Parsimonious Evaluation of Quantity-Sensitive Footing in Harmonic Serialism

Kuo-Chiao Lin

1. Introduction

Lamont (2022a) presents a theory of quantity-insensitive footing within the framework of *Harmonic Serialism* (HS; Prince & Smolensky 1993/2004; McCarthy 2000, 2016), specifically focusing on CON, which consists of constraints evaluated in a directional manner (Eisner 2000, 2002; Lamont 2022b, 2022c). Unlike traditional approaches that consider the total number of violations, directional constraints in this theory harmonically order candidate structures based on the location of violations. By adopting directional evaluation, an important consequence arises: the constraint PARSE(σ) not only motivates iterative footing but also determines the specific positions where feet emerge. Consequently, the theory eliminates the need for alignment constraints (McCarthy & Prince 1993; McCarthy 2003; Hyde 2012, 2016) present in HS models that rely on counting loci to determine foot positions (Pruitt 2010, 2012). Compared to HS with counting constraints and parallel *Optimality Theory* (Prince & Smolensky 1993/2004) with directional constraints, this theory employs a smaller number of constraints, maintains empirical adequacy, and generates more precise predictions. To expand Lamont's theory's empirical adequacy, the present paper shows in the context of Budai Rukai's stress distribution that, by revising TROCHEE and IAMB, applying directional HS to the domain of quantity-sensitive footing is viable.

2. Quantity-sensitive footing in Budai Rukai

In Budai Rukai, disyllabic roots have stress on the penultimate syllable (1a), while in trisyllabic or longer roots, the assignment of stress is influenced by syllabic quantity:[1] if the penultimate syllable is light, the main stress is placed on the antepenult (1b); if the penult is heavy, the main stress falls on the penult (1c). However, prefixes and infixes are excluded from bearing primary stress (1d).

(1) Stress distribution in Budai Rukai[2]
- a. Penultimate stress in disyllabic words:
  ˈLH; ˈLL; ˈHL
- b. Default antepenultimate stress:
  ˈLLL; ˈLLH; LˈLLL; LˈHLL; LˈL-LLsuffix; Lprefix-ˈLL-Lsuffix; Lprefix-ˈHL-Lsuffix
- c. Stressed heavy penults:
  LˈHL; LˈHH
- d. Exclusion of prefixes/infixes from primary stress:
  Lprefix-ˈL; Lprefix-ˈH; Lprefix-ˈLL; Lprefix-Linfix-ˈLL; Lprefix-Linfix-ˈLL
- e. Right-to-left secondary stress:
  LˌLLˈHL; ˌLLˈLLL; ˌLLˌLLˈLLL; LˌLLˌLLˈLLL

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* Kuo-Chiao Lin, Learning Center, Kang Chiao International School, Taipei, kuochiao.lin@nyu.edu. Thanks go to the audience at WCCFL 41 for useful comments and feedback.

[1] According to Chen (2006), in Budai Rukai a minimal syllable consists of only a vowel, while a maximal syllable has the structure CV: or CVG. Syllables with nasal or lateral codas are observed but are considered perceptual effects resulting from fast speech and the presence of a weak schwa at the end of words. Therefore, when excluding syllables with nasal and lateral codas, Budai Rukai exhibits the following syllable structure types: (C)VG, (C)V:, and GV. Among these types, (C)VG syllables are categorized as heavy, while the others are considered light.

[2] It is worth noting that monosyllabic words in Budai Rukai are always stressed, which straightforwardly reveals that HD(*w*), which penalizes every prosodic word that does not dominate any feet, is undominated. Due to limited space, I only present the footing pattern and will not delve into a discussion of monosyllabic words. I refer the reader to Chen (2006, 2011) for a comprehensive transcription of data and a whole picture of Budai Rukai phonology.

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3. Parsing syllables

According to Pruitt (2010, 2012), parsing syllables into feet does not violate any faithfulness constraints. As a result, the determination of foot structure is solely governed by markedness constraints. The constraint PARSE(σ) drives iterative footing by penalizing syllables that are not part of a foot (2). Although footing itself does not violate any faithfulness constraints, it competes with the faithful candidate at each step and must exhibit harmonic improvement to be optimal. Since the loci of violations for PARSE(σ) are individual syllables, their positions directly correspond to the positions of these violations.

(2) PARSE(σ):
Assign one violation for every syllable that is not dominated by a foot.

