Rhythmic Directionality by Positional Licensing

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1. Introduction

One particularly useful way of addressing the issue of adequacy of constraints is the construction of factorial typologies. If we compare factorial typologies on the criterion of how closely they match actually attested stress systems, we may find reasons to prefer one set of constraints over the other.

Gaps in factorial typologies often diagnose imperfections in the constraint set.

Gaps in directional stress systems to be discussed here:
- the lack of leftward iambic systems (Kager 1993, McCarthy & Prince 1993, Hayes 1995, Van de Vijver 1998, Alber 2000);
- the lack of bidirectional systems in which stresses alternate toward a fixed secondary stress at an edge (Kager 1990).

Both gaps originate from a single assumption, shared by current metrical models, that directionality involves **non-local, symmetrical** principles of foot distribution (a 'directionality parameter', Hayes 1980, 1995, or 'foot-to-edge alignment constraints', McCarthy & Prince 1993).

2. Gaps in metrical typologies

2.1 Strictly binary iambs are rightward

I define a strictly binary system as one in which all feet are disyllabic (unary feet are disallowed). In such systems, a word with an odd number of syllables cannot be exhaustively parsed into feet, and **one syllable** must remain **unparsed**. Under a symmetrical theory of directionality, one expects this to happen at the left edge or the right edge, in both trochaic and iambic systems, predicting four types:

(2.1)	foot type	directionality	even number	odd number	language
	trochees	left-to-right	(10)(20)(20)	(10)(20)(20)**0**	Pintupi (A.1)
		right-to-left	(20)(20)(10)	**0**(20)(20)(10)	Warao (A.2)
	iambs	left-to-right	(01)(02)(02)	(01)(02)(02)**0**	Araucanian (A.3)
		right-to-left	(02)(02)(01)	**0**(02)(02)(01)	***

This typology contains a well-known gap (Kager 1993, Hayes 1995): iambic parsing is leftward under strict binarity. Note that the other three options are all typologically well-attested. This gap is even more puzzling since it cannot be explained by a universal prohibition against leftward iambic parsing. Leftward iambic languages do occur, but all are of the kind that permit unary feet:

(2.2)	foot type	directionality	even number	odd number	language
	trochees	left-to-right	(10)(20)(20)	(10)(20)(20)**(2)**	Murinbata (A.4)
	iambs	right-to-left	(02)(02)(01)	**(2)**(02)(02)(01)	Weri (A.5)

The crucial case, Weri, is a precise mirror-image of Murinbata, a rightward trochaic language that allows unary feet.

(2.3) **The Iambic Asymmetry**: Strictly binary iambic systems are rightward.

If leftward iambs cannot be universally excluded, then what causes the gap in (2.1)? What rules out the iambic mirror-image of Pintupi? Why should there be a relation between three parameters, foot type, minimum foot size, and directionality?

I hypothesize that the explanation resides in the **lapse**, or sequence of two unstressed syllables, at the **beginning** of the domain. (E.g., #0020201.)

(2.4)	left-edge lapse	#00	(relatively **un**acceptable)
	right-edge lapse	00#	(relatively acceptable)

This asymmetry is well-known from other rhythmic domains, particularly the avoidance of 'double upbeats' in musical rhythm (Lerdahl and Jackendoff 1983).

(2.5) There are languages that

- allow right-edge lapses, but disallow left-edge lapses; (Pintupi A.1)
- allow both right-edge lapses and left-edge lapses; (Cayuvava A.6)
- disallow both left-edge lapses and left-edge lapses; (Warao A.2)

but there are **no** languages that

- allow left-edge lapses, but disallow right-edge lapses.

There is a relation with extrametricality/nonfinality here: right-edge lapses may either be allowed (as in Pintupi), or required (as in Cayuvava). But no language is known to require left-edge lapses.

(2.6)		required	allowed	disallowed
	left-edge lapse	***	Cayuvava	(many languages)
	right-edge lapse	Cayuvava	Pintupi	(many languages)

2.2 Secondaries run toward main stress in bidirectional systems

There is a second gap in the metrical typology, equally puzzling as the iambic gap, which was first observed by Kager (1991). This transpires from a minitypology of bidirectional trochaic systems. In a bidirectional system, one foot is specified at one edge, while the other feet are built starting at the opposite edge. Logically speaking, we can vary the edge (i) of the fixed foot and (ii) the main stress foot ('End Rule' L or R), predicting 4 systems:

(2.7)	fixed foot	directionality	End Rule	even number	odd number	language
	left	right-to-left	left	(10) (20)(20)	(10) **0**(20)(20)	Garawa (A.7)
			right	(20) (20)(10)	(20) **0**(20)(10)	***
	right	left-to-right	left	(20) (20)(10)	(20) (20)**0**(10)	Piro (A.8)
			right	(10) (20)(20)	(10) (20)**0**(20)	***

No bidirectional systems occur in which the fixed foot lodges at the edge opposite-to-the-peak. Or, to state it differently, secondaries run toward the main stress in bidirectional systems. Or, to phrase it in local rhythmic terminology, the ternary interval occupies a position after the main stress (if this is initial), or before the main stress (if this is penultimate). In both cases, the ternary interval occurs **adjacent to** the peak. [Alleged instantiations of the initial dactyl pattern discussed in Appendix B.]

