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THE IAMBIC LAW:
Quantitative Adjustment in Typological Perspective*

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Abstract: Many processes of Quantitative Adjustment (QA) in natural language are seen to follow from the Iambic/Trochaic Law (ITL), a basic principle of rhythmic organisation which favours quantitative evenness in trochaic systems an quantitative unevenness in iambic systems. The present paper takes issue with this claim, examining patterns of QA from the standpoint of language typology, and taking the position that evidence for the ITL is compelling only in iambic systems. The elimination of the ITL from trochaic systems — in essence reducing it to an Iambic Law — explains a number of other facts which are problematic on an ITL analysis.

1 The Iambic/Trochaic Law

Early studies of rhythm perception (Woodrow 1909, 1951) demonstrated a propensity for human subjects to parse a series of stimuli into groupings. The perceived groupings differed as the stimuli were manipulated in a number of different ways: intensity, pitch, duration of stimuli, duration between stimuli etc. One of the more interesting findings of these experiments has become known as the Iambic/Trochaic Law (ITL), taken by Hayes (1995) and others to be a fundamental principle of rhythmic organisation in human language. Hayes' formulation is given in (1) below.

(1) Iambic/Trochaic Law (Hayes 1995:71)
  a. Elements contrasting in intensity naturally form groupings with initial prominence.
  b. Elements contrasting in duration naturally form groupings with final prominence.

While the ITL clearly does not hold in many languages for strings of syllables, it has been argued to hold at the level of foot structure (Hayes 1985, 1987, 1995; Kager 1993, 1995, 1999; cf. McCarthy & Prince 1986, Prince 1992). Thus, prominence-initial (trochaic) systems are understood to differ from prominence-final (iambic) systems as in (2) below.

(2) Iambic/Trochaic Law (Kager 1993:382)
  a. Trochaic systems have durationally even feet.
  b. Iambic systems have durationally uneven feet.

The linguistic mechanism by which the ITL is manifested has become a topic of debate in recent years. Prince (1992) expresses the ITL in terms of a foot wellformedness hierarchy, where quantitatively even (LL) trochees are preferred over quantitatively uneven (HL) ones. Conversely, quantitatively uneven (LH) iambs are favoured over quantitatively even (LL) ones, as shown in (3) below.

(3) Bisyllabic foot types under the Iambic/Trochaic Law (Prince 1992:360)
  a. Iambic: (LH) >> (LL)
  b. Trochaic: (LL) >> (HL)

In Optimality Theory (OT: Prince & Smolensky 1993; McCarthy & Prince 1995), a framework which evaluates competing outputs against a set of ranked constriants, the ITL is expressed simply as a constraint. Alber's (1997) formulation is given in (4) below.

(4) IAMBIC/TROCHAIC LAW (ITL: Alber 1997:6)
  a. the components of a trochaic foot must be quantitatively equal, while
  b. those of an iambic foot must contrast in quantity.

Kager (1993, 1995, 1999) takes a slightly different approach. Following Prince's (1983) observation that stress falls only on the first mora of heavy syllables, Kager derives the effects of the ITL through an examination of the mora-rhythmic properties of different foot shapes. In table (5) below, ill-formed foot types are easily distinguishable on structural grounds from their well-formed counterparts: notice that ill-formed foot types are characterised by either a *final beat* (stress on the final mora) or a *foot-internal lapse* (a sequence of two unstressed moras).

(5) Mora Rhythmic Representations of Quantitative Feet
(Kager 1993, 1995:441; cf. Prince 1983, Selkirk 1984)

	WELL-FORMED	ILL-FORMED	
IAMBS	(LH) = (.x.)	(LL) = (.x)	*Final beat*
	(H) = (x.)	(L) = (x)	*Final beat*
TROCHEES	(LL) = (x.)	(HL) = (x..)	*Lapse*
	(H) = (x.)	(L) = (x)	*Final beat*

By contrast, all well-formed feet in table (5) share a common structural property — they all end in a strong-weak contour (a stressed mora followed by an unstressed one), suggesting that the relevant constraint is as in (6) below.

(6) RH-CONTOUR (Kager 1995, 1999:174)
A foot must end in a strong-weak contour at the moraic level.

While functionally almost indentical to (4), the constraint in (6) identifies a single structural property which unifies well-formed feet in both system types, thereby avoiding having to express the ITL in separate statements for iambic and trochaic systems. Taking RH-CONTOUR as our working functional definition of the ITL, the following section will address itself to the role of the ITL in processes of QA.

