compelling. I simply focus here on the stronger of the two cases.

[5] Although it was specifically intended as a modification of Goedemans's (1996) foot alignment proposal, it should be noted that ALIGN(F-HD, L, C, L) has similarities in effect, though not in formulation, to a proposal by Smith (2002). Smith proposes to produce onset sensitivity more directly by relativizing the familiar ONSET constraint (Itô 1989, Prince and Smolensky 1993) to the domain of stressed syllables. The different formulations do make slightly different predictions, however. Since Alignment constraints typically come in left- and right-oriented pairs, ALIGN(F-HD, L, C, L) would have a sister constraint, ALIGN(F-HD, R, C, R), which aligns the right edge of head syllables with a consonant. Such a constraint could plausibly explain coda sensitivity, like that found in Tiberian Hebrew (McCarthy 1979), where stress is attracted to CVC syllables but not to CVV syllables. Goedemans's foot alignment proposal shares the prediction of coda sensitivity, but Smith's relativized ONSET proposal does not.

When syllables do not have onsets, like the initial syllable in tableau (8), they cannot be stressed, because their left edge does not coincide with a consonant.

Next, producing Banawá's moraic alternations, without violating syllable integrity, requires two steps. The first is to adopt an approach based on the metrical grid (Liberman 1975, Liberman and Prince 1977, and numerous subsequent proposals) and to assume that the grid's base level is constructed in relation to moras rather than syllables (see Prince 1983, Kager 1993, 1995, Hyde 2001). As illustrated in (9), since both moras of a heavy syllable will correspond to an entry on the grid's base level, there will be two possible locations for stress within a heavy syllable.

(9) a. b.



Stress can then occur at the location that is appropriate for maintaining the necessary moraic alternations.

The second step is to recognize that no Banawá form has adjacent stressed moras or adjacent stressless moras. In other words, all Banawá forms conform to what Prince (1983) refers to as the *Perfect Grid*, a metrical grid with neither clash nor lapse of gridmark entries. The device for avoiding clash in the proposed account is the *Clash constraint, given in (10a), and the device for avoiding lapse is the HeadGap constraint, given in (10b). *Clash is adapted from Prince 1983, and HeadGap is similar to other lapse avoidance devices in the literature (see, e.g., Selkirk 1984, Kager 1994, Green 1995, Green and Kenstowicz 1995, Elenbaas and Kager 1999).

(10) a. **Clash*
For any two entries on level $n+1$ of the grid, there is an intervening entry on level n.

b. *HeadGap*[6]
For every two adjacent moras, one must be the head mora of a foot.

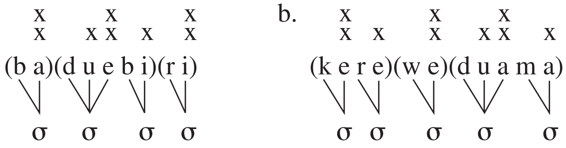
The role of *Clash in the present context is to prohibit adjacent stressed moras, and the role of HeadGap is to prohibit adjacent stressless moras. Utilizing these grid-oriented restrictions, we can easily produce moraic alternations without violating syllable integrity.

[6] The HeadGap constraint utilized here is a finer-grained and violable version of the HeadGap Condition from Hyde 2002.

(i) *HeadGap Condition*
For every two adjacent syllables, one must be the head syllable of a foot.

The HeadGap Condition is a nonviolable restriction that requires the head syllables of feet to occur no more than one syllable apart.

(11) a. b.



As illustrated in (11), stress will simply fall at a location within the syllable-based feet where clash and lapse will be avoided.

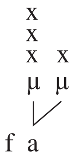
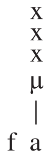
Finally, in the absence of an active foot minimality restriction, a restriction on the position of primary stress is the key to producing Banawá's bimoraic minimal word. The crucial observation is that primary stress never occurs on a prosodic word-final mora. If the prosodic word-level gridmark cannot occur over the prosodic word-final mora, then a form must be at least bimoraic to have a primary stress.

In the proposed account, the necessary restriction is implemented using a nonfinality constraint, NFIN(x_ω, μ, ω), given in (12).

(12) *NFIN(x_ω, μ, ω)*[7]
No prosodic word-level gridmark occurs over the final mora of a prosodic word.

In longer forms, the constraint has no discernible effect. Since primary stress typically occurs over the penultimate foot, there is no danger that it will occupy the prosodic word-final mora. In monosyllabic forms, however, primary stress will occur on the final mora, unless the syllable is heavy; see tableau (13).

(13) [fáa] 'water'

fa	NFIN(x_ω, μ, ω)
☞ a. 	
b. 	*!

This is the reason for the bimoraic minimum and the lengthening in underlyingly monomoraic words. In forms consisting of two light syllables, primary stress will occur on the final mora, unless the word is trochaic; see tableau (14).

[7] This type of formulation for Nonfinality constraints follows Hyde 2003. It differs from the original formulation given by Prince and Smolensky (1993) in that it focuses on grid entries rather than prosodic heads.

(14) [ába] 'fish'

a.ba	NFIN(x_ω, μ, ω)
☞ a. x x x x (a . b a)	
b. x x x x (a . b a)	*!

This is the reason that such forms have a strong-weak contour, even if they are vowel-initial.

In the sections that follow, I will present the analyses in fuller detail using the framework developed in Hyde 2001, 2002 for metrical stress. It should be noted at this point, however, that I have adopted this framework primarily because it is more accurate in the broader context of predicting stress typologies than more conventional Optimality Theory (OT) approaches.[8] The individual analyses proposed for Banawá are not intended as arguments for this particular framework, and the constraints proposed above, or constraints that are similarly formulated, could easily be used to produce the desired results in more conventional approaches. Section 2 introduces the relevant assumptions and constraints of Hyde 2001, 2002. Section 3 examines onset sensitivity, section 4 examines syllable integrity, and section 5 examines issues related to primary stress, including the minimal word. Section 6 contains a summary and concluding remarks.

2 The Adopted Framework

Although the framework adopted here diverges in several respects from conventional OT approaches, the differences do not play a central role in the analysis of Banawá. Nevertheless, it will be helpful to briefly address the particular departures that will be most noticeable in the discussion below. Section 2.1 outlines the relevant theoretical assumptions from the adopted framework, and section 2.2 introduces the constraints that are typically responsible for the types of stress patterns found in Banawá. For a more detailed presentation and supporting arguments, see Hyde 2001, 2002.

[8] The primary advantage of the Hyde 2001, 2002 framework is that it is more accurate than conventional OT frameworks in predicting iambic-trochaic asymmetries, asymmetries that arise in the typology when an attested trochaic pattern does not have an attested iambic counterpart or when an attested iambic pattern does not have an attested trochaic counterpart. The framework also eliminates certain types of even-parity pathologies—the prediction that languages with only even-parity forms are possible—and helps to predict certain lengthening effects found in Wargamay (Dixon 1981) and Yidiɲ (Dixon 1977a,b).

While the grid-oriented framework proposed by Gordon (2002) makes comparable predictions concerning the typology of quantity-insensitive systems, I adopt the Hyde 2001, 2002 framework here because it retains the foot as a prosodic category, and foot-based generalizations will be important in the analysis of Banawá.

2.1 Background and Theoretical Assumptions

There are two relevant differences in theoretical assumptions between the adopted framework and more conventional OT approaches. The first concerns the layering configurations that can be found in the prosodic hierarchy. As Nespor and Vogel (1986) and Itô and Mester (1992) explain, Selkirk's (1984) Strict Layering Hypothesis is usually taken to comprise the following two conditions:

(15) a. *Strict Succession* (adapted from Itô and Mester 1992)
Every prosodic category of level $n-1$ is immediately dominated by a prosodic category of level n (i.e., category levels are never skipped).

b. *Proper Bracketing* (adapted from Itô and Mester 1992)
Every prosodic category of level $n-1$ has one and only one mother node (i.e., a given prosodic constituent cannot be immediately dominated by two or more higher prosodic constituents).

Strict Succession mandates that the prosodic hierarchy's immediate dominance relationships be respected. All moras must be syllabified, all syllables must be footed, and all feet must be included in prosodic words. Proper Bracketing mandates that prosodic categories of the same level not overlap. Two syllables may not include the same mora, two feet may not include the same syllable, and two prosodic words may not include the same foot.[9]

More conventional OT approaches, such as those taken by McCarthy and Prince (1993a) and Crowhurst and Hewitt (1995), have followed Itô and Mester in making Strict Succession violable and Proper Bracketing nonviolable.[10] The adopted framework does just the opposite: it makes Proper Bracketing violable and Strict Succession nonviolable.

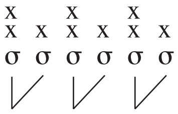
Although this difference has substantial consequences in a broader typological context, its significance in the analysis of Banawá is limited. The adopted framework would assign structures to Banawá's consonant-initial words that are very similar to more conventional structures.

[9] Following Itô and Mester (1992), I take it that Strict Succession and Proper Bracketing only constrain relationships between prosodic categories: moras, syllables, feet, prosodic words, and higher categories. They do not constrain relationships between segments and prosodic categories. For example, Strict Succession does not mandate that all segments be parsed at the mora level. Following McCarthy and Prince (1986) and Hayes (1989), I assume instead that onsets are always nonmoraic and that codas may or may not be moraic. Also, Strict Succession does not prevent nonmoraic consonants from being adjoined to prosodic structure higher than the syllable.

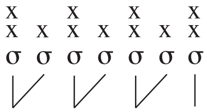
[10] In addition to Itô and Mester (1992), Selkirk (1995) presents several arguments in support of a violable Strict Succession. Although I will not focus on the debate here, I present arguments for the opposing view in Hyde 2001, 2002.

(16) a. *Conventional structures* b. *Proposed structures*

(σ́σ)(σ́σ)(σ́σ)



(σ́σ)(σ́σ)(σ́σ)(σ́)

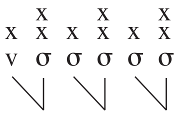


As illustrated in (16), both approaches would parse every syllable into feet, and there would be no improperly bracketed prosodic categories.

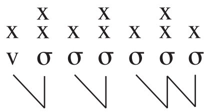
The structures assigned to vowel-initial words, however, would exhibit a slight difference in odd-parity forms. (In (17), a lowercase *v* represents an onsetless syllable.)

(17) a. *Conventional structures*[11] b. *Proposed structures*

(vσ́)(σσ́)(σσ́)



(vσ́)(σσ́)(σσ́)σ



In the final three syllables of an odd-parity form, conventional OT frameworks would foot the first two syllables and leave the third syllable unfooted. The adopted framework would parse all three syllables using two overlapping feet. The two feet share the middle syllable and the foot-level gridmark that occurs above it.

Without going into unnecessary detail, I will note here that the occurrence of overlapping feet is sharply restricted in the adopted framework, since alignment constraints typically confine them to one edge or the other of an odd-parity form. For present purposes, the best way to think of these structures is that they are simply the adopted framework's substitute for sequences involving a foot and an unfooted syllable, and they will arise in similar contexts.

The second difference is that the adopted framework distinguishes between *prosodic head* and *gridmark*,[12] while more conventional OT frameworks tend either to conflate these notions

[11] As we will see in section 3.2, approaches rooted in more conventional frameworks actually tend to use trochaic footing for vowel-initial forms. The iambic footing illustrated in (17a), however, is the structure typically used for this type of pattern when onset sensitivity is not an issue. I use iambic footing in this particular example only to highlight the differences in structural assumptions between the adopted framework and more conventional frameworks.