Again, this gap cannot be simply explained by some universal condition, for example, requiring a match between directionality of footing and the End Rule (Hammond 1984, Van der Hulst 1984). The position of main stress is, typologically speaking, not a reliable diagnostic of directionality. This is because languages exist that exhibit **mismatches** between directionality and the End Rule:

(2.8)	<u>foot type</u>	<u>directionality</u>	<u>End Rule</u>	<u>even number</u>	<u>odd number</u>	<u>language</u>
	trochaic	right-to-left	left	(10)(20)(20)	0(10)(20)(20)	Wargamay (A.9)
		left-to-right	right	(20)(20)(10)	(20)(20)(10)0	Cairo Arabic (A.10)
	iambic	left-to-right	right	(02)(02)(01)	(02)(02)(01)0	Creek (A.11)
		right-to-left	left	(unattested: Iambic Asymmetry)		

The gap (yet another directionality asymmetry) can be stated as follows:

(2.9) **The Bidirectionality Asymmetry**: Secondaries run toward the main stress in bidirectional systems. (Or: in bidirectional systems, the edges of the fixed foot and the End Rule match.)

If there is no universal ban against directionality-end-rule-mismatches, then what causes the gaps in (2.7)? What rules out the right-edge main stress counterpart of Garawa and the left-edge main stress counterpart of Piro? Why should there be any relation between three parameters: (i) edge-of-fixed-foot, (ii) End Rule, and (iii) directionality?

As in the iambic asymmetry, I hypothesize that the explanation resides in the position of **lapses**, now with respect to the main stress foot. More specifically, all systems that tolerate non-peripheral lapses, only tolerate these when **adjacent to the main stress**.

(2.10)	lapse-at-peak	001, 100	(relatively acceptable)
	lapse-elsewhere	002, 200	(relatively **un**acceptable)

(Nespor & Vogel (1989:86) claim that in a rhythmic interval between two peaks, a lapse following a peak is preferred to a lapse preceding a peak. If this is correct, this may point to another asymmetry in the statement of rhythmic constraints.)

2.3 Summary of typological findings

Cross-linguistically, local ternary intervals are restricted to two contexts: they are

(2.12)	(i) adjacent to the **right edge**:	Pintupi	1020202**00**		
	(ii) adjacent to the **peak**:	Garawa	1**00**202020	Piro	202020**0**10

Local ternarity seems **not** to occur, however,

(2.13)	(i) at the left edge:	**00**2020201	
	(ii) adjacent to a non-peak:	2**00**202010	102020**0**20

These findings suggest that ternary intervals are **locally licensed** in the stress domain (Kager 1994), specifically the **right edge** and the **peak**. The remainder of this paper will elaborate this idea into a local licensing theory of directionality.

First we must show that the standard **symmetrical** theory of directionality fails to explain the gaps, due to its intrinsic symmetry.

3. A licensing theory of directionality

3.1 Basic ideas

In the new theory, foot distribution will be controlled by local factors, rather than by long-distance orientation with respect to edges. 'Local' in the sense of **strictly adjacent** to an edge, or the peak.

For learning, my hypothesis is that local deviations from binarity provide **cues** to directionality (in the sense of Dresher & Kaye 1990). That is, the learner focusses on a window at the left or right edge, and determines the **(in)stability of local rhythmic patterns** across words of different lengths.

In line with observations made in section 2, I eliminate ALL-FT-X in favour of constraints that license rhythmically marked intervals (that is, lapses) near the right edge or the main stress.

(3.1) LAPSE-AT-PEAK: Lapse must be adjacent to the peak. (I.e. **If** 00 **then** 100 or 001)

(3.2) LAPSE-AT-END: Lapse must be adjacent to the right edge. (I.e. **If** 00 **then** 00])

Formally, these constraints assign violation marks in the following way. For each pair of (adjacent) weak syllables, e.g. $\sigma_i\,\sigma_j$, a test is applied. For example, LAPSE-AT-PEAK tests whether this sequence $\sigma_i\,\sigma_j$ is either preceded or followed by a stress peak; if not, a violation mark is assigned. Next, the constraint considers the following pair of unstressed syllables, e.g. $\sigma_j\,\sigma_k$, applying the same test, in an interative fashion, until all pairs of unstressed syllables in a word have been tested.

