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Revisiting Top-Down Primary Stress*

Kathryn Pruitt
Arizona State University
kathryn.pruitt@asu.edu

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Abstract

Metrical theory recognizes differences between primary and non-primary stresses, sometimes within the same language. In serial theories, this has often led to a parametric approach in derivation: some languages are 'top-down', with the primary stress assigned first, while other languages are 'bottom-up', where foot construction precedes primary stress placement. This paper examines two languages (Cahuilla and Yine) that have be treated as 'top-down' in rule-based metrical theory, and it shows that neither requires a top-down analysis in Harmonic Serialism, a derivational version of Optimality Theory. On the basis of these case studies it is argued that the common, intuitive notion of what makes a language 'top-down'—a primary stress's independence from non-primary stresses—is oversimplified. The case studies reveal the importance of theoretical framework and typological predictions in establishing the order of primary and non-primary stress assignment. The argument culminates in a concise statement of Harmonic Serialism-specific criteria for establishing that a top-down derivation is required.

Keywords: primary stress; Harmonic Serialism; metrical theory; top-down; bottom-up

Resum. *Un altre cop sobre l'accent primari*

La teoria mètrica admet diferències entre l'accent primari i el no primari, de vegades dins la mateixa llengua. En les teories serials, això ha comportat sovint un enfocament paramètric de la derivació: algunes llengües comencen per dalt (*top-down*), amb l'assignació de l'accent primari en primer lloc, mentre que d'altres comencen per baix (*bottom-up*), en les quals la construcció del peu precedeix l'assignació de l'accent primari. Aquest article examina dues llengües (cahuilla i yine) que han estat considerades *top-down* en la teoria mètrica basada en regles, i demostra que cap de les dues requereix aquest tipus d'anàlisi en el marc del serialisme harmònic, una versió derivacional de la teoria de l'optimitat. Prenent aquestes llengües com a base, l'article sosté que la noció general i intuïtiva del que fa que una llengua sigui *top-down* —l'accent primari independent del no primari— és massa simplificada. Els casos estudiats palesen la importància del marc teòric adoptat i de les prediccions tipològiques en l'establiment de l'ordre d'assignació de l'accent primari i no primari. L'argumentació culmina amb

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una relació concisa dels criteris específics per a establir els requisits d'una derivació *top-down* dins el serialisme harmònic.

Paraules clau: accent primari; serialisme harmònic; teoria mètrica; *top-down*; *bottom-up*

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1. Introduction

In the rule-based literature within metrical theory, iterative stress patterns are sometimes described as fitting into one of two categories: those that require the primary stress to be assigned before non-primary stresses, and those that do not. The term "top-down" has been used for systems of the first type (e.g., Hayes 1995: 116-117), reflecting the idea that the primary stress represents a higher category of metrical structure, namely, the head of the prosodic word. From this literature we can deduce that, descriptively, languages with top-down stress are those where the primary stress is independent in some sense from the non-primary stresses. Bidirectional stress systems present one type of example, where primary stress is assigned at one edge of the word, while iterative non-primary stresses are assigned from the opposite edge.[1] The data from Yine[2] (Matteson 1965) in (1) illustrate such a pattern. Yine exhibits a quantity-insensitive trochaic parsing, where the primary stress foot is right-aligned and non-primary feet are parsed from left to right. Monosyllabic feet are not permitted (or, alternatively, a stress clash is prevented), so the primary stress foot appears to stand at a slight distance from the secondary stress feet in words with an odd number of syllables (i.e., a stress lapse is tolerated).

1. Other kinds of primary stress independence discussed in the literature include languages with: lexical (or otherwise non-metrical) primary stress; 'early' primary stress and 'late' secondary stress; asymmetries in quantity-sensitivity between primary and non-primary stress; different treatment of primary and non-primary stress by extrametricality/Non-Finality; and a few others. For discussions see, for example, Odden (1979), Hayes (1995: 117), Bailey (1995: Ch 1), Hurch (1996), McGarrity (2003), and Goedemans and van der Hulst (2014).
2. Maipurean, Peru (Eberhard, Simons & Fennig 2019). Formerly referred to as Piro.

(1) Yine stress (Matteson 1965: 21)[3]

ru.(ˈt͡çi.t͡ça)	‘He observes taboo’
(ˌʧi.ja)(ˈha.ta)	‘He cries.’
(ˌsa.lwa).je.(ˈhka.kna)	‘They visit each other.’
(ˌpe.ʧi)(ˌʧhi.ma)(ˈtlo.na)	‘They say they stalk it.’
(ˌru.slu)(ˌno.ti).ni.(ˈtka.na)	‘Their voices already changed.’
(ˌsa.ple)(ˌwhi.ma)(ˌmta.na)(ˈtna.ka)	‘They say he went along screaming again.’
(ˌka.çru:)(ˌka.khi)(ˌma.na).ta.(ˈtka.na)	‘They were joking together then, it is said.’

A top-down interpretation of this pattern is that the primary stress is first assigned at the right edge of the prosodic word, *then* secondary stresses are filled in by iterating disyllabic foot construction from left-to-right, stopping when the primary stress foot is reached or when only one syllable remains unparsed. An alternative “bottom-up” derivation—where the non-primary stress feet are built as the first layer of metrical structure before one is later selected as the primary stress—yields the wrong parse in words with an odd-number of syllables. For example, the seven-syllable /ru.slu.no.ti.ni.tka.na/ ‘their voices already changed’, should surface as (ˌru.slu)(ˌno.ti).ni.(ˈ**tka**.na), with an unfooted antepenultimate syllable (underlined) and primary stress on the penult (in bold). But applying the general parsing algorithm for left-to-right trochees first yields this parse: (ˌru.slu)(ˌno.ti)(ˌni.**tka**)na, which has incorrectly stressed the antepenultimate syllable and made the penult the unstressed member of a foot. This analysis would then require some additional mechanism to place primary stress correctly, such as having the ability to erase the offending foot when it is time to assign primary stress or letting the secondary stress procedure ‘know’ in advance where the primary stress will be so that it does not encroach on the primary stress’s territory. The intuition, therefore, is that a top-down analysis, where the primary stress is assigned first and secondary stresses follow, is a more straightforward way to capture such patterns.[4]

In contrast, in most stress systems it seems that a bottom-up analysis is possible, or even preferred, because although the primary stress may have its own set of requirements, they do not appear to override the procedures for assigning secondary stresses. A language like Pintupi[5] (Hansen & Hansen 1969), with data shown in (2), displays a stress pattern than can be derived with a top-down or a bottom-up derivation, while the data in (3), from MalakMalak[6] (Birk 1976),

3. Throughout this paper, data are presented in IPA except where noted. Otherwise, the cited forms retain whatever conventions are followed in their respective sources; in some cases this means a relatively more phonemic transcription, and in others more allophonic.
4. This is deliberately framed here as the ‘intuitively’ preferred characterization. Section 4 revisits Yine and other bidirectional patterns from a more analytic standpoint.
5. Pama-Nyungan, Northern Territory and Western Australia (Eberhard, Simons & Fennig 2019).
6. Daly, Northern Territory (Eberhard, Simons & Fennig 2019).

demonstrate a pattern where a bottom-up derivation is the most straightforward analysis. In both cases, quantity-insensitive trochees are responsible for the stress pattern, and the leftmost one is assigned primary stress. This yields a consistent first-syllable primary stress in Pintupi because all feet are left-aligned (or, assigned left-to-right), so the primary stress could be easily derived before or after secondary stress assignment. In MalakMalak, the primary stress fluctuates between initial and peninitial positions because the feet are right aligned (or, assigned right-to-left), which means primary stress placement is not easily determined until the word is fully metrified.