[12] In other words, the adopted framework maintains a distinction between prosodic prominence and metrical prominence. In this respect, the approach is similar in spirit, if not in actual execution, to the original proposals of Liberman (1975) and Liberman and Prince (1977).

or to abandon the metrical grid altogether. A *head* is a prosodic category's most prominent constituent and a possible location for stress. A *gridmark* is an entry on the metrical grid indicating that a position is actually stressed.[13] Following Prince and Smolensky (1993), I assume that headship is defined recursively. For example, a foot's most prominent syllable is a head for that foot, and the most prominent mora of the head syllable is also a head for the foot.

In the adopted structures in (16b) and (17b), a vertical association line indicates a prosodic head, and an *x* above the prosodic structure indicates a gridmark entry. Although gridmarks above the base level must always occur over a prosodic head, a prosodic head may or may not be associated with a gridmark. For example, when feet overlap, as in (17b), the head syllable of the first foot—the syllable contained in both feet—is the only head syllable associated with a foot-level gridmark. Since the stressed syllable is a constituent of both feet, however, both feet are considered stressed.

In the present context, the primary significance of the distinction between *head* and *gridmark* is that constraints in the adopted framework may refer specifically to one or the other. The formulations presented in section 1 reflect this situation. The Nonfinality constraint, NFIN(x_ω, μ, ω), and the clash avoidance constraint, *CLASH, are formulated with reference to gridmarks. The Alignment constraint, ALIGN(F-HD, L, C, L), and the lapse avoidance constraint, HEADGAP, are formulated with reference to prosodic heads. Although the distinction does not play a crucial role in the analysis of Banawá, in particular, it may be helpful to keep it in mind when evaluating candidates in example tableaux.

2.2 Constraints

The analysis presented below relies on four types of constraints. Since the general formulations for most of these types will be familiar, I will introduce the constraints briefly and postpone illustrating their interactions until the point in the discussion where they are most directly relevant. The first group consists of the Perfect Grid constraints, the constraints responsible for avoiding clash and lapse. They were introduced in section 1 and are repeated in (18).

(18) a. **CLASH*

For any two entries on level $n+1$ of the grid, there is an intervening entry on level n.

b. *HEADGAP*

For every two adjacent moras, one must be the head mora of a foot.

[13] More precisely, through the formation of grid columns, gridmarks indicate the relative degrees of stress in different positions.

Recall that the role of *Clash in the present context is to prohibit adjacent stressed moras and that the role of HeadGap is to prohibit adjacent stressless moras.[14]

The second group consists of Alignment constraints (McCarthy and Prince 1993a). In addition to Align(F-hd, L, C, L), introduced in section 1 and repeated in (19a), the analysis utilizes Align(F-hd, R, ω, R), given in (19b), and Align(ω-hd, R, ω, R), given in (19c).[15]

(19) a. *Align(F-hd, L, C, L)*
The left edge of the head syllable of every foot is aligned with the left edge of some consonant.

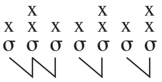
b. *Align(F-hd, R, ω, R)*
The right edge of the head syllable of every foot is aligned with the right edge of some prosodic word.

c. *Align(ω-hd, R, ω, R)*
The right edge of the head foot of every prosodic word is aligned with the right edge of some prosodic word.

Recall that Align(F-hd, L, C, L) is responsible for producing onset sensitivity. It aligns the left edge of head syllables with a consonant.

The second Alignment constraint, Align(F-hd, R, ω, R), aligns head syllables with the right edge of a prosodic word. As illustrated in tableau (20), this type of constraint can establish both foot type and footing directionality.

[14] Because it only prevents the head moras of feet from occurring more than one mora apart, HeadGap does not exclude lapse configurations that arise because a head syllable has been left stressless. For example, it does not exclude the lapse configuration created when overlapping feet occur at the left edge of an iambic form.

(i)


As illustrated in (i), when an iambic foot follows the stressless head syllable of two overlapping feet, the result is a lapse, even though the head moras never occur more than one mora apart. As tableau (20) will show, however, rightward foot-head alignment excludes such configurations in iambic forms by positioning overlapping feet, when they occur, at the right edge of the prosodic word. Since the possibility of positioning overlapping configurations somewhere other than the right edge of the prosodic word is of limited interest here, for the sake of simplicity I will assume throughout the article that HeadGap excludes both types of lapse configurations. See Hyde 2002, however, for additional discussion of the adopted framework's ability to control clash and lapse.

[15] As is customary with Alignment constraints referring to prosodic categories, violations of Align(F-hd, R, ω, R) and Align(ω-hd, R, ω, R) will be measured in terms of intervening syllables. Since Align(F-hd, L, C, L) has a reference to segments and requires finer measurements, its violations will be measured in terms of intervening segments.

(20)

σσσσσσσ	ALIGN(F-HD, R, ω, R)
☞ a. x x x x x x x x x x σ σ σ σ σ σ σ	* *** *****
b. x x x x x x x x x x σ σ σ σ σ σ σ	** **** ****!*
c. x x x x x x x x x x σ σ σ σ σ σ σ	* *** ***** *!*****
d. x x x x x x x x x x σ σ σ σ σ σ σ	* ** **** ***!***

In particular, given its rightward orientation, ALIGN(F-HD, R, ω, R) prefers the rightward iambic footing of candidate (20a) to the leftward iambic footing of candidate (20b), the leftward trochaic footing of candidate (20c), or the rightward trochaic footing of candidate (20d).

The final Alignment constraint, ALIGN(ω-HD, R, ω, R), aligns head feet toward the right edge of a prosodic word.

(21)

σσσσ	ALIGN(ω-HD, R, ω, R)
☞ a. x x x x x x x σ σ σ σ F F	
b. x x x x x x x σ σ σ σ F F	*!*

As illustrated in tableau (21), by influencing the position of the head foot, the constraint also influences the position of primary stress, drawing it toward the prosodic word's right edge.

Notice that I have retained traditional gradient evaluation in the formulation of Alignment constraints, despite McCarthy's (2003) claim that all OT constraints should be categorical. There are several reasons for this. First, the case for the Categoricality Hypothesis relies heavily on the ability of Kager's (2001) licensing approach to produce directionality effects in binary stress patterns, one of the traditional domains of gradient Alignment. Although Kager acknowledges that his theory is incomplete, he does show that it is possible to use constraints that license clash and lapse in certain positions to produce many of the effects of directional footing. The recent accounts in Hyde 2001, 2002 and Gordon 2002, however, both rely on gradient Alignment, and they appear to be better able to predict the typology of binary patterns. Also, it is unclear how successful the licensing approach could be when extended to other types of patterns. Lapse is the norm in ternary systems, for example, and clash is nonexistent, so it is difficult to see how licensing clash and lapse could account for the directionality effects found in ternary systems.

Second, McCarthy notes that the categoricality approach would be undermined by the existence of languages where primary stress prefers to occupy a nonperipheral foot. Categorical constraints can easily position primary stress over an initial or final foot, but they cannot, for example, reliably position primary stress over a penultimate foot. Although McCarthy calls into question some of the traditional examples, there are clear cases of stress preferring to fall on a penultimate foot. Khalkha and Buriat Mongolian (Walker 1997) are especially clear cases,[16] and, as we will see in section 5, Banawá itself may also provide an example.

Finally, it seems possible to reformulate Alignment constraints so that they actually have categorical evaluation while maintaining the power of gradient evaluation. For example, we might reformulate ALIGN(F-HD, R, ω, R) as in (22), counting a violation for every syllable every time it occurs between a head syllable and the right edge of the prosodic word.[17] The number of violations incurred by a given candidate under this type of evaluation would be identical to the number of violations incurred under the gradient evaluation from (19b).

(22) *ALIGN(F-HD, R, ω, R)*

$$*\sigma \;/\; \underset{\substack{|\\ \mathrm{F}}}{\sigma} \;\ldots\; \_\_\_\_ \;\ldots\; {}_{\omega}]$$

Although McCarthy tends to avoid allowing a single locus of violation to receive a violation mark in more than one offending context, his discussion of the LINEARITY constraint indicates that he considers it appropriate to count such evaluations as categorical. In fact, the method of evaluation for ALIGN(F-HD, R, ω, R) under (22) is parallel to his proposed method of evaluation for LINEARITY. Overall, then, it would seem to be a mistake, at this point, to abandon gradient evaluation for Alignment constraints.

[16] In Khalkha and Buriat Mongolian (Walker 1997), the initial syllable of a form is stressed, and every heavy syllable is stressed. When there are multiple stresses, the rightmost is primary, unless it happens to occur over the final syllable. When the rightmost stress occurs over the final syllable, the penultimate stress is the primary stress. It is this latter situation that is problematic for the Categoricality Hypothesis, because the primary stress prefers, and must somehow be positioned over, the penultimate foot.

[17] In other words, where *S* is a syllable, *H* is a head syllable, and *E* is the right edge of the prosodic word, a violation mark is assigned for every ordered triplet ⟨*S*, *H*, *E*⟩ such that *S* intervenes between *H* and *E*.

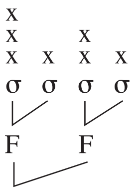
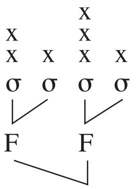
The third group of constraints consists of Nonfinality constraints (Prince and Smolensky 1993). In addition to NFin(x_ω, μ, ω), introduced in section 1 and repeated in (23a), the analysis utilizes NFin(x_F, μ, ω), given in (23b), and NFin(x_ω, F, ω), given in (23c).

(23) a. *NFin(x_ω, μ, ω)*
No prosodic word-level gridmark occurs over the final mora of a prosodic word.
b. *NFin(x_F, μ, ω)*
No foot-level gridmark occurs over the final mora of a prosodic word.
c. *NFin(x_ω, F, ω)*
No prosodic word-level gridmark occurs over the final foot of a prosodic word.

Recall that NFin(x_ω, μ, ω) is responsible for establishing Banawá's bimoraic minimal word. It prohibits primary stress from occupying a prosodic word-final mora. The second constraint, NFin(x_F, μ, ω), is similar, except that it applies to foot-level gridmarks rather than prosodic word-level gridmarks. It prohibits both primary and secondary stress from occupying a prosodic word-final mora.[18]

The third Nonfinality constraint, NFin(x_ω, F, ω), prohibits primary stress from occupying a prosodic word-final foot.

(24)

σσσσ	NFin(x_ω, F, ω)
☞ a. 	
b. 	*!

In the present context, as illustrated in tableau (24), it helps to produce a foot extrametricality effect, an effect where primary stress prefers the penultimate foot to the final foot.

The final type of constraint is the Initial Gridmark constraint (Hyde 2001, 2002), and this type may be less familiar. Initial Gridmark performs a function opposite to that of Nonfinality. Where Nonfinality requires the absence of a grid entry over a final element, Initial Gridmark

[18] NFin(x_F, μ, ω) will not actually play a role in the analysis of Banawá, but it will play a role in Southern Paiute, which I consider briefly in section 4.3 for purposes of comparison.

requires the presence of a grid entry over an initial element. The particular formulation utilized here applies to foot-level gridmarks and prosodic word-initial moras.

(25) *IGRID(x_F, μ, ω)*
A foot-level gridmark occurs over the initial mora of a prosodic word.

As illustrated in tableau (26), IGRID(x_F, μ, ω) simply requires that a prosodic word have stress on its initial mora.

(26)

<table>
<tr><th>σσσσ</th><th>IGRID(x_F, μ, ω)</th></tr>
<tr><td>☞ a. x   x
x x x x
σ σ σ σ</td><td></td></tr>
<tr><td>b.   x   x
x x x x
σ σ σ σ</td><td>*!</td></tr>
</table>

Since most trochaic patterns meet this requirement and most iambic patterns do not, this constraint will be responsible for producing the trochaic pattern of Banawá's consonant-initial forms.

Having introduced the relevant theoretical assumptions and the core constraints, I turn now to a more detailed analysis of the problematic Banawá phenomena. Section 3 examines onset sensitivity, section 4 examines syllable integrity, and section 5 examines issues related to primary stress, including the bimoraic minimal word.

