Non-intervention constraints and the binary-to-ternary rhythmic continuum

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1 Introduction

- **Ternary rhythm**: stress falls on every third syllable, e.g. Cayuvava (Key 1961, 1967), Chugach Alutiiq (Leer 1985a, b, c), Tripura Bangla (Das 2001), Estonian (Hint 1973).

(1) Ternary rhythm in Cayuvava (Key 1961, 1967)

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

- Elements of earlier proposals

(i) Representations

- **Binary feet + unfooted syllables** (Weak Local Parsing) ...('σσ)σ('σσ)σ...
  (Hammond 1990, Hayes 1995, Elenbaas & Kager 1999)
- **Ternary 'flat' feet** ...(σ'σσ)(σ'σσ)...
  (Levin 1985, 1988; Halle & Vergnaud 1987, Halle 1990, Buckley 2009)
- **Ternary 'internally layered' feet** ...(('σσ)σ)(('σσ)σ)...
  (Prince 1980, Dresher & Lahiri 1991, Itô & Mester 1992/2003, Hewitt 1992, Rice 1992, Kager 1994, 2012; Zoll 2004, Caballero 2008, 2011; Bennett 2012, Martínez-Paricio 2012)

(ii) Constraints

- **Gradient alignment constraints**: measure distances between edges of feet / grid marks and prosodic words (McCarthy & Prince 1993, Elenbaas & Kager 1999, Gordon 2002).
- **Anti-lapse constraints:** ban sequences of two or three weak syllables (*LAPSE, *EXTENDEDLAPSE; Selkirk 1984, Elenbaas & Kager 1999, Gordon 2002).
- **Lapse licensing constraints**: license lapses in specific positions (LAPSE-AT-PEAK, LAPSE-AT-END; Kager 2001, 2005; EXTENDED-LAPSE-AT-PEAK, EXTENDED-LAPSE-AT-END; Houghton 2006).

(2) Anti-lapse constraints + gradient alignment (Elenbaas & Kager 1999)

	*EXTENDED LAPSE	**ALIGN-FT-L** (gradient)	**ALIGN-FT-R** (gradient)
☞a. ma.(ˌra.ha).ha.('e.i).ki		*, ****	*, ****
b. ma.ra.(ˌha.ha).('e.i).ki		**, ****!	*, ***
c. (ˌma.ra).(ˌha.ha).('e.i).ki		**, ****!	*, ***, *****
d. (ˌma.ra).('ha.ha).e.i.ki	*!*	**	***, *****
e. ('ma.ra).ha.ha.e.i.ki	*!***		*****

⇒ Gradient alignment is able to capture **directionality** effects in rhythmic systems (i.e. control edge-oriented distributions of feet within the prosodic word). But...

⇒ **Theoretical & typological problems** with gradient alignment (Eisner 1997, 2000; Kager 2001, 2005; McCarthy 2003, Riggle 2004, Bíró 2005, Heinz, Kobele & Riggle 2005, Hyde 2008)

Hence, lapse licensing models assume categorical alignment constraints (McCarthy 2003)

(3) Lapse licensing + categorical alignment (Kager 2004, Houghton 2006)

	LAPSE-AT-PEAK	**ALIGN-FT-L** (categorical)	**ALIGN-FT-R** (categorical)
☞ a. ma.(ˌra.**ha**).**ha**.('e.**i**).**ki**		**	**
b. **ma.ra**.(ˌha.ha).('e.**i**).**ki**	*!	**	**
c. (ˌma.ra).(ˌha.ha).('e.**i**).**ki**		**	***!
d. ('ma.**ra**).**ha**.**ha**.**e**.**i**.**ki**	*!***		*

⇒ Lapse licensing constraints are able to compensate for loss of gradient alignment. But...

⇒ **Theoretical & typological problems** with lapse licensing constraints (Rice 2006, 2007, 2008; Buckley 2009, Kager 2004, 2012)

(4) Licensor attraction: the main stress shifts to license a lapse (odd-numbered forms)

	ALIGN-PRWD-L	LAPSE-AT-PEAK	LAPSE-AT-END	END-RULE-L
☞ a. (20)(20)(1**0**)**0**				*
b. (10)(20)(2**0**)**0**		*!		
c. (10)(2**0**)**0**(20)		*!	*	
d. (1**0**)**0**(20)(20)			*!	

GRADIENT ALIGNMENT CONSTRAINTS	**LAPSE LICENSING CONSTRAINTS**
▪ Phonology cannot *count* ▪ Computationally problematic ▪ Undergeneration & pathological overgeneration: midpoint pathology	▪ Contextual anti-lapse constraints are necessarily **non-local**: 00 is not a unit. ▪ Undergeneration & pathological overgeneration: midpoint pathology, odd-even pathology, licensor attraction, etc.