2 Quantitative Adjustment Driven by the Iambic/Trochaic Law

In some languages, metrical feet are brought into conformity with the structural requirements of the ITL through Quantitative Adjustment (QA). In OT, this occurs in systems where RH-CONTOUR outranks IDENTWEIGHT, the constraint which demands like syllable weight in inputs and outputs. This ranking is given in (7) below.

(7) Quantitative Adjustment under the Iambic/Trochaic Law
RH-CONTOUR >> IDENTWEIGHT

Since the ITL has differing requirements in iambic and trochaic systems, the manifestation of QA under the constraint ranking in (7) will differ in the two system types. The two predicted patterns are given in (8) below.

(8) Quantitative Adjustment predicted under the Iambic/Trochaic Law

a.	Iambic systems:	/LL/ → (LH)	*iambic lengthening*
b.	Trochaic systems:	/HL/ → (LL)	*trochaic levelling*

Iambic lengthening occurs in Choctaw, and is exemplified in (9) below. (Example (9a) from Hayes 1995:210, citing Munro & Ulrich 1984:192; example (9b) from Hayes 1995:210, citing Ulrich 1986:54.)

(9) Iambic Lengthening in Choctaw: /LL/ → (LH)

a.	/sa-litiha-tok/	(sa.li:)(ti.ha:) tok	*(sa.li)(ti.ha) tok	'I was dirty'
	/L L L L ... /	(LH) (LH) (H)	*(LL) (LL) (H)	
b.	/oktʃa -li-li-h/	(ok)(tʃa.li:)(lih)	*(ok)(tʃa.li)(lih)	'I woke him up'
	/H L L H/	(H) (LH) (H)	*(H) (LL) (H)	

In (9), underlyingly short vowels undergo lengthening in the final syllables of iambic feet. The tableaux for iambic lengthening is given in (10) below.

(10) Iambic Lengthening: /LL/ → (LH)

Input: /LL/	RH-CONTOUR	IDENTWEIGHT
a. → (LH)		*
b. (LL)	*!	

Candidate (10b) fatally violates RH-CONTOUR since the even (LL) iamb does not end in a strong-weak contour (recall from the mora-rhythmic representations in (5) that (LL) = (.x)). Candidate (10a) is thus optimal, despite a violation of lower-ranked IDENTWEIGHT due to the discrepancy in syllable weight with the input.

In trochaic systems, QA takes the form of trochaic levelling. Examples from Fijian are given in (11) below. (Example (11a) from Hayes 1995:145, citing Schütz 1985:528; example (11b) from Dixon 1988.)

(11) Trochaic Levelling in Fijian: /HL/ → (LL)

a.	/^{m}bu:-^{ŋ}gu/	/^{m}bú.^{ŋ}gu)	*(^{m}bú:.^{ŋ}gu)	'my grandmother'
	/HL/	(LL)	*(HL)	
b.	/si:vi/	(sí.βi)	*(sí:. βi)	'exceed'
	/HL/	(LL)	*(HL)	

In (11), underlyingly long vowels undergo truncation in the initial syllable of trochaic feet forming an even (LL) trochee. The tableau for this process follows the same constraint ranking as iambic lengthening, and is given in (12) below.

(12) Trochaic Levelling: /HL/ → (LL)

Input: /HL/	RH-CONTOUR	IDENTWEIGHT
a. → (LL)		*
b. (HL)	*!	

Candidate (12b) fatally violates RH-CONTOUR since the uneven (HL) trochee does not end in a strong-weak contour (recall from (5) that (HL) = (x..)). Candidate (12a) is thus optimal, despite a violation of IDENTWEIGHT.

As with the formulation of the RH-CONTOUR constraint itself, the use of the same constraint ranking to account for processes of QA in trochaic as well as iambic systems represents a formal parallelism between these processes in the two system types. Such a view — where QA is understood to follow from a single formal mechanism irrespective of system type — makes certain cross-linguistic predictions with regard to QA. Firstly, one would predict occurrences of QA to be evenly distributed across both system types, and secondly, one would predict QA to be manifested in the same way in both system types. Both these predictions turn out to be false, however, when QA is examined from the perspective of language typology — a discussion to be taken up in the following section.

Quantitative Adjustment and Language Typology: While ITL-driven QA is attested in both iambic and trochaic systems, an examination of the typology of these processes is revealing. A list of languages exhibiting ITL-driven QA taken from Hayes (1995:83, 148) is given in (13) below.