In a nutshell, the constraints are exemplified by the treatment of Pintupi, whose pattern I repeat:

(3.3) (10)(20)(20)
(10)(20)(20)0

In standard foot alignment theory, this pattern is characterized by the following ranking:

(3.4) Foot alignment analysis of Pintupi
FT-BIN, HEAD-L » PARSE-SYL » **ALL-FT-L** » **ALL-FT-R**

(3.5)

Input: /puliŋkalaʈʲu/	FT-BIN	HEAD-L	PARSE-SYL	ALL-FT-L	ALL-FT-R
* a. (pú.liŋ).(kà.la).ʈʲu			*	**	*, ***
b. (pú.liŋ).ka.(là.ʈʲu)			*	***!	***
c. pu.(líŋ.ka).(là.ʈʲu)		*!	*	* ***	**
d. (pú.liŋ).ka.la.ʈʲu			**!*		***
e. (pú.liŋ).(kà.la).(ʈʲù)	*!			**, ****	*, ***

In rhythmic licensing theory, the following ranking produces the pattern:

(3.6) Rhythmic licensing analysis of Pintupi
FT-BIN, HEAD-L » PARSE-SYL » **LAPSE-AT-END** » **LAPSE-AT-PEAK**

(3.7)

Input: /puliŋkalaʈʲu/	FT-BIN	HEAD-L	PARSE-SYL	LAPSE-AT-END	LAPSE-AT-PEAK
* a. (pú.liŋ).(kà.la).ʈʲu			*		*
b. (pú.liŋ).ka.(là.ʈʲu)			*	*!	
c. pu.(líŋ.ka).(là.ʈʲu)		*!	*		
d. (pú.liŋ).ka.la.ʈʲu			**!*	**	**
e. (pú.liŋ).(kà.la).(ʈʲù)	*!				

Note the gross difference in **complexity** of evaluation between ALL-FT-X and LAPSE-AT-X in a longer form like:

(3.8)

	ALL-FT-L	LAPSE-AT-END
(tʲí.ɭi).ri.(ŋu.làm).(pà.tʲu)	Ft_1: - Ft_2: tʲi, ɭi, ri Ft_3: tʲi, ɭi, ri, ŋu, lam Total: ***, *****	*ɭi.ri (a nonfinal sequence of unstressed syllables)

For a slightly different approach, see Alber (2000), who abandons ALL-FT-R while retaining ALL-FT-L.

Paralellisms occur between lapse licensing constraints and metrical licensing approaches found in the literature (Zoll 1996, Walker 1997; see also Dresher & Van der Hulst 1998).

The fundamental insight (due to Zoll 1996) is that a constraint licenses a **marked** property in a '**strong**' position. The marked property is excluded by a context-free constraint, but may be licensed in a limited number of positions. No doubt, lapses are rhythmically marked. No doubt, the peak and the right edge of a domain are 'strong', in the sense that they are natural licensors of marked prosodic properties (such as syllabic appendices, or vowel length).

In the overall constraint system, the lapse licensing constraints function together with a context-free markedness constraint banning lapses (3.9), and contextual markedness constraints (3.10, 11):

(3.9) *LAPSE: No two adjacent unstressed syllables. (I.e. *00)
(Selkirk 1984)

(3.10) *LONG-LAPSE: No lapse in the context of an unstressed syllable. (I.e. *00 / 0)
(Nespor & Vogel 1989; Elenbaas & Kager 1999)

(3.11) *INITIAL-LAPSE: No lapse at the left edge. (I.e. *00 / [__)

Similar constraint constellations ('licensing systems') have been identified for other properties, such as vowel length, obstruent voicing, etc.

(3.12) A licensing system for length
Context-free: No long vowels. (Rosenthall 1997)

Contextual: No long vowel in final syllable.
Licensing: VV under main stress, in first syllable/foot only. (Kager 1996, Zoll 1997)

3.2 Accounting for the gaps

Rhythmic licensing theory was primarily motivated by the urge to eliminate two typological gaps, the iambic asymmetry and the bidirectionality asymmetry. Let us see how this works.

A constraint system is typologically validated (with respect to a universally unattested pattern), if no permutation of these constraints generates the ill-formed pattern. This is equivalent to showing that the ill-formed pattern is 'harmonically bounded' (Samek-Lodovici & Prince 1999). If constraint violations of a candidate C_1 are a proper subset of the ill-formed pattern C_2, then candidate C_2 cannot be generated under any ranking. (C_2 is said to be harmonically bounded by C_1.)

The candidate to be excluded, (3.13e) is harmonically bounded since its violations are a superset of those incurred by candidates (3.13b,c), which are themselves rhythmically bounded by (3.13.b):

(3.13)

		Parse-Syl	*Lapse	*Initial-Lapse	Lapse-at-End	Lapse-at-Peak	Align-R
	a. (02)(02)(02)(01)**0**	*					*
	b. (02)(02)(02)**0**(01)	*	*		*		
5	c. (02)(02)**0**(02)(01)	*	*		*	*	
5	d. (02)**0**(02)(02)(01)	*	*		*	*	
5	e. **0**(02)(02)(02)(01)	*	*	*	*	*	

Here, (3.13a) is Creek (A.11), and (3.13b) - nearly - Central Alaskan Yupik (A.12; rightward iambs plus final stress).

The bidirectionality gap is accounted for equally straightforwardly.