(2) Pintupi stress (Hansen & Hansen 1969: 163)

a.	(ˈpa.ɲa)	‘earth’
b.	(ˈt̪u.ʈa).ja	‘many’
c.	(ˈma.ɭa)(ˌwa.na)	‘through (from) behind’
d.	(ˈpu.ɭiŋ)(ˌka.la).t̪u	‘we (sat) on the hill’
e.	(ˈt̪a.mu)(ˌlim.pa)(ˌt̪uŋ.ku)	‘our relation’
f.	(ˈʈi.ɭi)(ˌɾi.ŋu)(ˌlam.pa).t̪u	‘the fire for our benefit flared up’
g.	(ˈku.ɾa)(ˌn̪u.lu)(ˌlim.pa)(ˌt̪u.ɾa)	‘the first one (who is) our relation’

(3) MalakMalak stress (Birk 1976: 16-17)

a.	(ˈwu.ru)	‘arm (or rivulet)’
b.	(ˈa.la)(ˌwar)[7]	‘woman’
c.	(ˈmu.t̪uɾ)(ˌwu.na)	‘very much’
d.	t̪ɛt.(ˈwɛ.ɾa)(ˌmaŋ.kil)	‘fork-stick’
e.	(ˈne̠ŋ.ke̠)(ˌɾe̠.ne̠)(ˌjuŋ.ka)	‘you-pl will lie down.’
f.	wu.(ˈwun.tu)(ˌnu.nu)(ˌwak.na)	‘He would have (given) you-sg (meat).’[8]
g.	(ˈnuŋ.ku)(ˌɾun.tu)(ˌwe̠.ɾe̠)(ˌwak.ka)	‘You-pl would have (given) them (meat).’

Some metrical theorists have advocated top-down-only modes of analysis (e.g., van der Hulst 1984, 1997, 2009; Bailey 1995; Hurch 1996), but in practice these proposals are usually implemented as ‘top-down-mostly’ in light of patterns like MalakMalak (or else such patterns are reinterpreted, e.g., van der Hulst

7. The three-syllable stress pattern does not conform to the pattern in longer words. I set this aside here. See Goldsmith (1990: 173ff) and Chen (1999: 115f) for discussions that involve a different footing for trisyllables, (ˈσ)(σˌσ).
8. The cited forms in (3)f and g are verbal auxiliaries (“a free form… encod[ing] person, number, tense, mood, and aspect”, Birk 1976: 4). To derive the given translations, the auxiliary is preceded by *tɛ aŋ* (ibid. p. 17), lit. ‘meat give’ (as glossed in Birk p. 37, for example).

1997, 2012). A more common approach in the derivational literature is to assume bottom-up parsing as the default mode of structure-building, with top-down parsing available and used by some languages, exemplified in explicit form by Hayes (1995: 116-117). In general, then, the ordering of primary and secondary stress assignment has been treated more or less parametrically, as a language-particular choice.

A consequence of this parametric approach to primary stress derivation is that the distinction between 'top-down' and 'bottom-up' has been seemingly codified as an empirical classification. For example, as a footnote to an otherwise-bottom-up demonstration of metrical stress, Goldsmith (1990: 343) remarks, "[i]n a good number of languages primary or word-level stress is assigned first, and secondary stress is assigned on the basis of the position of the word-level stress that is already assigned"; no examples or other sources are cited, so the implication is that such systems must be easy to spot. In general, the understanding seems to be that languages where primary stress is independent from secondary stresses are those where a top-down analysis is warranted, as in my characterization of Yine above. However, this paper will take a closer look at several such patterns and show that the common, intuitive notion of what makes a language 'top-down' is oversimplified. Using Harmonic Serialism (HS; Prince & Smolensky 1993/2004; McCarthy 2000, 2016) as the theoretical backdrop, I will show that it is possible to argue within a particular analytical and typological context for an analysis that is top-down in the sense just identified, but in so doing, I will challenge the idea that it is possible to label a language or stress pattern as 'top-down' in a primarily empirical or atheoretical way.[9,10]

To some extent, this conclusion may already be deduced from the literature. For example, the stress pattern of Tübatulabal (Uto-Aztecan; Voegelin 1935) is as follows: stress falls on the final syllable and every other mora counting backward from the final; heavy syllables are stressed and restart the mora count. Representative examples are given in (4)a. This pattern has been analyzed by some with iambs, as in (4)b, and by others with moraic trochees, as in (4)c. Although Voegelin (1935: 75) hedges about which syllable is the primary stress, it has been traditionally interpreted to be on the final syllable (see Hayes 1995: 265 for discussion).

9. Two anonymous reviewers question whether this statement is not already self-evident. Indeed, practically all labels (e.g., iamb/trochee, quantity-(in)sensitive, etc.) are couched within a specific set of assumptions and theoretical framework. However, I believe making this point explicit is still valuable, particularly in this case, because doing so reveals the *specific* issues underlying the use of the term and also allows us to identify differences among superficially-similar models. While it is correct to recognize that terms like 'top-down' have no meaning outside of a particular framework, it is also valuable to identify whether or not, or to what extent, the use of the term tends to correlates with particular empirical features and whether those features signal the same kinds of analyses in different frameworks.
10. A reviewer also asks what this has to do with theories of phonological cognition. Although I make no particular claims regarding cognition in the text, my assumption is that theories of typological variation provide an indirect way to examine human linguistic potential. In this sense, characterizing a typology of stress patterns, and being clear about the various empirical and theoretical issues therein, implicitly furthers this goal.

(4) Tübatulabal stress (examples from Voegelin 1935)

a. ha.nìː.lá — wì.taŋ.hà.ta.làː.ba.ʦú
‘the house (obj.)’ — ‘away from the Tejon Indians’

b. Iambic analysis (Hayes 1981; Crowhurst 1991)
(ha.ˌniː)(ˈla) — (ˌwɪ)(taŋ.ˌha)(ta.ˌlaː)(ba.ˈʦu)

c. Trochaic analysis (Kager 1989; Hayes 1995)
ha(ˌniː)(ˈla) — (ˌwɪ.taŋ)(ˌha.ta)(ˌlaː)ba(ˈʦu)

The iambic analysis can be derived bottom-up by building right-to-left iambic feet of the form (LˌL), (LˌH), or (ˌL), and assigning primary stress to the rightmost one. The trochaic analysis, on the other hand, introduces a difference between primary and secondary stress feet, with only the former occupying a monomoraic foot, (ˈL). To account for this, the final primary stress has to be assigned first, as initially proposed by Kager (1989: 134) and taken up by Hayes (1995: 264). Tübatulabal thus demonstrates that the same stress pattern may be ‘top-down’, or not, depending on factors external to the location of stresses themselves.

