Iquito: the prosodic colon and evaluation of OT stress accounts*

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0. Abstract

Iquito (Michael in press) presents R-L bimoraic trochees and normally bans degenerate feet, unless by including them, a dipodic prosodic word is formed. Thus, alongside the binary-only-footed L(ˌLL)(ˈLL) or L(ˌLL)(ˌLL)(ˈLL), one also finds unary feet in (ˌL)(ˈLL), (ˌL)(ˈH) and (ˌL)(ˈHL). I claim that this asymmetrical tolerance of degenerate feet in odd-parity words is attributed to the existence of the colon κ, a constituent that has marginally been considered in past literature (primarily Hammond 1987 and Green 1997). Next, I consider evidence in support of the colon from other languages and suggest that (re-)introduction of the constituent meshes nicely with two other ideas; first, the existence of foot structure beyond the purely metrical one, e.g. tonal feet in Bambara (Leben 2001) or prosodic-templatic feet in Japanese (Poser 1990), and second, the language-specific character of prosodic constituents (Schiering et al. 2010; Hyman 2011). Returning to Iquito, three analyses of the data couched within OT are examined, all of which share use of κ. Eventually, all three manage to capture the facts in question, but only the one placed within Harmonic Serialism (HS; Pruitt 2010) manages to do so as a direct result of the model's architecture. Based on further conceptual and technical grounds, I argue that the HS analysis is thus to be preferred.

1. Introduction

The present paper discusses the stress data of Iquito, a Zaparoan language of Peru, using the language facts reported in Michael (in press). Empirically, the language is interesting, since besides the binary trochaic feet it always allows, it also *partially* permits degenerate feet. Michael (in press) claims that the reason the latter only contextually arise is so that words contain a prosodic colon κ, that is, two feet within the word. This idea is also adopted here[1].

Iquito is theoretically interesting too; in particular, it serves as a case study for three analyses couched within OT. Although all three prove successful in *empirically* capturing the data, it is only one, i.e. the account set within Harmonic Serialism (HS) that proves *technically* more elegant and *conceptually* more solid. On the analytical side, it will be suggested that the synchronous formation of a colon and of a (single) foot does not violate HS' principle of gradualness. This merely extends McCarthy's (2008a, §3.3) claim that prosodic word and head foot formation happens in a single step. In fact, it will be argued that Iquito simultaneously illustrates the need for both a limited and a broader understanding of GEN in HS (McCarthy 2010b). Finally, it will be claimed that the language provides an additional argument as to why FTBIN has to be understood as minimally bimoraic and maximally disyllabic.

[1] Note that the colon κ may refer to different entities in poetry as opposed to prosody in language. For instance, Golston (1998) uses the term colon to indicate the poetic half-line. What is considered instead a κ in the present conception of the term, i.e. two feet, corresponds in his system to what he calls Verse Foot (VF).

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The paper however deals with plenty other empirical and more general theoretical issues and as such should appeal to a wider audience beyond OT theorists. More specifically, it offers support for the colon from various languages and phenomena including tonal assignment in Matumbi or prosodic templates in Japanese. Taking stock of proposals that suggest the existence of other feet beyond the metrical ones (Poser 1990; Leben 2001) and of language-particular prosodic hierarchies (Schiering et al. 2010; Hyman 2011), I argue that the colon is a constituent that may be referred to not only by stress, but also by other prosodic phenomena. In addition its integration into the prosodic hierarchy (e.g. Selkirk 1972, 1981; Nespor and Vogel 1986) is to be admitted when positive evidence for it in the language is available, but not necessarily otherwise.

The paper is structured as follows. Section 2 presents the tonal and stress data that support the existence of the colon in Iquito (§2.1) and then extends the discussion to other manifestations of the constituent in other languages and phenomena (§2.2). Three OT-analyses are tested against the Iquito data in Section 3, with HS proclaimed as the most fitting of all (§3.1). A classic parallel OT account (§3.2) and a more unorthodox version of it are also explored (§3.3). Even though all three empirically succeed, §4.1 suggests that on technical and conceptual grounds, HS is to be preferred. Section 4.2 addresses the anticipated scepticism that some readers may have against the introduction and integration of the colon in the prosodic hierarchy and attempts to remove, or at the very least, alleviate the relevant concerns. The alternative analysis that is based on mere acceptance of dipodicity is considered and is shown to be problematic or even inadequate.

2. Evidence for the colon

2.1. Within Iquito: stress and tone

Iquito is described as a low-density tonal language that also displays stress (Michael in press). The two prosodic components are identified through distinct acoustic correlates, namely pitch for tone and post-tonic consonant lengthening for stress. The tonal system is privative, employing a H/∅ pattern. That tone is contrastive is indicated through the existence of minimal pairs where stress remains constant, but the pitch peak is found on different positions, e.g. [máˈʃiku] 'raft' vs. [maˈʃíku] 'bird species'. Although largely independent from one another, tone and stress interact in the sense that every prosodic word contains at least one *High* tone (henceforth simply referred to as 'tone'). In addition, both make reference to the colon κ. The current section presents the relevant facts. Note that the present paper primarily focuses on stress and supplements the discussion with the tonal data when the latter are relevant. However, as the tonal facts are not yet fully understood, no formal analysis is offered at this time.

Iquito forms leftward bimoraic trochees (H) or (LL) with rightmost primary stress. That feet must be bimoraic rather than bisyllabic becomes evident in (1). To distinguish easily between stress and tone, the following notation will be used: ˈ = primary stress, ˌ = secondary stress, ´ = H tone, H = heavy syllable, L = light syllable. In what follows, tone will only be indicated if relevant to the discussion, otherwise it will be omitted.

(1)	*Bimoraic feet*		*and NOT bisyllabic feet*		
	a. L(ˌLL)(ˈH)	nu(ˌtaku)(ˈrɨɨ)	*(ˌLL)(ˈLH)	*(ˌnuta)(ˈkurɨɨ)	‘s/he stood up’
	b. (ˌH)(ˈH)	(ˌii)(ˈpɨɨ)	*(ˈHH)	*(ˈiipɨɨ)	‘Red Howler Monkey’

Normally degenerate (L) feet are not admitted, as (2c, e) clearly illustrate, but this ban is not absolute. The data in (3) present relevant examples.

(2)	*Preference for binary feet*			
		a. (ˈLL)	(ˈaʃi)	‘bird sp. (Chloroceryle amazon)’
			(ˈisɨ)	‘lizard spp. (Gonatodes spp.)’
		b. (ˌLL)(ˈLL)	(ˌkuma)(ˈkiha)	‘suri (edible beetle grub)’
			(ˌnaʃi)(ˈkaki)	‘snap (it) - IMP’
	→	c. L(ˌLL)(ˈLL)	nu(ˌtaki)(ˈnaka)	‘his owls’
			ki(ˌtani)(ˈkura)	‘I wove (a few days ago)’
		d. (ˌLL)(ˌLL)(ˈLL)	(ˌkana)(ˌnahu)(ˈkura)	‘we (excl.) wrote (a few days ago)’
			(ˌnuni)(ˌkikɨ)(ˈkɨki)	‘s/he trembled’
	→	e. L(ˌLL)(ˌLL)(ˈLL)	nu(ˌniki)(ˌkɨkɨ)(ˈkura)	‘s/he trembled (a few days ago)’
			ka(ˌnamɨ)(ˌyiki)(ˈkura)	‘we (excl.) returned (a few days ago)’

(3)	*Degenerate feet exceptionally admitted*		
	a. (ˌL)(ˈLL)	(ˌsa)(ˈtaki)	‘laugh-IMP’
		(ˌni)(ˈyiti)	‘male child’
		(ˌka)(ˈhaʃi)	‘hair’
	b. (ˌL)(ˈH)	(ˌma)(ˈhuu)	‘tree sp. (Rheedia sp.)’
	c. (ˌL)(ˈHL)	(ˌmɨ)(ˈtiiha)	‘turtle sp. (Podocnemis unifilis)’

Michael (in press: 6) states that “a single light syllable at the left edge of the word is parsed into a degenerate foot in precisely those cases in which doing so results in a dipodic prosodic word”. In other words, degenerate feet are only justified in order to obtain a colon κ; in longer words like (2c) or (2e) where the colon-satisfaction has already been achieved through binary feet, the presence of a degenerate foot is not legitimized.

Notice that degenerate feet are only allowed at the left edge of the word, never at the right, hence forms such as *[(ˌH)(ˈL)] are disallowed. A HL sequence word-finally will instead receive a single stress on H, presumably creating a ternary foot (ˈHL), as in (4). While this is Michael’s chosen parsing, it is not however the only possibility; compatible with facts would also be a metrification that leaves more syllables unparsed, yet conforms to the bimoraic requirement, e.g. [(ˈH)L] or [(ˌL)(ˈH)L].