3 Onset Sensitivity

Although onset sensitivity is rare, it appears to be the reason that Banawá has two distinct stress patterns. For convenience, these patterns are illustrated again in (27) and (28) using forms that contain only light syllables.

(27) a. téme 'foot'
b. mákarì 'cloth'
c. báburùru 'cockroach'
d. mètuwásimà 'find them'
e. tìnarífabùne 'you are going to work'

(28) a. enéki 'middle'
b. ukúmu 'parasite'
c. abébirì 'gnat'
d. abárikò 'moon'

As (27) illustrates, consonant-initial forms always stress their initial syllable, exhibiting a trochaic pattern where stress occurs on every odd-numbered mora counting from the left. In contrast, as

(28) illustrates, vowel-initial forms always leave their initial syllable stressless, exhibiting an iambic pattern where stress occurs on every even-numbered mora counting from the left.

If we were to analyze the situation in terms of prominence, we might say that syllables with onsets are prominent enough to bear stress but syllables without onsets are not. Because onsets do not play a role in the standard types of weight-based processes (Hyman 1985, 1990, McCarthy and Prince 1986, Hayes 1989), however, it has long been assumed that they do not contribute to mora count, the conventional measure of syllable prominence. The problem presented by Banawá and similar cases, then, is to produce onset sensitivity without relying on the mediation of moras.

To avoid the mediation of moras, the proposed approach posits a direct alignment relationship between head syllables and consonants, a relationship established by ALIGN(F-HD, L, C, L), repeated in (29).

(29) *ALIGN(F-HD, L, C, L)*
The left edge of the head syllable of every foot is aligned with the left edge of some consonant.

Because it requires the left edges of head syllables to coincide with a consonant, and because stress must always occur over a head syllable, a high-ranking ALIGN(F-HD, L, C, L) ensures that stressed syllables always have onsets. The discussion proceeds as follows. Section 3.1 shows how ALIGN(F-HD, L, C, L) helps to produce the basic Banawá stress patterns. Section 3.2 examines some of the more recent alternatives to the proposed account.

3.1 The Proposed Account

The issue of onset sensitivity arises in Banawá in the context of a shift from a trochaic pattern to an iambic pattern. When the initial syllable has an onset, it can be stressed, and the form exhibits the default trochaic pattern. When the initial syllable does not have an onset, it cannot be stressed, so the trochaic pattern must be avoided. An iambic pattern, which leaves the initial syllable stressless, emerges instead.

Schematically, to establish the trochaic pattern as the default pattern, constraints that prefer trochaic footing must dominate constraints that prefer iambic footing. Given such a ranking, a trochaic pattern will always emerge, unless a more important consideration requires that it be avoided. In Banawá, of course, a more important consideration is that stress avoid onsetless syllables, and this makes it necessary to rank ALIGN(F-HD, L, C, L) above the constraints that prefer trochaic footing.

(30) ALIGN(F-HD, L, C, L) $\gg$ trochaic constraints $\gg$ iambic constraints

Given such a ranking, ALIGN(F-HD, L, C, L) will negate the preferences of the trochaic constraints in those contexts where trochaic footing would position stress on an onsetless syllable. Since onsetless syllables are restricted to initial position, and the trochaic pattern always stresses the initial syllable, ALIGN(F-HD, L, C, L) will require an iambic pattern in vowel-initial forms.

In the adopted framework, a constraint that produces iambic footing is ALIGN(F-HD, R, ω, R), repeated in (31a), which aligns head syllables with the right edge of the prosodic word. A constraint that produces trochaic footing is IGRID(x_F, μ, ω), repeated in (31b), which requires a foot-level gridmark over the prosodic word-initial mora. When the trochee-producing IGRID(x_F, μ, ω) dominates the iamb-producing ALIGN(F-HD, R, ω, R), Banawá's trochaic pattern is established as its default pattern.

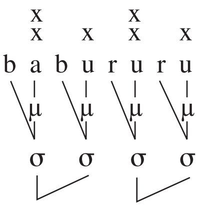
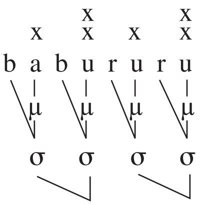
(31) a. *ALIGN(F-HD, R, ω, R)*
The right edge of the head syllable of every foot is aligned with the right edge of some prosodic word.
b. *IGRID(x_F, μ, ω)*
A foot-level gridmark occurs over the initial mora of a prosodic word.

To avoid the default trochaic pattern in forms with an initial onsetless syllable, the onset-sensitive ALIGN(F-HD, L, C, L) must dominate the trochee-producing IGRID(x_F, μ, ω).

(32) ALIGN(F-HD, L, C, L) ≫ IGRID(x_F, μ, ω) ≫ ALIGN(F-HD, R, ω, R)

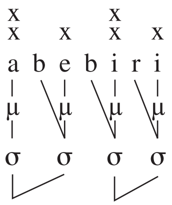
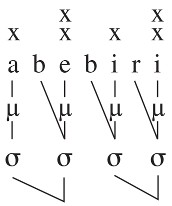
ALIGN(F-HD, L, C, L) can then require an iambic pattern in vowel-initial forms, but IGRID(x_F, μ, ω) will be free to reestablish the trochaic pattern in consonant-initial forms. Tableaux (33) and (34) use even-parity forms to illustrate the crucial interactions.

(33) [báburùru] 'cockroach'

ba.bu.ru.ru	ALIGN (F-HD, L, C, L)	IGRID (x_F, μ, ω)	ALIGN (F-HD, R, ω, R)
☞ a. 			* ***
b. 		*!	**

In tableau (33), the input is a consonant-initial form. Candidate (33a) exhibits Banawá's trochaic pattern, and candidate (33b) exhibits Banawá's iambic pattern. Since every head syllable in both candidates coincides with a consonant, both satisfy ALIGN(F-HD, L, C, L), and the decision falls to the lower-ranked constraints. The crucial ranking in this case, then, is IGRID(x_F, μ, ω) ≫ ALIGN(F-HD, R, ω, R). Since candidate (33b)'s footing is iambic, it positions its head syllables with the best possible rightward alignment, given the length of the form, so that it performs better on ALIGN(F-HD, R, ω, R). However, since candidate (33a)'s trochaic footing positions a foot-level gridmark over the initial mora, whereas candidate (33b)'s iambic footing does not, (33a) better satisfies the higher-ranked IGRID(x_F, μ, ω) and emerges as the winner. This is the desired result for a consonant-initial form.

(34) [abébirì] 'gnat'

a.be.bi.ri	ALIGN (F-HD, L, C, L)	IGRID (x_F, μ, ω)	ALIGN (F-HD, R, ω, R)
a. 	*!		* ***
☞ b. 		*	**

In tableau (34), the input is a vowel-initial form. Candidate (34a) exhibits Banawá's trochaic pattern, and candidate (34b) exhibits Banawá's iambic pattern. In this case, the crucial ranking is ALIGN(F-HD, L, C, L) ≫ IGRID(x_F, μ, ω). Since candidate (34a)'s trochaic pattern positions a foot-level gridmark over the initial mora, it better satisfies IGRID(x_F, μ, ω). However, since candidate (34b)'s iambic pattern avoids making the onsetless syllable a head syllable, whereas candidate (34a)'s trochaic pattern does not, (34b) better satisfies the higher-ranked ALIGN(F-HD, L, C, L) and emerges as the winner. This is the desired result for a vowel-initial form.

Tableaux (33) and (34) illustrate the basic schema by highlighting the central roles of ALIGN(F-HD, L, C, L) and IGRID(x_F, μ, ω). The ranking between these two constraints provides the crucial interaction for producing Banawá's onset-sensitive stress shift. Since we only considered two candidates in the example tableaux, however, candidates that both exhibited one of Banawá's basic patterns, we do not yet have a clear picture of how these patterns are selected over other possible patterns. To really understand the situation, we must also consider the role of clash and lapse avoidance.

There are only four possible patterns that conform to Prince's (1983) Perfect Grid, a metrical grid with neither clash nor lapse of gridmark entries. I will refer to the first pair of patterns, illustrated in (35), as the *minimal alternation* patterns. These have the smallest number of foot-level gridmarks possible without producing a lapse. The trochaic version stresses every even-numbered position counting from the right, and the iambic version stresses every even-numbered position counting from the left. I will refer to the second pair of patterns, illustrated in (36), as the *maximal alternation* patterns. These have the greatest number of foot-level gridmarks possible without producing a clash. The trochaic version stresses every odd-numbered position counting from the left, and the iambic version stresses every odd-numbered position counting from the right.

(35) *Minimal alternation*

a. Trochaic b. Iambic

```
 x   x   x          x   x   x
 x x x x x x      x x x x x x

   x   x   x        x   x   x
 x x x x x x x    x x x x x x x
```

(36) *Maximal alternation*

a. Trochaic b. Iambic

```
 x   x   x            x   x   x
 x x x x x x        x x x x x x

 x   x   x   x      x   x   x   x
 x x x x x x x      x x x x x x x
```

*Clash, the clash avoidance constraint, and HeadGap, the lapse avoidance constraint, are repeated in (37).

(37) a. **Clash*
For any two entries on level $n+1$ of the grid, there is an intervening entry on level n.

b. *HeadGap*
For every two adjacent moras, one must be the head mora of a foot.

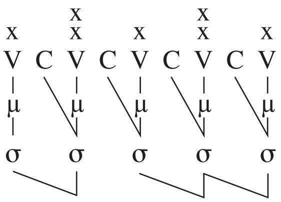
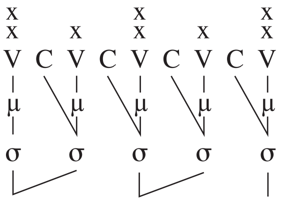
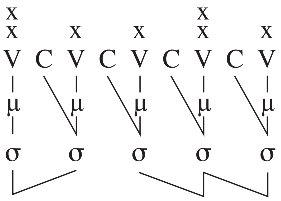
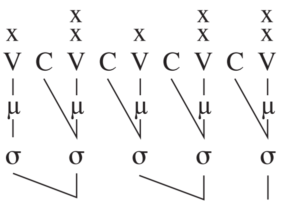
If we assume that both are undominated, as in (38), they limit the candidates available for consideration by the other constraints to the four patterns that conform to the Perfect Grid.

(38) *Clash, HeadGap, Align(F-hd, L, C, L) $\gg$ IGrid(x_F, μ, ω) $\gg$ Align(F-hd, R, ω, R)

Once *Clash and HeadGap have excluded all but the four Perfect Grid patterns, the decision between the remaining candidates falls to Align(F-hd, L, C, L) and IGrid(x_F, μ, ω). Since iambic minimal alternation is the only Perfect Grid pattern that always leaves the initial position stressless, this is the pattern preferred by the onset-sensitive Align(F-hd, L, C, L) when a form's initial syllable does not have an onset. Since trochaic maximal alternation is the only Perfect Grid pattern that always stresses the initial position, it is the pattern preferred by IGrid(x_F, μ, ω) when a form's initial syllable does have an onset.