Two additional cases are examined in this paper. The first of these is Cahuilla (§3), a language analyzed as ‘top-down’ by Hayes (1995) and subsequently classified as such by others (e.g., Bailey 1995; Kager 1995; McGarrity 2003). However, we will see that the top-down analysis is only needed under Hayes’s (re)interpretation of the source data. In a different light, the Cahuilla stress pattern is straightforwardly accounted for with a bottom-up analysis in HS. The second case study returns to Yine (§4). We will see that despite the independence of primary stress in Yine, both bottom-up and top-down analyses are readily available in HS using common stress constraints. However, the two analyses make different typological predictions, and it is therefore only on these grounds that one analysis can be preferred over another. The two case studies provide a detailed exemplification of the central theme of this paper: that apparent primary stress independence is not sufficient grounds to justify calling a language ‘top-down’. Informed by these case studies, the paper culminates in a precise statement of the empirical criteria that would favor a top-down analysis in Harmonic Serialism.

Before moving on to the case studies, the next section (§2) presents some background on HS and defines ‘top-down’ and ‘bottom-up’ in this theory, with brief comparisons to rule-based theories of stress.

2. Defining top-down and bottom-up

The discussion in this paper is framed in terms of Harmonic Serialism (HS), a version of OT with a series of optimizations that iteratively apply to select an optimal output. Similar to (most) rule-based phonology, HS is a model of grammar that assumes a phonological underlying form is mapped to a surface form in a series of discrete steps, with one operation applying at a time. But like classical Optimality Theory (OT), the steps are determined not by directed rewrite rules, but by a competition among candidates that is settled on the basis of a hierarchy of ranked constraints. HS provides a relevant framework for the argument of this paper because it is serial, meaning the relative order of primary and secondary stress assignment must be explicitly defined, and because it is constraint-based, which permits many of the insights of classical OT to be retained. These include the use of violable constraints and the connection between individual analyses and typological predictions. In fact, as we will see in this paper, it is precisely the shift from rule-based theories to constraint-based HS that reveals the shaky status of 'top-down' as an empirical category, rather than a theory-dependent analytical one.

In this section I begin by providing more background on HS. I then define top-down and bottom-up modes of parsing in HS, with comparisons to the rule-based theory of Hayes (1995).

2.1. Harmonic Serialism

An HS derivation begins with an underlying form, which is input to the grammar as in classic OT, but the candidate generation function (Gen) is restricted to producing candidates that differ from the input by the application of only one operation, contra classic, parallel OT, where Gen produces candidates that differ in any and all possible ways from an input. A winner is chosen among the HS candidates on the basis of a hierarchy of violable constraints, as in the Eval component of parallel OT. In another departure from classic OT, however, this output is then fed back into the grammar as an intermediate input, from which an additional set of one-operation candidates is produced and compared. The derivation continues in this way, looping between Gen and Eval. The derivation converges when the input to an iteration is chosen as its own output; this indicates that no additional single operations improve the harmony of the form (as determined by the constraint ranking).

In general, the definition of Gen in HS is a question of ongoing research (McCarthy 2010). For stress, it has been argued that the building of one foot counts as a single operation (Kimper 2011; Pruitt 2010, 2012) and that metrical structure-building is a separate operation from deletion, epenthesis, and feature-changing (McCarthy 2008; Jesney 2011; Staubs 2013; Elfner 2016). The steps of a stress derivation in HS thus tend to look similar to those of rule-based metrical theory, though the conditions leading to the derivation are different. In HS, a whole-word metrical parse can only be optimal if each of its component feet were selected as the best possible foot at some iteration and as more harmonic than the outcome of applying other segmental and prosodic operations. I will also generally assume, following Pruitt (2010, 2012), that foot structure cannot be altered once it is built. This assumption can be derived from the harmonic improvement imperative of Harmonic Serialism in many cases (Pruitt 2012: 9), as existing foot structure has been selected as optimal at previous stages of a derivation (and may be absent from underlying forms, according to McCarthy & Pruitt 2013).

The tableau in (6) below will illustrate a derivation of Pintupi's stress pattern, setting aside for the moment the distinction between primary and secondary stress. This illustration assumes standard stress constraints including PARSE-σ, TROCHEE/IAMB, and FTBIN (Prince & Smolensky 1993/2004) and generalized alignment (McCarthy & Prince 1993). Kager (1999) provides a summary of this theory of stress constraints in parallel OT, and Pruitt (2012) defends the use of quadratic alignment constraints in HS. The constraints are defined in (5).

(5) Stress constraints

a. PARSE-σ: Assign one violation mark for every unparsed syllable.

b. TROCHEE: Assign one violation mark for every foot whose head is not at its left edge.

c. FTBIN: Assign one violation mark for a foot that is less than two morae.

d. ALLFTL/R: For each foot in a word, assign one violation mark for every syllable intervening between the left/right edge of the foot and the left/right edge of the word.

At the first iteration of stress assignment, all possible ways of building one foot are considered. The tableau in (6) shows representative candidates, with (a) no feet, (b) a left-aligned trochee, (c) a left-aligned iamb, and (d) a right-aligned trochee. The high rank of TROCHEE ensures that a trochaic foot wins out, and the ranking ALLFTL >> ALLFTR determines that it will be at the left edge, so (b) is the winner at the first step. The ranking of PARSE-σ over both alignment constraints is necessary to establish iterative footing, which continues until the fourth iteration. At that point, there is one remaining unparsed syllable, but footing it runs afoul of high-ranked FTBIN, so the derivation converges on candidate (i).[11]

11. An anonymous reviewer asks whether we might consider foot-building as decomposed into two separate operations: one that builds constituent foot structure and another than assigns headedness within that structure (analogous to the separation of footing and primary stress assignment that we will see in the bottom-up derivations). This alternative certainly deserves to be considered further, but doing so here would require an elaborated theory of metrical representations and constraints. Proposals that decouple constituency and headedness have been made in serial rule-based (Crowhurst & Hewitt 1995b) and parallel constraint-based (Hyde 2001, et seq.) frameworks, but I am not yet aware of similar extant proposals within Harmonic Serialism.