(4)	*Ternary foot preferred over degenerate at the R edge*		
	a. (ˈHL) and not *(ˌH)(ˈL)	(ˈsaapi)	‘stingray’
		(ˈmɨɨsɨ)	‘plant sp. (Mansoa alliacea)’
	b. (ˌL)(ˈHL) and not *(ˌL)(ˌH)(ˈL)	(ˌmɨ)(ˈtiiha)	‘turtle sp. (Podocnemis unifilis)’

Beyond stress, the colon emerges as the domain in which lexical and metrical tone are incompatible. Since every Iquito word has to have at least one tone, in the absence of a lexical tone (T_L), a metrical tone (T_M) is inserted on the head of primary stress.

(5) *T_M realized on head of primary stress*

a. (ˌpi)(ˈrú$_M$su) ‘electric eel’

b. (ˌpiru)(ˈsú$_M$ka) ‘electric eels’

Metrical and lexical tones cannot co-exist. Thus, when a prefix like /ki-/ with an input T_L is added to (5a), the T_M on *ru* no longer arises. Instead, only the lexical one on the prefix surfaces (6a). In longer forms however, both types of tone can co-exist (6b). What at first blush looks puzzling easily dissolves once one realizes that the seemingly contradictory distribution is regulated by the presence of cola and the tones within or across them. In particular, T_L and T_M cannot co-exist when they belong to the same colon, but they can across cola.

(6) a. *Ban on T_L and T_M within the same colon*

(ˌkí$_L$pi)(ˈrusu) *(ˌkí$_L$pi)(ˈrú$_M$su) ‘my electric eel’ /kiH- /

b. *Admission of T_L and T_M across cola*

kí$_L$(ˌpiru)(ˈsú$_M$ka) ‘my electric eels’

kí$_L$(ˌpiru)(ˌsuka)(ˈhá$_M$ta) ‘with my electric eels’

This co-occurrence prohibition does not affect lexical tones. While morphemes with lexical tones are not very frequent, it is possible to combine them. Whether the tones belong to the same colon or not is immaterial. Lexical tones are always preserved.

(7) *Multiple lexical tones always preserved*

(ˌkí$_L$-ná$_L$){(ˌhuu)-(ˈtɨɨ́$_L$)}$_κ$ ‘I made someone write’

The distribution of lexical and metrical tones within and across a colon is summarized in (8). Still, many aspects in tone distribution and its interaction with cola are not yet understood[2]. Hopefully, future fieldwork should help clarify the situation.

(8) *Summary of tonal facts and cola*

Within κ	Across κ
T_L	T_L] [T_M
T_M	T_L] [T_L
T_L T_L (T_L) …	* T_M] [T_M (Michael, p.c)
* **T_L T_M**	

[2] Matt Gordon (p.c.), for example, observes that the absence of footing of the lexical tone in (6b) could possibly account for the lack of co-occurrence restriction between metrical and lexical tones, instead of reference to cola. He thus proposes inclusion of an example where T_L is footed and separated by T_M with a colon. An anonymous reviewer suggests that (6a) should be compared to a form like [Ĺ(ˌH)(ˈĹL)]. If this is admitted – as predicted – it would clearly show that the co-occurrence restriction is not about string distance, but about structure. At the time of writing, no data of the sort have been available to me.

2.2. Beyond Iquito

The colon has occasionally been implemented elsewhere in the literature. Some of the more prominent examples follow. In Hungarian (Hammond 1987, but see Blaho and Szeredi 2011), primary and secondary stress are associated with heads of cola, unlike tertiary stress. Explicit and more extensive reference to the colon is made in Green's (1997) dissertation, where the distribution of stresses in Munster Irish, East Mayo Irish and Manx is claimed to be regulated by cola. In addition, Green (1997; see therein for references) also endorses the colon for various other languages such as Passamaquoddy, Eastern Ojibwa, Asheninca, Garawa and Neo-Štokavian.

Besides stress, cola seem to play a role in root/word-size restrictions as well as in tonal phonology. According to Ola (1995), several Benue-Congo languages, such as Kakanda, Ebira, Idoma and Yoruba, set a maximally dipodic, i.e. a colon, size for roots. In Yoruba in particular, the maximum is also evident in diminutives, clefted nouns and prefixes. A comparable, but quadrimoraic, maximum arises in Bella Coola, a language of the British Columbia (Bagemihl 1998; Topintzi 2010). A similar requirement appears in Japanese hypocoristic formation with the suffix –*tyan*; for hypocoristics of long names (Poser 1990: 88), two foot-based templates are available: one with 2μ and one with 4μ. Thus, the base name *gisaburoo* can be truncated as *gii-tyan* or *gisaburo-tyan* and *kenzaburoo* as *ken-tyan* or *kenzabu-tyan*, respectively. A secret language used in the entertainment industry also activates a two-foot template (Poser 1990: 95-96); there, foot transposition typically occurs accompanied by either shortening of a form if it exceeds 4 moras, e.g. *maneezyaa* 'manager' becomes (*zyaa)(mane)* deleting one extra mora, or lengthening if the number of moras is not sufficient, thus *mesi* 'meal' becomes (*sii)(mee)*.

Moving to the tonal domain now, in languages such as Kuria (Marlo et al. 2013) or Matumbi Odden (2011), a H-tone is assigned on the 4^{th} mora, as shown next.

(9) Matumbi H-tone (Odden 2011: 484)

'you should V'	'you should go V'	
ulʊbé	ukalʊbé	'ask'
upakatíke	ukapakátike	'shake down'
ukaʧabánike	ukakaʧábanike	'be confused'
uʧaŋgaále	ukaʧaŋgáale	'wonder'
upapaákije	ukapapáakije	'grope'
ulaambáte	ukalaámbate	'lick'
ukeeŋgéembe	ukakeéŋgeembe	'dig up'

While only some of the aforementioned accounts (e.g. Marlo et al. 2013) consider the possibility of re-analysing these facts by means of cola, e.g. "assign a H-tone at the right edge of a colon" instead of "assign a H-tone on the 4^{th} mora", this route is obvious and as Marlo et al. (2013) acknowledge, advantageous, as it requires no counting beyond the usually accepted limit of two[3]. An obvious

[3] Although reference to the number '3' might still be needed, cf. ternary feet or trimoraic syllables. In many cases though, the binary distinction can be preserved by means of weak local parsing (Hayes 1995; Elenbaas and Kager 1999) for ternary feet or by asserting that the binary weight distinction is maintained at the level of each subsyllabic constituent.

alternative, and one that several authors actually allude to, as indicated above, would be reference not to cola but to two feet, rather than just one. This would capture many of the facts above and would be compatible with counting considerations. Anticipating the discussion in §4.2, I claim that introduction of the colon - in at least some cases – is to be preferred since it offers better empirical coverage, superior analyses and prediction of (attested) patterns that the dipodicity explanation fails to produce.

Before moving on to the analysis of Iquito by means of cola and the comparison across different OT accounts, it is at this point appropriate to address a concern an anonymous reviewer has raised that could jeopardize employment of the colon as a constituent. Consider Bella Coola for a moment, a language which, as mentioned, places a 4-moraic maximum on roots. The reviewer observes that if we were to understand this maximum in terms of cola, then a string of the type [LHL], which satisfies maximality, should be interpreted as a colon footed - using trochaic feet for illustration – either fully as [(L)(HL)] or as [(L)(H)L], admitting both a degenerate foot and an unparsed L. But either representation makes some incorrect prediction; if (HL) feet are admitted, as the first footing suggests, then it should be the case that a string such as [(HL)(HL)] should also be possible by virtue of being a colon. Such a form though does not emerge, since it is actually 6-moraic. The same problem occurs with the other footing too; a form like [(H)(H)L] should be allowed, and yet it is not. Moreover, in Matumbi, tonal assignment at the right edge of a colon seems to violate Syllable Integrity (Prince 1976; Hayes 1995: 50, 121-123), the principle which prohibits syllable splitting in foot construction. For example, the form [ukeeŋgéembe] above would be footed as [{(u.ke)(eŋ.gé)}$_{\kappa}$em.be] forcing at least the syllable [keeŋ] to straddle two feet.

However, both problems – as the reviewer also notes – disappear once we admit the possibility that feet in such languages are built directly over moras, not over syllables. Such a move would then allow us to build cola in Bella Coola of exactly 4μ and it would downgrade Syllable Integrity from an inviolable principle to a strong tendency. The latter is in fact the position advocated by Buller, Buller & Everett (1993) and Everett (1996) on Banawá, Blevins & Harrison (1999) on Gilbertese, Cairns (2002) and Cairns & Raimy (2009) on Southern Paiute, among others. Note that although it has been possible to re-analyze some of the relevant facts in a manner compatible to Syllable Integrity, e.g. Hyde (2007a) on Banawá, in other cases such re-analysis has proven inadequate (cf. Cairns 2002 and Cairns & Raimy 2009 who challenge Hayes' 1995 account of Southern Paiute). Thus, Blevins & Harrison (1999: 219) end up treating Syllable Integrity as a violable constraint - defined as σ-INT: Align the {R/L} edge of a foot with the {R/L} edge of a syllable – which if sufficiently low-ranked, produces overt violations of the principle. Presumably, that would also occur in Matumbi.