(13) Typology of Quantitative Adjustments Driven by the ITL[1]

a. IAMBIC SYSTEMS Iambic Lengthening /LL/ → (LH)		b. TROCHAIC SYSTEMS Trochaic Levelling /HL/ → (LL)	
Cariban:	Hixkaryana	Austronesian:	Fijian
	Macushi		Hawaiian
	Surinam Carib		Tongan
Choctaw/Chicasaw		W. Germanic:	Middle English
Algonquian:	Menomini	Romance:	Abruzzese Italian
	Potawatomi		
Lake Iroquoian:	Cayuga		
	Onondaga		
	Seneca		
Eskimo:	St. Lawrence Island Yupik		
	Central Alaskan Yupik		
	Pacific Yupik		
N. California:	Kashaya		
	Maidu		
	Sierra Miwok		
Yidiɲ			

In table (13) we observe that ITL-driven QA is significantly better-attested in iambic systems than in trochaic ones. Such a result comes as somewhat of a surprise on the standard view; indeed, if QA is assumed to follow from the same formal mechanism in trochaic and iambic systems there would be no reason to expect such a marked distributional asymmetry between the two system types.

Another asymmetry can be observed by examining QA of a different type. Not all instances of QA follow from the ITL, and a number of languages exhibit processes of QA which directly contravene it. Not only do these languages allow foot types which violate the ITL, but they actually derive these feet through QA from feet which would have otherwise conformed to the ITL's requirements. A list of languages in which this occurs is given in (14) below.

(14) Anti-ITL Quantitative Adjustments[2]

a. IAMBIC SYSTEMS Iambic Levelling /LH/ → (LL)	b. TROCHAIC SYSTEMS Trochaic Length./Shortening /LL/ or /HH/ → (HL)
	Mohawk Michelson (1988); Hayes (1995); Piggott (1998) Icelandic Kiparsky (1984); Hayes (1995) Chimalapa Zoque Knudsen (1975); Hayes (1995) Selayarese Mithun & Basri (1986); Piggott (2001) Chamorro Chung (1983) Gilbertese Blevins & Harrison (1999) Slovak Bethin (1998); Mellander (2001)

It is surprising that such processes should exist at all if the ITL is to be considered a fundamental organising principle of human language as assumed by Hayes and others. Perhaps more striking, however, is the fact that anti-ITL QA is restricted to trochaic systems; the iambic counterpart to trochaic levelling (cf. Fijian) — iambic levelling — is unattested ((14a)). Summarizing, ITL-driven QA is not only poorly attested in trochaic systems relative to their iambic counterparts, but anti-ITL QA occurs in trochaic systems only. Both facts must be considered accidental on the standard view, which appeals to same formal mechanism in both system types.

Even more revealing is the summary of QA in trochaic systems given in table (15) below (repeated from the trochaic columns of tables (13) and (14) above). Column (15a) lists trochaic languages exhibiting ITL-driven QA, while trochaic languages exhibiting anti-ITL QA are listed in column (15b).

(15) Quantitative Adjustment in Trochaic Systems

a. Trochaic Levelling *(repeated from (13b) above)* /HL/ → (LL)	b. Trochaic Length./Shortening *(repeated from (14b) above)* /LL/ or /HH/ → (HL)
Fijian	Mohawk
Hawaiian	Icelandic
Tongan	Chimalapa Zoque
Middle English	Selayarese
Abruzzese Italian	Chamorro
	Gilbertese
	Slovak

It is striking that in trochaic systems, anti-ITL QA ((15b)) is actually slightly better-attested than ITL-driven QA ((15a)). In other words, with regard to QA in trochaic languages there appear to be more systems which counterexemplify the ITL than there are exemplars of it. This casts doubt on the relevance of the ITL as an organising principle in trochaic systems.

A clear asymmetry emerges from the typological evidence on QA introduced above. While in iambic systems attested patterns of QA are consistent with the ITL, QA in trochaic systems leaves us with no clear pattern with respect to the ITL. The following section takes a closer look at the ITL's role in trochaic QA by examining the facts of trochaic levelling in Fijian and other languages.

3 Trochaic Levelling

The most well-documented system where trochaic levelling occurs is Fijian, described in detail by Schütz (1985) and Dixon (1988). In his analysis of levelling in Fijian, Hayes (1995:84) attributes the process to the desire to achieve "a maximal parse of syllables into perfect moraic trochees of even duration." The relevant constraints are RH-CONTOUR and PARSESYLLABLE, a requirement that syllables be parsed into feet, given in (16) below.

(16) PARSE SYLLABLE (PARSESYLL: cf. Prince & Smolensky 1993)
Syllables are parsed by metrical feet.

When these constraints are ranked above IDENTWEIGHT, trochaic levelling is correctly predicted in Fijian final trapping contexts, i.e. in contexts where the final syllable is potentially stray. This is shown in tableau (17) below.