(6) Pintupi stress in HS: [ʈí.ɭi.ɾì.ŋu.làm.pa.ʈ̪u] 'the fire for our benefit flared up'

	/ʈi.ɭi.ɾi.ŋu.lam.pa.ʈ̪u/	FtBin	Trochee	Parse-σ	AllFtL	AllFtR
	1st iteration					
a.	ʈi.ɭi.ɾi.ŋu.lam.pa.ʈ̪u			7 W		L
b. →	(ˈʈi.ɭi).ɾi.ŋu.lam.pa.ʈ̪u			5		5
c.	(ʈi.ˈɭi).ɾi.ŋu.lam.pa.ʈ̪u		1 W	5		5
d.	ʈi.ɭi.ɾi.ŋu.lam.(ˈpa.ʈ̪u)			5	5 W	L
	2nd iteration					
e.	(ˈʈi.ɭi).ɾi.ŋu.lam.pa.ʈ̪u			5 W	L	5 L
f. →	(ˈʈi.ɭi)(ˈɾi.ŋu).lam.pa.ʈ̪u			3	2	8
	3rd iteration					
g.	(ˈʈi.ɭi)(ˈɾi.ŋu).lam.pa.ʈ̪u			3 W	2 L	8 L
h. →	(ˈʈi.ɭi)(ˈɾi.ŋu)(ˈlam.pa).ʈ̪u			1	6	9
	4th iteration (Convergence)					
i. →	(ˈʈi.ɭi)(ˈɾi.ŋu)(ˈlam.pa).ʈ̪u			1	6	9
j.	(ˈʈi.ɭi)(ˈɾi.ŋu)(ˈlam.pa)(ˈʈ̪u)	1 W		L	12 W	9

Admitting HS as a theory of stress has advantages over classic OT and over rule-based theories, which are explored in other work (e.g., Pruitt 2010; see McCarthy 2016 for a summary of some results). But it also brings with it further questions about the definition of Gen, in particular, how and when the distinction between primary and secondary stresses is determined. It is possible to imagine two definitions of Gen: one where the primary stress is treated in a top-down fashion (§2.2) or one where the primary stress is assigned in a bottom-up way (§2.3). These are now discussed in turn.

2.2. Top-down

A logical relationship between primary and secondary stress in HS is to assume that the first foot is the primary stress foot by default, with subsequent steps building secondary stress feet on the remaining syllables. This is more or less the view assumed (implicitly or explicitly) by previous work in HS including McCarthy (2008), Elfner (2016), and McCarthy, Pater & Pruitt (2016), and, in the terms used in the introduction, could be considered a top-down model of primary stress assignment. The serial tableau in (8) below demonstrates how Pintupi's primary stress is modeled when parsing is top-down. Because primary stress is assigned right away (and because Pintupi's primary stress is left-aligned along with other feet), the derivation is essentially identical to the one in (6) above, which derived left-aligned trochees without reference to primary stress. The primary stress constraints I assume are defined in (7). In (8), these constraints are set apart in the tableau to show that in this case they are not necessarily active in selecting the correct derivation.

(7) Primary stress constraints

a. HEADEDNESS(PWD): Assign a violation mark for a prosodic word (PWd) that does not have a primary stress.

b. ALIGNHDL/R: Assign a violation mark for each syllable intervening between the primary stress syllable and the left/right word edge.

(8) Top-down derivation of Pintupi primary stress

	/ʈi.ɭi.ɾi.ŋu.lam.pa.t̪u/	FTBIN	PARSE-σ	ALLFTL	ALLFTR	HD(PWD)	ALHDL	ALHDR
	1st iteration							
a.	ʈi.ɭi.ɾi.ŋu.lam.pa.t̪u		7 W		L	1 W		L
b. →	(ˈʈi.ɭi).ɾi.ŋu.lam.pa.t̪u		5		5			6
c.	ʈi.ɭi.ɾi.ŋu.lam.(ˈpa.t̪u)		5	5 W	L		5 W	1 L
	2nd iteration							
d.	(ˈʈi.ɭi).ɾi.ŋu.lam.pa.t̪u		5 W	L	5 L			6
e. →	(ˈʈi.ɭi)(ˌɾi.ŋu)lam.pa.t̪u		3	2	8			6
f.	(ˈʈi.ɭi).ɾi.ŋu.lam.(ˌpa.t̪u)		3	5 W	5 L			6
	3rd iteration							
g.	(ˈʈi.ɭi)(ˌɾi.ŋu).lam.pa.t̪u		3 W	2 L	8 L			6
h. →	(ˈʈi.ɭi)(ˌɾi.ŋu)(ˌlam.pa).t̪u		1	6	9			6
	4th iteration (Convergence)							
i. →	(ˈʈi.ɭi)(ˌɾi.ŋu)(ˌlam.pa).t̪u		1	6	9			6
j.	(ˈʈi.ɭi)(ˌɾi.ŋu)(ˌlam.pa)(ˌt̪u)	1 W	L	12 W	9			6

Since primary stress is automatically assigned to the candidates for the first foot, any constraints that are specific to primary stress can also have a say in where that foot is placed. In this example, primary-stress-specific constraints were set apart because the primary stress foot matches the other feet in Pintupi in all relevant properties (left-aligned, trochaic, quantity-insensitive, and binary). But when a conflicting primary-stress-specific constraint is higher-ranked than a general stress constraint, a top-down derivation yields a stress pattern with some asymmetry between primary and secondary stresses (as in Yine, for example, where the primary and secondary stresses are aligned to opposite edges of the word; see section 4).

This implementation of 'top-down' differs from that of Hayes (1995) and other metrical theories that employ grids or bracketed grids for primary stress. For Hayes and others, top-down stressing involves the application of the End Rule—the rule responsible for placing a word-level grid mark (Prince 1983)—before feet are constructed (Hayes 1995: 61). The End Rule does not build foot-level constituents, but in a top-down derivation a foot head is entailed 'under' the word-level grid mark during foot construction by the Continuous Column Constraint (Hayes 1995: 116-117). A top-down derivation of Pintupi would thus look like that shown in (9) according to this theory; the derivation is hypothetical because when systems can be analyzed either top-down or bottom-up, the bottom-up one is usually assumed.

(9) Hypothetical top-down derivation for Pintupi in the theory of Hayes (1995)

Wd-level	(x)	(x)	(x)	(x)
Ft-level		(x .)	(x .)(x .)	(x .)(x .)(x .)
	t̪il̪i ɾi ŋu lam pa t̪u →	t̪il̪i ɾi ŋu lam pa t̪u →	t̪il̪i ɾi ŋu lam pa t̪u →	t̪il̪i ɾi ŋu lam pa t̪u

To summarize the difference between the two approaches, for Hayes a top-down derivation means that primary stress is designated on an initial or final syllable (modulo potential extrametricality), but it is then up to the regular parsing rules to govern what kind of foot is constructed there. In contrast, as just noted, the top-down HS model just defined will begin a stress derivation by building a foot that is the optimal outcome of both the regular parsing constraints and any constraints specific to primary stress. Although it is possible to imagine a definition of Gen in HS that would bring it closer to that of Hayes's theory, this has not yet been explored.

2.3. Bottom-up

Alternatively, it is possible to define Gen in a way that delivers only bottom-up derivations. In this case, the construction of individual feet and the designation of one as the primary stress foot are distinct operations. This version of Gen can be called bottom-up, since some metrical structure must be built before the primary stress is formally identified. The derivation in (10) illustrates how this definition of Gen would work to derive the same stress pattern as above. At the first iteration, only candidates with non-primary stress are available, so the only constraints relevant for selecting among them are the general stress constraints. The derivation builds left-aligned trochees until the 4th iteration, much like the derivation in (6) above. However, at this point candidates with primary stress are included, and candidate (k) wins because it has promoted the initial syllable to primary, in simultaneous satisfaction of HEAD(PWD) and ALIGNHDL. The primary stress constraints are again set apart for expositional clarity, though there is a potential interaction between them and the general parsing constraints, which is described at the end of this section.