But, even if all the cases that challenge Syllable Integrity were subject to re-analysis, the κ-analysis outlined above might still remain unscathed. This is because Syllable Integrity is grounded on the idea that "stress is always perceived as stress on a syllable, not as stress on some smaller portion of a syllable" (Hyde 2007a: 262-3), but the Bella Coola or the Matumbi facts - perhaps crucially – refer to prosodic phenomena other than stress, namely root maximality and tone. We might thus be able to maintain Syllable Integrity as an inviolable principle with regard to to stress, but not with regard to general prosody[4].

[4] This variability is reminiscent of variability in syllable weight criteria. Steriade (1991), for instance, shows that Classical Greek treats CV as light uniformly but CVV and CVC differently; while both are treated as heavy for minimal word

What this suggests in turn is the possibility of footing in the absence of stress or the existence of additional foot structure alongside metrical foot structure (due to stress). The clearest example for a language of the former type is perhaps Japanese (Poser 1990), whose accentual system is tonal in nature. Quite spectacularly, Japanese, a language that as we have seen already lacks stress, nonetheless makes use of rhythmic bimoraic feet for a number of prosodic phenomena, such as hypocoristic formation, reduplication, secret languages etc. Leben (2001) also clearly points to this type of languages, when in his discussion of Hausa and Bambara, he argues for the existence of tone languages that offer evidence in favor of tonal, rather than metrical, feet. On the other hand, the second type of languages can be illustrated by Serbo-Croatian, a pitch-accent language where tone docks on a position that is metrically defined. This leads Zec (1999) to claim that next to trochaic feet of the type ($\sigma_{\mu\mu}$) and ($\sigma_{\mu}\,\sigma_{\mu}$), the language also employs feet of the type ($\sigma^{H}_{\mu\mu}$) and (σ^{H}_{μ}) when H tone – associated to the first mora – is involved.

While the concept of 'tonal feet' has been used in some shape and form elsewhere (also see Zec 1999; Kubozono 2008; Zec & Zsiga 2010), there is no consensus as to how tonal feet are to be represented, nor as to how they should interact with metrical feet. The topic is complex and rather understudied (but see Leben 2001 for some references) and certainly beyond the scope of the present work. What is of interest to us however is the implication this has; if multiple types of feet exist (metrical, tonal, prosodic-templatic), then it should not be surprising if cola can have access to or refer to any of them. Naturally, it remains to be seen how exactly this effect is generally achieved as well as what kind of interactions are allowed, both topics for future research.

More generally, and as will be discussed in more detail in §4.2, this paper is in line with recent approaches which acknowledge the role language-specificity plays in prosodic universals, either in terms of imposing language particular (instead of universal) prosodic hierarchies (Schiering et al. 2010) or by suggesting that (the same) prosodic categories may be active to different extents depending on the language (Hyman 2011). It seems that in the present context, either approach will do, so I will not take any specific stance. For current purposes it suffices to point out that such views enable us to accept the data of e.g. Bella Coola maximal quadrimoraic roots as evidence for the existence of *κ* as a prosodic category active in the language, without necessary implications about the prosodic categories below and above it, for which we have no actual evidence.

3. Testing the data against different OT accounts

In this section I present three OT analyses of the Iquito data. Their selection has been made on the grounds of two independent axes: (a) model type and (b) stress theory. The first refers to the choice between parallel versus iterative OT-models, an issue that has recently attracted lots of attention, as it reveals how a general framework of phonology should be structured; the second factor compares theories specifically designed to understand stress. In that respect, the contrast is between what I call, 'standard' accounts along the lines of e.g. McCarthy and Prince (1993) and Kager (1999), that use

requirements and poetic metrics, only CVV is heavy for pitch accent assignment. See Gordon (2006) for an extensive typological study and argumentation in favor of a process- rather than a language-specific account of the phenomenon.

familiar constraints on foot parsing (PARSE-σ) and size (FOOTBINARITY) alongside foot alignment against less-widely used stress-accounts. For that purpose, I chose the grid-based account of Hyde, which in numerous recent papers (Hyde 2002, 2007b, 2012) has proved particularly successful and as such, renders itself a direct contender to the *standard* stress account. The three analyses explored in turn are[5]:

- (i) Harmonic-Serialism (HS)-cum-standard-assumptions (§3.1)
- (ii) Parallel-OT (ParOT)-cum-standard-assumptions (§3.2)
- (iii) ParOT-cum-non-standard-assumptions (§3.3)

It will be shown next, that while all three analyses produce the Iquito pattern, HS's main advantage over the others is that it is actually the model's own architecture that allows us to generate the pattern in question transparently through a minimal set of constraints. The alternatives need to engage additional mechanisms or assumptions that lead to loss of insight when one considers the data that involve use of the colon more generally.

3.1. Harmonic-Serialism-cum-standard-assumptions

The first account to be considered here is also the one claimed to be the most successful. At its core, it implements the HS stress account of Pruitt (2010) for Iquito, dubbed **IFO** (Iterative Foot Optimization). Details about Harmonic Serialism can be found in McCarthy (2008a, b; 2010a), but for current purposes, it suffices to spell out the basics, namely that HS is a serial version of OT that involves multiple iterations. Like classic ParOT, it employs a single constraint ranking throughout (in contrast to e.g. Stratal Optimality Theory), but instead of a single /input/ → [output] mapping, it allows multiple sequential mappings of this type, the so-called iterations. In this framework GEN is more constrained in the sense that beyond the faithful candidate, the remaining candidates may only exhibit a single change per iteration compared to the input, a property dubbed gradualness. For instance, for an input such as /lab/, possible outputs like [labi] or [lap] are acceptable, but not one like [lapi], since it exhibits multiple changes, *i*-epenthesis **and** a featural change. Notice that in classic ParOT, the latter candidate would be acceptable. It will become evident that exactly this property will allow the HS analysis of Iquito to fare better than the corresponding ParOT one. The repeated procedure is completed with convergence, that is, when *an* output is the same as the most recent input, a fact that designates such output as the *final* output.

Some additional background from Pruitt (2010) is also needed to follow the proposed analysis. GEN is assumed to only produce maximally disyllabic feet and create metrical structure which cannot be altered or removed (*STRICT INHERITANCE*). Consequently, feet like (LLL) cannot be even generated, hence they are not considered at all. FTBIN requires that feet are binary at *some* level of analysis (μ, σ) (Prince & Smolensky 1993/2004), effectively permitting feet that are minimally bimoraic and maximally disyllabic.

The only additional ingredient we need to capture Iquito is the constraint **HAVE-κ**, which states that each word must contain (at least) a colon. The simple ranking HAVE-κ >> ALL-FT-R, FTBIN

[5] A fourth possibility, not investigated here, would involve a combination of HS and a stress-theory à la Hyde, a combination that as far as I am aware, has not been employed in any work. At least for current purposes, its inclusion seems unwarranted since it introduces an unnecessary level of complexity.

generates all the desirable results. For ease of presentation, abstract examples will be used throughout with L(ight) and H(eavy) syllables. Tone is omitted. The patterns our analysis will need to capture are summarised in (10).

(10) *The Iquito Patterns*

No degenerate foot	*Degenerate foot allowed*
(ˈLL)	(ˌL)(ˈLL)
(ˈHL)	(ˌL)(ˈH)
(ˌLL)(ˈLL)	(ˌL)(ˈHL)
L(ˌLL)(ˈLL)	

Starting from the simplest /LL/ case, no candidate in (11) can satisfy HAVE-κ, since none contains minimally two feet. And yet, (11a) wins, as it fully satisfies the lower-ranked constraints. On the second iteration – for which no tableau is shown – convergence is achieved resulting in (11a). Crucially, and unlike ParOT, no candidate [(ˌL)(ˈL)] for input /LL/ or for /(ˈLL)/ - after the first iteration – can be considered. In the first instance, gradualness is violated, since construction of two feet constitutes two changes (hence the name IFO); in the second case, strict inheritance (and possibly, also gradualness) is violated, as metrical structure already built is altered.