The constraint PARSE(σ) serves two purposes under directional evaluation: driving the process of footing and determining which syllables should be part of a foot (Lamont 2022a). It achieves the latter by harmonically ordering candidate structures based on the presence or absence of footed syllables, as shown in (3)-(4). Regardless of the direction of evaluation, the worst candidate σσσσ lacks any feet, while the second-worst candidate features a monosyllabic foot incorrectly positioned at the word's edge: σσσ(σ) under left-to-right evaluation and (σ)σσσ under right-to-left evaluation. The remaining candidates progressively exhibit greater harmony with the leftmost/rightmost footed syllable, with preference for disyllabic feet over monosyllabic feet, without distinguishing between trochees and iambs. Due to directional evaluation focusing solely on the location of violations rather than their total count, there exist monosyllabic footing candidates that are strictly superior to disyllabic footing candidates, such as σσ(σσ) ≺ (σ)σσσ under left-to-right evaluation. All in all, directionally evaluating PARSE(σ) replicates the directional effects typically associated with alignment constraints, thereby eliminating the need for the inclusion of the ALIGN family.

(3) Violation vectors and harmonic ordering by PARSE(σ)$^{\Rightarrow}$:
1111 > 1110 > 1101 > 1100 > 1011 > 1001 > 0111 > 0011
σσσσ ≺ σσσ(σ) ≺ σσ(σ)σ ≺ σσ(σσ) ≺ σ(σ)σσ ≺ σ(σσ)σ ≺ (σ)σσσ ≺ (σσ)σσ

(4) Violation vectors and harmonic ordering by PARSE(σ)$^{\Leftarrow}$:
1111 > 0111 > 1011 > 0011 > 1101 > 1001 > 1110 > 1100
σσσσ ≺ (σ)σσσ ≺ σ(σ)σσ ≺ (σσ)σσ ≺ σσ(σ)σ ≺ σ(σσ)σ ≺ σσσ(σ) ≺ σσ(σσ)

The determination of whether disyllabic feet are left-headed or right-headed depends on the relative ranking of TROCHEE (5) and IAMB (6).

(5) TROCHEE (revised):
Assign one violation for a monomoraic syllable that is
i) a foot-initial non-head, i.e., *(LˈH), *(LˈL), *(L) or
ii) a foot-final head, i.e., *(LˈL), *(ˈL), *(HˈL).

(6) IAMB (revised):
Assign one violation for a monomoraic syllable that is
i) a foot-final non-head, i.e., *(ˈHL), *(ˈLL), *(L) or
ii) a foot-initial head, i.e., *(ˈLL), *(ˈL), *(ˈLH).

The definitions provided above deviate from Lamont's (2022a) (7)-(8), which, when working hand in hand and as both penalize monosyllabic feet, eliminate FTBIN (Prince & Smolensky 1993/2004) for a more parsimonious theory.

(7) TROCHEE (Lamont 2022a):
Assign one violation for every foot whose rightmost child is its head.

(8) IAMB (Lamont 2022a):
Assign one violation for every foot whose leftmost child is its head.

However, (7)-(8) restrict the theory's empirical adequacy from extending to quantity-sensitive footing, because under (7)-(8) a foot headed by a heavy syllable is penalized as well. To expand the theory's empirical adequacy without sacrificing theoretical simplicity, I propose to revise TROCHEE and IAMB in reference to the moraic level as in (5)-(6). Revising TROCHEE and IAMB as such maintains the elimination of FTBIN and accommodates quantity-sensitivity at once.

4. Quantity-sensitive footing in directional HS: Budai Rukai for example

Like in quantity-insensitive footing in Lamont (2022a), the directional evaluation of Budai Rukai's stress distribution requires no alignment constraints and FTBIN (cf. Lin 2014). With NONFINALITY (9) taken into consideration, the default leftward trochee in Budai Rukai can be derived by the ranking NONFINALITY⇒ > TROCHEE⇒ > PARSE(σ)⇐ > IAMB⇒/PARSE(σ)⇒ (10).[3]

(9) NONFINALITY⇒:
Assign one violation to every prosodic word whose rightmost syllable is dominated by a foot.