(17) Trochaic Levelling in Fijian: /HL/ → (LL)

Input: /HL/	PARSE SYLLABLE	RH-CONTOUR	IDENT WEIGHT
a. (H) <L>	*!		
b. (HL)		*!	
c. (H)(L)		*!	
d. → (LL)			*

While candidate (17a) fatally violates PARSESYLL due to an unfooted syllable, candidates (17b) and (17c) both incur fatal violations of RH-CONTOUR, the requirements of which neither the uneven ((HL) = (x..)) trochee in (17b) nor the degenerate ((L) = (x)) foot in (17c) comply. This leaves the levelling candidate, (17d) as optimal despite a violation of IDENTWEIGHT.

While this constraint ranking accounts for levelling in final trapping contexts, it incorrectly predicts levelling in Fijian initial trapping contexts where no levelling occurs, and in Fijian medial trapping contexts where levelling is not obligatory. Examples of non-levelling in initial and medial trapping contexts are given in (18) and (19), respectively. (Example (18a) from Schütz 1985:489; example (18b) from Dixon 1988:17; examples (19a-b) from Hayes 1995:143 citing Schütz 1978.)

(18) Fijian initial trapping contexts: No Levelling

a.	se.ŋái	<se> (ŋái)	*(sé.ŋa)	'no'
		<L> (H)	*(LL)	
b.	/ʔila-a/	<ʔi> (lá:)	*(ʔí.la)	'know' trans.
		<L> (H)	*(LL)	

(19) Fijian medial trapping contexts: Levelling is not obligatory

a.	pa.rò:.ka.rá.mu	<pa> (rò:) <ka> (rá.mu)	'program'
	... H L ...	... (H) <L> ...	
b.	pa.rai.ma.ri:	<pa> (ràì) <ma> (rí:)	'primary'
	... H L ...	... (H) <L> ...	

Heavy syllables adjacent to metrically stray syllables in (18) and (19) do not undergo levelling as they do in initial trapping contexts ((11)). The tableaux yielding false predictions in these contexts are given in (20) and (21) below. (The ungrammatical optimal candidate is indicated by a backwards arrow.)

(20) Levelling incorrectly predicted in Fijian initial trapping contexts

Input: /LH/	PARSE SYLLABLE	RH-CONTOUR	IDENT WEIGHT
a. <L> (H)	*!		
b. (L)(H)		*!	
c. (LH)		*!	
d. ← (LL)			*

While grammatical candidate (20a) is ruled out due to an unfooted syllable, the degenerate foot in (20b) and the reverse ((LH) = (x..)) trochee in (20c) both incur fatal violations of RH-CONTOUR, leaving candidate (20d) as optimal.

(21) Levelling incorrectly predicted in Fijian medial trapping contexts

Input: / ... HLLL/	PARSE SYLLABLE	RH-CONTOUR	IDENT WEIGHT
a. ...(H) <L> (LL)	*!		
b. ...(H)(L)(LL)		*!	
c. ...(HL)(LL)		*!	
d. ← ...(LL)(LL)			*

Similarly, grammatical candidate (21a) is eliminated by PARSESYLL while the degenerate foot in (21b) as well as the uneven trochee in (21c) fatally violate RH-CONTOUR. The levelling candidate, (21d), is thus optimal.

The fact that obligatory levelling occurs only in the final (main) stress foot in Fijian thus requires appeal to another constraint. Kager (1999) analyses the Fijian pattern of trochaic levelling by appealing to a requirement that a the main stress foot be aligned with the right word edge, given in (22) below.

(22) RIGHTMOST (Kager 1999; Alber 1997; cf. McCarthy & Prince 1993)
Align the right edge of the prosodic word with the right edge of the head of the prosodic word.

The revised analysis for trochaic levelling in Fijian final trapping contexts is given in (23) below.

(23) Trochaic Levelling in Fijian final trapping contexts
(after Kager 1999:176; cf. (17))

Input:	/HL/	PARSE SYLLABLE	RH-CONTOUR	IDENT WEIGHT
a.	(H) <L>	*!		
b.	(HL)		*!	
c.	(H)(L)		*!	
d. →	(LL)			*

Candidate (23a) fatally violates RIGHTMOST because the head foot of the prosodic word is not right-aligned within the prosodic word. Candidates (23b) and (23c) achieve right-alignment of the head foot, but incur fatal violations for noncompliance with RH-CONTOUR, leaving levelling candidate (23d) as optimal.

Levelling in initial and medial trapping contexts is unnecessary, as shown in (24) and (25), respectively.