To illustrate, in vowel-initial forms, *Clash and HeadGap exclude all patterns with clash or lapse, leaving only the Perfect Grid patterns. From these, Align(F-hd, L, C, L) selects iambic minimal alternation, because it leaves the onsetless initial syllable stressless. Tableau (39) demonstrates using a hypothetical vowel-initial form containing five light syllables.[19]

(39) V.CV́.CV.CV̀.CV

V.CV.CV.CV.CV	*CLASH	HEADGAP	ALIGN (F-HD, L, C, L)	IGRID (x_F, μ, ω)
☞ a. 				*
b. 			*!	
c. 		*!	*	
d. 	*!			*

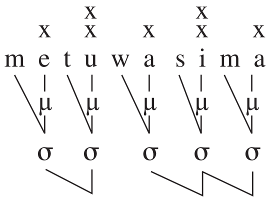
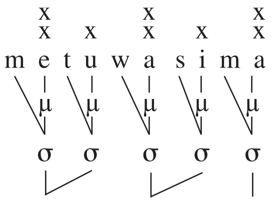
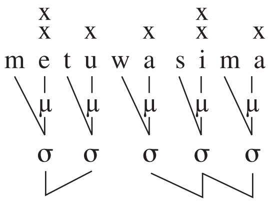
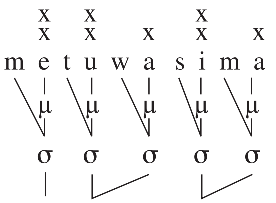
In tableau (39), candidates (39a) and (39b) exhibit the two most relevant Perfect Grid patterns, candidate (39c) contains a lapse configuration, and candidate (39d) contains a clash configuration. *CLASH excludes candidate (39d)'s adjacent stressed moras, and HEADGAP excludes candidate (39c)'s adjacent stressless moras, so that only the Perfect Grid patterns remain. Since the initial

[19] Buller, Buller, and Everett (1993) and Everett (1996a,b) do provide examples of vowel-initial forms containing more than four syllables. These examples, however, also happen to contain heavy syllables, and I do not examine forms with heavy syllables until section 4.

stress of the trochaic candidate (39b) requires an onsetless syllable to be a head syllable, it is excluded by ALIGN(F-HD, L, C, L), and the iambic candidate (39a) emerges as the winner.

In consonant-initial forms, *CLASH and HEADGAP again exclude all patterns with clash or lapse, leaving only the Perfect Grid patterns. Since there are no onsetless syllables to be avoided in this situation, ALIGN(F-HD, L, C, L) does not affect the evaluation, and IGRID(x_F, μ, ω) is free to select the trochaic maximal alternation pattern.

(40) [mètuwásimà] 'find them'

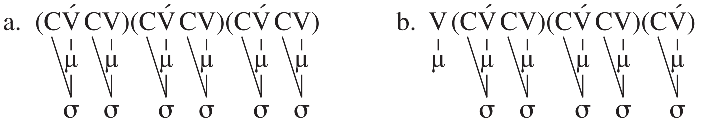
me.tu.wa.si.ma	*CLASH	HEADGAP	ALIGN (F-HD, L, C, L)	IGRID (x_F, μ, ω)
a. 				*!
☞ b. 				
c. 		*!		
d. 	*!			

In tableau (40), candidates (40a) and (40b) exhibit the two most relevant Perfect Grid patterns, and the other candidates exhibit clash or lapse configurations. *CLASH excludes the adjacent stressed moras in candidate (40d), and HEADGAP excludes the adjacent stressless moras in candidate (40c). Both of the Perfect Grid candidates satisfy ALIGN(F-HD, L, C, L), and the decision falls to IGRID(x_F, μ, ω). Since the iambic candidate (40a) leaves the initial mora stressless, it is excluded, and the trochaic candidate (40b) emerges as the winner.

To summarize, in the proposed analysis, the undominated *CLASH and HEADGAP constraints exclude all candidates with clash or lapse, leaving only the four Perfect Grid patterns for ALIGN(F-HD, L, C, L) and IGRID(x_F, μ, ω) to consider. For vowel-initial forms, the higher-ranked ALIGN(F-HD, L, C, L) selects iambic minimal alternation, since it is the only Perfect Grid pattern that always leaves the initial syllable stressless. For consonant-initial forms, the lower-ranked IGRID(x_F, μ, ω) is free to select trochaic maximal alternation, the Perfect Grid pattern that always stresses the initial mora. Next, we will consider some of the more recent alternatives to the proposed account.

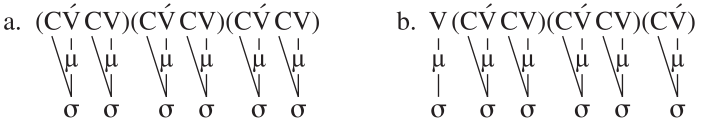
3.2 Alternatives

Though rare, onset sensitivity is not unique to Banawá. Languages like Western Aranda (Strehlow 1942) and Alyawarra (Yallop 1977) exhibit similar onset-sensitive stress shifts, and recent approaches fall into two types. The first is based on the idea that vowels cannot be syllabified unless they have onsets (though they are licensed in the output because they have moraic status), and higher prosodic structure must avoid unsyllabified vowels. Downing (1993), for example, argues that unsyllabified vowels cannot be parsed into feet, and Everett (1996a,b) argues that unsyllabified vowels cannot begin a prosodic word. In either case, an unsyllabified vowel causes a rightward shift in footing, and this, in turn, causes a rightward shift in the stress pattern.

(41)


As (41a) illustrates, when a form begins with a syllable, a foot can occur at the left edge. As (41b) illustrates, however, when a form begins with an unsyllabified vowel, a foot cannot occur at the left edge, so footing must shift to the right. The result is the same whether unsyllabified vowels are excluded from feet directly, as in Downing 1993, or indirectly, as in Everett 1996a,b.

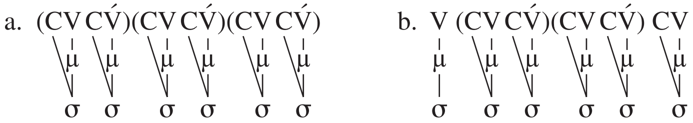
The second approach is a bit more direct, requiring that the left edge of some higher prosodic category be aligned with an onset. Goedemans (1996), for example, argues that the left edges of feet must coincide with an onset, and Downing (1998) argues that the left edges of prosodic words must coincide with an onset. In either case, an initial vowel again causes a rightward shift in footing.

(42)


As (42a) illustrates, when a form begins with a consonant, a foot can occur at the left edge. As (42b) illustrates, however, when a form begins with a vowel, a foot cannot occur at the left edge, and footing must shift to the right. The result is the same whether initial vowels are excluded from feet directly, as in Goedemans 1996, or indirectly, as in Downing 1998.

Although the alternative approaches do produce the correct stress patterns, they also encounter significant difficulties. First, the phenomenon seems truly to result from the sensitivity of prominent syllables to onsets rather than the sensitivity of syllabification generally to onsets or the sensitivity of feet or prosodic words to onsets. Banawá, Western Aranda, and Alyawarra are all trochaic in consonant-initial forms, so that the left edge of each foot coincides with a stress. Shifting the trochaic feet rightward in vowel-initial forms also happens to leave the initial vowel stressless. If it is truly syllabification generally, however, or the edges of feet or prosodic words that are sensitive to onsets, we would expect to see the same type of rightward shift in iambic systems.

(43)



In such a case, a vowel-initial form would shift the leftmost stress from the peninitial syllable to the postpeninitial syllable.[20] To my knowledge, such systems are unattested.

The second difficulty is that the alternatives crucially rely on underparsing and therefore could not conform to Strict Succession. In Downing 1993, the moras of initial vowels are excluded from syllables and feet. In Everett 1996a,b, they are excluded from syllables, feet, and prosodic words. In Goedemans 1996, onsetless initial syllables are excluded from feet, and, in Downing 1998, they are excluded from feet and prosodic words. Since Strict Succession, as demonstrated in Hyde 2002, is especially well motivated, given its role in predicting iambic-trochaic asymmetries (see footnote 8), abandoning it at this point would seem to be a step backward.

Underparsing creates a third difficulty for approaches like those proposed by Everett (1996a,b) and Downing (1998), where initial vowels are excluded from the prosodic word. In general, two concerns arise in accounting for languages that restrict onsetless syllables to initial position. The first arises in languages that utilize feature-changing processes, such as gliding, that might be used to avoid onsetless syllables. As Downing (1993, 1998) points out, this situation is not particularly problematic. Such processes always require a preceding segment that they can act upon to provide a vowel with an appropriate onset. Since there is no segmental material preceding initial vowels, such processes could not be applied word-initially.

The second concern arises in languages with insertion or deletion processes that might be used to avoid onsetless syllables. The problem is to prevent such processes from applying word-initially, while still allowing them to apply in other positions. McCarthy and Prince (1993b) argue that this can be accomplished by requiring the left edge of the prosodic word to align with the

[20] Halle and Vergnaud's (1987) analysis of Western Aranda, which relies on initial segment extrametricality, would produce similar results if applied to iambic systems.

left edge of the underlying stem. Insertion and deletion could not be applied in initial position, because they would result in misalignment between the underlying stem and the prosodic word.[21]

While the answer to the first concern is not dependent on a particular theory, the answer to the second concern is. By crucially requiring the prosodic word to exclude stem-initial vowels, Everett (1996a,b) and Downing (1998) cannot exploit McCarthy and Prince's explanation for the absence of initial insertion and deletion processes.[22] This would seem to be especially problematic for Downing, since she explicitly endorses McCarthy and Prince's approach.[23]

The proposed approach does not encounter such difficulties. First, as tableaux (34) and (39) make clear, ALIGN(F-HD, L, C, L) does not discourage an initial iambic foot in forms with an onsetless initial syllable, so there would be no pressure to avoid such syllables in thoroughly iambic systems by shifting feet to the right in the fashion illustrated in (43). Second, the proposed analysis makes it possible to maintain Strict Succession, which would actually make the shifts in footing employed by the alternatives impossible in any case. Finally, since underparsing is not required, the left edge of the prosodic word can always coincide with stem-initial vowels, allowing the proposal to exploit McCarthy and Prince's explanation for the confinement of onsetless syllables to initial position.

Next, we turn to the issue of syllable integrity.

4 Syllable Integrity

Although they are conceptually and formally distinct, as discussed by Hayes (1995), the principle of syllable integrity is often connected to the idea that the syllable is the smallest stressable unit. The latter idea seems to be motivated by perceptual considerations. According to Hayes, there are no languages with syllable-internal stress distinctions. Stress is always perceived as stress on

[21] McCarthy and Prince's Alignment approach was clearly intended to prevent both deletion of initial vowels and insertion of consonants before initial vowels. Alignment could obtain this result because the approach was formulated within a version of OT where input segments, even deleted segments, were always contained in the output in some form. This meant that insertion and deletion would both result in misalignment between the prosodic word and the underlying stem. In more recent versions of OT Faithfulness (see McCarthy and Prince 1995), deleted input segments are no longer contained in the output. This being the case, the analysis should probably be reformulated in terms of Anchoring (McCarthy and Prince 1993b), essentially a Faithfulness formulation with a directional component.

[22] While Banawá, Western Aranda, and Alyawarra all seem to lack insertion processes, Western Aranda and Alyawarra do have certain deletion processes that support McCarthy and Prince's (1993b) idea that a stem's left edge is more stable than its right edge. In the context of hiatus resolution across word boundaries, for example, Western Aranda typically deletes the final vowel of the first word and rarely deletes the initial vowel of the second word. Alyawarra seems always to delete the final vowel of the first word. Both languages, then, avoid changes at the left edge of a stem, preferring to modify other positions. This is expected under McCarthy and Prince's account, if the constraint aligning the prosodic word with the left edge of the stem dominates the constraint aligning it with the right edge.

[23] Everett (1996a) presents a different proposal for restricting onsetless syllables to initial position, but, for several reasons, the proposal clearly does not work. The most obvious reason, perhaps, is that Everett's account relies on the notion that his SONORITY INCREASE constraint penalizes vowels that are only licensed by moras.

(i) *SONORITY INCREASE*
The sonority of the nuclear segment exceeds the sonority of the initial syllabic segment by at least two values.