(11) *1st Iteration: /LL/* → (ˈLL)

		/LL/	HAVE-κ	ALL-FT-R	FTBIN
☞	a.	(ˈLL)	*		
	b.	L(ˈL)	*		*!
	c.	(ˈL)L	*	*!	*

Convergence on 2nd Iteration, i.e. (ˈLL) → *[(ˈLL)]*

For input /LLL/ again only a single foot can be constructed at the first iteration favouring (12b), which presents the best possible structure in terms of alignment and binarity. On the second iteration however, construction of a second, albeit unary, foot is licensed, because by doing so, the dominant colon-constraint can now be satisfied. Thus, (12b) wins and produces convergence on the next iteration.

(12) *1st Iteration: /LLL/* → L(ˈLL)

		/LLL/	HAVE-κ	ALL-FT-R	FTBIN
	a.	LL(ˈL)	*		*!
☞	b.	L(ˈLL)	*		
	c.	(ˈLL)L	*	*!	
	d.	(ˈL)LL	*	**	*!

2nd Iteration: /L(ˈLL)/ → (ˌL)(ˈLL)

	/L(ˈLL)/	HAVE-κ	ALL-FT-R	FTBIN
	a. L(ˈLL)	*!		
☞	b. (ˌL)(ˈLL)		**	*

Convergence on 3rd Iteration

Jochen Trommer (p.c) observes that this tableau raises an issue as to what counts as a step. The idea is that an output such as [{(ˌL)(ˈLL)}$_{\kappa}$] from input /L(ˈLL)/ potentially violates gradualness, as it constructs both an additional foot, as well as a colon. If that is the case, then the winner should be [L(ˈLL)], which of course is wrong. Assuming this reasoning is correct, Trommer suggests that a way-out is the use of a constraint such as *Wd=2Ft* 'a word contains (at least) two feet' instead of reference to the colon. While this is possible, it is not plausible, since the lack of colon makes it more difficult to account for tone placement in languages such as Matumbi, discussed in (9) above.

The point however remains; for the analysis to work as suggested, construction of a colon should not count as an independent step. I argue that this indeed the case. In fact, this falls out from recent investigations of the structure of GEN. McCarthy (2010b: 11[6]) claims that "GEN determines how much and what kind of information is available to EVAL at each step of the derivation. Since there is no look-ahead, all of the information necessary to determine whether the right candidate wins has to be available at the point where it is crucial for that candidate to win". He thus permits instances where GEN must receive a broader understanding so as to allow for two processes to apply in one-go, cf. syncope and resyllabification in Arabic, as well as for cases where GEN must be more limited, so that a *single*, rather than multiple, application of an operation is admitted.

Iquito is interesting as it simultaneously displays both possible modifications of GEN. In line with Pruitt (2010), it parses one foot at a time (limited GEN). This has proved of paramount importance in the consideration of candidates for a /LL/ input, where a candidate like [(ˌL)(ˈL)] cannot be considered in the first iteration. At that point [(ˈLL)] wins. Due to *Strict Inheritance*, this parsing cannot be undone, effectively banning [(ˌL)(ˈL)] from being considered as a winner. In the case of /LLL/ inputs on the other hand, [L(ˈLL)] wins at the first iteration. Next, the addition of a second (here, degenerate) foot applies, leading to the form [(ˌL)(ˈLL)], whose bipodicity fulfils the prerequisite of having a colon. The latter's formation in the same step (broader GEN) ensures [{(ˌL)(ˈLL)}$_{\kappa}$] is the winner.

A further remark that is presently relevant is McCarthy's (2010b: 12, 26) observation that GEN is limited to a single unfaithful operation at a time, but places no limit to the number of faithful operations. In the case McCarthy discusses, resyllabification is a faithful operation, since it never appears to be contrastive in a single language. While the contrastiveness of feet, let alone of cola, is less clear, it could potentially be argued that colon formation is also a faithful operation. Foot-parsing on the other hand has been assumed by Pruitt (2010) to occur serially, pointing to a non-faithful contrastive operation. Evidence for this idea can be found in the existence of underlying foot structure in lexically-stressed languages or the presence of both trochaic and iambic feet in the same language (as argued for Larike or Wichita in Goedemans and van der Hulst 2013).

[6] Page numbers refer to the electronic version of the paper found at the author's webpage.

Assuming that colon formation occurs in one step alongside (single-)foot parsing, we may now return to the remaining cases. Degenerate feet also appear in [(ˌL)(ˈH)] forms. Their production is comparable to the one in (12), the only difference being that an additional constraint, informally stated here as *(ˈLH), rules out a candidate like (13a) in the 1st iteration. A (LH) trochee seems very unlikely anyway. Thus, the constraint in question should not be surprising. The exact location of this constraint is unclear. Its present placement is however sufficient for illustration purposes.

(13) *1st Iteration: /LH/* → L(ˈH)

	/LH/	HAVE-K	*(ˈLH)	ALL-FT-R	FTBIN
	a. (ˈLH)	*	*!		
	b. (ˈL)H	*		*!	*
☞	c. L(ˈH)	*			

2nd Iteration: /L(ˈH)/ → (ˌL)(ˈH)

	/L(ˈH)/	HAVE-K	*(ˈLH)	ALL-FT-R	FTBIN
	a. L(ˈH)	*!			
☞	b. (ˌL)(ˈH)			*	*

Convergence on 3rd Iteration

Tableau (14) demonstrates the lack of a degenerate foot. As before, during the first iteration, all possible candidates violate HAVE-K. The chosen winner at this stage merely constructs a binary left-headed foot at the right edge of the word. On the second iteration, formation of a second foot is welcome, as it offers satisfaction to HAVE-K. Unlike the previous cases though, the construction of a degenerate foot on the 3rd iteration is no longer justified. The colon-constraint has already been satisfied, so there is no trigger anymore for a unary foot. Foot-alignment and foot-binarity will thus opt for a non-fully parsed winner.

(14) *1st Iteration*: /LLLLL/ → [LLL(ˈLL)]

	/LLLLL/	HAVE-K	ALL-FT-R	FTBIN
☞	a. LLL(ˈLL)	*		
	b. LLLL(ˈL)	*		*!
	c. (ˈLL)LLL	*	***!	
	d. (ˈL)LLLL	*	****!	*

2nt Iteration: /LLL(ˈLL)/ → [L(ˌLL)(ˈLL)]

	/LLL(ˈLL)/	HAVE-K	ALL-FT-R	FTBIN
	a. LLL(ˈLL)	*!		
☞	b. L(ˌLL)(ˈLL)		**	

3^{rd} Iteration: /L(ˌLL)(ˈLL)/ → [L(ˌLL)(ˈLL)]

	/L(ˌLL)(ˈLL)/	HAVE-κ	ALL-FT-R	FTBIN
☞	a. L(ˌLL)(ˈLL)		**	
	b. (L)(ˌLL)(ˈLL)		****!	*

Convergence on 4^{th} Iteration

It is in cases like this one, where the power of the step-wise analysis and the gradualness hypothesis is unravelled. The distinction in the behaviour of odd-parity words that exclusively contain light syllables (among other instances), with the 3σ-ones allowing for degenerate feet versus the 5σ-ones which ban them, comes naturally under the idea of the colon as the triggering mechanism of degenerate feet and the serial foot-construction. In a global ParOT account, as will be shown next, this is not the case. Because this approach can 'look ahead' it will produce more degenerate feet than actually attested, unless prevented by another constraint that blocks such structures.

Finally, the form /HL/ surfaces as [ˈHL], which, recall, may be interpreted as [(ˈHL)] or as [(ˈH)L]. Our current analysis promotes the former, i.e. (15c). As a minor point, note that the winner violates the constraint *ˈHL (not shown here) - after Pruitt (2010) - which consequently has to be low ranked.

(15) *1^{st} Iteration: /HL/ → (ˈHL)*

	/HL/	HAVE-κ	ALL-FT-R	FTBIN
	a. H(ˈL)	*		*!
	b. (ˈH)L	*	*!	
☞	c. (ˈHL)	*		

Convergence on 2^{nd} Iteration

For reasons of space, remaining patterns such as (ˌLL)(ˈLL) or (ˌL)(ˈHL) are not displayed here, but the interested reader should be able to confirm that the proposed analysis also correctly produces them.

3.2. ParOT-cum-standard-assumptions

An analysis on the other hand that utilizes *exactly* the same constraints as in §3.1, but which is set in the classical Parallel OT mechanism, only partially delivers, even when various relevant modifications are applied in the way constraints are ranked or are to be understood. The problem can be resolved if an additional constraint is added to this set. While this eventually captures the empirical facts, I will argue in §4.1. that it does so in a less elegant way than the HS account. In what follows, the incorrectly predicted winners are surrounded by the symbol ✖ (where applicable) and marked with 💣 in tableaux, whereas correct winners appear on the left side.

The first analysis to be considered adopts the ranking in §3.1, the only difference being that left rather than right-foot-alignment is employed. A summary of the (in)correct results is laid out in (16). The tableaux in (17) focus on the wrongly-generated patterns.