(24) No Levelling in Fijian initial trapping contexts (cf. (20))

Input:	/LH/	RIGHT-MOST	RH-CONTOUR	IDENT WEIGHT
a. →	<L> (H)			
b.	(L)(H)		*!	
c.	(LH)		*!	
d.	(LL)			*!

(25) No Levelling in Fijian medial trapping contexts (cf. (21))

Input:	/ ... HLLL/	RIGHT-MOST	RH-CONTOUR	IDENT WEIGHT
a. →	...(H) <L> (LL)			
b.	...(H)(L)(LL)		*!	
c.	...(HL)(LL)		*!	
d.	...(LL)(LL)			*!

Unlike final trapping contexts (cf. (23)) where a violation of IDENTWEIGHT is preferred to that of higher-ranking RIGHTMOST, levelling is completely unnecessary in (24) and (25) where RIGHTMOST is satisfied by all candidates. Levelling thus entails a gratuitous violation of IDENTWEIGHT and is thus suboptimal.

Attested and Unattested Patterns of Trochaic Levelling: The fact that the analysis of trochaic levelling in Fijian requires an additional constraint like RIGHTMOST is unexpected. Indeed, if trochaic levelling followed directly from the ITL, we would expect to find a trochaic system in which levelling was not limited to the rightmost foot, but rather, applied obligatorily in every foot in the word, as is the norm in iambic systems (Hayes 1995:84; cf. iambic lengthening in Choctaw in (9), analysed in Section 4, below). Such a system would correspond to the constraint ranking in (26) below, a logical possibility in the factorial typology of OT grammars, where all constraints are assumed to be present in all languages.

(26) RH-CONTOUR >> IDENTWEIGHT >> RIGHTMOST

A trochaic system with the ranking in (26), however, is unattested. Hayes (1995:148) describes the levelling rule in Hawaiian as "like that of Fijian, except that it applies only when the long vowel is followed by /ʔ/," while levelling in Tongan "also resembles that of Fijian, except that it applies only sporadically."

The remaining two cases of trochaic levelling, Middle English (e.g. Lass 1992) and Abruzzese Italian (Fong 1979) are cases of *trisyllabic shortening,* where long vowels are shortened in antepenultimate syllables only. Middle English examples are given in (27) below.

(27) Trochaic Levelling in Middle English (Trisyllabic Shortening)

a.	su:ð	'south'	(su.ðer) <ne>	*(su:.ðer) <ne>	'southern'
b.	divi:n	'divine'	di (vi.ni) <tie>	*di (vi:.ni) <tie>	'divinity'

Prince (1992:269) points out that in cases of trisyllabic shortening, it is the antepenults rather than the penults which are shortened due to final syllable extrametricality. Thus, the foot in which trochaic levelling occurs contains the antepenultimate and penultimate syllables rather than the penultimate and final syllables as in Fijian. In OT, final syllable extrametricality is captured by appealing to the constraint in (28) below.

(28) NONFINALITY(PRWD) (Prince &Smolensky 1993:52)
No head of a PrWd is final in the PrWd.

NONFINALITY(PRWD) forbids the head foot from encompassing the final syllable of the prosodic word. This is in direct conflict with RIGHTMOST ((22)), which *requires* the head foot to occur finally in the prosodic word. In grammars where NONFINALITY(PRWD) outranks RIGHTMOST, the effect is final syllable extrametricality. Trochaic levelling thus affects a long vowel in antepenultimate rather than penultimate position as illustrated in (29) below.

(29) Trisyllabic Shortening

Input: /HLL/	NONFIN (PRWD)	RIGHT-MOST	RH-CONT	IDENT WEIGHT
a. (H)(LL)	*!			
b. (H)(L)<L>		*	*!	
c. (HL) <L>		*	*!	
d. → (LL) <L>		*		*

Highly-ranked NONFINALITY(PRWD) eliminates any candidate (such as (29a)) which foots a final syllable. Surviving candidates necessarily violate RIGHTMOST, but levelling ensues to avoid violations of RH-CONTOUR (candidates (29b) and (29c)) at the expense of lower-ranked IDENTWEIGHT ((29d)).

Cases of trisyllabic shortening are thus exactly parallel to the Fijian case of levelling — trochaic levelling still takes place in the rightmost foot *only*. Thus, even these cases fail to provide us with a trochaic language with the logically possible ranking in (26).

The absence of such a system is problematic for analyses where QA processes are seen to follow from the ITL. Taken together with the typological evidence presented in Section 2 showing a general preponderence of ITL-driven QA processes in iambic rather than trochaic systems, it seems reasonable to investigate whether the ITL can be eliminated formally from trochaic systems altogether. Such a move would demand an alternative analysis for trochaic levelling, a topic which will be the focus of the following section.