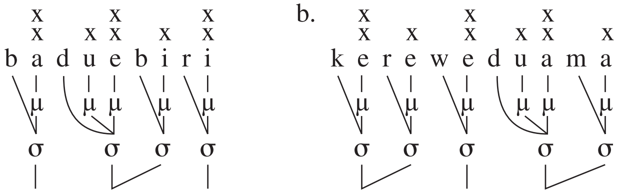
From the definition in (i), however, it is clear that SONORITY INCREASE can apply only to syllables. Since there are no syllables associated with mora-licensed vowels, they vacuously satisfy the constraint.

a syllable, not as stress on some smaller portion of a syllable. While it might seem desirable to maintain this position, it seems impossible to do so in light of Banawá data that contradict Hayes's generalization. As mentioned in section 1, Buller, Buller, and Everett (1993) and Everett (1996a,b) describe a distinction between heavy syllables with stress on their first mora, like the first syllable in [kèiyárinè] 'happy', and heavy syllables with stress on their second mora, like the second syllable in [bàduébirì] 'species of deer'. They present this distinction as an empirical observation and not as a distinction made for theoretical convenience (see footnote 3). Taking their claim at face value, it is clear that moras must be stressable units, and the idea that the syllable is the smallest stressable unit must be abandoned.

Some have taken the stronger position, however, that cases like Banawá also require us to abandon the principle of syllable integrity, claiming that such languages must have the option of building feet directly on moras and ignoring syllable boundaries (Halle and Vergnaud 1987, Buller, Buller, and Everett 1993, Everett 1996a,b). This position seems to be due to a misunderstanding of the principle's role. Syllable integrity concerns the most basic dominance relationship of the prosodic hierarchy: which particular lower category is the basic building block for which particular higher category. It says that syllables, not moras, are the building blocks for feet, so the boundaries of feet must coincide with the boundaries of syllables.

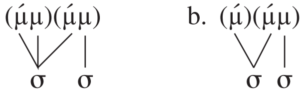
Syllable integrity clearly does not, however, exclude syllable-internal stress distinctions like those exhibited by Banawá. Since the Banawá patterns never have more than one stress per syllable, we can easily produce these patterns with syllable-based feet.

(44) a. b.



The primary advantage of syllable integrity is that it allows us to exclude unattested syllable-internal stress distinctions: those situations where more than one position within a syllable is stressed.[24]

(45) a. b.



Since the theory must still be restrictive enough to exclude such cases, the fact that Banawá forces us to abandon the syllable as the smallest stressable unit actually makes it all the more crucial to maintain syllable integrity.[25]

[24] Assuming that a theory requires feet, there are only two ways that it might produce multiple stresses in the same syllable. It might allow feet to split syllables, as in the examples in (45), or it might allow more than one stress per foot. Since the proposed account does not permit either option, it cannot produce multiple stresses in the same syllable.

[25] It might also be argued that syllable integrity allows us to retain a weaker version of the syllable as the smallest stressable unit, a version where the perception of stress relies on a phonetic interpretation of the formal structure. Though

The purpose of this section, then, is to demonstrate that we can allow for Banawá's syllable-internal stress distinctions while maintaining syllable integrity. This is possible if we assume (as in Prince 1983, Kager 1993, 1995, Hyde 2001) that the grid's base level corresponds to moras rather than syllables. Since heavy syllables will have two mora-level gridmarks, there will be two possible locations for the foot-level gridmark when a heavy syllable is stressed. By focusing on clash and lapse avoidance, we can then produce the appropriate stress patterns with syllable-based feet.

Although the position of stress within a heavy syllable will necessarily vary, I will assume that the default is for stress to fall on a syllable's initial mora. This seems likely, since most languages associate initial moras with the most sonorous segments, at least in those cases where sonority distinctions can be made. For the purposes of illustration, I will implement this preference in the analysis below with the formulation in (46).

(46) *FirstMora*
In a stressed syllable, the foot-level gridmark occurs over the leftmost mora.

When a syllable is stressed, FirstMora simply requires that the stress occur over the syllable's initial mora.

The discussion proceeds as follows. Section 4.1 shows how the proposed account produces the Banawá stress pattern using syllable-based feet. Section 4.2 briefly discusses the alternative account that utilizes mora-based feet. We will see that there are considerations within Banawá itself, as well as the more general considerations mentioned above, that prevent us from abandoning syllable integrity. Finally, section 4.3 briefly examines the case of Southern Paiute, which has also been argued to exhibit mora-based footing. We will see that we can preserve syllable-based footing in Southern Paiute, as well, using principles similar to those involved in the analysis of Banawá.

4.1 Heavy Syllables

The issue of syllable integrity arises in the Banawá stress patterns because they exhibit a perfectly binary moraic alternation, even in forms that contain heavy syllables. When heavy syllables are present, they fail to perturb the basic patterns.

(47) a.	LLH	kárabùa	'blowgun'
b.	HHL	tìasíanì	'acquire'
c.	LLLH	tìkadámuè	'you forget'
d.	HLLL	kèiyárinè	'happy'
e.	LHLL	bàduébirì	'species of deer'
f.	LLLHL	kèrewéduàma	'turn end over end'

stress is associated with a particular portion of the syllable in the formal structure, syllable integrity ensures that there is never more than one stress per syllable. It should not be surprising, then, that stress is typically perceived as stress on a syllable, especially in languages where the phonetic correlates of stress are present throughout the syllable.

(48) a. LH uwía 'go out (as a fire)'
b. LLH uwárià 'one'
c. LLHLLL atìkeíyarìne 'happy'

As illustrated in (47), when a consonant-initial form contains heavy syllables, stress still occurs on every odd-numbered mora counting from the left. Similarly, as illustrated in (48), when a vowel-initial form contains heavy syllables, stress still occurs on every even-numbered mora counting from the left.

Two important consequences arise from maintaining the basic patterns in forms with heavy syllables. The first is that heavy syllables are always stressed, and the second is that stress often occurs over a heavy syllable's second mora.[26] Both are part of Banawá's effort to avoid clash and lapse. If a heavy syllable were to remain stressless, the result would be adjacent stressless moras and a lapse configuration. If a heavy syllable always had to have stress on its initial mora, even when immediately preceded by another stressed syllable, the result would often be adjacent stressed moras and a clash configuration. The key, then, is to rank *CLASH and HEADGAP above other conflicting parsing constraints, so that the stress patterns always conform to the Perfect Grid.

While each of the other constraints discussed thus far potentially conflicts with either *CLASH or HEADGAP, the trochee-producing IGRID(x_F, μ, ω) and the onset-sensitive ALIGN(F-HD, L, C, L) are never violated for the purpose of maintaining a Perfect Grid. The initial stress in consonant-initial forms and the initial stresslessness in vowel-initial forms are themselves always compatible with one of the Perfect Grid patterns. Instead, when adjustments are made for the purpose of avoiding clash, they are made at the expense of FIRSTMORA, the constraint that requires stressed syllables to locate their stress on their initial mora. When adjustments are made for the purpose of avoiding lapse, they are made at the expense of FIRSTMORA or ALIGN(F-HD, R, ω, R), the latter being the constraint that aligns head syllables with the right edge of the prosodic word. This being the case, we would modify the basic Banawá ranking as in (49).

(49) *CLASH, HEADGAP, ALIGN(F-HD, L, C, L) ≫ IGRID(x_F, μ, ω) ≫ ALIGN(F-HD, R, ω, R), FIRSTMORA

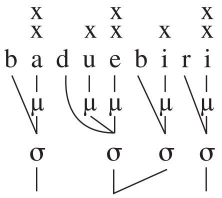
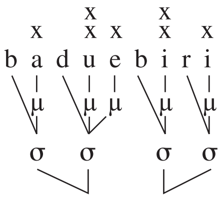
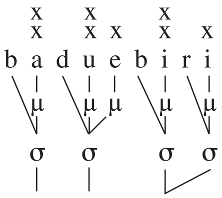
The only difference between the ranking in (49) and the ranking from section 3 is that FIRSTMORA has been included at the bottom with ALIGN(F-HD, R, ω, R). To illustrate the crucial interactions, I will focus on the low ranking of these two constraints.

First, in examining how clash can be avoided by shifting stress to a heavy syllable's second mora, we can see that it is necessary for *CLASH and IGRID(x_F, μ, ω) both to dominate FIRSTMORA.

[26] Though it appears to be rare, there are languages other than Banawá where stress has been claimed to occur on a heavy syllable's second mora. This claim has been made, for example, for Southern Paiute (Sapir 1930, Harms 1966), though it appears that the occurrence of second-mora stress is much more restricted than it is in Banawá (see footnote 28). Also, citing evidence from syllable-internal tonal contours, Leer (1985a,b), Miyaoka (1985), and Kager (1993) assume that stress may occur on second moras in some Yupik dialects. Derived long vowels have stress on their first mora, while underlyingly long vowels have stress on their second.

A high-ranking *CLASH is necessary, of course, to prevent a clash configuration in the first place, but a high-ranking IGRID(x_F, μ, ω) is also necessary, because it ensures that the initial mora of the prosodic word cannot be left stressless for the purpose of avoiding clash. Tableau (50) uses a consonant-initial form to demonstrate the crucial interactions.

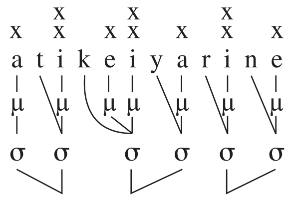
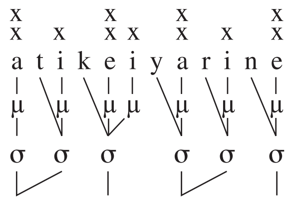
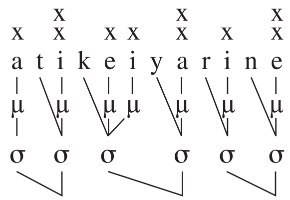
(50) [bàduébirì] 'species of deer'

ba.due.bi.ri	*CLASH	IGRID (x_F, μ, ω)	FIRSTMORA
☞ a. 			*
b. 		*!	
c. 	*!		

In tableau (50), *CLASH excludes candidate (50c)'s clash configuration, created because a stressed light syllable is immediately followed by an initially stressed heavy syllable. IGRID(x_F, μ, ω) excludes candidate (50b)'s initial iambic foot, because it fails to stress the prosodic word's initial mora. Although candidate (50a)'s trochaic maximal alternation pattern stresses the heavy syllable's second mora, it also avoids clash and stresses the initial mora of the prosodic word. Candidate (50a) correctly emerges as the winner.

Next, avoiding a lapse configuration also can make it necessary to shift stress to a heavy syllable's second mora. In examining a situation of this type, we can see that it is necessary for HEADGAP and ALIGN(F-HD, L, C, L) both to dominate FIRSTMORA. HEADGAP must be highly ranked to avoid lapse in the first place, but ALIGN(F-HD, L, C, L) must also be highly ranked, so that lapse avoidance cannot be an excuse to stress an initial onsetless syllable. Tableau (51) demonstrates, using a vowel-initial form.

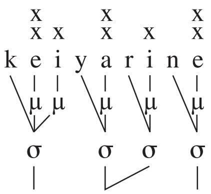
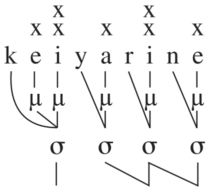
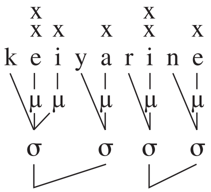
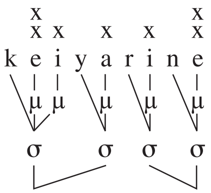
(51) [atìkeíyarìne] ‘happy’

a.ti.kei.ya.ri.ne	HeadGap	Align (F-hd, L, C, L)	FirstMora
☞ a. 			*
b. 		*!	
c. 	*!		