(10) Bottom-up derivation of Pintupi stress in HS

	/ʈi.ɭi.ɾi.ŋu.lam.pa.t̪u/	FtBin	Parse-σ	AllFtL	AllFtR	Hd(PWd)	AlHdL	AlHdR
	1st iteration							
a.	ʈi.ɭi.ɾi.ŋu.lam.pa.t̪u		7 W		L	1		
b. →	(ˌʈi.ɭi).ɾi.ŋu.lam.pa.t̪u		5		5	1		
c.	ʈi.ɭi.ɾi.ŋu.lam.(ˌpa.t̪u)		5	5 W	L	1		
	2nd iteration							
d.	(ˌʈi.ɭi).ɾi.ŋu.lam.pa.t̪u		5 W	L	5 L	1		
e. →	(ˌʈi.ɭi)(ˌɾi.ŋu)lam.pa.t̪u		3	2	8	1		
f.	(ˌʈi.ɭi).ɾi.ŋu.lam.(ˌpa.t̪u)		3	5 W	5 L	1		
	3rd iteration							
g.	(ˌʈi.ɭi)(ˌɾi.ŋu).lam.pa.t̪u		3 W	2 L	8 L	1		
h. →	(ˌʈi.ɭi)(ˌɾi.ŋu)(ˌlam.pa).t̪u		1	6	9	1		
	4th iteration							
i.	(ˌʈi.ɭi)(ˌɾi.ŋu)(ˌlam.pa).t̪u		1	6	9	1 W		L
j.	(ˌʈi.ɭi)(ˌɾi.ŋu)(ˌlam.pa)(ˌt̪u)	1 W	L	12 W	9	1 W		L
k. →	(ˈʈi.ɭi)(ˌɾi.ŋu)(ˌlam.pa).t̪u		1	6	9			6
l.	(ˌʈi.ɭi)(ˌɾi.ŋu)(ˈlam.pa).t̪u		1	6	9		4 W	2 L

In Hayes's (1995) theory, an iterative foot construction rule creates feet in a directional sweep of the word, obeying various language-specific parameters and universal principles. Then, the End Rule selects the leftmost or rightmost available syllable on which to place the word-level grid mark. The Continuous Column Constraint ensures in this case that only a syllable which already has a foot-level grid mark can be a contender for the word-level grid mark (Hayes 1995: 36).

(11) Bottom-up derivation of Pintupi [ʈí.ɭi.ɾì.ŋu.làm.pa.t̪u] (Hayes 1995: 63)

```
Wd-level                                                                     ( x                    )
Ft-level  ( x  . )                 ( x  . )( x  . )           ( x  . )( x  . )( x   . )     ( x  . )( x  . )( x   . )
            ʈi  ɭi ɾi ŋu lam pa t̪u →  ʈi  ɭi  ɾi  ŋu lam pa t̪u →  ʈi  ɭi  ɾi ŋu lam pa t̪u →  ʈi  ɭi  ɾi  ŋu  lam  pa t̪u
```

A difference between the two theories is that in HS, operations compete at each iteration, so candidates with primary stress are available as soon as there is a foot in the (local) input on which to place it. This means that, contrary to Hayes's theory, the bottom-up Gen in HS could produce a derivation which builds a foot at step 1, assigns it primary stress at step 2, and continues selecting (non-primary-stress) feet at the next steps. Such a derivation is predicted when the constraint mandating a primary stress (here, HEAD(PWD)) outranks the constraint demanding additional feet (here, PARSE-σ). When the opposite ranking holds, foot construction will generally precede primary stress assignment, as in the bottom-up illustration given just above in (10). Potential implications of this difference are not explored here, but are merely described as a point of reference for comparing the two theories.

2.4. Discussion

A priori, both alternatives—top-down Gen or bottom-up Gen—are theoretically coherent, though each faces potential challenges with different types of stress systems. The top-down Gen defined in §2.2 has the same problem as other top-down models: a difficulty in accounting for primary stress placement in languages like MalakMalak (discussed in section 1), where primary stress is determined in reference to foot structure rather than primarily to word edges. A top-down model in HS would thus require elaboration to admit an analysis of those systems. In contrast, the bottom-up model can straightforwardly handle MalakMalak (by building right-aligned trochees and selecting the leftmost one for primary stress), but could face challenges from the traditionally 'top-down' languages, where primary stress seems to obey generalizations different from those of secondary stresses. These same challenges are what lead Hayes (1995), and some others in the rule-based literature, to the conclusion that languages may select either parsing method parametrically. However, there is no way to replicate this parameter in HS: allowing both top-down and bottom-up primary stress operations in Gen with the intention of letting languages 'choose' via ranking is an untenable solution (Pruitt 2012: 119-123, in prep).[12]

A fuller comparison of top-down and bottom-up definitions of HS Gen in light of the attested typology of primary stress patterns is pursued in other work. To capture both types of stress systems, Pruitt (2012, in prep) proposes a theory of primary stress that enforces top-down parsing by default[13] and allows primary stress movement to account for languages like MalakMalak. The goal here is not to

12. Since languages cannot have different Gens, this would mean defining a Gen that produces candidates that assign primary stress right away *and* candidates that do not. But as demonstrated in Pruitt (2012), a Gen defined in this way makes the implausible typological prediction that languages may assign primary stress in some words but not others (a prediction which is termed "non-uniform culminativity" in that work). Individually, top-down and bottom-up Gens can be defined to avoid the prediction, but a Gen with both top-down and bottom-up options cannot (see Pruitt 2012: Chs 3-4).
13. In Pruitt (2012) this is accomplished with a wholesale restriction on primary stress constraint definitions, while in Pruitt (in prep) it is simply built into the definition of Gen.

duplicate those efforts but instead to shine a light on the language evidence itself and on preconceived notions a 'top-down' language. Toward this end, the next section turns to a discussion of Cahuilla, the first case study.

3. The role of theory in identifying asymmetries

This section takes the stress pattern of Cahuilla (Uto-Aztecan; Seiler 1965, 1967, 1977) as a case study in top-down stress. Hayes (1995) analyzes Cahuilla as top-down due to an asymmetry in the primary and secondary stresses in whether they are permitted to occur as degenerate feet, similar to the Tübatulabal example in section 1, and subsequent references to Cahuilla in the literature have often continued to refer to it as top-down or primary-stress-first (e.g., Bailey 1995; Kager 1995; McGarrity 2003). In the case of Cahuilla, the asymmetry hinges on a particular interpretation of the source data. If we take Seiler's (1965, 1967, 1977) description of the stress pattern at face value, however, no asymmetry is present and a bottom-up analysis is possible. I will suggest that constraint inviolability is the fundamental issue at work in motivating the asymmetric interpretation and therefore the top-down analysis. In particular, when we shift from rule-based serial stress derivations (with typically-inviolable constraints) to HS (which inherits constraint violability from classic OT), we also see that data interpretations, and top-down arguments based on them, shift as well.