(3.14)

		Parse-Syl	*Lapse	*Initial-Lapse	Lapse-at-End	Lapse-at-Peak	Align-L
	a. (10)(20)(20)(20)**0**	*	*			*	
5	b. (10)(20)(20)**0**(20)	*	*		*	*	
5	c. (10)(20)**0**(20)(20)	*	*		*	*	
	d. (10)**0**(20)(20)(20)	*	*		*		
	e. **0**(10)(20)(20)(20)	*			*		*

Pattern (3.14a) is instantiated by Pintupi, (3.14d) by Garawa, and (3.14e) by Wargamay. Patterns (3.14-b-c) are both unattested, as predicted.

The mirror-image patterns, with right-edge peaks, are presented below:

(3.15)

		Parse-Syl	*Lapse	*Initial-Lapse	Lapse-at-End	Lapse-at-Peak	Align-L
	a. (20)(20)(20)(10)**0**	*	*				
	b. (20)(20)(20)**0**(10)	*	*		*		
5	c. (20)(20)**0**(20)(10)	*	*		*	*	
5	d. (20)**0**(20)(20)(10)	*	*		*	*	
	e. **0**(20)(20)(20)(10)	*			*	*	*

Pattern (3.14a) is instantiated by Cairene Arabic, (3.14b) by Piro, and (3.14e) by Warao. Patterns (3.14c-d) are unattested. (See section 6 on alleged cases of the initial dactyl pattern 3.14d.)

3.4 Factorial typology

Preliminary results indicate that rhythmic licensing theory gives a tight factorial typology. [So far I have computed the typology for strictly binary systems, all with FT-BIN » PARSE-SYL.]

Typology for seven-syllable **trochees**, with the peak on the **left**most foot (HEAD-L » HEAD-R):

(3.16)

7-syllable input	Ranking	Exemple
1. (10)(20)(20)0	HEAD-L, ALIGN-L, LAPSE-AT-END » *LAPSE, LAPSE-AT-PK	Pintupi
2. (10)0(20)(20)	HEAD-L, ALIGN-L, LAPSE-AT-PK » *LAPSE, LAPSE-AT-END	Garawa
3. 0(10)(20)(20)	*LAPSE, LAPSE-AT-END, LAPSE-AT-PK » HEAD-L, ALIGN-L	Wargamay

Typology for seven-syllable **trochees**, with the peak on the **right**most foot (HEAD-R » HEAD-L):

(3.17)

7-syllable input	Ranking	Exemple
1. (20)(20)(10)0	ALIGN-L, LAPSE-AT-END, LAPSE-AT-PK » *LAPSE, HEAD-R	Cairene Arabic
2. (20)(20)0(10)	HEAD-R, ALIGN-L, LAPSE-AT-PK » *LAPSE, LAPSE-AT-END	Piro
3. 0(20)(20)(10)	*LAPSE, LAPSE-AT-END, LAPSE-AT-PK, HEAD-R » ALIGN-L	Warao

Typology for seven-syllable **iambs**, with the peak on the **left**most foot (HEAD-L » HEAD-R):

(3.18)

7-syllable input	Ranking	Exemple
1. (01)(02)(02)0	HEAD-L, *LAPSE, LAPSE-AT-END, LAPSE-AT-PK » ALIGN-R	Araucanian
2. (01)0(02)(02)	HEAD-L, ALIGN-R, LAPSE-AT-END, LAPSE-AT-PK » *LAPSE	???

Typology for seven-syllable **iambs**, with the peak on the **right**most foot (HEAD-R » HEAD-L):

(3.19)	7-syllable input	Ranking	Exemple
	1. (02)(02)(01)0	HEAD-R, *LAPSE, LAPSE-AT-END, LAPSE-AT-PK » ALIGN-R	Creek
	2. (02)(02)0(01)	HEAD-R, ALIGN-R, LAPSE-AT-PK » *LAPSE, LAPSE-AT-END	???

Even though leftward iambs are eliminated, the iambic typology still contains two gaps (predicted yet unattested patterns). However, the new asymmetrical typology is more restrictive than the standard symmetrical one, which also generates both gaps.

4. Extensions to systems with unary feet

4.1 Unary feet and lapse avoidance

Thus far we have dealt with strictly binary stress systems only, which impose an abolute ban against unary feet. However, not all stress systems are of this type.

How to deal with systems like Murinbata and Weri ((2.2), repeated below), which allow unary feet?

(4.1)	foot type	directionality	even number	odd number	language
	trochees	left-to-right	(10)(20)(20)	(10)(20)(20)**(2)**	Murinbata (A.4)
	iambs	right-to-left	(02)(02)(01)	**(2)**(02)(02)(01)	Weri (A.5)

Intuitively, unary feet arise under pressure for perfect rhythm (*no-clash, no-lapse*), under exhaustive parsing. The unary feet is placed at the edge where rhythmic damage (in terms of clash) is minimal. This is at the right periphery in a trochaic parse:

(4.2)	Murinbata	PARSE-SYL	*LAPSE	*CLASH	FT-BIN
	* a. (10)(20)(20)(20)**(2)**				*
	b. (10)(20)(20)**(2)**(20)			*!	*
	c. (10)(20)**(2)**(20)(20)			*!	*
	d. (10)**(2)**(20)(20)(20)			*!	*
	e. **(1)**(10)(20)(20)(20)			*!	*
	f. (10)(20)(20)(20) **0**	*!	*		

And at the left edge in iambic systems:

(4.3)	Weri	PARSE-SYL	*LAPSE	*CLASH	FT-BIN
	a. (01)(02)(02)(02)**(2)**			*!	*
	b. (01)(02)(02)**(2)**(02)			*!	*
	c. (01)(02)**(2)**(02)(02)			*!	*
	d. (01)**(2)**(02)(02)(02)			*!	*
	* e. **(1)**(02)(02)(02)(02)				*
	f. (01)(02)(02)(02) **0**	*!			