In tableau (51), HeadGap excludes candidate (51c)’s lapse configuration, created by leaving the heavy syllable stressless. Neither of the heavy syllable’s (adjacent) moras is the head mora of a foot. Next, Align(F-hd, L, C, L) excludes candidate (51b)’s stressed onsetless syllable. Although candidate (51a)’s iambic minimal alternation pattern stresses the heavy syllable’s second mora, it also avoids lapse and a stressed onsetless syllable. Candidate (51a) correctly emerges as the winner.

Finally, in some situations, lapse avoidance can also come at the expense of Align(F-hd, R, ω, R), and forms with heavy syllables reinforce the point that it must rank at least below HeadGap and IGrid(x_F, μ, ω). As demonstrated in tableau (52), HeadGap must be highly ranked to avoid a lapse, and IGrid(x_F, μ, ω) must also be highly ranked, so that lapse avoidance cannot be an excuse to leave a prosodic word’s initial mora stressless.

(52) [kèiyárinè] 'happy'

kei.ya.ri.ne	HEADGAP	IGRID (x_F, μ, ω)	ALIGN (F-HD, R, ω, R)
☞ a. 			** ***
b. 		*!	* ***
c. 	*!		* ***
d. 	*!*		***

In tableau (52), candidate (52d) is an extreme case of lapse, where the second, third, and fourth moras are left stressless, and candidate (52c) is a less extreme case, where the second and third moras are left stressless. HEADGAP excludes both cases. Next, because candidate (52b) fails to stress the prosodic word's initial mora, it is excluded by IGRID(x_F, μ, ω). Although candidate (52a) has poorer rightward alignment of its head syllables than candidates (52b–d), it avoids lapse and an initial stressless mora. Candidate (52a) correctly emerges as the winner.

In this part of the discussion, we examined forms that contain heavy syllables and found that it is a simple matter to produce the Banawá patterns with syllable-based feet. In fact, there is not much more to the analysis of forms containing heavy syllables than there is to the analysis of forms containing only light syllables. We simply use *CLASH and HEADGAP to avoid clash and lapse at the expense of FIRSTMORA and ALIGN(F-HD, R, ω, R). This ensures that even forms with heavy syllables conform to the Perfect Grid.

4.2 Mora-Based Feet: An Alternative Account

Rather than focusing on clash and lapse avoidance, Buller, Buller, and Everett (1993) and Everett (1996a,b) argue that Banawá footing violates syllable integrity. According to their accounts, since Banawá's binary alternation is moraic, rather than syllabic, its feet must be maximally bimoraic and free to ignore syllable boundaries.

(53) a. (b à d u)(é b i)(r ì) σ σ σ σ

b. a (t ì k e)(í y a)(r ì n e) σ σ σ σ σ

As illustrated in (53), once initial vowels are excluded from the prosodic word, the appropriate stress patterns are obtained simply by aligning the maximally bimoraic feet toward the prosodic word's right edge.

While the approach is simple and produces the correct stress patterns, it must be rejected for two reasons. The first is due to considerations that extend beyond the particular situation in Banawá. As discussed above, syllable integrity is simply a more restrictive theoretical position, because it allows the theory to predict fewer stress patterns. In particular, it excludes patterns with unattested types of syllable-internal stress distinctions. It also has the advantage of preserving the prosodic hierarchy's most basic dominance relationships. Since there is little evidence even suggesting that it is necessary to violate syllable integrity, we should maintain it as a universal characteristic of foot construction until there is a compelling case for abandoning it. Since it is a simple matter to produce its stress patterns with syllable-based footing, Banawá fails to present a compelling case.

The second reason is due to considerations that arise within Banawá itself. Banawá appears to undergo processes that require syllable-based feet. For example, Everett (1996a,b) cites name truncation as evidence that syllables play an important role in Banawá phonology. Names truncate to two syllables rather than two moras. The examples in (54) are shown with the special vocative stress pattern, an iambic pattern that positions primary stress on the final syllable.

(54) a. hóbetù → betú
b. tídekè → deká
c. téresìna → siná
d. sábatàu → batáu
e. sólimàu → rimáu

From the viewpoint of Prosodic Morphology (McCarthy and Prince 1986, 1990, 1993b), the simplest way to account for these truncations is to say that the new forms retain as much material as will fit into a single foot.[27] This avoids the arbitrary stipulation of ''two'' for the appropriate

[27] Everett (1996a,b) indicates that truncations take the vocative stress pattern when spoken in isolation but that they revert to their expected trochaic patterns in connected speech.

(i) a. bétu d. bátaù
b. déka e. rímaù
c. sína

number of syllables. Such an account is impossible, however, if Banawá footing is based on moras. If Banawá feet are maximally bimoraic, then the trimoraic truncations in (54d–e) should be impossible. The upshot, then, is that there are considerations within Banawá itself, as well as more general considerations, that prevent us from abandoning syllable integrity.

4.3 Southern Paiute

Before moving on, I should note that several other languages have been claimed to violate syllable integrity. For example, Halle and Vergnaud (1987) argue that Lithuanian, Southern Paiute, and Winnebago violate syllable integrity, and Poser (1990) argues that Japanese violates syllable integrity. Since Southern Paiute appears to present the strongest case, let us examine it briefly here.

Southern Paiute (Sapir 1930, 1949, Harms 1966) is an iambic language whose basic stress pattern exhibits an imperfect moraic alternation. Stress occurs on the penultimate mora and on every even-numbered mora that precedes the penultimate mora.

(55)	a. LL	wár̥ḁ	‘edible seeds’
	b. LH	puráu̥	‘flour’
	c. LLL	tɨ̥kákḁ	‘several eat’
	d. LLLL	šɨnáŋʷàɸi̥	‘coyote’
	e. LLLH	oβímpaxɨ̀ɨ̥	‘wooden fish’
	f. LHLL	čḁkáicìn̥i̥	‘my younger brother’
	g. LLLLL	u̥túšuŋʷɨ̀ʔi	‘to cause to go to sleep’
	h. LLLLLH	naráɸi̥kàpɨxàḁ	‘they threw rocks at each other’
	i. LLLHLL	narɨ́yaβàantùxʷḁ	‘to be between his hoofs’
	j. LHLLLLHLL	tɨxʷíinàtɨβìčuxʷàiʔìŋʷḁ	‘go and ask him to tell a story’

The forms that present the strongest case for violating syllable integrity are forms like (55f,i,j), where a stressed heavy syllable is immediately followed by another stressed syllable.[28] As illustrated in (56), using [tɨxʷíinàtɨβìčuxʷàiʔìŋʷḁ] ‘go and ask him to tell a story’, it may seem that

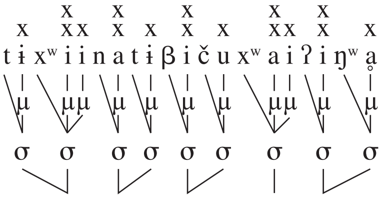
Although the presence of two stresses in the trimoraic connected-speech forms indicates the presence of two feet, this does not undermine the account of truncation based on a single maximal foot. Vocative forms are likely derived from the original forms through truncation to a maximal foot and restressing with the special vocative pattern. The connected-speech form is likely derived, in turn, by restressing the vocative form with the basic trochaic pattern. Of course, I use the term *derived* loosely here. Given the OT framework, a Transderivational Faithfulness approach (see Benua 1997) would be appropriate.

[28] Southern Paiute has less flexibility than Banawá with respect to the position of stress in heavy syllables. Stress usually prefers to fall on a heavy syllable’s initial mora, even when the alternating count would place it on the second, and this can perturb the basic pattern described in the text. This is the case, for example, in the form [nančákàicìŋʷɨ̥] ‘brothers to each other’, where stress on an initial mora creates a clash configuration with a preceding stressed syllable. Since these types of perturbations are not directly relevant to syllable integrity, I will not address the issue in detail here.

the only way to account for such forms would be to parse them from left to right with mora-based iambs that are free to ignore syllable boundaries.

(56)


As demonstrated in (57), however, since Southern Paiute never has more than a single stress per syllable, it is clearly possible to produce the necessary patterns with syllable-based feet.

(57)


In the discussion that follows, we will focus on the four constraints repeated in (58). Recall that NFɪɴ(x_F, μ, ω) requires stress to avoid the prosodic word-final mora, and that Aʟɪɢɴ(F-ʜᴅ, R, ω, R) promotes rightward iambic footing. *Cʟᴀsʜ discourages adjacent stressed moras, and HᴇᴀᴅGᴀᴘ discourages adjacent stressless moras.

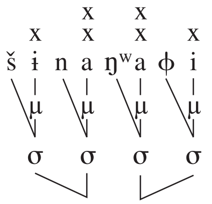
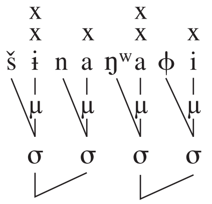
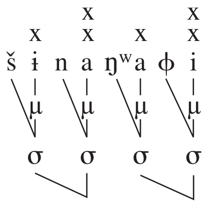
(58) a. *NFɪɴ(x_F, μ, ω)*
No foot-level gridmark occurs over the final mora of a prosodic word.
b. *Aʟɪɢɴ(F-ʜᴅ, R, ω, R)*
The right edge of the head syllable of every foot is aligned with the right edge of some prosodic word.
c. **Cʟᴀsʜ*
For any two entries on level $n+1$ of the grid, there is an intervening entry on level n.
d. *HᴇᴀᴅGᴀᴘ*
For every two adjacent moras, one must be the head mora of a foot.

First, we will see how the basic Southern Paiute pattern is produced by an appropriate ranking of NFɪɴ(x_F, μ, ω), Aʟɪɢɴ(F-ʜᴅ, R, ω, R), and *Cʟᴀsʜ. Then, we will see how adding a high-ranking HᴇᴀᴅGᴀᴘ to the ranking helps to produce the type of form that seems to support violating syllable integrity.

In ranking the constraints, an important point to keep in mind is that, unlike Banawá, Southern Paiute does not exhibit a perfect moraic alternation. In particular, Southern Paiute often tolerates clash. In forms with an even number of moras, for example, such as [šɨnáŋʷàɸi̥] 'coyote', stress will fall on both the penultimate mora and the antepenultimate mora, resulting in a clash configuration. This being the case, *Cʟᴀsʜ must be ranked low, and clash avoidance cannot play the central role in Southern Paiute that it does in Banawá. Instead, it is the ability of a high-ranking HᴇᴀᴅGᴀᴘ to avoid lapse at the expense of ALIGN(F-HD, R, ω, R) that creates a limited moraic alternation and the illusion of mora-based footing.[29]

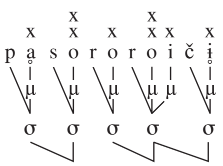
To produce the basic Southern Paiute pattern, NFIN(x_F, μ, ω) must dominate ALIGN(F-HD, R, ω, R), and ALIGN(F-HD, R, ω, R) must dominate *CLASH.

(59) [šɨnáŋʷàɸi̥] ‘coyote’

šɨ.na.ŋʷa.ɸi	NFIN (x_F, μ, ω)	ALIGN (F-HD, R, ω, R)	*CLASH
☞ a. 		* **	*
b. 		* ***!	
c. 	*!	**	

[29] There is a particular context where lapse can occur in Southern Paiute. When the penult is a stressed heavy syllable (see footnote 28), and the ultima is a stressless light syllable, the result is two adjacent stressless moras at the right edge of the prosodic word. This is the case, for example, in [pḁsóroròičɨ̥] ‘waterfall’. While this may seem problematic at first, the difficulty disappears when we consider the appropriate structure.