Section 3.1 gives the stress pattern of Cahuilla according to Seiler's description and provides a bottom-up analysis in HS. Section 3.2 summarizes Hayes's arguments for his reinterpretation of the data, which introduces a primary/secondary stress asymmetry, and it shows how this motivates his top-down analysis. Section 3.3 presents counterarguments to Hayes's interpretation of the data and discusses the role of one's theoretical framework in establishing primary/secondary stress asymmetries.

3.1. Cahuilla stress and HS analysis

Cahuilla[14] is a Uto-Aztecan language of Southern California (Seiler 1977) whose stress pattern is analyzed by Hayes (1995: 132-140) with moraic trochees, where feet typically consist either of a single heavy syllable, (ˈH), or two light syllables (ˈLL). According to Seiler (1965, 1967, 1977), primary stress usually falls on the first syllable of the root regardless of its weight, and secondary stress alternates by mora rightward (and leftward, if sufficient prefixal material is present; Seiler 1977: 27). Long vowels and diphthongs count as heavy, as do syllables closed by a glottal stop.[15] The forms in (12) illustrate the patterns, which are shown along

14. The historical and contemporary sources I was able to access use the language name Cahuilla, which I follow here, but an anonymous reviewer has informed me that Ivilyuat is the language name used by its speakers. The number of speakers now probably numbers fewer than ten (as documented in Eberhard, Simons & Fennig 2019).
15. Although this follows Hayes's (1995: 132-133) text description of Cahuilla syllable weight, the discussion of weight by Seiler (1965, 1967, 1977) is more complex. See footnotes 22 and 23 for additional information.

with the quantity profiles and associated foot types they entail. Forms (a)-(c) show alternation in the absence of quantity, and (d)-(j) show that the alternation of stress is reset after a heavy syllable. In (a)-(d) primary stress occupies a (ˈLL) foot, while in (e)-(h) it is instead (ˈH). Finally, (i) and (j) are crucial forms for establishing that the primary stress remains on the first syllable of a root even when it results in a monosyllabic light syllable foot, (ˈL). These forms will be discussed in detail below.

(12) Cahuilla stress (Seiler 1965, 1967, 1977)

a.	kísiʎ	‘chicken hawk’	(ˈLL)	(1977: 36)
b.	súvalwàl	‘sparrow’	(ˈLL)(ˌL)	(1965: 53)
c.	sásmatnèktʃem	‘slim canes’	(ˈLL)(ˌLL)	(1967: 140)
d.	táxmuʔàʔtì	‘the song, obj. case’	(ˈLL)(ˌH)(ˌL)	(1977: 31/33/57)
e.	táːtwàl	‘blind’	(ˈH)(ˌL)	(1977: 35)
f.	ɲáʔtʃèh	‘sit down’	(ˈH)(ˌL)	(1965: 52)
g.	qáːnkìtʃem	‘palo verde, pl.’	(ˈH)(ˌLL)	(1977: 27)
h.	háʔtìsqal	‘he is sneezing’	(ˈH)(ˌLL)	(1965: 52)
i.	súkàʔtì	‘the deer, obj. case’	(ˈL)(ˌH)(ˌL)	(1977: 28)
j.	ménìʔlì	‘the moon, obj. case’	(ˈL)(ˌH)(ˌL)	(1965: 52)

A bottom-up analysis of this pattern is possible in HS with a ranking that parses words into trochees (Trochee >> Iamb), iterates left-to-right (Parse-σ >> AllFtL >> AllFtR), allows degenerate feet (Parse-σ >> FtBin)[16], and assigns primary stress to the leftmost foot (AlignHdL >> AlignHdR). The derivational tableaux in (13) and (15) show the HS analysis with, respectively, words of the form /LLL/, parsed as (ˈLL)(ˌL), and /LHL/, parsed as (ˈL)(ˌH)ˌ(L).

In (13) we see that /su.val.wal/ ‘sparrow’ is parsed into a left-aligned disyllabic trochee at the first iteration (candidate c), and a monosyllabic foot is added at the second (candidate e). At the third iteration, candidates for primary stress placement are considered, and (g) wins because of AlignHdL.[17]

16. Prefixal strings do not seem to tolerate degenerate feet, so this ranking is appropriate for the stem+suffix domain only. Something more will need to be said for a full analysis incorporating prefixes, which may ultimately require a cyclic derivation. As noted in the text above, prefixes are also exceptional in the reported directionality of their stress alternation.
17. Two rankings deserve additional mention: (i) Parse-σ over Hd(Pwd) determines that parsing completely precedes primary stress assignment. The opposite ranking predicts a derivation where primary stress is assigned at the second iteration of stress (i.e., as soon as an input foot is available to place primary place stress on), but both derivational paths achieve the same outcome in this case. (ii) The ranking of AllFtL >> FtBin determines that parsing will proceed from the left edge regardless of FtBin violations, which becomes relevant in (15). If this ranking is inverted, the derivation instead builds feet on H syllables first and then goes back to build (L) where needed later. But again, the outcome of the derivations is the same.

(13) Bottom-up HS derivation of [sú.val.wàl] 'sparrow'

	/su.val.wal/	AlHdL	Parse-σ	AllFtL	Hd(PWd)	FtBin
	1st iteration					
a.	su.val.wal		3 W		1	
b.	(ˌsu).val.wal		2 W		1	1 W
c. →	(ˌsu.val).wal		1		1	
	2nd iteration					
d.	(ˌsu.val).wal		1 W	L	1	L
e. →	(ˌsu.val)(ˌwal)			2	1	1
	3rd iteration					
f.	(ˌsu.val)(ˌwal)			2	1 W	1
g. →	(ˈsu.val)(ˌwal)			2		1
h.	(ˌsu.val)(ˈwal)	2 W		2		1

The analysis shown so far also predicts the pattern of the (ˈL)(ˌH)(ˌL) form [sú.kàʔ.tì] 'the deer, obj. case', with one additional assumption. Consistent with other moraic trochee stress systems, a constraint is needed to rule out (ˈLH) and (ˈHL) as possible trochaic feet (Prince 1990; Prince & Smolensky 1993/2004). I make no particular commitment to the nature of such a constraint and will assume the formulation in (14) below for the purposes of this analysis.

(14) Ft≤2μ: Assign a violation mark for any foot larger than two morae.

With the ranking Ft≤2μ >> Parse-σ >> FtBin, we correctly predict the stress pattern of /su.kaʔ.ti/, as shown in (15). At the first iteration, a left-aligned monosyllabic foot is chosen (candidate b) because it satisfies AllFtL (unlike candidate c) and does not violate Ft≤2μ (unlike candidate d); a violation of FtBin is tolerated. At the second iteration, a foot is built on the middle heavy syllable (candidate f) because doing so satisfies FtBin and does not violate Ft≤2μ (unlike candidate g). At the third iteration, the remaining syllable is parsed into a monosyllabic foot (candidate i) due to Parse-σ >> FtBin, and at the fourth, the leftmost foot is selected as the primary stress (candidate k).