(10) Default leftward trochee: cf. (1b) and (1e)

/LLLLLL/	NONFIN⇒	TROCHEE⇒	PARSE(σ)⇐	IAMB⇒	PARSE(σ)⇒
☞ LLL(ˈLL)L			100111 654321	000110 123456	111001 123456
LLL(LˈL)L		W 000110 123456	100111 654321	L	111001 123456
LLLL(ˈLL)	W 000001 123456		L 001111 654321	L 000011 123456	W 111100 123456
(ˈLL)LLLL			W 111100 654321	W 110000 123456	L 001111 123456
LLL(ˈLL)L			W 100111 654321	L 000110 123456	W 111001 123456
☞ L(ˌLL)(ˈLL)L			100001 654321	011110 123456	100001 123456
(ˌLL)L(ˈLL)L			W 100100 654321	W 110110 123456	L 001001 123456
☞ L(ˌLL)(ˈLL)L			100001 654321	011110 123456	100001 123456
(ˌL)(ˌLL)(ˈLL)L		W 100000 123456	L 100000 654321	W 111110 123456	L 000001 123456

(Convergence at 3rd iteration omitted)

Note that in (10) both TROCHEE⇒ and IAMB⇒ penalize monosyllabic feet with a light syllable, hence obviating FTBIN: as TROCHEE⇒ dominates PARSE(σ)⇐, (ˌL)(ˌLL)(ˈLL)L is disfavored. Moreover, the ranking also straightforwardly explains why stress drops on the first syllable in disyllabic words. Although a candidate with stress on the word-final syllable satisfies at once TROCHEE⇒, PARSE(σ)⇐, and IAMB⇒, it is ruled out by the higher ranked NONFINALITY⇒ (11).

[3] In the analysis below, the directionalities of the constraints do not affect the outcome and are assumed to be rightward by default, except for PARSE(σ)⇐/PARSE(σ)⇒, whose directionalities determine where feet surface.

(11) Penultimate stress in disyllabic words: cf. (1a)

/LH/	NONFINALITY⇒	TROCHEE⇒	PARSE(σ)⇐	IAMB⇒
☞ (ˈL)H		10 12	10 21	10 12
L(ˈH)	W 01 12	L	L 01 21	L

(Convergence at 2nd iteration omitted)

On the other hand, heavy penultimate stress emerges as both TROCHEE⇒ and the constraint on unbalanced trochee *(ˈLH)⇒ dominate PARSE(σ)⇐ (12).

(12) Heavy penultimate stress: cf. (1c)

/LHH/	*(ˈLH)⇒	TROCHEE⇒	PARSE(σ)⇐	IAMB⇒
☞ L(ˈH)H			101 321	
(LˈH)H		W 100 123	L 100 321	L
(ˈLH)H	W 010 123		L 100 321	W 100 123

(Convergence at 2nd iteration omitted)

Finally, the exclusion of prefixes/infixes from bearing primary stress is a consequence of the lexically indexed constraint (Pater 2007) IAMBPREFIX⇒ being undominated (13).

(13) Exclusion of prefixation/infixation from primary stress: cf. (1d)

/LPREFIX-LL/	IAMBPREFIX⇒	NONFINALITY⇒	TROCHEE⇒	PARSE(σ)⇐	IAMB⇒
☞ (LPREFIX-ˈL)L			110 123	100 321	
(ˈLPREFIX-L)L	W 100 123		L	100 321	W 100 123
/LPREFIX-H/	IAMBPREFIX⇒	NONFINALITY⇒	TROCHEE⇒	PARSE(σ)⇐	IAMB⇒
☞ LPREFIX-(ˈH)		01 12		01 21	
(ˈLPREFIX)-H	W 10 12	L	W 10 12	W 10 21	W 10 12

(Convergence at 2nd iteration omitted)

In sum, the current analysis does not resort to FTBIN and ALIGN. Like in directionally evaluated quantity-insensitive footing, the directionality of PARSE(σ) and the revised TROCHEE/IAMB replicate the effects of FTBIN and alignment constraints, respectively, in determining where and how feet surface in Budai Rukai's quantity-sensitive footing (cf. Lin 2014). Therefore, it seems promising to extend over Lamont's restrictive, parsimonious directional HS to languages with quantity-sensitive footing.

5. Conclusion

Applying directional HS to quantity-insensitive footing serves as an initial step toward achieving a phonological theory that is empirically sound while employing as few formal mechanisms as possible (Lamont 2022: 74). Drawing upon the Lamont (2022), this squib takes a step further by employing revised TROCHEE and IAMB, defined in reference to the moraic level, to extend the empirical adequacy of directional HS to quantity-sensitive footing. Just like in the case of quantity-insensitive footing, directional evaluation of quantity-sensitive footing in directional HS employs a smaller set of constraints, specifically excluding alignment constraints and FTBIN. Instead, the directional properties of PARSE(σ), TROCHEE, and IAMB are utilized to emulate the effects of alignment constraints in determining the placement of feet. Future research to carry this project steps further forward may include locality in metrical typology, such as local trochaic shortening in Fijian, local weight sensitivity in Wergaia, and local rhythmic reversal in Axininca. See Pruitt (2010, 2012) for HS analyses of these phenomena using traditional constraints.

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