(16) *Attempt A:* *HAVE-κ >> ALL-FT-L, FTBIN*

Correctly Produces		*Fails On*	
(ˌL)(ˈLL)	✓	*(ˌL)(ˈL) instead of (ˈLL)	×
(ˌL)(ˈH)	✓	*(ˌH)(ˈL) instead of (ˈHL)	×
L(ˌLL)(ˈLL)	✓		

(17) /LL/ → (ˈLL) ⌘ *(ˌL)(ˈL) ⌘

/LL/	HAVE-κ	ALL-FT-L	FTBIN
☞ a. (ˈLL)	*!		
💣 b. (ˌL)(ˈL)		*	**

/HL/ → (ˈHL) ⌘ *(ˌH)(ˈL) ⌘

/HL/	HAVE-κ	ALL-FT-L	FTBIN
☞ a. (ˈH)L	*!		
b. (ˈHL)	*!		
💣 c. (ˌH)(ˈL)		*	*

The problem, as hinted at before, is that global OT overgenerates; by looking-ahead, it produces more degenerate feet than are actually allowed. HS side-steps this problem, because it can only parse one foot at a time, thus in words of the /LL/ type, only <(L)L, L(L), (LL)> are viable candidates, but crucially no *[(L)(L)]. This latter option is perfectly feasible in ParOT and due to global evaluation, HAVE-κ will wrongly pick it out as the winner. The same applies to /HL/words.

An anonymous reviewer suggests that a somewhat different ranking – shown in (18) – solves the problem, but this is not quite the case. To his/her original suggestion, I have also added consideration of PARSE-σ, as it slightly improves the results. This modification eventually fails too, which is why I have chosen not to present it in the main text in any detail. The interested reader may consult the **Appendix** for further discussion.

(18) *Attempt B:* *HAVE-κ, FTBIN >> PARSE-σ >> ALL-FT-L*

Correctly Produces		*Fails On*	
(ˈLL)	✓	*(ˌLL)(ˈLL)L instead of L(ˌLL)(ˈLL)	×
(ˌL)(ˈLL)	✓		
(ˈHL)	✓		
(ˌL)(ˈH)	✓		

A different route to the problem is to suggest that rather than modifying the constraint ranking, we could simply slightly alter the definition of constraints, whose understanding is not uniform across the literature. In particular, we can interpret FTBIN as enforcing strictly bimoraic feet, i.e. 2μ-FTBIN[7].

[7] Pruitt (2010) shows that 2μ-FTBIN is problematic in the examination of a generalised trochee type of language, as in Weɽgaia. The system is partially QS in odd-parity words, but not in even-parity ones, thus: *odd-parity*: (ˌσσ)(ˈH) *(ˌbuna)(ˈɖug)* ‘broad-leaved mallee’ or (ˈσσ)L *(ˈdelgu)na* ‘to cure’ vs. *even-parity*: (ˌσσ)(ˈσσ) *(ˌwiɽim)(ˈbuliɲ)* ‘to chase’. The system is derivable in both ParOT and HS, but only under the version of FTBIN used here. Use of 2μ-FTBIN in 2μ-FTBIN >> PARSE-σ >> ALL-FT-L

In fact, this produces even worse results. Using the ranking in (18) – the most successful in our ParOT examination so far – not only do we derive the wrong form *[(ˌLL)(ˈLL)L], but others too, such as *[L(ˈH)L] instead of [(ˌL)(ˈHL)] or *[(ˌH)(ˈL)], as depicted in (19).[8]

(19) /HL/ → (ˈH)L or (ˈHL) ⧓ *(ˌH)(ˈL) ⧓

/HL/	HAVE-κ	2μ-FTBIN	PARSE-σ	ALL-FT-L
💣 a. (ˌH)(ˈL)		*		*
b. (ˈH)L	*		*!	
☞ c. (ˈHL)	*	*!		

A third strategy yet, and one that two of the reviewers have suggested, involves the addition of a constraint to the constraint set. As the reader will have noticed through examination of (16), the problematic winners for this account are [*(ˌL)(ˈL)] and *[(ˌH)(ˈL)], whereby the *primary* stress belongs to a degenerate foot. So, one should seek to somehow eliminate them. There are at least two ways to do that. In the light of facts which suggest that in some languages primary stress (or head feet) exhibits special behavior, various approaches pose primary-stress-specific constraints (e.g. McGarrity 2003; Pruitt 2012); it is thus reasonable to consider a constraint that bans degenerate head-feet. Such a constraint has been suggested in McCarthy (2008a: 519) in terms of FTBIN-σ_{head}.[9] Alternatively, one can employ a version of NONFINALITY that militates against stressing light syllables, while allowing for final stress on heavy syllables. Because such a constraint is discussed in the next section anyway, I will utilize the former constraint for illustration purposes, but the concerns raised in §4.1 should hold equally well for both.

Adopting the constraint ranking achieved in §3.1 and complementing it with the high-ranking FTBIN-σ_{head} produces the desirable results, as illustrated by means of a few representative tableaux below. The enforcement of a single bimoraic foot in (20) is due to the newly introduced constraint, which explicitly bans a degenerate foot in primary stress position. Crucially, it has to be ranked above HAVE-κ. This top-most constraint is also responsible for the correct production of [(ˈHL)] instead of *[(ˌH)(ˈL)][10].

(20) /LL/ → (ˈLL)

/LL/	FTBIN-σ_{head}	HAVE-κ	ALL-FT-R	FTBIN
a. (ˌL)(ˈL)	*!		*	**

correctly predicts *(ˌbuna)(ˈɖug)*, but wrongly **(ˌdel)(ˈguna)*. A solution is to add top-ranked *CLASH to eliminate **(ˌdel)(ˈguna)* in favour of *(ˈdelgu)na*. Hyde (2007b: 312-6) though notes that admission of *CLASH in ParOT predicts unattested patterns. Pruitt however argues that HS employing FTBIN avoids these problems even if *CLASH continues to be admitted in CON.

[8] The opposite ranking ALL-FT-L >> PARSE-σ would save the day for (19), but not for the other problematic winners.

[9] At the same time, it should be noted, that there are other primary-stress-specific constraints that would actually promote exactly the candidates we wish to exclude. For example, McGarrity (2003: 227) employs ALIGNHDǿ-R "the R-edge of the word must be aligned with a primary stressed syllable", alongside a left-alignment constraint of stress to produce the *hammock* pattern, as she calls it, in Armenian illustrated by e.g. [ʃàlák] 'back'. On these grounds, the NONFINALITY constraint which is independently motivated is perhaps better suited.

[10] Originally, FTBIN-σ_{head} was stated as a "requirement that the head foot contain two syllables" McCarthy (2008a: 519). To allow the form [(ˌL)(ˈH)] too one needs only revise the constraint so that it refers to moras instead of syllables. In that case, a (ˈH) head-foot would escape a FTBIN-σ_{head} violation and HAVE-κ would promote construction of a further unary foot.

☞ b. (ˈLL)		*		

In (21) the winner has enough structure to not only form a binary head-foot and thus avoid violation of FTBIN-σ_{head}, but to also construct a degenerate foot with secondary stress, as imposed by the high ranking HAVE-κ. The low ranking binarity and alignment constraints reveal their power in longer words. In (22), all reasonable candidates satisfy the two dominant constraints and it is the job of the lower ones to decide in favor of (22c) that lacks degenerate feet.

(21) /LLL/ → (ˌL)(ˈLL)

/LL/	FTBIN-σ_{head}	HAVE-κ	ALL-FT-R	FTBIN
a. (ˌLL)(ˈL)	*!		*	*
b. L(ˈLL)		*!		
☞ c. (ˌL)(ˈLL)			**	*

(22) /LLLLL/ → (ˌL)(ˈLL)

/LL/	FTBIN-σ_{head}	HAVE-κ	ALL-FT-R	FTBIN
a. (ˌL)(ˌLL)(ˈLL)			** *!***	*
b. (ˌLL)(ˌL)(ˈLL)			** *!**	*
☞ c. L(ˌLL)(ˈLL)			**	

3.3. ParOT-cum-non-standard-assumptions

The preceding discussion has shown that in ParOT a slight enrichment of the constraint set compared to the one assumed in the HS analysis is required, so that it captures the Iquito facts. In Section 4.1., I will claim that such enrichment is not purely superficial. Instead, it highlights a difference between the standard ParOT vs. HS model that renders the latter technically more elegant. Because of that conclusion, it is worthwhile to consider another alternative within the ParOT paradigm. A good candidate for that is Brett Hyde's model (2002, 2007b, 2012), since it constitutes a comprehensive theory of stress relying on somewhat different principles than those previously employed.