(15) Bottom-up HS derivation of [sú.kàʔ.tì] ‘the deer, obj. case’

	/su.kaʔ.ti/	AlHdL	Ft≤2μ	Parse-σ	AllFtL	Hd(PWd)	FtBin
	1st iteration						
a.	su.kaʔ.ti			3 W		1	L
b. →	(ˌsu).kaʔ.ti			2		1	1
c.	su.(ˌkaʔ).ti			2	1 W	1	L
d.	(ˌsu.kaʔ).ti		1 W	1 L		1	L
	2nd iteration						
e.	(ˌsu).kaʔ.ti			2 W	L	1	1
f. →	(ˌsu)(ˌkaʔ).ti			1	1	1	1
g.	(ˌsu)(ˌkaʔ.ti)		1 W	L	1	1	1
	3rd iteration						
h.	(ˌsu)(ˌkaʔ).ti			1 W	1 L	1	1 L
i. →	(ˌsu)(ˌkaʔ)(ˌti)				3	1	2
	4th iteration						
j.	(ˌsu)(ˌkaʔ)(ˌti)				3	1 W	2
k. →	(ˈsu)(ˌkaʔ)(ˌti)				3		2
l.	(ˌsu)(ˌkaʔ)(ˈti)	2 W			3		2

The Cahuilla data and its analysis show that degenerate feet, (ˈL), are required in two positions: (i) initially, if the primary stress occupies a light syllable immediately followed by a heavy syllable, and (ii) finally, if a light syllable would otherwise be ‘left over’ at the end of the parse. The HS analysis treats the two instances essentially the same, both arising as the optimal outcome when Parse-σ (and AllFtL) outranks FtBin. Primary stress is later assigned to the initial syllable (of the root), regardless of the type of foot built there, (ˌL), (ˌLL), or (ˌH). In other words, the HS analysis encounters no difficulty with a bottom-up analysis of the primary stress degenerate foot specifically because the ranking must allow for degenerate feet anyway (i.e., Parse-σ >> FtBin).

3.2. Hayes’s (1995) top-down analysis

In contrast to the HS analysis we have just provided, degenerate feet are not typically permitted in the theory of Hayes (1995), and his analysis of Cahuilla deals with the two instances (initial and final) in disparate ways. The stress transcribed on certain final syllables in the source data is argued to be non-metrical final lengthening, so no degenerate foot need be constructed there. Hayes (1995: 137) presents three arguments this effect. First, citing Seiler (1965), he notes that that a correlate of stress in Cahuilla is a change in pitch, but this is never seen in word-final syllables. Second, citing Seiler (1957), Hayes notes that vowel allophony (for /a/ and /e/) which normally accompanies stress alternation is absent in word-final syllables, with only the stressless allophones occurring in final position. And finally, Hayes points to stress shift seen with some monosyllabic noun stems to suggest that degenerate feet are marked in Cahuilla, drawing on data from Seiler (1977). (These arguments are revisited in section 3.3 below.) The initial (primary stress) degenerate foot, however, is assumed to be genuine. This introduces an asymmetry between primary and secondary stress, which must then be derived with top-down parsing, as we now describe.

In Hayes's theory, degenerate feet are normally avoided, which is implemented in large part by the following constraint on foot-building.

(16) The Priority Clause

If at any stage in foot parsing the portion of the string being scanned would yield a degenerate foot, the parse scans further along the string to construct a proper foot where possible. (Hayes 1995: 95)

Cahuilla's stress pattern is directionally left-to-right from the first syllable of the root. Thus, in forms such as /sukaʔti/, the first two syllables scanned are the light [su] and heavy [kaʔ]. An (ˈLH) foot as in (17)a is impossible a priori in this theory, leaving L(ˈH) and (ˈL), shown in (17)b and (17)c, as the only options in principle.

(17) Possible first feet in /sukaʔti/, according to Hayes (1995)

a. (su.kaʔ)ti never allowed, no (ˈLH) trochees permitted

b. su(kaʔ)ti typically-preferred due to Priority Clause

c. (su)kaʔti actual Cahuilla outcome, but violates Priority Clause

The Priority Clause is intended to settle the competition in favor of an unparsed light syllable, i.e., (17)b. But since Cahuilla appears to violate the Priority Clause, preferring (17)c, another factor must be present to override it. This is achieved by allowing the End Rule to occur before regular foot parsing. This entails a foot—degenerate or not—in subsequent foot building as a consequence of the Continuous Column Constraint, as discussed in section 2.2.

The derivation in (18)a illustrates the top-down analysis of Cahuilla stress for the form /sukaʔti/ 'deer, obj', which is parsed as (sú)(kàʔ)ti according to Hayes's interpretation of the data. The derivation in (18)b shows what would go wrong if parsing were instead bottom-up, with regular foot building preceding the application of the End Rule. In the latter case, the first syllable remains unparsed altogether because the Priority Clause is normally inviolable.

(18) Result of top-down vs. bottom-up parsing for Cahuilla[18]

a. Top-down derivation; Result: [(sú)(kàʔ)ti]

```
Wd-level                  (x       )   (x       )   (x       )
Ft-level                               (x)          (x) (x)
            su. kaʔ .ti → su. kaʔ .ti → su. kaʔ .ti → su. kaʔ .ti
```

b. Bottom-up derivation; Result: *[su(káʔ)ti]

```
Wd-level                                 (   x   )
Ft-level                        (x)          (x)
            su. kaʔ .ti → su. kaʔ .ti → su. kaʔ .ti
```

To summarize, the top-down analysis of Cahuilla stress by Hayes (1995) is motivated by the fact that the primary stress may occupy a degenerate foot, which would otherwise never be constructed. The degenerate final foot in some words is reinterpreted as final lengthening, so regular parsing simply does not build degenerate feet and a bottom-up analysis consequently fails.

3.3. Final stress?

The status of the final stress is crucial to motivating a primary-stress-first analysis of Cahuilla because this is what determines whether the primary and secondary stresses show an asymmetry—a necessary precondition for motivating a top-down analysis. If instead the final stress is metrical (that is, if it is really *stressed*), then it too requires a degenerate foot, and the regular parsing algorithm must be capable of building degenerate feet. As we saw in section 3.1, this would mean that a bottom-up analysis is possible. Thus, we will now examine in some detail the arguments Hayes (1995: 137) gives for his interpretation of the final stress.