⇒ *How to account for directionality effects in binary and ternary systems without gradient alignment or lapse licensing constraints?*

(5) Drifting foot problem ☹

	PARSE-σ	ALIGN-FT-L (categorical)	ALIGN-FT-R (categorical)
☞ ma.(ˌra.ha).ha.('e.i).ki	***	**	**
☞ ma.ra.(ˌha.ha).('e.i).ki	***	**	**

⇒ *Hint: abandon the 'underparsing' account of ternarity & rehabilitate ternary feet.*

Goals

- To provide an analysis of quantity-insensitive **binary** and **ternary** rhythm without using problematic gradient alignment and lapse licensing constraints.
- To provide new support for **ternary feet with internal layering** $((^{\text{l}}\sigma\sigma)_{\text{Ft}}\sigma)_{\text{Ft}}$ (Prince 1980, Dresher & Lahiri 1992, Bennett 2012, Kager 2012, Martínez-Paricio 2012) from metrical typology.
- To demonstrate the adequacy of **categorical alignment constraints stated in a non-intervention format** (Prince 1983, McCarthy & Prince 1993, McCarthy 2003, Houghton 2006, Hyde 2012) in predicting the full attested typology, while avoiding pathological overgeneration. Linguistic typology ~ Factorial typology (OTSoft, Hayes, Tesar & Zuraw 2003).
- To argue there is no clearly defined boundary between strictly binary and strictly ternary systems since binarity and ternarity may naturally co-exist in rhythmic stress systems, i.e. there is a **binary-to-ternary rhythmic continuum**.

Outline

- Architecture of the present model: representations and constraints (§2)
  - Ternary feet with internal layering (minimal recursion): $((^{\text{l}}\sigma\sigma)_{\text{Ft}}\sigma)_{\text{Ft}}$
  - Categorical alignment constraints in the non-intervention format
- Linguistic typology ~ Factorial typology (§3)
- Further support for $((^{\text{l}}\sigma\sigma)_{\text{Ft}}\sigma)_{\text{Ft}}$ (§4)
  - Binary systems: Wargamay & Yidiɲ lengthening
  - Ternary systems: Chugach pitch
- Conclusions

2 Architecture of the theory

2.1 Representations: minimal recursion at the level of the foot

- **Ternary feet with internal layering** (Selkirk 1980, Prince 1980, Dresher & Lahiri 1991, Hewitt 1992, Rice 1992, 2006; Kager 1994, 2012; Blevins & Harrison 1999, Zoll 2004, Caballero 2008, Bennett 2012, Martínez-Paricio 2012).
- Based on research above the prosodic word, which has demonstrated that new layers in the prosodic hierarchy can arise via recursion (Itô & Mester 2007a,b, 2009, 2010, 2012, 2013; Selkirk 2011, Elfner 2011, 2012), we will assume that a metrical foot can undergo **minimal recursion** by adjunction of a (light) syllable at its left or right edge (Martínez-Paricio in prep. for details)

(6) a. Non-recursion b. Minimal recursion: one additional layer

- Projections of a metrical foot Ft (following Itô & Mester 2007 *et seq*.)
  - **Maximal**: Ft not dominated by Ft — The largest projection of Ft
  - **Minimal**: Ft not dominating Ft — The smallest projection of Ft

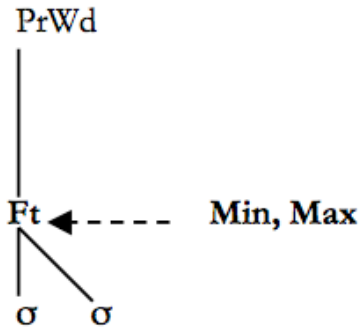
- The terms 'Minimal/Non-minimal' and 'Maximal/Non-maximal' are **relational labels**, not new categories in the prosodic hierarchy (≠ superfoot, colon). Labels can be fully & **locally inferred from domination relations**.

(7)

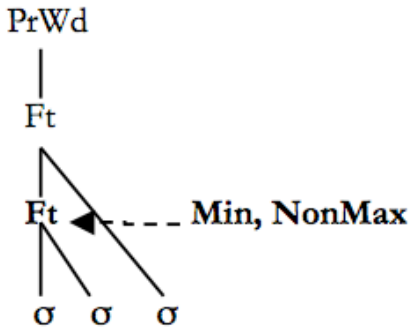
Natural class	**Defining structural property**
Minimal foot	Dominating a syllable (8a, b)
Maximal foot	Dominated by the PrWd (8a, c)
Non-minimal foot	Dominating a foot (8c, d)
Non-maximal foot	Dominated by a foot (8b, d)