Before proceeding with the particulars of the analysis, some preliminaries are in order. Since gridmarks are fundamental in this framework, I will call this theory ***GM*** for ease of reference. The basic architecture of GM contains both inviolable conditions in GEN as well as standard violable constraints. The former include:

(23) *GM Inviolable conditions* (Hyde 2002: 318)

a. *Strict Succession* (adapted from Ito & Mester 1992): exhaustive parsing into feet

b. *Headedness*: every foot has a head (even if it's unstressed)

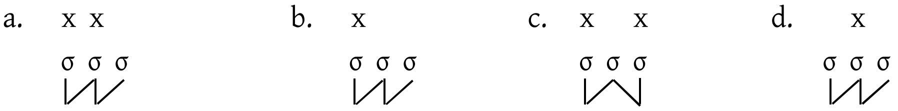
c. *Gridmark to Head*: Gridmarks must correspond to heads, but heads need not correspond to gridmarks

d. *FootCap*: Feet are maximally disyllabic

e. *HeadGap*: For every two adjacent syllables, one must be a foot-head

While most of these are self-explanatory, some additional remarks will appear as the discussion unfolds. At the outset, a property needs to be mentioned that is alluded to through (23c). Besides gridmarks, independent reference to heads is made, which are represented through vertical lines. Moreover, intersecting and stressless feet are admitted.

(24) *Intersecting feet in Hyde* (a-c: in Hyde 2002: 317; d in Hyde 2002: 324, ex. 14a)



For example, (24a) contains two trochaic feet over three syllables. Stress is on the 1st and 2nd syllables. These positions are also heads. An intersection appears on the 2nd syllable since it is at the same time the tail of the first foot (diagonal line), as well as the head of the second foot (vertical line). (24b, d) are representationally identical to (24a) with the exception that there is no stress on the 2nd syllable (b) or the 1st syllable (d), hence stressless feet are permitted, indicating that there is no 1-to-1 correspondence between stress and feet in this framework. (24c) contains one trochaic and one iambic foot, with stresses on the 1st and the 3rd syllable, respectively. The 2nd syllable is a tail for both feet. Note that (24a, d) also present gridmark sharing on the 2nd syllable.

Before moving on to the Iquito analysis, we need to present the constraints that will be administered. (25) states just the subset of constraints pertinent to us presently. Informal versions are given here. The interested reader should consult Hyde (2002) for the formal definitions.

(25) *Constraints used* (Hyde 2002: 319-320)
HDS-R: The R edge of every foot-head is aligned with the R edge of some PrWd
PRWD-L: The L edge of every PrWd is aligned with the L edge of some foot-head
MAP GRIDMARK: No stressless feet
*CLASH: No adjacent stressed syllables
NON-FINALITY: No stress on the final syllable of a prosodic word (to be revised)

(26) /LL/ → ˈLL *correct*: establishes NONFINAL >> HAVE-κ

/LL/	NONFINAL	HAVE-κ	HDS-R	*CLASH
a. x x L L | |	*!		*	*
b. x L L \\\|	*!	*		
☞ c. x L L |/		*	*	

Starting with the simple ['LL] case, the ranking NONFINAL >> HAVE-κ, HDS-R, *CLASH is sufficient, ensuring that a single stress on a binary trochaic foot at the left edge of the word, will be the winner. To produce the degenerate foot found in a /LLL/sequence, the role of HAVE-κ has to be promoted, so that it dominates the HDS-R and *CLASH constraints.

(27) /LLL/ → ˌL'LL *correct result with *variability* in representation*

/LLL/	NONFINAL	HAVE-κ	HDS-R	*CLASH
☞ a. x x L L L | V			* **	*
☞ b. x x L L L VV			* **	*
c. x L L L | V		*!	* **	
d. x L L L VV		*!	* **	

Candidates (27b, d) consist of intersecting feet, whereas (27a, c) prefer a unary foot on the left edge in accordance to *FootCap* (23d). Also (27a, b) contain two stresses, as opposed to (27c, d) that present just one. NONFINAL is of no importance here, so it should fall onto the relative high-ranking HAVE-κ to eliminate the single-stressed (27c, d), as desired. For this to happen, HAVE-κ is to be *crucially* understood as referring to having two prominences per word (gridmarks), rather than two particular prosodic constituents, i.e. feet, otherwise (27c, d) – in the oval - would wrongly qualify as winners. Notice that even if the constraint MAP GRIDMARK, were to be included in the ranking (cf. (30)), it would still not suffice to exclude both losing candidates. It would rule out (27c) by virtue of the stressless first foot, but it would still not eliminate (27d), as it conforms to the definition of MAP GRIDMARK: "A foot-level gridmark occurs within the domain of every foot." (Hyde 2002: 319). In fact, Hyde's (2002: 324) candidate (14a) is identical to (27d) and is considered to fully satisfy MAP GRIDMARK. Consequently, HAVE-κ – under the interpretation of requiring two prominences per word – is indispensable in producing (27a, b), both of which empirically correspond to the winner. To my understanding, there is no constraint in Hyde's system that would choose one over the other, hence no single winner can be chosen, offering ambiguity in the representation.

To correctly generate the [ˌL'H] and [ˌL'HL] forms, an amendment to NONFINAL must be made, such that final stress is banned on L but not on H syllables. Such a provision is made (cf. Hyde 2007b: 300), through the constraint NONFIN ($X_{F,}$ X_{μ}, σ) "No foot-level gridmark occurs over the final μ-level gridmark of a σ" which effectively allows stress on final H, under the idea that this version of NONFINAL penalizes prominence on the second (and final mora) of a heavy syllable, but the assumption here is that stress docks onto the first mora of H. This version of NONFINAL allows all of (a-c) to escape violation of that constraint, leaving it to HAVE-κ to decide between some of the candidates. As before, single-stressed options are ruled out and the remaining ones fare equally well. Once more, variability in the representation emerges.

(28) /LH/ → ˌLˈH *correct result with *variability* in representation*

/LH/	NonFinal	Have-κ	Hds-R	*Clash
☞ a. x x L H			*	*
☞ b. x x L H			*	*
c. x L H		*!	*	
d. x L H		*!	*	

As for the longer words that consist of light syllables throughout, the situation is clear-cut. However, some constraints need to be added to the mix, to generate the right results. The tableaux are presented here for completeness, but for reasons of space they are only briefly discussed[11].

(29) /LLLL/ → ˌLLˈLL *correct result*

/LLLL/	Have-κ	PrWd-L	Hds-R	*Clash
☞ a. x x L L L L			1 3	
b. x x L L L L		*!	1 2	*
c. x L L L L	*!		1 3	

Alternating rightward trochees with two prominences (29a) are correctly selected over those with a single prominence (29c) because of Have-κ, while the addition of PrWd-L ensures that (29b) will not be rendered an equally plausible winner as (29a).

[11] In the next two tableaux, I use numbers rather than asterisks in the evaluation of Hds-R, to make the computation of violations clearer.

(30) /LLLLL/ → LˌLLˈLL *correct result*

/LLLLL/	HAVE-κ	PRWD-L	MAP-GM	HDS-R	*CLASH
a. x x LLLLL			*!	1 3 4	
☞ b. x x LLLLL				1 3 4	
c. xx x LLLLL				1 3 4	*!
d. x x LLLLL		*!		1 3 3	

/LLLLL/ inputs correctly map to a winner that only contains two stresses, as in (30b). A degenerate foot without prominence (30a) can be avoided if MAP-GM is appropriately ranked, whereas (30d) – a doubly-headed intersecting foot – is wiped out by independently high-ranked PRWD-L. The remaining candidate (30c), i.e. the true contender in terms of additional stresses, is eliminated due to a low-ranking *CLASH violation.

4. Discussion

4.1. Evaluation of analyses

To summarize, Section 3 has explored three alternatives couched within OT for the analysis of Iquito. The first utilized IFO à la Pruitt (2010) within Harmonic Serialism (§3.1), the second employed ParOT with standard assumptions (§3.2) and the third one applied Hyde's GM model (2002, 2007b, 2010; §3.3)[12]. On empirical grounds, it was shown that all three are able to produce the data in question. I nonetheless argue that the former is to be preferred. Conceptually speaking, HS neatly captures the *degenerate-foot-only-with-colon* effect directly through the model's architecture. In both the other alternatives, extra factors have to be introduced. Moreover, IFO, as is shown next, appears to be more restrictive in comparison to ParOT. It also requires an understanding of the colon that is compatible with other facts that support such a constituent (§2.2). Finally, IFO's technical implementation requires no additional constraints or representations, unlike GM. These points are developed in detail immediately below.

As we have seen in §3.1, the ranking HAVE-κ >> ALL-FT-R, FTBIN has proved sufficient to produce the Iquito pattern under HS. On the other hand, in the remaining two accounts, the constraints used – either identical to those of HS, as in §3.2, or the comparable ones in Hyde's model

[12] Although IFO is a specific implementation of HS for stress, in this section I will use the terms IFO and HS interchangeably to refer to that particular application of the HS model onto stress.