This is a nice result, since it follows without directionality principles, from ‘pure’ rhythm (compare Prince’s 1983 ‘perfect grid’).

4.2 The distribution of clashes

We now turn to languages in which lapse-avoidance does not go hand in hand with clash-avoidance.

Consider the rhythmic patterns below (references: MacDonald 1990, Dubert & Dubert 1973, Miller 1996, Miyaoka 1985). These four languages have fixed stresses at two edges (initial and final, initial and penult, or second and final). In the area between the fixed stresses, lapses are strictly avoided, at the expense of clashes:

(4.4)	fixed stresses	even number	odd number	direction, foot	language
	initial & final	(**2**)(**2**)(02)(01)	(2)(02)(02)(01)	leftward iamb	Tauya
	initial & penult	(**2**)(**2**0)(20)(10)	(20)(20)(20)(10)	leftward trochee	Biangai
	initial & final	(10)(20)(**2**)(**2**)	(10)(20)(20)(2)	rightward trochee	Gosiute Shoshone
	second & final	(01)(01)(0**1**)(**2**)	(01)(01)(01)(02)	rightward iamb	Central Alaskan Yupik

(In the rightward iambic Central Alaskan Yupik pattern, final stresses occur on non-final units only, carrying a ‘pre-boundary regressive accent’ that is weaker than the rhythmic stresses in the word, see Miyaoka 1985:69-75. Accordingly, I mark strong rhythmic stresses as ‘1’, and weaker pre-boundary stresses as ‘2’.)

If the string of syllables in between the fixed stresses is even-numbered, a clash arises, with either the lefthand or righthand fixed stress.

(4.5) clash with stress at left **X2**02020X
clash with stress at right X02020**2X**

The generalization emerging for the languages in (4.4) is that *clashes do not involve the main stress* (that is, if there is a single main stress).

That is, given two fixed stresses, and an even-numbered string of syllables between them, and a strict anti-lapse constraint, there is only **one** attested outcome in each case. This is the one where the clash is between stresses of **smallest** possible prominence: two secondary stresses (rather than primary and secondary), or a primary and a secondary stress (rather than two primary stresses - as in CA Yupik):

(4.6)		Initial & final	Initial & penult	Initial & final	Second & final
	Attested:	(**2**)(**2**)(02)(01)	(**2**)(**20**)(20)(10)	(10)(20)(**2**)(**2**)	(01)(01)(0**1**)(**2**)
	Unattested:	(2)(02)(0**2**)(**1**)	(20)(20)(**2**)(**10**)	(**1**)(**20**)(20)(2)	(0**1**)(**1**)(01)(02)

Note that once again, there is no independent role for directionality. Stress distributions follow purely **rhythmic** patterns, rather than being governed by principles regarding their distances from edges.

We find evidence for a contextual markedness constraint (4.8) next to the general constraint (4.7):

(4.7) *CLASH: No two adjacent stressed syllables. (Liberman & Prince 1977, Prince 1983)

(4.8) *CLASH-AT-PEAK: No clash involves a stress peak. (cf. STRESS-WELL in Pater 1995)

Constraint (4.8) is related to Hammond's (1984) 'Trigger Prominence Principle', according to which clashes with the main stress are resolved before clashes involving secondary stresses. It is also related to Selkirk's (1984) 'Montana filter' (banning **Mòntàna cówboy*), see also Kiparsky (1979).

Functionally, constraint (4.8) is the counterpart to LAPSE-TO-PEAK. Both constraints have the effect of moving other stresses away from the peak, either by licensing lapse, or banning clash. Intuitively, rhythmic space is not equally dense at all points. Peaks are focal points of rhythmic density, which must be compensated in their immediate surroundings by less dense (rarified) portions.

Tableau (4.9) shows CLASH-AT-PEAK in action, locating the clash away from the main stress:

(4.9)

Tauya (iambic parse)	LEFT	RIGHT	*LAPSE	*CLASH-AT-PEAK	*CLASH
* a. (**2**)(**2**)(02)(01)					*
b. (2)(02)(0**2**)(**1**)				*!	*
c. (2) 0 (02)(01)			*!		
d. (2)(02)(0**2**) 0		*!			
e. (02)(02)(01)	*!				