(8) Theoretically possible foot structures

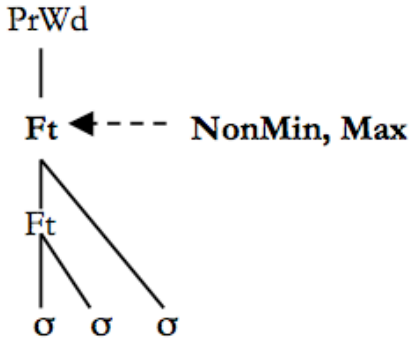
a. Minimal & maximal Ft



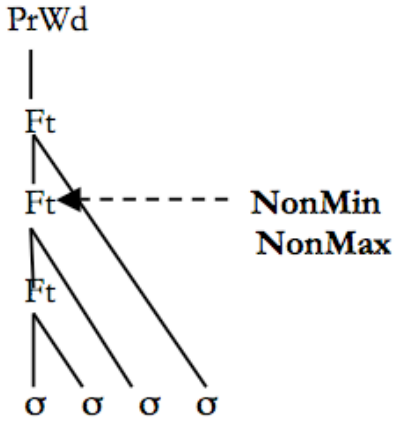
b. Minimal & non-maximal



c. Non-minimal and maximal



d. *Non-minimal & non-maximal



- Arguments *against* intermediate foot projections (*8d) and arguments *for* the **One-Layer Recursive Foot hypothesis** (Martínez-Paricio in prep.)
  - **Rhythmic nature** of the foot *vs*. prosodic categories above the PrWd (regulated by syntax-phonology mappings) (Itô & Mester 2007, 2013)
  - **Typology**: size of stress windows (Kager 2012)
  - **Metrically dependent processes**: this predicts two types of prominent syllables: (i) head of a minimal foot; (ii) head of a non-minimal foot; and three types of non-prominent syllables: (i) dependent of a minimal foot, (ii) dependent of a non-minimal foot, and (iii) unfooted syllable. These predictions are corroborated by a review of strength prosodic systems (Martínez-Paricio in prep.). (8d would predict additional, unattested strength distinctions).
  - **Learnability**: only binary and ternary systems are learnable (Heinz 2006)
  - **Further support**: a wide range of language particular phenomena receive a unified account if we allow phonology to distinguish between minimal feet (non-recursive) and non-minimal feet (recursive) (e.g. a three-syllable stress window in Choguita Rarámuri, Caballero 2008; Huariapano [h] coda epenthesis, Bennett 2012; Wargamay and Yidiɲ lengthening; ternary rhythm; distributions of pitch in Chugach; Seneca accent, etc. (Martínez-Paricio 2012, in prep.)

- **Restrictions on *Gen*** (Martínez-Paricio in prep.)
  - Maximally binary-branching feet (*ternary flat feet)
  - Maximally one-layer of recursion
  - Head Uniqueness: the head of NonMax foot = head of a NonMin foot

2.2 Constraints: categorical alignment, non-intervention format

- Phonological constraints can generally refer to different foot projections and different foot categories created by *Gen*.
- Evaluation of alignment constraints is **categorical** (Eisner 1997, 2000; Kager 2001, 2005; McCarthy 2003; Biró 2004; Riggle 2004; Heinz, Kobele & Riggle, 2005; Hyde 2008, Buckley 2009)
- Alignment constraints have a **non-intervention** format (McCarthy 2003, Hyde 2012). We impose two **locality** conditions, consistent with McCarthy (2003:80) "Constraints are inherently local because they can never mention more than two distinct constituents and a relation between them, such as **adjacency** or **shared membership in a super-ordinate constituent**"

(9) **ALIGN-LEFT/RIGHT (Cat1, *Cat2, Cat3)**
For every prosodic category Cat1, assign a violation mark if some prosodic category Cat2 intervenes between Cat1 and the left/right edge of Cat3.

Locality conditions:

a. Daughterhood Condition: Cat1 and Cat2 must be immediately dominated by Cat3 (hence, Cat1 and Cat2 are daughters of Cat3)

b. Adjacency Condition: Cat2-Cat3 are adjacent categories in the Prosodic Hierarchy (e.g. if Cat3 = ω → Cat2 = Ft
if Cat3 = Ft → Cat2 = σ)

Note: the DC & AC **fully** determine values of Cat2 and Cat3 for any given value of Cat1.

Our constraint set includes the following values of Cat1: Fthead, Ftmin, Ftmax, Ftnon-min, Ftmain, Ftunary, and (unfooted) syllable.

Constraint set

I. Constraints regulating the location of the foot-head and foot-dependents

(10) **ALIGN-L/R(Fthead, *σ, Ft)** (= TROCHEE/IAMB)
For every foot head, assign a violation mark if some footed syllable intervenes between the foot head and the left/right edge of its containing foot

(11) **ALIGN-L/R(Ftmin, *σ, Ft)** (= NONMINTROCHEE/NONMINIAMB)
For every minimal foot, assign a violation mark if some footed syllable intervenes between the minimal foot and the left/right edge of its containing foot

II. Constraints regulating the location and number of foot projections

(12) **ALIGN-L/R ([Ftmax]ω, *Ft, ω)** ALIGN-FT-L/R
For every maximal foot Ftmax^{i} assign a violation mark if some foot intervenes between Ftmax^{i} and the left/right edge of its containing prosodic word.