An Alternative: Trochaic Levelling through Strict Binarity: The breakdown of QA processes in trochaic systems by system type in (30) below reveals an interesting pattern of distribution.

(30) QA in Trochaic Systems by System Type (cf. (15)[3])

	Troch. Levelling (repeated from (13b) above) /HL/ → (LL)	Troch. Length./Shortening (repeated from (14b) above) /LL/ or /HH/ → (HL)
Moraic Trochee Systems	Fijian Hawaiian Tongan Middle English Abruzzese Italian	
Syllabic Trochee Systems		Mohawk Icelandic Chimalapa Zoque Selayarese Chamorro Slovak

While trochaic lengthening and shortening are restricted to syllabic trochee systems, trochaic levelling occurs only in moraic trochee systems. This latter gap constitutes somewhat of a surprise if trochaic levelling is assumed to follow from the ITL; if the ITL is a structural constraint on foot shape, it is unclear what would prevent ITL-driven QA from applying in all trochaic systems rather than in a subset of them.[4]

A valuable clue to this problem is provided by Mester (1994) who defines moraic trochee systems in terms of strict binarity — a system which enforces a bimoraic minimum as well as a bimoraic maximum on foot shape. Mester's definition is given in (31) below.

(31) Moraic Trochee Theory (Mester 1994:6-7)
  a. Metrical feet contain a maximum of two moras.
  b. Metrical feet contain a minimum of two moras.

The restrictions in (31) are satisfied by exactly two trochaic foot types, both of which contain exactly two moras: (LL) and (H). In OT, the conditions in (31a) and (31b) are formalised as in (32) and (33) below.

(32) FOOT MAXIMUM:(μμ) (FOOTMAX: cf. Crowhurst 1996; Mester 1994)
  Feet are maximally binary at the moraic level.

(33) FOOT MINIMUM:(μμ) (FOOTMIN: Crowhurst 1996:412; Mester 1994)
  Feet are minimally binary at the moraic level.

A moraic trochee system in OT, then, is a grammar in which (32) and (33) are highly ranked.

Turning now to trochaic levelling, since this phenomenon is restricted to moraic trochee systems, FootMax and FootMin are always highly ranked in grammars where trochaic levelling applies. Recalling from Section 3.0 that the ranking of Rightmost over IdentWeight is a necessary condition for levelling, the crucial ranking for levelling systems is as in (34) below.

(34) FootMax, FootMin, Rightmost >> IdentWeight

The ranking in (34) is sufficient to generate the effects of levelling in Fijian final trapping contexts *without* Rh-Contour, as the tableau in (35) below demonstrates (cf. (23)).

(35) Trochaic Levelling in Fijian final trapping contexts: /HL/ → (LL), *(HL)

Input:	/HL/	Foot Max	Foot Min	Right-most	Ident Weight
a.	(H) <L>			*!	
b.	(H)(L)		*!		
c.	(HL)	*!			
d. →	(LL)				*

While candidate (35a) is eliminated by Rightmost because the head foot is not right-aligned within the prosodic word, Candidates (35b) and (35c) are ruled out by FootMin and FootMax, respectively. Candidate (35b) violates FootMin because it contains a degenerate (L) foot — a foot which contains less than two moras, while candidate (35c) violates FootMax because the uneven (HL) trochee contains more than two moras. This leaves levelling candidate (35d) as optimal.

The ranking in (34) also yields the correct results for Fijian initial and medial trapping contexts where levelling does not apply. This is illustrated below in tableaux (36) and (37), respectively (cf. (24) and (25)).

(36) No Levelling in Fijian initial trapping contexts: /LH/ → <L> (H), *(LL)

Input:	/LH/	Foot Max	Foot Min	Right-most	Ident Weight
a. →	<L> (H)				
b.	(L)(H)		*!		
c.	(LH)	*!			
d.	(LL)				*!

(37) No Levelling in Fijian medial trapping contexts: /HL/ → (H) <L>, *(LL)

Input:	/... HLLL/	FOOT MAX	FOOT MIN	RIGHT-MOST	IDENT WEIGHT
a. →	...(H) <L> (LL)				
b.	...(H)(L)(LL)		*!		
c.	...(HL)(LL)	*!			
d.	...(LL)(LL)				*!

While candidates (36b) and (37b) are eliminated By FOOTMIN due to a degenerate foot, candidates (36c) and (37c) fatally violate FOOTMAX due to a trimoraic foot (the uneven (HL) trochee). Since candidates (36a) and (37a) do not violate RIGHTMOST (cf. (35a)), levelling is not functionally motivated, and levelling candidates (36d) and (37d) are ruled out by IDENTWEIGHT.