– had to be supplemented by an extra constraint, FTBIN-σ_{head} or NONFINALITY, whose sole purpose was to explicitly rule out candidates *(ˌL)(ˈL) and *(ˌH)(ˈL) that were otherwise predicted to win.

In IFO this effect comes naturally as part of the model's architecture – as applied elsewhere with success (Pruitt 2010) – and complemented by the high-ranked HAVE-κ, which all analyses have to enlist anyway. There is thus no need for an additional mechanism or constraint to block the undesirable forms. Due to gradualness, a candidate like [(ˌL)(ˈL)] will never be constructed in a single step; instead [(ˈLL)] will be preferred.

This is not to say that [(ˌL)(ˈL)] can never be produced though. On the contrary, we want to be able to derive it, in the light of e.g. the Armenian *hammock* pattern mentioned in footnote 9. In Standard Parallel OT, this schema is in fact exactly what we would expect to get by default for /LL/ [and /HL/ forms] given the main ranking in §3.1-§3.2 (i.e. HAVE-κ >> ALL-FT-R, FTBIN), unless another constraint blocks its generation. In HS, it is the other way round; we expect the production of [(ˈLL)] forms, unless there are other, additional requirements/constraints that impose the construction of unary feet. In that latter case though, the unary feet will not be created in one go, but rather iteratively, i.e. /LL/ → [L(ˈL)] → [(ˌL)(ˈL)] , in line with gradualness.

With these data in mind, one could of course say that ParOT and HS are after all effectively comparable: where ParOT requires a constraint to block [(ˌL)(ˈL)] forms, HS needs other(s) to generate exactly those. It would then seem to be a matter of taste which particular model to use. Other languages though prove more enlightening; while Armenian posits two degenerate feet in disyllables, there are other languages, such as Pattani Malay (Yupho 1989), which typically foot every syllable into a unary foot also in longer words, thus [(ˌmã)(ˌkɛ)(ˈnɛ̃)] 'food' (Yupho 1989: 135). In such a case, simple reference to the colon would not suffice to foot everything by means of degenerate feet. Instead, simultaneous satisfaction of constraints such as FT-HD-L and FT-HD-R[13] ought to be utilized regardless of whether the analysis is placed within ParOT with standard metrical constraints or its HS counterpart. If it is correct that ParOT needs such constraints anyway, then it not only requires a way to block unary feet in certain contexts in languages such as Iquito[14], but it also needs to be able to generate them in languages such as Pattani Malay. HS thus becomes more restrictive; Iquito's pattern is simply derived through the architecture of the model. It is only for Pattani Malay that something extra needs to be said, along the lines just outlined.

While HS' technical superiority as far as Iquito is concerned is equally applicable to GM too, there is a shortcoming that is specific to that latter model only. Recall that in its original interpretation HAVE-κ necessitates the presence of minimally two feet in the structure. In GM though, this requirement could be satisfied even if there were only one stress in the word, as in (27c, d), in which case they'd wrongly be winners. This was the reason why HAVE-κ *had* to be understood as referring to a demand of two prominences per word (gridmarks), rather than of a particular prosodic constituent. In turn, that would call instead for a constraint such as HAVE-2-STRESSES or HAVE-2NDARY-STRESS[15] whose grounding remains at this point unclear. Assuming for a moment that such a constraint is justified, then it would effectively dissociate the pattern found in Iquito from

[13] FT-HD-L: "Align the L edge of every foot with the L edge of a foot-head" and FT-HD-R: "Align the R edge of every foot with the R edge of a foot-head" (see Topintzi 2010: 172 and references therein).

[14] It needs to be acknowledged that this argument possibly only goes through when the 'extra' constraint is FTBIN-σ_{head}. If NONFINALITY proves more suitable, then no distinction of the accounts would be possible, since NONFINAL is independently needed in general. Even so, this does not change the fact that IFO generates the Iquito pattern more straightforwardly.

[15] This second option has been suggested to me by Harry van der Hulst (p.c).

most of the languages mentioned in §2.2, where reference to the colon seems necessary. Worse still, it might suggest an entirely different treatment for phenomena within Iquito itself, namely stress and tone, despite the existence of preliminary evidence in §2.1. which suggests that both make reference to the same prosodic domain – what has been called colon in the present paper. To put it differently, the GM account can handle the data, but because of its assumptions, it must explain the Iquito stress facts by making reference not to foot structure itself, but to prominence. The price to pay is loss of insight, both within the language (cf. tonal facts), as well as cross-linguistically, since the κ – if one insists to maintain the label – in Hyde's theory bears no resemblance to the prosodic element required in many of the languages in §2.2. On the other hand, the ordinary understanding of footing in IFO, and for that matter, in Standard ParOT, is able to maintain this connection.

A more general problem in GM is the admission of intersecting feet, as this implies a proliferation of possible foot configurations. While some structures are explicitly banned in Hyde's model, such as the cross-intersecting foot in (31) [cf. Hyde 2001: 53], others could in principle be produced, although – to my understanding – are never discussed. The first half of the structure in (30d) that involves a doubly-headed intersecting foot is an example of that type. Also observe that if it weren't for high-ranking PRWD-L, this form would be predicted to win under the ranking in (30).

(31) *Banned cross-intersecting feet*

x
L L

A somewhat related issue concerns the richer representations that GM heavily relies on. For example, Hyde (2002: 323-4) argues that intersections are to be preferred over unary feet because they can avoid clashes/lapses, as illustrated in the partial tableau in (32).

(32) *Intersections vs. unary feet*

/σσσσσ/	HDS-L	*CLASH
☞ a. x x σ σ σ σ σ	* ***	
b. x x x σ σ σ σ σ	* ***	*!

In Iquito, it was exactly in cases with degenerate feet (cf. (27&28)) that monosyllabic or intersecting feet could emerge, but unlike (32), no constraint seemed to choose between those. This situation is shown in (33), a partial reproduction of (27), where either (a) or (b) could win.

(33) /LLL/ → ˌLˈLL *correct result with *variability* in representation – partial copy of (27)*

/LLL/	NonFinal	Have-κ	Hds-R	*Clash
☞ a. x x L L L | \/			* **	*
☞ b. x x L L L \/\/			* **	*

While empirically this has no serious repercussions for the data in question, it does nonetheless seem to entail that both structures co-exist in the language, an ambiguity that could potentially be thought of as a weakness in the light of absence of supporting data. Perhaps more importantly, it becomes hard to conceptualize what a degenerate foot is really in Iquito. Not only can it be a truly unary foot, as in (33a) and as standardly assumed, but it can also look identical to a normal binary foot as indicated by the second part of the intersecting foot in (33b). Intuitively though we would presumably want to maintain the empirical difference between a degenerate and a binary foot, but for at least some cases, as in Iquito, this contrast is neutralized. All in all, given that the introduction of intersecting feet remains a controversial topic, also potentially producing unnecessary complications, an analysis that achieves the same – if not better – results without them, is advantageous.

4.2. Why the colon is not a problem

Independently of which of the aforementioned OT stress models one eventually subscribes to, it should be evident that the bigger picture remains ultimately the same regardless. More specifically, a vital point throughout has been the use of the – less accepted – prosodic colon κ. This section thus wishes to conclude the paper by addressing two concerns that have not been voiced till now, but will undoubtedly trouble some readers. First, is the introduction of the κ a problem? And second, can we entertain an alternative explanation of the facts and thus make do without it?

Inclusion of κ into the prosodic hierarchy (e.g. Selkirk 1972, 1981; Nespor & Vogel 1986) places it between the prosodic word and the foot, as shown in (34). The question is whether such a move burdens the hierarchy unnecessarily, given that in many languages there are no arguments in favor of the use of the colon whatsoever.

(34) *Commonly accepted prosodic hierarchy with the addition of κ*

Intonational Phrase (ι)
Phonological Phrase (φ)
Prosodic Word (ω)
← Colon (κ)
Foot (π)
Syllable (σ)
Mora (μ)

Note however that this problem is not inherent to κ. For example, Schiering et al. (2010)[16] show that Vietnamese visibly only makes use of σ & φ as domains for phonological processes, but not of ω & π, both of which happen to be well-accepted and well-argued-for prosodic categories. Would that imply then that we should discard the prosodic word *ω* and the foot *π*? Perhaps YES, with regard to Vietnamese, but most likely NO when these are viewed as possible prosodic constituents cross-linguistically. Indeed, this possibility is sanctioned by Schiering's et al. (2010) proposal that prosodic categories[17] are language particular, in the sense that prosodic structure should be constructed based on the individual processes at work in the language, instead of imposing a limited number of domain types defined a priori (2010: 705). In other words, the prosodic hierarchy is emergent rather than fixed. A weaker version of this idea is adopted by Hyman (2011), who argues that Gokana organizes its phonology around moras, whereas syllables play at best a cursory role. He then goes on to maintain the universality of the prosodic categories but suggest that these might be exploited to different degrees across languages (2011: 82).