(13) **ALIGN-L/R ([Ftmin]ω, *Ft, ω)** ALIGN-MIN-L/R
For every foot that is minimal and maximal (i.e. [Ftmin^{i}]ω), assign a violation mark if some foot intervenes between [Ftmin^{i}]ω and the left/right edge of its containing prosodic word.

(14) **ALIGN-L/R ([Ftnon-min]ω, *Ft, ω)** ALIGN-NONMIN-L/R
For every non-minimal foot Ftnon-min^{i} assign a violation mark if some foot intervenes between Ftnon-min^{i} and the left/right edge of its containing prosodic word.

(15) **ALIGN-L/R ([Ftunary]ω, *Ft, ω)** ALIGN-UNARY-L/R
For every unary foot Ftunary^{i}, assign a violation mark if some foot intervenes between Ftunary^{i} and the left/right edge of its containing prosodic word.

(16) **ALIGN-L/R ([Ftmain]ω, *Ft, ω)** (=ENDRULE-L/R; Prince 1983, McCarthy 2003)
For every head foot of the prosodic word Ftmain^{i}, assign a violation mark if some foot intervenes between Ftmain^{i} and the left/right edge of its containing prosodic word.

III. Constraints regulating the location of unfooted syllables

(17) **ALIGN-L/R ([σ] ω, *Ft, ω)** ALIGN-σ-L/R
For every unfooted syllable [σ^{i}]ω assign a violation mark if some foot intervenes between [σ^{i}]ω and the left/right edge of its containing prosodic word.

Deviates from strict locality (Eisner 1997): non-adjacent Cat1, Cat2 in **σ^{i} σ *Ft** ... **]ω**
(but accords with McCarthy 2003 format)

(18) Effects of PrWd domain constraints

	undominated pair	**active ALIGN-(Cat1)-X**
ALIGN-MIN-L/R	only ternary Ft	maximize ternary Ft pull non-ternary Ft to edge X
ALIGN-FT-L/R	single Ft per ω	minimize number of Ft
ALIGN-NONMIN-L/R	no ternary Ft (except: ω = ternary Ft)	minimize ternary Ft pull ternary Ft to edge X
ALIGN-UNARY-L/R	no unary Ft (except: ω = unary Ft)	minimize unary Ft pull unary Ft to edge X
END-RULE-L/R	single Ft per ω	X-most Ft carries primary stress
ALIGN-σ-L/R	**exhaustive parsing**	**maximize parsing** pull unparsed σ to edge X

3 Rhythmic typology and factorial typology

Sample parsings of ternary systems

(19) Cayuvava (Key 1967): only ternary feet allowed (('σ σ) σ)

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

(20) Tripura Bangla (Das 2001): preferred foot (('σ σ) σ), only one ('σ σ) per word

2σ	('ra.za)	'king'
3σ	(('go.ra)li)	'ankle'
4σ	(('bi.βɛ).sɔ).na	'consideration'
5σ	(('ʃɔ.ma).lɔ).(ˌsɔ.na)	'criticism'
6σ	(('o.nu).kɔ).((ˌro.ni).jɔ)	'imitable'
7σ	(('o.no).nu).((ˌda. βo).ni).jɔ	'unintelligible'
8σ	(('o.no).nu).((ˌkɔ.ro).ni).(ˌjɔ.ta)	'inimitability'

(21) Winnebago (Miner 1979, 1981): preferred foot (σ (σ 'σ)), only one (σ 'σ) per word

2σ	(wa.'je)	'dress'
3σ	(ho.(ta.'xi))	'expose to smoke'
4σ	(hi.(dʒo.'wi)).re	'fall in'
5σ	(ho.(ki.'wa)).(ro.'ke)	'swing (noun)'
6σ	(ho.(ki.'wa)).(ro.(ro.'ke))	'swing (verb intr.) '
7σ	(hi(i.'ʒu)).(go.(ki.'rus)).ge	'double-barrelled shotgun'

(22) Estonian (Hint 1973): preferred foot (('σ σ) σ); one ('σ σ) in 3*n*+2, two in 3*n*+1

2σ	('pa.lat)	'ward'
3σ	(('o.sa).va)	'skillful'
4σ	('re.te).(ˌli.le)	'ladder-all sg.'
5σ	(('pi.mes).ta).(ˌva.le)	'blinding' (ILL.SG.)
6σ	(('o.sa).va).((ˌma.le).ki)	'also more skillful' (ABL.SG.)