The foregoing analysis of trochaic levelling relies on strict binarity in the form of high-ranking FOOTMAX and FOOTMIN constraints — constraints which are independently required in a moraic trochee system. Not only can the effects of trochaic levelling in Fijian be captured without appeal to RH-CONTOUR, but the analysis also correctly predicts that trochaic levelling should be restricted to moraic trochee systems — a fact which remains unexplained on the standard view.

4 Iambic Lengthening and the Iambic Law

The fact that RH-CONTOUR is no longer required for trochaic levelling eliminates the link between QA and the ITL in trochaic systems. As a result, the ITL is in effect reduced to an Iambic Law — since its effects appear to be restricted to iambic systems only. A preliminary formularion is given in (38) below (cf. (2b)).

(38) IAMBIC LAW (cf. (2))
Iambic systems have durationally uneven feet.

One consequence of this reformulation is that the uneven (HL) trochee is no longer to be considered an ill-formed structure. This is reflected in the revised table of foot types in (39) below (cf. (5)).

(39) Mora Rhythmic Representations of Quantitative Feet Revised

	WELL-FORMED	ILL-FORMED
IAMBS	(LH) = (.x.) (H) = (x.)	(LL) = (.x) *Final beat* (L) = (x) *Final beat*
TROCHEES	(LL) = (x.) (H) = (x.) (HL) = (x..)	(L) = (x) *Final beat*

Ill-formed feet in (39) above are now limited to the degenerate (L) foot and the even (LL) iamb. Since it is precisely these foot types which are characterised by a final beat, it would appear that the relevant constraint would be a ban on final stressed moras. Support for such a constraint can be found in prosodic theory. Recall that NONFINALITY(PRWD) forbids a head of the prosodic word from occurring finally in the domain. It is reasonable to assume that a similar constraint could be operative at the foot level as well. This constraint would prevent the head of the foot — the stressed mora — from occurring finally within the foot. Both constraints are given below.

(40) NONFINALITY(FOOT)
No head of a Foot is final in the Foot.

(41) NONFINALITY(PRWD) (repeated from (28))
No head of a PrWd is final in the PrWd.

NONFINALITY prevents the head of a domain from occurring finally in that domain, and can apply either at the level of the foot as in (40) or at that of the prosodic word as in (41).

Quantitative Adjustment under the Iambic Law thus results from the ranking in (42) below.

(42) Quantitative Adjustment under the Iambic Law (cf. (7))
NONFINALITY(FOOT) >> IDENTWEIGHT

The ranking in (42) accounts for iambic lengthening as illustrated in (43) below.

(43) Iambic Lengthening: /LL/ → (LH)

Input: /LL/	NONFINALITY(FT)	IDENTWEIGHT
a. → (LH) = (.x.)		*
b. (LL) = (.x)	*!	

While the even (LL) iamb (candidate (43b)) fatally violates NONFINALITY(FOOT) due to a stressed final mora, candidate (43a) undergoes lengthening to avoid this problem at the expense of lower-ranked IDENTWEIGHT.

Full constraint rankings are given below. Notice in (44) that when highly ranked, NONFINALITY(FOOT) forces iambic lengthening in every foot (cf. Choctaw).

(44) Iambic Lengthening in every foot (e.g. Choctaw[5] (9))

Input: /LLLL/	NON FINFT	FOOT MAX	FOOT MIN	RIGHT -MOST	IDENT WT
a. (LL)(LL)	*!*				
b. (LL)(LH)	*!	*			*
c. → (LH)(LH)		**			**

The input in tableau (44) above is a string of four light syllables. When parsed into two iambic feet ((44a)), two violations of NONFINALITY(FOOT) result — one for each even (LL) iambic foot. Candidate (44b), with lengthening in one foot, incurs only a single violation of NONFINALITY(FOOT) due to a single even (LL) iamb. The optimal candidate, (44c), avoids all violations of NONFINALITY(FOOT) by lengthening both feet, violations of FOOTMAX and IDENTWEIGHT notwithstanding. This ranking ensures iambic lengthening in *every* foot since a violation of NONFINALITY(FOOT) is incurred for *every* even (LL) iamb in the output.

In contrast to iambic systems where iambic lengthening ensues to repair structurally ill-formed feet, trochaic levelling occurs in response RIGHTMOST — a structural constraint at the level of the prosodic word — and only under conditions of strict binarity as discussed in Section 3.0. The two processes are thus fundamentally different in character. Notice in (45) and (46) below that NONFINALITY(FOOT) does not interfere with trochaic levelling, as its effects in trochaic systems are minimal.