Entertaining this hypothesis and assuming for exposition purposes the Schiering et al. (2010) view, we would then say that Iquito's emergent prosodic hierarchy *must* include κ next to other levels (π, μ, and maybe σ) that the stress and tonal systems exploit, but without any implication that other languages will utilize κ too unless there is positive evidence that actively supports it.

Turning now to the second question, we need to consider alternatives that potentially render the colon redundant. The best contender for colon-replacement would be the reference to two feet that Poser (1990) offers for some of the prosodic templates in Japanese. Such an option is reasonable, given that it imposes no new constituent and keeps in line with counting up to two. I will argue that for some data, including possibly Iquito itself, such an alternative is viable. For many other cases though, such solution either requires considerable additional modifications – a move that undermines the whole enterprise, since theory-enrichment is not after all avoided – or fails completely.

Let us start by reconsidering Matumbi (see (9) for data), where the H-tone is placed at the right edge of the *2nd* foot. How is this to be formally understood? Under the two-foot approach, one could imagine an analysis whereby the tone is attracted to the R edge of the rightmost foot, under the assumption that only two feet are created or whereby the H tone is placed at the right edge of the first foot, but the actual first foot is rendered extrametrical, thus effectively positioning the tone at the edge of the *second* foot. None of these solutions is particularly satisfactory; the first relies on a very specific footing, imposed basically by the desire to 'skip' the first foot, whereas the second one achieves this effect through extrametricality, an established mechanism at the right edge of the word, but at best questionable at the left edge of the word, with some researchers even denying it altogether (Gordon 2002; Hyde 2002; but see Buckley 2009). Employing the colon instead produces a more straightforward account: the H tone is attracted to the head of a right-headed moraic colon at the left edge of the stem (Marlo et al. 2013: 12).

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[16] Irene Vogel (p.c.) brings to my attention acoustic work by Ingram and Nguyen (2006) which concludes that stress is a phonetic tendency in Vietnamese and not truly phonologically contrastive. I refer the interested reader to Schiering et al. (2010: 672) for answers against this criticism, as well as more recent work by the same authors. In any case, I remark that besides Vietnamese, Schiering et al. (2010) argue in favour of the emergent prosodic word using data from Limbu too.

[17] To be accurate, their argument is built on the prosodic word, but it presumably extends to other categories too.

Another argument, germane to counting, is perhaps even stronger; if phonology – with the caveat in footnote 3 - indeed counts up to two, then we could actually expect other languages to place maxima of the type 'two cola', although these may not be worded in this way. Western Apache (Greenfeld 1972) and Wapishana (Tracy 1972) instantiate exactly that. Greenfeld (1972: 273) speaks about the higher phonological unit in W. Apache – what he calls the "meter" – that roughly corresponds to the grammatical phrase, as the one that consists of one to four phonological feet. Similarly, Tracy (1972) calls attention to the "contour" which "groups together feet that have syntactic relationships" and mentions that this comprises one to four feet (possibly more). Although it is an issue what exactly the concepts "meter" and "contour" here allude to, this reference to up to four feet should not be overlooked. Obviously the range of prosodic sizes here can be better re-worded as "one foot to two cola".

Support for *κ* comes from yet a third source; more specifically, the colon seems to be serving as the domain of phonological processes. For example, in Canadian English, raising of the diphthong /aɪ/ to [əi] is triggered by a voiceless segment within the prosodic word, as in [ɹəit] 'write' vs. [ɹaɪd] 'ride'. In the latter, raising fails due to the following voiced *d*. The triggering element can belong to a weaker foot, but not to a stronger one, a fact that Bermudez-Otero (2004) interprets as an indication that Raising applies within the prosodic domain *κ*, hence [$_{\omega}$[$_{\kappa}$[$_{\pi}$ ˈnəi][$_{\pi}$ ˌtɹeɪt]]] 'nitrate' where raising emerges, as opposed to [$_{\omega}$[$_{\pi}$ ˌsaɪ][$_{\kappa}$[$_{\pi}$ ˈfɑːnɪk]]] 'syphonic' where it does not. Simple reference to dipodicity would be insufficient to characterize the domain in question and would require supplementary reference to strong and weak feet. Accepting the colon as a domain on the other hand captures the generalization neatly.

4.3. Concluding remarks

To sum up, the present paper has examined the stress data of Iquito and focused on the contextual emergence of degenerate feet. In line with Michael (in press), it has been claimed that the language normally avoids unary feet, but permits them exceptionally to satisfy a requirement that a word contains a prosodic colon *κ*. Evidence for such a prosodic constituent has been supplied both from Iquito itself, as well as from a host of different languages and phenomena, including tone association in Matumbi, prosodic templates in Japanese and Bella Coola, and Canadian raising, among others. A recurring theme throughout the paper - emphasized in §2.2 and §4.2 - has been the proposal that introduction of the colon in the prosodic hierarchy is unproblematic given recent approaches that accept language-specificity in prosodic universals, either by means of language particular (instead of universal) prosodic hierarchies (Schiering et al. 2010) or by suggesting that (the same) prosodic categories may be active to different extents depending on the language (Hyman 2011). In addition, it has been argued that while alternative proposals that avoid reference to the colon may be workable for some of the data under consideration, it is only the colon that manages to cover for all the data uniformly. What is more, its admittance makes certain predictions that no other alternative does. As §4.2 has shown, these predictions are indeed borne out.

On the formal side of things, three different OT accounts of stress have been entertained for the analysis of the Iquito facts (see §3). Despite their differences, an indispensable component of all has been the constraint HAVE-κ that imposed the formation of a colon where applicable. It has been suggested that while all three eventually manage to capture the Iquito data, it is only the approach couched within Harmonic Serialism that proves technically superior and whose own architecture, viz. gradualness, offers a straightforward explanation of the partial emergence of degenerate feet (§4.1).

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APPENDIX to §3.2.

The ranking in (18), while seemingly better than that in (17) also fails to produce the right results.

(18) ***Attempt B:*** *Have-κ, FtBin >> Parse-σ >> All-Ft-L*

Correctly Produces		*Fails On*	
('LL)	✓	*(ˌLL)('LL)L instead of L(ˌLL)('LL)	✗
(ˌL)('LL)	✓		
('HL)	✓		
(ˌL)('H)	✓		

The equal ranking (cf. Crowhurst & Michael 2005; Topintzi 2005; Rice 2006), rather than the dominance of Have-κ over FtBin balances out the negative effect that Have-κ previously had (cf. (17)), correctly generating [('LL)] as the winner.

(I) /LL/ → ('LL)

	/LLL/	Have-κ	FtBin	Parse-σ	All-Ft-L
	a. (ˌL)('L)		*!*		*
☞	b. ('LL)	*			

In fact, it should also be that Parse-σ >> All-Ft-L, so that the desirable winner (d) is chosen over (a).

(II) /LLL/ → (ˌL)('LL)

	/LLL/	Have-κ	FtBin	Parse-σ	All-Ft-L
	a. ('LL)L	*		*!	
	b. (ˌLL)('L)		*		**!
	c. L('LL)	*		*!	*
☞	d. (ˌL)('LL)		*		*

/LH/ → (ˌL)('H) is also correctly produced, under the assumption that the constraint *('LH) (cf. (13)) is in action to rule out the contender *('LH). In addition, the ranking maps /HL/ to the output [('HL)], which besides [('H)L], is an equally conceivable parse for the stress pattern in question. Where this version fails though is with the pattern in (III), which favours alignment closer to the L-edge, rather than the desirable rightward.

(III) /LLLLL/ → L(ˌLL)('LL) ✗ *(ˌLL)('LL)L ✗

	/LLL/	Have-κ	FtBin	Parse-σ	All-Ft-L
💣	a. (ˌLL)('LL)L			*	**
	b. (ˌLL)(ˌLL)('L)		*!		** ****
☞	c. L(ˌLL)('LL)			*	* ***!
	d. (ˌL)(ˌLL)('LL)		*!		* ***

Of course, it could be argued that the problem is exactly that, i.e. with the alignment-edge. But the ranking *Have-κ, FtBin >> Parse-σ, All-Ft-R* reverses the problem. It correctly derives all forms – including L(ˌLL)('LL) – aside from (ˌL)('LL). For that, it predicts either *L('LL) (under All-Ft-R >> Parse-σ) or (ˌLL)('L) (under Parse-σ >> All-Ft-R). This is thus no solution either.