(23) Chugach (Leer 1985): preferred foot ((σ 'σ) σ); one (σ 'σ) in 3*n*+2, two in 3*n*+1

2σ	(pə̧.'naq)	'cliff'
3σ	((a.'ta).ka)	'my father'
4σ	(a.'ku).(ta.'mek)	*akutaq* (a food; ABL SG)
5σ	((ta.'qa).ma).(lu.'ni)	'apparently getting done'
6σ	((a.'ku).tar).((tu.'nir).tuq)	'he stopped eating *akutaq*'
7σ	((ma.'ŋar).su).(qu.'ta).(qu.'ni)	'if he (refl) is going to hunt porpoise'

The binary-to-ternary rhythmic continuum

	Garawa / Wargamay	Estonian / Chugach	Tripura / Winnebago	Cayuvava (mirror)
3*n*	**(('σσ)σ)**	**(('σσ)σ)**	**(('σσ)σ)**	**(('σσ)σ)**
3*n*+1	('σσ) ('σσ)	('σσ) ('σσ)	**(('σσ)σ)** σ	**(('σσ)σ)** σ
3*n*+2	**(('σσ)σ)** ('σσ)	**(('σσ)σ)** ('σσ)	**(('σσ)σ)** ('σσ)	**(('σσ)σ)** σ σ
3*n*	('σσ) ('σσ) ('σσ)	**(('σσ)σ) (('σσ)σ)**	**(('σσ)σ) (('σσ)σ)**	**(('σσ)σ) (('σσ)σ)**
3*n*+1	**(('σσ)σ)** ('σσ) ('σσ)	**(('σσ)σ)** ('σσ) ('σσ)	**(('σσ)σ) (('σσ)σ)** σ	**(('σσ)σ) (('σσ)σ)** σ
3*n*+2	('σσ) ('σσ) ('σσ) ('σσ)	**(('σσ)σ) (('σσ)σ)** ('σσ)	**(('σσ)σ) (('σσ)σ)** ('σσ)	**(('σσ)σ) (('σσ)σ)** σ σ
	(ternary) binary*	ternary* (binary)(binary)	ternary* (binary/stray)	ternary* (stray)(stray)

Ternary feet as a last resort device to ensure exhaustivity (Bennett 2012, Martínez-Paricio 2012)

Ternary feet as a default parsing sacrificing exhaustivity (Kager 1994, Kager & Elenbaas 1999, Hyde 2002, Martínez-Paricio in prep.)

The binary-to-ternary rhythmic continuum emerges by the re-ranking of three constraint pairs: ALIGN-σ-L/R (promotes exhaustivity), ALIGN-MIN-L/R (promotes ternarity), ALIGN-NONMIN-L/R (promotes binarity).

Garawa ALIGN-σ-R/L, ALIGN-NONMIN-L » ALIGN-NONMIN-R, ALIGN-MIN-L/R
Estonian ALIGN-σ-R/L » ALIGN-MIN-R » ALIGN-NONMIN-L/R » ALIGN-MIN-L
Tripura ALIGN-σ-R, ALIGN-MIN-R » ALIGN-σ-L » ALIGN-NONMIN-L/R, ALIGN-MIN-L
Cayuvava ALIGN-σ-R, ALIGN-MIN-L/R » ALIGN-σ-L » ALIGN-NONMIN-L/R

Below we will highlight the crucial boundaries on the continuum:

Garawa ~ Estonian 3*n*

(24)

	Garawa	ALIGN-σ-R	ALIGN-σ-L	ALIGN-NONMIN-L	ALIGN-NONMIN-R	ALIGN-MIN-L	ALIGN-MIN-R
☞	('σσ) ('σσ) ('σσ)					**	**
	(('σσ)σ) (('σσ)σ)			*!	*		
	(('σσ)σ) σ σ σ		*!**				

(25)

	Estonian	ALIGN-σ-R	ALIGN-σ-L	ALIGN-MIN-R	ALIGN-NONMIN-L	ALIGN-NONMIN-R	ALIGN-MIN-L
	('σσ) ('σσ) ('σσ)			*!*			**
☞	(('σσ)σ) (('σσ)σ)				*	*	
	(('σσ)σ) σ σ σ		*!**				

Garawa prefers binarity to ternarity; Estonian, ternarity to binarity.

Estonian ~ Tripura 3*n*+1

(26)

	Estonian	ALIGN-σ-R	**ALIGN-σ-L**	**ALIGN-MIN-R**	ALIGN-NONMIN-L	ALIGN-NONMIN-R	ALIGN-MIN-L
☞	(('σσ)σ) ('σσ) ('σσ)			*		*	*
	(('σσ)σ) (('σσ)σ) σ		*!		*	*	
	(('σσ)σ) σ σ σ σ		*!***				

(27)

	Tripura	ALIGN-σ-R	**ALIGN-MIN-R**	**ALIGN-σ-L**	ALIGN-NONMIN-L	ALIGN-NONMIN-R	ALIGN-MIN-L
	(('σσ)σ) ('σσ) ('σσ)		*!			*	*
☞	(('σσ)σ) (('σσ)σ) σ			*	*	*	
	(('σσ)σ) σ σ σ σ			**!**			

Estonian prefers exhaustivity to strict ternarity; Tripura, strict ternarity to exhaustivity.