The choice between clash with main stress and clash with secondary stress thus depends on rhythmic principles, without any role for foot alignment with respect to edges. (Note, however, that the result has not yet been completely established, since we must also account for the position of the clash near the edge, an issue which will be addressed below.)

One factor which potentially undermines this result must be discussed, though. There may seem to be interaction with foot type, since the location of clashes evidently depends on the headedness of feet. Since it is not so easy to determine foot type in an even number of stresses between fixed stresses, we may legitimately ask whether the result is preserved regardless of headedness.

For Tauya, there is evidence from odd-numbered words that parsing is iambic. Essentially, Tauya is identical to Weri in words of this type. But what if we assumed feet to be trochees? In that case, the tableau in (4.10) would arise:

(4.10)

Tauya (trochaic parse)	LEFT	RIGHT	*LAPSE	*CLASH-AT-PEAK	*CLASH
* a. (**2**)(**2**0)(20)(1)					*
b. (20)(20)(**2**)(**1**)				*!	*
c. (20) 0 (20)(1)			*!		
d. (20)(20)(**2**0)		*!			
e. 0(20)(20)(1)	*!				

The distribution of violation marks is fully identical to the iambic tableau, the only difference being in the location of foot boundaries. For example, the winning (a.) candidates of the tableaux perfectly align in terms of their stresses, although foot boundaries differ:

(4.11) trochaic (2)(2 0)(2 0)(1)
iambic (2)(2)(0 2)(0 1)

We thus find that the result (the asymmetrical distribution of stresses) hold regardless of foot type.

One important question still remains. Why does the clash drift toward the **edge** of the domain? In all four of the patterns in (4.4), the clash occurs involves two **peripheral** syllables:

(4.12)		Initial & final	Initial & penult	Initial & final	Second & final
	Attested:	(**2**)(**2**)(02)(01)	(**2**)(**2**0)(20)(10)	(10)(20)(**2**)(**2**)	(01)(01)(0**1**)(**2**)
	Unattested:	(2)(0**2**)(**2**)(01)	(20)(**2**)(**2**0)(10)	(10)(**2**)(**2**0)(2)	(01)(0**1**)(**1**)(02)

This gives evidence for the licensing of clashes at edges. The responsible constraint is:

(4.13) CLASH-AT-EDGE: Clash must be adjacent to the left edge.

This licensing constraint is consistent with the rhythmic density view I suggested earlier: clashes are ideally located where rhythmic density is minimal, that is, where there are no neighbouring syllables.

There may be edge-specific versions of these constraints, with left edges taking precedence over right edges in licensing lapses. (Compare lapse licensing and non-finality.) But given the lack of empirical evidence on this matter, I will assume just a single, asymmetrical constraint.

(4.14)

		*LAPSE	*CLASH-AT-PEAK	CLASH-AT-EDGE	*CLASH
*	a. (**2**)(**2**)(02)(01)				*
	b. (2)(02)(0**2**)(**1**)		*!		*
	c. (2)(0**2**)(**2**)(01)			*!	*

Finally, foot alignment theory is not able to produce this result, since foot-alignment constraints will produce both left-oriented and right-oriented parsings in the factorial typology, depending on the relative ranking of ALL-FT-LEFT and ALL-FT-RIGHT.

(4.15)

		ALL-FT-RIGHT	ALL-FT-LEFT
	a. (**2**)(**2**)(02)(01)	**, ****, ****!*	*, **, ****
*	b. (2)(02)(0**2**)(**1**)	*, ***, *****	*, ***, *****

5. Conclusions

In this paper, I have shown that local rhythmic licensing constraints successfully restrict the typology of alternating stress systems. The general form of these licensing constraints is:

(5.1) **Rhythmic Licensing**
License a rhythmic configuration X (a clash or a lapse) in the immediate context of element Y (a peak or an edge).

These licensing constraints interact with rhythmic markedness constraints (which ban rhythmically marked configurations), allowing the elimination of ALL-FT-X. However, the theory preserves word-to-foot-alignment, e.g. ALIGN (PrWd, L/R, Foot, L/R).

Note the analogous asymmetry between word-to-category and category-to-word alignment in syllable alignment: while ALIGN (PrWd, L/R, Syllable, L/R) is well-attested, the counterpart ALIGN (Syllable, L/R, PrWd, L/R), is not. (Paul Kiparsky, p.c.)

From the discussion above, the following picture emerges. Rhythmic constraints (regarding clash and lapse) are grounded in a small number of rhythmic laws.

(5.2) **Rhythmic Laws**

a. Rarefy near peaks. (Hence, license lapse, ban clash).
b. Rarefy at the right edge. (Hence, license lapse, ban final stress).
c. Stress-mark edges. (Hence, ban lapses, license clash).

Each laws constitutes the substantive basis for a set of constraints.

(5.3)

	Positional markedness		**Licensing**	
	clash	*lapse*	*clash*	*lapse*
Rarefy near peaks	*CLASH-AT-PEAK	---	---	LAPSE-AT-PEAK
Rarefy at right edge	*CLASH-AT-END(?)	---	---	LAPSE-AT-END
Demarcate edges	---	*INITIAL-LAPSE *FINAL-LAPSE	CLASH-AT-EDGE	---

This lays the groundwork for a full typology, including quantity-sensitive and ternary systems, which has not been developed yet (work in progress).