(i)



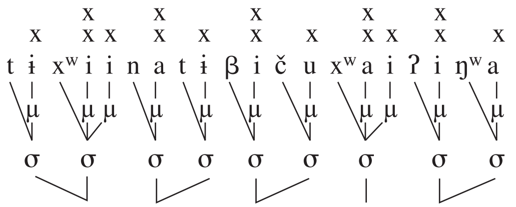
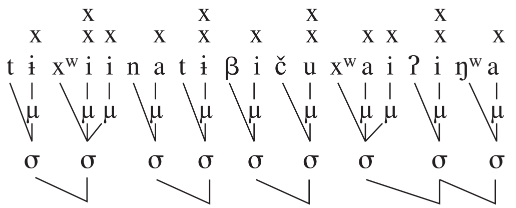
Since there are two overlapping iambic feet at the right edge of the prosodic word, the final mora is a head mora (even though it is not associated with a foot-level gridmark), and it is only one mora removed from the previous head mora. Since HEADGAP is defined in terms of head moras, rather than grid entries, the structure would not actually violate the constraint. This is one case, then, where the distinction between heads and gridmarks is crucial (see section 2.1).

As tableau (59) demonstrates, in forms with an even number of moras, ranking NFin(x_F, μ, ω) above Align(F-hd, R, ω, R) ensures that the final stress retracts to the penultimate mora. Stress cannot occur over the final mora, as in candidate (59c), in an effort to promote better rightward alignment of head syllables. In turn, ranking Align(F-hd, R, ω, R) above *Clash ensures that nonfinal feet will be iambic. Nonfinal feet cannot be trochaic, as in candidate (59b), to avoid a clash configuration. Candidate (59a), where stress occurs on the penultimate mora and every even-numbered mora preceding the penultimate mora, correctly emerges as the winner.

Although I omit the additional tableau, it should be clear that the ranking also produces the correct result for forms with an odd number of moras, such as [ʉ̥túšuŋʷɨ̀ʔi] 'to cause to go to sleep'. Optimal rightward alignment would position two overlapping feet at the prosodic word's right edge, much as it does in Banawá's iambic pattern. Since only the shared syllable of the overlapping feet would be stressed, the form would avoid stress on its final mora while also avoiding a clash configuration.

The ranking demonstrated in tableau (59), then, is adequate for producing the basic Southern Paiute pattern, but we must also consider the effects of the HeadGap constraint if we intend to account for those forms that seem to support mora-based footing. To produce a form like [tɨxʷíinàtɨβìčuxʷàiʔìŋʷḁ] 'go and ask him to tell a story', HeadGap must dominate Align(F-hd, R, ω, R), so that alignment cannot draw head moras so far apart that they create a lapse configuration. As tableau (60) demonstrates, restricting lapse configurations helps to position stress within syllable-based feet in such a way that the desired pattern emerges.

(60) [tɨxʷíinàtɨβìčuxʷàiʔìŋʷḁ] 'go and ask him to tell a story'

tɨ.xʷii.na.tɨ.βi.ču.xʷai.ʔi.ŋʷa	HeadGap	Align (F-hd, R, ω, R)
☞ a. 		* ** **** ***** ******* (20)
b. 	*!*	* *** ***** ******* (16)

In tableau (60), although candidate (60b) exhibits better rightward alignment, it is excluded by HeadGap, because some of the head moras have been pulled more than one mora apart. The candidate contains two pairs of adjacent moras where neither is the head mora of a foot. The first pair consists of the third and fourth moras, and the second pair consists of the eighth and ninth moras. Although candidate (60a) has additional violations of ALIGN(F-HD, R, ω, R), its head moras are close enough together to avoid lapse. Since it satisfies the higher-ranked HEADGAP, candidate (60a) correctly emerges as the winner.

Although we have not examined Southern Paiute in great detail, it should be clear at this point that we can maintain syllable integrity in this case, as well, simply by using principles that we have already seen at work in the analysis of Banawá. While it is true that clash avoidance does not play as significant a role in Southern Paiute, the combination of lapse avoidance and alignment is sufficient to correctly position stress using syllable-based feet.

Next, we turn to the final issue in our examination of Banawá prosody: Banawá's bimoraic minimal word.

5 Primary Stress and the Minimal Word

Having seen how the proposal produces the correct distribution for secondary stress in Banawá, without violating syllable integrity, we turn now to issues involving primary stress. To present a complete picture, I will address both the position of primary stress in longer forms and the role of primary stress in producing Banawá's bimoraic minimal word. Discussion of the pattern in longer forms provides an example of a foot extrametricality effect, an effect that McCarthy (2003) claims may be unattested.[30] It should be noted, however, that Buller, Buller, and Everett (1993) mention that there are a number of unexplained exceptions to this description, so Banawá does not present a completely compelling counterexample at this point. Banawá's minimal word is significant because it cannot be obtained through a minimal foot restriction, the mechanism that theories like those of McCarthy and Prince (1986) and Hayes (1995) typically use to produce minimal words.

5.1 Positioning Primary Stress

As (61) illustrates, the location of primary stress in Banawá provides an example of a foot extrametricality effect.

(61) a. téme ‘foot’
b. enéki ‘middle’
c. báburùru ‘cockroach’
d. abárikò ‘moon’
e. mètuwásimà ‘find them’
f. tìnarífabùne ‘you are going to work’

[30] Examples of foot extrametricality effects are problematic for the Categoricality Hypothesis. When a head foot cannot be the final foot (due to Nonfinality, for example), categorical Alignment constraints cannot ensure that the head foot will then be the penultimate foot. If they are blocked from achieving exact alignment with the right edge of the prosodic word, they cannot persuade the head foot to occur in penultimate position, rather than initial position or some other nonfinal position. See section 2.2 and footnote 16 for additional discussion.

In forms long enough to contain two or more stressed moras, the primary stress is the penultimate stress, indicating that primary stress prefers to occur over the penultimate foot, rather than the final foot.

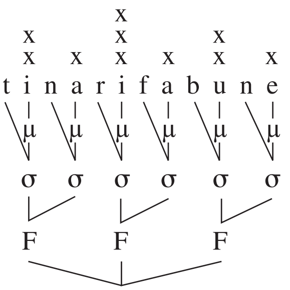
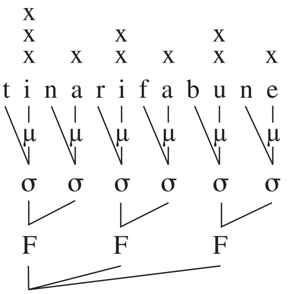
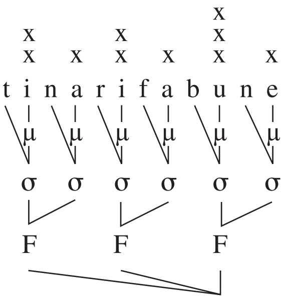
Beyond the constraints utilized in sections 3 and 4 to produce the correct distribution for secondary stress, two additional constraints are needed to produce the foot extrametricality effect for primary stress. The two constraints are ALIGN(ω-HD, R, ω, R), repeated in (62a), which aligns the head foot with the right edge of the prosodic word, and NFIN(x_ω, F, ω), repeated in (62b), which prohibits primary stress from occurring over the prosodic word-final foot.

(62) a. *ALIGN(ω-HD, R, ω, R)*
The right edge of the head foot of every prosodic word is aligned with the right edge of some prosodic word.
b. *NFIN(x_ω, F, ω)*
No prosodic word-level gridmark occurs over the final foot of a prosodic word.

When NFIN(x_ω, F, ω) dominates ALIGN(ω-HD, R, ω, R), as demonstrated in tableau (63), Alignment draws the head foot as far to the right as possible, but Nonfinality prevents it from drawing the head foot into final position. Since a head foot in final position would mean that primary stress had to occur over the final foot, the best that Alignment can do is to make the penultimate foot the head foot. In tableau (63), NFIN(x_ω, F, ω) excludes candidate (63c). Because its final foot is the head foot, its prosodic word-level gridmark occurs over the final foot. Candidates (63a) and (63b) both satisfy NFIN(x_ω, F, ω), but ALIGN(ω-HD, R, ω, R) excludes candidate (63b), because its head foot occurs further to the left than necessary. Candidate (63a)—where the head foot is the penultimate foot and the primary stress the penultimate stress—correctly emerges as the winner.

The ranking in tableau (63) correctly positions stress in forms with two or more stressed moras. More should be said, however, about shorter forms with only a single stressed mora. In such forms, stress always occurs over the final foot, violating NFIN(x_ω, F, ω).

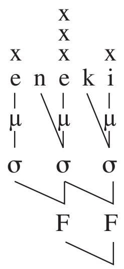
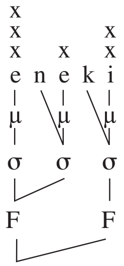
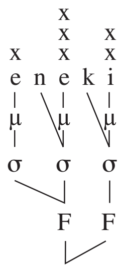
(63) [tìnaríhabùne] ‘you are going to work’

ti.na.ri.fa.bu.ne	NFIN (x_ω, F, ω)	ALIGN (ω-HD, R, ω, R)
☞ a. 		**
b. 		***!*
c. 	*!	

While there are possibilities that would allow stress to avoid the final foot in light disyllabic forms, like [téme] ‘foot’, and vowel-initial trimoraic forms, like [enéki] ‘middle’, these options would require violating one of the constraints that determine the basic distribution of stress. In particular, they would require that either *CLASH, the clash avoidance constraint, or ALIGN(F-HD, L, C, L), the onset-sensitive constraint, be violated. Since Banawá never departs from its basic stress patterns to maintain its foot extrametricality effect, we can safely assume that the constraints responsible for these patterns dominate NFIN(x_ω, F, ω).

Tableau (64) uses a trimoraic vowel-initial form to demonstrate that *CLASH and ALIGN(F-HD, L, C, L) must both dominate NFIN(x_ω, F, ω).

(64) [enéki] ‘middle’

e.ne.ki	*CLASH	ALIGN (F-HD, L, C, L)	NFIN (x_ω, F, ω)
☞ a. 			*
b. 		*!	
c. 	*!		

In tableau (64), candidates (64b) and (64c) both satisfy NFIN(x_ω, F, ω), but the optimal candidate (64a) does not. *CLASH excludes candidate (64c), where a monosyllabic foot follows an iamb, because it has a clash configuration at the word’s right edge. ALIGN(F-HD, L, C, L) excludes candidate (64b), where a monosyllabic foot follows a trochee, because its leftmost head syllable is not aligned with a consonant. The improperly bracketed structure of candidate (64a), which avoids both a clash configuration and a stressed onsetless syllable, correctly emerges as the winner.

Although I omit the additional tableau, ranking *CLASH above NFIN(x_ω, F, ω) also avoids the possibility of parsing light disyllabic forms with two monomoraic feet. Primary stress would be able to avoid the final foot with such a configuration, but the adjacent degenerate feet would result in clash.

We have seen, then, that the proposed account uses a Nonfinality constraint, NFIN(x_ω, F, ω), to produce Banawá’s foot extrametricality effect in longer forms. We also saw that the effect can be suspended in shorter forms by ranking NFIN(x_{ω}, F, ω) below the constraints that determine the basic stress patterns. These are the desired results. Next, we examine the role of primary stress in producing Banawá's bimoraic minimal word.

5.2 Producing the Minimal Word

Two phenomena help to demonstrate the nature of Banawá's minimal word. First, as (65) illustrates, long vowels occur only in monosyllabic forms. This suggests that they are derived to support a bimoraic minimality requirement, rather than being specified underlyingly.

(65) a. fáa 'water'
b. bíi 'fan'
c. búu 'beat'

Second, as (66) illustrates, vowel-initial forms consisting of two light syllables exhibit a trochaic pattern, rather than the iambic pattern of their longer counterparts. Banawá not only requires that its minimal words be bimoraic, it also requires that they have a strong-weak contour.