Tripura ~ Cayuvava 3*n*+2

(28)

	Tripura	ALIGN-σ-R	ALIGN-MIN-R	**ALIGN-σ-L**	ALIGN-NONMIN-L	ALIGN-NONMIN-R	**ALIGN-MIN-L**
☞	(('σσ)σ) (('σσ)σ) ('σσ)				*	**	*
	(('σσ)σ) (('σσ)σ) σ σ			*!*	*	*	
	(('σσ)σ) σ σ σ σ σ			*!****			
	('σσ) ('σσ) ('σσ) ('σσ)		*!**				***

(29)

	Cayuvava	ALIGN-σ-R	ALIGN-MIN-R	**ALIGN-MIN-L**	**ALIGN-σ-L**	ALIGN-NONMIN-L	ALIGN-NONMIN-R
	(('σσ)σ) (('σσ)σ) ('σσ)			*!		*	**
☞	(('σσ)σ) (('σσ)σ) σ σ				**	*	*
	(('σσ)σ) σ σ σ σ σ				***!**		
	('σσ) ('σσ) ('σσ) ('σσ)		*!**	***			

Tripura prefers binarity to non-exhaustive parsing; Cayuvava, non-exhaustive parsing to binarity.

Exhaustive parsing: default binarity ~ ternarity (Garawa ~ Estonian)
Non-exhaustive parsing: residual binarity ~ strict ternarity (Tripura ~ Cayuvava)

Factorial typology

Calculated by means of OTSoft (Hayes, Tesar & Zuraw 2003).

Candidate set:
- All logically possible parsings of forms 1-8 syllables; no quantity distinctions.
- *Gen* limited to unary, binary and ternary feet, plus unparsed syllables.
- All candidates subject to culminativity: one and only one primary stress foot.
- Total number of candidates: 10,612 (distributed over different word lengths).

Constraint set: All 12 ω-domain constraints and all 4 Ft-domain constraints.

With 16 constraints, the number of logically possible grammars is 20,922,789,888,000. There were **316** different output patterns.

For reasons of conciseness, we have collapsed
- Primary/secondary stress
- Left/right mirror images
- Foot form:

U	(σ)		(1)
B	(σσ)	collapses	(01), (10)
T	(σσσ)	collapses	((10)0), ((01)0), (0(10)) (0(01))

This produces 22 patterns, classified into 9 categories along a rhythmic continuum

A. Single foot systems (e.g. Hungarian, Mohawk)

(σσ)	(σσ)
(σσ) σ	(σσσ)
(σσ) σσ	(σσσ) σ
(σσ) σσσ	(σσσ) σσ
(σσ) σσσσ	(σσσ) σσσ
(σσ) σσσσσ	(σσσ) σσσσ
(σσ) σσσσσσ	(σσσ) σσσσσ
B (σ*)	**T (σ*)**

B. Strictly binary systems (Pintupi, Cairene, Araucanian, Creek, etc. → also see D.)

(σσ)	(σσ)
(σσ) σ	(σσσ)
(σσ) (σσ)	(σσ) (σσ)
(σσ) (σσ) σ	(σσ) (σσ) σ
(σσ) (σσ) (σσ)	(σσ) (σσ) (σσ)
(σσ) (σσ) (σσ) σ	(σσ) (σσ) (σσ) σ
(σσ) (σσ) (σσ) (σσ)	(σσ) (σσ) (σσ) (σσ)
B* (σ)	**T in 3σ; B* (σ)**

C. Mixed binary/unary systems (Maranungku, Passamaquoddy, Ojibwa, Weri, etc.)

(σσ)	(σσ)
(σσ) (σ)	(σσσ)
(σσ) (σσ)	(σσ) (σσ)
(σσ) (σσ) (σ)	(σσ) (σσ) (σ)
(σσ) (σσ) (σσ)	(σσ) (σσ) (σσ)
(σσ) (σσ) (σσ) (σ)	(σσ) (σσ) (σσ) (σ)
(σσ) (σσ) (σσ) (σσ)	(σσ) (σσ) (σσ) (σσ)
B* (U)	**T in 3σ; B* (U)**

D. Mixed binary/ternary systems (Pintupi, Warao, Araucanian; Garawa, Piro, etc.)

(σσ)	(σσ)
(σσσ)	(σσσ)
(σσ) (σσ)	(σσ) (σσ)
(σσ) (σσσ)	(σσ) (σσσ)
(σσ) (σσ) (σσ)	(σσ) (σσ) (σσ)
(σσ) (σσ) (σσσ)	(σσ) (σσσ) (σσ)
(σσ) (σσ) (σσ) (σσ)	(σσ) (σσ) (σσ) (σσ)
B* (T)	**B (T) B***