This theory has computational advantages, since long-distance, iterative computation of the distance between foot and word edges is no longer required. Finally, this theory brings metrical phonology closer to metrics, which is also based on locally inspectable rhythmic patterns (Paul Kiparsky, p.c.).

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Appendix A: exemplification

(A.1) Pintupi (Hansen & Hansen 1969): initial main stress, secondaries on odd-numbered non-final syllables.

2σ	10	ˈpa.ɳa	‘earth’
3σ	100	ˈɲu.ɳi.tʲu	‘mother’
4σ	1020	ˈma.la.ˌwa.na	‘through (from) behind’
5σ	10200	ˈpu.liŋ.ˌka.la.tʲu	‘we (sat) on the hill’
6σ	102020	ˈtʲa.mu.ˌlim.pa.ˌtʲuŋ.ku	‘our relation’
7σ	1020200	ˈtʲi.ɭi.ˌri.ŋu.ˌlam.pa.tʲu	‘the fire for our benefit flared up’
8σ	10202020	ˈku.ra.ˌɳu.lu.ˌlim.pa.ˌtʲu.ɻa	‘the first one (who is) our relation’
9σ	102020200	ˈyu.ma.ˌɻiŋ.ka.ˌma.ra.ˌtʲa.ɻa.ka	‘because of mother-in-law’

(A.2) Warao (Osborn 1966): main stress on penult, secondaries on alternating syllables before it:

3σ	010	ko.ˈra.nu	‘drink it!’
5σ	02010	yi.ˌwa.ra.ˈna.e	‘he finished it’
8σ	20202010	ˌya.pu.ˌru.ki.ˌta.ne.ˈha.se	‘verily to climb’
9σ	020202010	e.ˌna.ho.ˌro.a.ˌha.ku.ˈta.i	‘the one who caused him to eat’

(A.3) Araucanian (Echeverría & Contreras 1965): main stress on second syllable, secondaries on alternating even-numbered syllables:

2σ	01	wu.ˈle	‘tomorrow’
3σ	010	ti.ˈpan.to	‘year’
4σ	0102	e.ˈlu.mu.ˌyu	‘give us’
5σ	01020	e.ˈlu.a.ˌe.new	‘he will give me’
6σ	010202	ki.ˈmu.fa.ˌlu.wu.ˌlay	‘he pretended not to know’

(A.4) Murinbata (Steeet & Mollinjin 1981): initial main stress, secondaries on odd-numbered syllables:

2σ	10	ˈmam.ŋe	‘I/he/she said/did to her’
3σ	102	ˈla.la.ˌma	‘shoulder’
4σ	1020	ˈwa.lʊ.ˌmʊ.ma	‘blue-tonge lizard’
5σ	10202	ˈpʰe.řɛ.ˌwe.řɛ.ˌtʲɛn	‘season just before the “dry” ’
6σ	102020	ˈŋa.řam.ˌka.rʊᶦ.ˌŋi.me	‘we (excl pc f) arrived’

(A.5) Weri (Boxwell & Boxwell 1966): final main stress plus secondaries on alternating syllables counting backward.

2σ	01	ŋɪn.ˈtɪp	‘bee’
3σ	201	ˌkʊ.lɪ.ˈpʊ	‘hair of arm’
4σ	0201	ʊ.ˌlʊ.a.ˈmɪt	‘mist’
5σ	20201	ˌa.kʊ.ˌne.te.ˈpal	‘times’

(A.6) Cayuvava (Key 1961): main stress on antepenult, secondaries on every third syllable before it.

2σ	10	ˈda.pa	‘canoe’
3σ	100	ˈto.mo.ho	‘small water container’
4σ	0100	a.ˈri.po.ro	‘he already turned around’
5σ	00100	a.ri.ˈpi.ri.to	‘already planted’
6σ	200100	ˌa.ri.hi.ˈhi.be.e	‘I have already put the top on’
7σ	0200100	ma.ˌra.ha.ha.ˈe.i.ki	‘their blankets’
8σ	00200100	i.ki.ˌta.pa.re.ˈre.pe.ha	‘the water is clean’

(A.7) Garawa (Furby 1974): initial main stress plus secondaries from right edge.

3σ	100	ˈpun.ya.ɭa	‘white’
5σ	10020	ˈka.ma.ɭa.ˌɽi.ɲi	‘wrist’
6σ	102020	ˈya.ka.ˌla.ka.ˌla.mpa	‘loose’
7σ	1002020	ˈŋan.ki.ɽi.ˌki.rim.ˌpa.yi	‘fought with boomerangs’

(A.8) Piro (Matteson 1965): penultimate main stress, secondaries on alternating syllables counting from left edge.