(66) a. ába 'fish'
b. áwa 'wood'
c. áwi 'tapir'

In theories like those of McCarthy and Prince (1986) and Hayes (1995), minimal word restrictions are typically derived from minimal foot restrictions. If feet are minimally bimoraic, and words must contain at least one foot, then words must be minimally bimoraic, as well. In the Banawá case, however, such an analysis is impossible. Banawá utilizes monomoraic feet to produce final stress in odd-parity consonant-initial forms, such as [mákarì] 'cloth' and [mètuwásimà] 'find them'. Since Banawá does not have an active minimal foot restriction, foot minimality cannot be responsible for the bimoraic minimal word.

The inability of a minimal foot restriction to account for the Banawá minimal word does not indicate, however, as Everett (1996a,b) suggests, that a separate stipulation concerning word minimality is necessary. Nonfinality constraints are obvious candidates for producing the necessary strong-weak contours, and they are also effective mechanisms for establishing minimal words. Although final positions often have some degree of stress in Banawá, the crucial observation is that primary stress, in particular, never occurs on a final mora.[31] If primary stress cannot occur on the final mora, then a word must be at least bimoraic to have a primary stress.

[31] The vocative stress pattern, mentioned in section 4.2, always positions primary stress on the final syllable, even if it means placing it on the final mora. This does not constitute a counterexample to the Nonfinality analysis presented here, however, because there is no need to enforce a word minimality requirement for forms with the vocative pattern directly. If we consider forms with the vocative pattern to be derived from forms with the regular patterns (see footnote 27), then Nonfinality can establish a minimal word in the original forms, and its effects can be transferred to the derived forms through Transderivational Faithfulness (see Benua 1997). Since the original forms will always be at least bimoraic, because of Nonfinality, and since truncated forms copy as much material as possible, up to a maximal foot, the derived vocative forms will always be at least bimoraic. Also because of Transderivational Faithfulness, derived forms with the vocative pattern would fail to exhibit the lengthening effects found in monosyllabic forms with the regular pattern.

To implement the appropriate restriction, the proposed account uses NFin(x_{ω}, μ, ω), repeated in (67), which prohibits prosodic word-level gridmarks from occupying a prosodic word-final mora.

(67) *NFin(x_{ω}, μ, ω)*
No prosodic word-level gridmark occurs over the final mora of a prosodic word.

Different types of forms react in different ways to a high-ranking NFin(x_{ω}, μ, ω). In longer forms, the constraint has no discernible effect. Since primary stress prefers to avoid the final foot, there is no danger that it will occupy the final mora. The reaction in shorter forms, however, where there is a danger that primary stress might occupy the final mora, is largely determined by the ranking of the Faithfulness constraint that prohibits vowel lengthening.

In this context, the role of Dep-μ, given in (68), is simply to prohibit vowels that are monomoraic in the input from being bimoraic in the output.

(68) *Dep-μ*
All moras present in the output are present in the input.

An underlyingly monomoraic form, like [fáa] 'water', reacts to a high-ranking NFin(x_{ω}, μ, ω) by violating Dep-μ and lengthening its vowel. A vowel-initial disyllabic form, however, like [ába] 'fish', avoids violating Dep-μ. Instead, it reacts by shifting its stress to its initial onsetless syllable, violating the onset-sensitive Align(F-hd, L, C, L). The ranking required to produce these results is given in (69).

(69) NFin(x_{ω}, μ, ω) ≫ Dep-μ ≫ Align(F-hd, L, C, L)

NFin(x_{ω}, μ, ω) must dominate Dep-μ, and Dep-μ, in turn, must dominate Align(F-hd, L, C, L).

To illustrate, to produce the surface long vowels in underlyingly monomoraic words, NFin(x_{ω}, μ, ω) must dominate Dep-μ. Given this ranking, a mora can be added to an underlyingly monomoraic vowel, so that primary stress can avoid the final mora of the prosodic word. Tableau (70) demonstrates the crucial interaction.

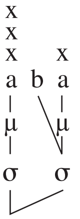
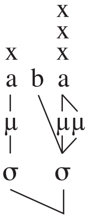
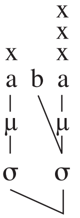
(70) [fáa] 'water'

fa	NFin(x_{ω}, μ, ω)	Dep-μ
☞ a. x x x x μ μ f a		*
b. x x x μ f a	*!	

In tableau (70), NFin(x_ω, μ, ω) excludes candidate (70b). Positioning primary stress over a final short vowel also positions it over a final mora. Although the optimal candidate (70a) violates Dep-μ, lengthening its vowel allows primary stress to avoid the final mora, satisfying the higher-ranked NFin(x_ω, μ, ω). This is the desired result.

To produce the strong-weak contours in vowel-initial disyllabic forms, Dep-μ and NFin(x_ω, μ, ω) must both dominate Align(F-hd, L, C, L). Ranking Dep-μ above Align(F-hd, L, C, L) ensures that light disyllabic forms will prefer to retract primary stress to their initial syllable, rather than lengthening their final vowel, even if the initial syllable does not have an onset.

(71) [ába] 'fish'

a.ba	NFin (x_ω, μ, ω)	Dep-μ	Align (F-hd, L, C, L)
☞ a. 			*
b. 		*!	
c. 	*!		

In tableau (71), NFin(x_ω, μ, ω) excludes candidate (71c), because its primary stress occurs over the prosodic word-final mora. Dep-μ excludes candidate (71b), because it lengthens its rightmost vowel. In candidate (71a), the onsetless initial syllable is a foot head, violating Align(F-hd, L, C, L). Stressing the initial syllable, however, allows (71a) to satisfy the higher-ranked Dep-μ and NFin(x_ω, μ, ω) simultaneously, so (71a) emerges as the winner.

Whether one assumes the framework pursued by Everett (1996a,b) or the framework adopted here, Banawá's bimoraic minimal word cannot be explained by a minimal foot restriction. This does not mean, however, that the Banawá minimal word is especially challenging or problematic. Nor does it mean that a special word minimality condition must be stipulated. We can achieve the desired result simply by using an appropriate constraint drawn from a general and independently motivated Nonfinality framework.

5.3 Nonfinality and Extrametricality

The significance of the Banawá minimal word extends beyond its resistance to explanation in terms of a minimal foot restriction. It is also significant because it provides a case for distinguishing between Nonfinality formulations and Extrametricality formulations. While Nonfinality and its predecessor, Extrametricality, have both been used on a limited basis to produce minimal words (see, e.g., Hayes 1995, Kenstowicz 1995, Itô, Kitagawa, and Mester 1996, Hyde 2003), an Extrametricality formulation could not have produced the particular type of minimal word that is required for Banawá. Since Nonfinality and Extrametricality are often conflated, this may be a reason why a Nonfinality analysis might not have been as obvious in this particular situation.

Extrametricality produces its effect by excluding a final element from a higher level of prosodic structure. In particular, in Hayes 1995, Extrametricality is a collection of three rules. Consonant Extrametricality prohibits final consonants from being moraic, Syllable Extrametricality prevents final syllables from being footed, and Foot Extrametricality prevents final feet from being included in the prosodic word. In his account, however, Hayes excludes the possibility of Mora Extrametricality, the type that would be needed to produce Banawá's minimal word, and it is important to understand why.

For Mora Extrametricality to achieve its desired effect, it would have to be possible to uniquely exclude a final mora from some higher level of prosodic structure. As Hayes observes, however, if the final syllable is bimoraic—exactly the case where mora extrametricality can be distinguished from syllable extrametricality—it would have to be possible for higher prosodic structure to split the final syllable; otherwise, it could not uniquely exclude the final mora. In Banawá, since the final mora often has a secondary stress and clearly could not be invisible to foot structure, the prosodic word would have to be able to split the final syllable and, often, the final foot as well.

A Nonfinality formulation does not encounter this difficulty. Since Nonfinality focuses on the location of stress peaks rather than the parsability of final elements (Prince and Smolensky 1993), it need not exclude a final element from higher prosodic structure to achieve its effect. Requiring a prosodic word-level gridmark to avoid the final mora does not require that the final mora be excluded from a foot or prosodic word, so there is no need to allow higher prosodic structure to split a syllable.

6 Conclusion

In this article, I examined three phenomena in Banawá that have previously been argued to present significant difficulties for metrical stress theory. First, onset sensitivity challenges theories of syllable weight that exclude onsets from the types of elements that can have moraic status. Second, the distribution of stress in forms containing heavy syllables challenges theories that require syllable integrity. Finally, the coexistence of degenerate feet and a bimoraic minimal word challenges the connection between minimal foot restrictions and minimal word restrictions.

In section 1, I introduced each of these issues, as well as the constraints that form the core of the proposed analyses. ALIGN(F-HD, L, C, L), which aligns the left edges of head syllables with consonants, produces onset sensitivity without the mediation of moras. The clash and lapse avoidance constraints, *CLASH and HEADGAP, are responsible for producing Banawá's moraic alternations without sacrificing syllable integrity. NFIN(x_ω, μ, ω), which prohibits primary stress from occupying a prosodic word-final mora, produces Banawá's bimoraic minimal word in the absence of an active foot minimality restriction.

To illustrate the analyses in fuller detail, I briefly outlined the most relevant assumptions of Hyde 2001, 2002, and I demonstrated how the proposal might be implemented in this particular framework. The ranking summarized in (72) and (73) accounts for the problematic Banawá phenomena.

(72) *CLASH, HEADGAP, ALIGN(F-HD, L, C, L) ≫ IGRID(x_F, μ, ω) ≫ ALIGN(F-HD, R, ω, R), FIRSTMORA

(73) *CLASH, NFIN(x_ω, μ, ω) ≫ DEP-μ ≫ ALIGN(F-HD, L, C, L) ≫ NFIN(x_ω, F, ω) ≫ ALIGN(ω-HD, R, ω, R)

The portion of the ranking in (72) is responsible for the distribution of stress in general, and the portion of the ranking in (73) deals with phenomena connected to primary stress in particular.

In section 3, I examined onset sensitivity. I showed that the high-ranking *CLASH and HEADGAP constraints limit the candidates available for consideration by other constraints to those that conform to the Perfect Grid. Given this situation, the proposal can produce Banawá's two basic stress patterns simply by ranking the onset-sensitive ALIGN(F-HD, L, C, L) above the trochee-producing IGRID(x_F, μ, ω). In consonant-initial forms, IGRID(x_F, μ, ω) can position a stress on an initial mora, without violating ALIGN(F-HD, L, C, L), and the result is a trochaic Perfect Grid pattern. In vowel-initial forms, however, ALIGN(F-HD, L, C, L) prevents initial moras from bearing stress, and the result is an iambic Perfect Grid pattern. Adopting this approach allows the theory to maintain the nonmoraic status of onsets, while avoiding the difficulties encountered by alternatives that rely on underparsing.

In section 4, I examined the issue of syllable integrity. I showed that the ranking used in section 3 for forms containing only light syllables can also produce the Banawá patterns in forms containing heavy syllables and that it can do so with syllable-based footing. There were two steps to the analysis. The first was to assume that the grid's base level corresponds to moras rather than syllables. This makes it possible to have moraic alternations without requiring feet to be mora-based. The second step was to give clash and lapse avoidance priority over other footing considerations, so that the resulting patterns always conform to the Perfect Grid. The foot-level gridmarks are always able to fall at a location within the syllable-based feet that preserve the moraic alternations. In no case is it necessary for a foot to split a syllable.

Finally, in section 5, I examined the difficulties presented by Banawá's bimoraic minimal word. While it is true that the minimal word cannot be derived from a minimal foot restriction, this fact poses no significant challenge to the theory. The Nonfinality constraint, NFIN(x_ω, μ, ω), easily produces the minimal word. Ranking NFIN(x_ω, μ, ω) above the Faithfulness constraint DEP-μ produces the necessary lengthening in underlyingly monomoraic forms. Ranking NFIN(x_ω, μ, ω) above ALIGN(F-HD, L, C, L) produces the trochaic pattern found in disyllabic vowel-initial forms. There is no need for a separate stipulation concerning word minimality.

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