(45) Trochaic Non-Levelling in medial trapping contexts
(e.g. Fijian in (19), cf. (37))

Input: / ... HLLL/	NON FINFT	FOOT MAX	FOOT MIN	RIGHT -MOST	IDENT WT
a. → ...(H) <L> (LL)					
b. ...(H)(L)(LL)	*!		*		
c. ...(HL)(LL)		*!			
d. ...(LL)(LL)					*!

Candidate (45a) satisfies RIGHTMOST without any adjustment of syllable quantity, and thus beats out the levelling candidate, (45d), which fatally violates IDENTWEIGHT.

(46) Trochaic Levelling in final trapping contexts (e.g. Fijian (11) cf. (35))

Input: /HL/		NON FINFT	FOOT MAX	FOOT MIN	RIGHT -MOST	IDENT WT
a.	(H) <L>				*!	
b.	(H)(L)	*!		*		
c.	(HL)		*!			
d. →	(LL)					*

Trochaic levelling only occurs in the rightmost foot, as shown in (46) above, where levelling is the only way to satisfy RIGHTMOST under conditions of strict binarity.

One could imagine a scenario where the same conditions — i.e. binarity constraints outranking IDENTWEIGHT — applied in an iambic system. One might expect to find *iambic levelling* — the unattested iambic counterpart to trochaic levelling. However, strict binarity is predicted to be significantly less common in iambic systems than in trochaic ones. This is because in iambic systems it conflicts with NONFINALITY(FOOT), while in trochaic systems it does not. Recall that an even (LL) iamb violates NONFINALITY(FOOT) whereas an even (LL) trochee does not. Consequently, strict binarity in an iambic system requires NONFINALITY(FOOT) to be ranked below the binarity constraints, FOOTMAX and FOOTMIN, while trochaic systems can manifest strict binarity even if NONFINALITY(FOOT) is highly ranked, e.g. (45) and (46).

As it turns out, iambic systems enforcing strict binarity (so-called "even iamb" systems) are in fact quite rare. Hayes (1995:266-7) lists just four languages which require such an analysis, and of these, none exhibit iambic levelling. This is perhaps not surprising given that out of countless trochaic lenguages enforcing strict binarity, trochaic levelling in manifested in just a handful of systems due to the very specific set of conditions under which it applies.

A final consequence of the decoupling of trochaic QA and the ITL is that the existence of processes of trochaic lengthening and shortening ((14b)) in syllabic trochee systems no longer seem so bizarre.[6] Recall that these processes actually *create* uneven (HL) trochees in defiance of the ITL. Such ITL-contravening processes are restricted to trochaic systems precisely because there is no Trochaic Law, but only an Iambic Law, i.e. the uneven (HL) trochee is a well-formed phonological structure while the even (LL) iamb is not. (HL)-creating processes are predicted to occur is syllabic trochee systems only because it is precisely these systems where strict binarity is not enforced, allowing the trimoraic uneven (<u>H</u>L) trochee to surface.

5 <u>Conclusions</u>

The present paper has examined typological evidence and demonstrated clear asymmetries in the context and manifestation of QA between iambic and trochaic systems. Processes of QA consistent with the ITL are far better attested in iambic systems than in trochaic ones while processes of QA which contravene the ITL are attested in trochaic systems only. Moreover, while iambic lengthening tends to apply in every stress foot, obligatory trochaic levelling occurs in a very restricted context — in the rightmost foot of moraic trochee systems. The analysis developed in this paper attempts to account for these asymmetries by attributing trochaic levelling to independently motivated constraints specific to the environment in which it occurs, and thereby rejecting a unified ITL in favour of an Iambic Law only. The relevant constraint is the foot-level formulation of NONFINALITY — a ban on domain-heads in the final position of the domain that they head — which can apply at either the level of the foot or of the prosodic word.

The major advantage of this analysis is that the observed typological asymmetries between the two system types are predicted. Iambic lengthening is well-attested and tends to occur in every foot in a word because it follows from an Iambic Law, expressed as a structural constraint on feet. Trochaic levelling, by contrast, is typologically marked and distributionally restricted because it follows from a number of factors, the convergence of which is statistically limited. A final consequence of the elimination of the trochaic branch of the ITL is that the uneven (<u>H</u>L) trochee is understood to be a well-formed phonological structure, accounting for other types of QA (trochaic lengthening and shortening, listed in (14b)) which are problematic for a view of QA governed by the ITL.

NOTES

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