3σ	010	ru.ˈt͜xi.t͜xa	‘he observes taboo’
5σ	20010	ˌsa.lwa.je.ˈhka.kna	‘they visit each other’
6σ	202010	ˌpe.t͡ʃi.ˌt͡ʃhi.ma.ˈtlo.na	‘they say they stalk it’
7σ	2020010	ˌru.slu.ˌno.ti.ni.ˈtka.na	‘their voices already changed’

(A.9) Wargamay (Dixon 1981):

2σ	10	ˈba.da	‘dog’
3σ	010	mu.ˈŋan.da	‘mountain-LOC’
4σ	1020	ˈgi.dʲa.ˌwu.lu	‘freshwater jewfish’
5σ	01020	dʲu.ˈɽa.gay.ˌmi.ri	‘Niagara Vale-FROM’

(A.10) Cairene Arabic (Mitchell 1960): stress on the rightmost non-final odd-numbered syllable, counting from the left edge.

3σ	100	ˈkɑ.tɑ.bɑ	‘he wrote’
4σ	2010	kɑ.tɑ.ˈbi.tu	‘she wrote it (m.)’
5σ	20100	sɑ.jɑ.ˈrɑ.tu.hu	‘his tree (nom.)’
6σ	202010	sɑ.jɑ.rɑ.tu.ˈhu.mɑː	‘their (dual.) tree (nom.)’

(A.11) Creek (Haas 1977): stress on rightmost even-numbered syllable counting from the left edge.

2σ	01	co.ˈfi	‘rabbit’
3σ	010	i.ˈsi.ta	‘one to take one’
4σ	0201	a.ˌpa.na.ˈta	‘mist’
5σ	02010	ca.ˌwa.na.ˈyi.ta	‘one person to tie me’
6σ	020201	i.ˌsi.ma.ˌhi.ci.ˈta	‘one to sight at one’
7σ	0202010	i.ˌti.wa.ˌna.yi.ˈpi.ta	‘to tie each other’

(A.12) Central Alaskan Yupik (Leer 1985, Hayes 1995): same as Creek, but with final stresses in phrase-medial words.

3σ	021	qɑ.ˈyɑː.ˈni	‘his own kayak’
4σ	0201	ɑŋ.ˈyɑχ.pɑ.ˈkɑ	‘my big boat’
5σ	02021	qɑ.ˈyɑː.pix.ˈkɑː.ˈni	‘his own future authentic kayak’

Appendix B: Initial dactyls

In section 2 the empirical claim was made that pattern marked '***' is typologically unattested:

(B.1)

fixed foot	directionality	End Rule	even number	odd number	language
right	left-to-right	right	(20)(20) (10)	(20)(20) **0** (10)	Piro (A.8)
left	right-to-left	right	(20) (20)(10)	(20) **0**(20)(10)	***

That is, initial dactyls occur after the main stress but are claimed not to occur after a secondary stress. This claim seems problematic given the evidence from various languages. Kager (1990) discusses the evidence. Here I summarise the results for Hawaiian, Indonesian, and Spanish, which suggests that if an initial dactyl pattern exists, it is never the single possible pattern, but alternates with other patterns or is doubtful for other reasons.

5.1 Hawaiian

Prince (1983) analyses 'a simplified Hawaiian' (Hawaiian as reported in Elbert 1970, but with the difference of 'ignoring the contributions of long vowels'), with the pattern 2002010. More recent literature, however, (Schütz 1978, 1981; Elbert and Pukui 1979) sketches a different picture, where secondary stress is more variable than is suggested in Elbert (1970), and in fact partly lexicalized.

(B.2) pùlelehúa 'butterfly' versus Kalìkimáka 'Christmas'

A similar situation occurs in Fijian (Schütz 1978, 1985). The generalization is that secondary stress is free within the limits of general rhythmic well-formedness: no lapses, no clashes. Another view is to assume that secondary stress is actually marked in underlying representations.

5.2 Indonesian

Indonesian (Cohn 1989) is claimed to have main stress is on the penult and a secondary stress on the initial syllable in words of minimally four syllables long. In words of six or more syllables, there is a leftward alternation of secondaries on syllables *preceding* the penult:

(B.3) a. (à.me).ri.(kà.ni).(sá.si) 'Americanisation'
b. (dè.mi).li.(tà.ri).(sá.si) 'demilitarization'

All exemplifying words are borrowed from Dutch, where the corresponding words have identical secondary stress contours: *dèmilitàrisátie, Àmerikànisátie*. Both words are morphologically derived: /de+militer+isatsi/, /amerikan+isatsi/, whose bases /milité:r/ and /amerikán/ have final stress, matching the position of secondary stresses in the words derived from them (presumably cyclically). Hence, it is highly plausible that Indonesian simply borrowed these long words together with their secondary stress patterns.

5.3 Spanish

According to Roca (1986), the initial dactyl pattern arises when a word with initial secondary stress occurs after a clitic:

(B.4) a. constàntinópla 'Constantinople'
b. cònstantìnopléño 'Constantinople guy'
c. èl constantìnopléño 'the Constantinople guy'

The initial dactyl pattern is not basic, but derived. This suggests clash avoidance under faithfulness to the base.