E. Mixed ternary/binary/unary systems (unattested, not pathological)

(σσ)	(σσ)	(σσ)	(σσ)
(σσσ)	(σσσ)	(σσσ)	(σσσ)
(σσσ) (σ)	(σσσ) (σ)	(σσσ) (σ)	(σσσ) **(σ)**
(σσσ) (σσ)	(σσσ) (σσ)	(σσσ) (σσ)	**(σσ)** (σσσ)
(σσσ) (σσ) (σ)	(σσσ) (σσσ)	(σσσ) (σσσ)	(σσσ) (σσσ)
(σσσ) (σσ) (σσ)	(σσσ) (σσ) (σσ)	(σσσ) (σσσ) (σ)	(σσσ) (σσσ) **(σ)**
(σσσ) (σσ) (σσ) (σ)	(σσσ) (σσσ) (σσ)	(σσσ) (σσσ) (σσ)	**(σσ)** (σσσ) (σσσ)
T (B*) (U)	**T* (B/U) (B)**	**T* (B/U)**	**(B) T* (U)** *non-directional*

F. Exhaustive ternary/binary systems (Estonian, Chugach)

(σσ)	(σσ)	(σσ)
(σσσ)	(σσσ)	(σσσ)
(σσ) (σσ)	(σσ) (σσ)	**(σσ) (σσ)**
(σσσ) (σσ)	(σσσ) (σσ)	(σσσ) **(σσ)**
(σσσ) (σσσ)	(σσσ) (σσσ)	(σσσ) (σσσ)
(σσσ) (σσ) (σσ)	(σσσ) (σσ) (σσ)	**(σσ)** (σσσ) **(σσ)**
(σσσ) (σσσ) (σσ)	(σσσ) (σσ) (σσσ)	(σσσ) (σσσ) **(σσ)**
T* (B) (B)	**T* (B) (B/T)**	**(B) T* (B!)** *non-directional*

G. Non-exhaustive ternary/binary systems (Tripura Bangla, Winnebago)

(σσ)	(σσ)
(σσσ)	(σσσ)
(σσσ) σ	(σσσ) **σ**
(σσσ) (σσ)	**(σσ)** (σσσ)
(σσσ) (σσσ)	(σσσ) (σσσ)
(σσσ) (σσσ) σ	(σσσ) (σσσ) **σ**
(σσσ) (σσσ) (σσ)	**(σσ)** (σσσ) (σσσ)
T* (B/σ)	**(B) T* (σ)** *non-directional*

H. Strictly ternary systems (Cayuvava, Gilbertese, Sentani)

(σσ)
(σσσ)
(σσσ) σ
(σσσ) σσ
(σσσ) (σσσ)
(σσσ) (σσσ) σ
(σσσ) (σσσ) σσ
T* (σ) (σ)

I. Mixed ternary/binary dual foot systems (unattested, not pathological)

(σσ)	(σσ)	(σσ)	(σσ)
(σσσ)	(σσσ)	(σσσ)	(σσσ)
(σσσ) σ	(σσσ) (σ)	(σσσ) σ	(σ) (σσσ)
(σσσ) (σσ)	(σσσ) (σσ)	(σσ) (σσσ)	(σσ) (σσσ)
(σσσ) (σσ) σ	(σσσ) (σσ) σ	(σσ) (σσσ) σ	(σσ) (σσσ) σ
(σσσ) (σσ) σσ	(σσσ) (σσ) σσ	(σσ) (σσσ) σσ	(σσ) (σσσ) σσ
(σσσ) (σσ) σσσ	(σσσ) (σσ) σσσ	(σσ) (σσσ) σσσ	(σσ) (σσσ) σσσ
T (B) σ*	**T (B/U) (σ*)**	**(B) T (σ*)**	**(B/U) T (σ*)**

Conclusion

Goal	**Assessment**	**Comments**
Full coverage	(✓)	covers full typology of binary & ternary iambic & trochaic QI systems; still to be done: QS systems
Non-gradient	✓	
Local	(✓)	consistent with McCarthy (2003); largely consistent with Eisner (1997)
Avoid pathology	(✓)	residual non-directionality; pursue implementation in Harmonic Serialism

4 Independent evidence for ternary feet with internal branching structure

4.1 Ternarity in binary systems: Wargamay and Yidiɲ

- Vowel inventory /i, iː, a, aː, u, uː/. Additionally, metrically conditioned **lengthening**:
  - Yidiɲ lengthens the **penultimate** syllable in **odd** parity forms
  - Wargamay lengthens the **peninitial** syllable in **odd** parity forms

(18) *Yidiɲ* (Dixon 1977a:5,6; 1977b)

Even-parity forms

a.	/galiŋ/	['ga.liŋ]	'go-Present'
b.	/gudagagu/	['gu.da.'ga.gu]	'dog-Purposive'

Odd-parity forms: penultimate lengthening

c.	/galina/	→ [ga.'**liː**.na]	'go-Purposive'
d.	/gudagudaga/	→ [gu.'da.gu.'**daː**.ga]	'dog-Redup-Abs'

(19) *Wargamay* (Dixon 1981: 17) (Dixon 1981)

Even-parity forms

a.	/bada/	[ˈba.da]	'dog'
b.	/giɟawulu/	[ˈgi.ɟa.ˌwu.lu]	'freshwater jewfish'

Odd-parity forms: peninitial lengthening

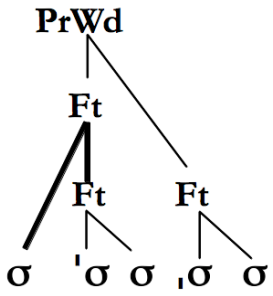
c.	/gagara/	[ga.ˈ**gaˑ**.ra]	'dilly bag'
d.	/ɟuɽagay-miri/	[ɟu.ˈ**ɽaˑ**.gay.ˌmi.ri]	'Niagara Vale-from'

⇒ Only if the initial syllable does not have a /Vː/

e.	/giːbara/	[ˈgiː.ba.ra]	'fig tree'

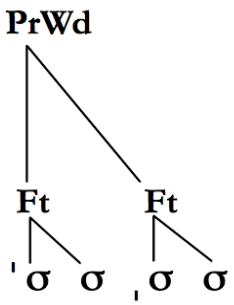
- **Puzzling** target of lengthening (Hyde 2002)
  - Only a subset of the 'σ in odd-parity forms
  - It does not always coincide with primary stress
- **Solution**: prosodic prominence and recursive footing (Martínez-Paricio 2012, in prep.)
  - Target of lengthening: the head of a NonMinFt (double head status, 20a)
  - Head of NonMinFt ≠ head of MinFt
  - NonMinFt: only built as a last resort device to ensure **exhaustive** parsings and **avoid unary feet**.

(20) a. Odd-parity form: 5σ



ɟu. 'ɾa' gay.ˌmi. ri
'Niagara Vale-from'

b. Even-parity form: 4σ



'gi. ɟa. ˌwu. lu
'freshwater jewfish'

(21)

Yidiɲ		**Wargamay**	
Even	**Odd**	**Even**	**Odd**
('σσ)	**((σ'σ)σ)**	('σσ)	**(σ('σσ))**
('σσ) ('σσ)	(σ'σ) **((σ'σ)σ)**	('σσ) ('σσ)	**(σ('σσ))** ('σσ)
('σσ) ('σσ) ('σσ)	(σ'σ) (σ'σ) **((σ'σ)σ)**	('σσ) (ˌσσ) (ˌσσ)	**(σ('σσ))** ('σσ)('σσ)

4.2 Internally layered ternary feet: Chugach

- Metrically conditioned distribution of pitch (Leer 1985c)
  - Head of a foot: attracts HIGH
  - Dependent of a NonMinFt: attracts a LOW (Martínez-Paricio, in prep.)

  ⇒ **Dependent of NonMinFt ≠ Dependent of MinFt**

(22) a. ((sa. 'ra). ni). ((wa. 'kar). tuq)
H L H L

b. ((ta. 'qu). ma). (lu. 'ni)
H L H

  - Do we really need to refer to metrical structure?
  - Couldn't we just state that L targets post-stressed syllables?

- Distribution of H, L in quantity sensitive forms: *taátaqá vs. ánciquá*
  - 3 syllables, first and third syllable stressed, but different pitch

(23) a. Dependent of MinFt: ∅

(μ μ^h)	(μ μ^h)
(ta á).	(ta. qá)
|	|
H	¡H

b. Dependent of NonMinFt: L

((μ^h μ)	μ)	(μ μ^h)
((á n).	ci).	(qu á)
|	|	|
H	L	H

5 Conclusions

- We have presented a novel OT analysis of **quantity-insensitive binary** and **ternary rhythm** and demonstrated that our model accomplishes **full coverage** of the attested typology, while **avoiding pathological overgeneration**, using a computer generated factorial typology (OTSoft, Hayes *et al*. 2003).
- Main ingredients of our proposal:

  ⇒ **Internally layered ternary feet** (minimal recursion at the level of the foot)
  - Embedded in theory of recursion for prosodic categories.
  - Retreating from Weak Local Parsing.
  - New evidence for ternary feet, not only from ternary systems, but also from binary systems.

  ⇒ **Categorical alignment constraints** of the **non-intervention type**

  ALIGN-LEFT/RIGHT (Cat 1, *Cat2, Cat3)

  For every prosodic category Cat1, assign a violation mark if some prosodic category Cat2 intervenes between Cat1 and the left/right edge of Cat3.

  - **Local constraints:** Daughterhood Condition (vertical locality)
    Adjacency Condition (restricts category of separator *Cat2)

Overall conclusions

- Allowing the elimination of gradient alignment and lapse licensing constraints, which had been criticized on theoretical and empirical grounds.
- Predicting the binary-to-ternary rhythmic continuum from representations and constraints.
- Solving the drifing foot problem.
- Coverage: Full coverage of the attested typology
- Restrictiveness: No overgeneration of pathological patterns.

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