Intonation. Hayes cites Seiler (1965: 52) for the observation that stress generally correlates with a change in pitch in Cahuilla, which does not occur in word-final syllables. Specifically, Seiler notes that stress involves a rise in pitch on the stressed syllable and a fall back down to a following unstressed syllable, with magnitudes of "about a fifth" for primary stress and "about a third" for secondary, though "[w]ord-final moras always have low pitch" (1965: 52). In the corresponding description of stress realization in Seiler (1977: 26) the pitch changes of primary and secondary stresses are reported in a similar way, but the final syllable is not mentioned, though it is difficult to draw any conclusions from this omission. We may also consider the brief discussion of intonation in Seiler (1977: 25-26). Seiler

18. A bit of technicalia is suppressed here. Hayes permits languages to parametrically employ a "weak" ban on degenerate feet; this permits their construction at the end of a parse, where the Priority Clause is irrelevant. However, at the end of the derivation, an across-the-board erasure applies to any degenerate foot which has not subsequently been assigned primary stress or repaired by another rule. Thus, the predicted outcomes are the same as those represented in the derivations in (18), i.e., with the final syllable remaining unparsed.

indicates that word-final syllables can receive high pitch in service of interrogative intonation, which is "marked by a stress pattern full stress – unstressed – full stress distributed over the last three syllables of the predicate (verb) of the main clause; full stress is accompanied by high pitch, unstressed by low pitch" (1977: 25). Although there is no indication that the alignment of the pitch/stress targets of interrogative intonation are metrically-constrained (i.e., affected by word-level mora alternation), this does indicate that the pitch level of the final syllable may be conditioned by higher-level intonational factors. The intonational system is not discussed in further detail in the works I was able to consult (Seiler 1965, 1967, 1977), but since there is clearly some interaction between the word- and phrase-level prosody, Seiler's observation of low pitch for final syllables is, arguably, not clear evidence against a metrical final stress.

Vowel allophony. Hayes's second argument concerns vowel allophony. He cites Seiler (1957) for the observation that only stressless allophones of /a/ and /e/ may occur in final position. However, Seiler 1957 and 1977 both suggest a rather more complex system of vowel quality alternation. According to Seiler (1977: 29-35), Cahuilla's vowel system has four phonemic vowel qualities, /i, e, a, u/,[19] whose allophones (front, central, or back for /a/ and closed, half-open, or open for the others) are conditioned by a combination of factors that include stress, adjacent consonants, vowels in neighboring syllables, and word position (final vs. non-final). Interestingly, for example, when a high vowel, /i/ or /u/, receives primary stress, it is either closed or half-open, usually depending on the preceding consonant; subsequent phonemically-identical vowels in the same word will then dissimilate to produce an alternation between closed and half-open (p. 30), but the association with stress could go either way: the stressed vowels may be closed and unstressed vowels half-open; or the stressed vowels may be half-open and the unstressed vowels closed. The high vowels obey somewhat different generalizations from /e/, whose behavior is described as "altogether not too clear" (p. 31), though all three, /i, u, e/, are reported to exhibit "open" allophones in word-final position (i.e., [ɪ, ʊ, æ]; p. 31), which corresponds to neither stressed nor unstressed allophones word-internally. The phoneme /a/ shows a still different generalization, where its quality varies based on whether it is the only /a/ in the word (if yes, then it is pronounced as fronted) and otherwise based on stress (back if stressed, mid if unstressed) (p. 31-32), with no mention of a particular allophone in word-final position in Seiler (1977). In other words, I would argue that it is not possible to identify a direct correlation between stress and vowel quality more generally in Cahuilla, so the behavior of word-final vowels is not clearly indicative of their metrical status.

Stress shift with monosyllabic stems. The final argument rests on the behavior of some monosyllabic noun stems, where stress is seen to shift under prefixation and which Hayes suggests is evidence that Cahuilla treats monomoraic feet as marked,

19. And a phonemic length distinction, which is discussed separately by Seiler (1977) and involves a somewhat different generalization (p. 33-34).

rather than freely allowed. The data are as follows: when monomoraic nouns like the ones in (19)a receive a personal prefix to indicate possession, the primary stress shifts to the prefix as in (19)b; but when the root is at least bimoraic, as in (20)a, the stress does not shift, (20)b. The intuition is that the monomoraic nouns will surface as stressed when no other options are available, but a prefix makes available an alternative parse that avoids a degenerate foot.

(19) Stress shift (Seiler 1977: 33, 39)

a.	–na[20]	'father'	–ʔaʃ	'pet'
b.	ʧém-na	'our father'	né-ʔaʃ	'my pet'

(20) No stress shift (ibid.)

a.	–túʔat	'flour'	–júwl[21]	'younger brother'
b.	ne-túʔat	'my flour'	ne-júwl	'my younger brother'

However, these examples are difficult to draw conclusions from for two reasons. First, the lack of stress shift in [ne-júwl] in (20)b appears to be the only potential evidence that vowel-glide sequences are bimoraic, unlike other VC rimes in the language which are monomoraic (1977: 27), and this makes the argument partly circular.[22] Relatedly, stress is reported to shift only in monosyllabic roots, whereas if the shift were metrically/quantitatively motivated we would also expect to see shift in polysyllabic words with a monomoraic primary stress foot, like [(sú)(kàʔ)(tì)].[23] Second, this process is rather morphologically limited, as it is reported by Seiler (1977: 39) to apply just with noun roots (only one verb root exceptionally shifts its stress in comparable environments) and to occur only with "[p]ersonal prefixes of the class P_1" (ibid). The doubtful quantitative status of vowel-glide sequences and the limited character of the generalization would seem not to provide clear evidence about the status of degenerate feet in Cahuilla in general.

20. Seiler does not mark stress on the monosyllabic bare forms here. I believe this represents a choice about the phonemic representation of the stems, as stressed monomoraic words are freely permitted as surface forms in Cahuilla (e.g., [pál] 'water', Seiler 1977: 25).
21. Hayes transcribes the [uw] in this example as [uː] (1995: 137), but Seiler is explicit that VG sequences are phonemically (and usually phonetically) distinct from VV sequences (1977: 34-35) and consistently gives the form as *yuwl* (1977: 33, 39).
22. Although vowel-glide sequences are categorized with long vowels for mora count in Seiler 1977 (p. 27), in at least one other work (1965), Seiler describes the moraic status of (pre-consonantal) vowel-glide sequences as "not entirely conclusive" (p. 53). No secondary-stress-marked examples are given to confirm their status in Seiler (1977), and counterexamples can be found among those that are provided (e.g., [pàʔ.máj.ʎu.qà.li.vè] 'where she was giving birth to', 1977: 57, where *[pàʔ.máj.ʎù.qa.lì.ve] would be expected if *maj* is bimoraic).
23. In addition, a CVʔ root should not show stress shift if glottal stops are moraic in coda position, but they apparently do, e.g., [hí-jeʔ] 'his mother' (Seiler 1977: 347, text no. 10, line 1), not *[hi-jéʔ]. This fact, along with Seiler's characterization of glottal stop (and glides) as potentially moraic only in pre- and/or post-consonantal position, suggests that quantity in Cahuilla might fruitfully be reexamined altogether, but this is not pursued here.

On the basis of these considerations, there does not seem to be strong phonological evidence against Seiler's report of final stress in the relevant forms. To cement this conclusion, we will note two additional pieces of information that *favor* an interpretation of the transcribed final prominence as stress. The first is that Seiler only marks final stress in words that end in an odd-numbered string of light syllables. This alone strongly suggests a metrical patterning. An alternative interpretation in terms of non-metrical final lengthening would need to explain why the same emphasis is not marked on all final syllables, regardless of where they fall in the alternating count.

The second reason to prefer a metrical, or stress-based, interpretation of the final prominence derives from the fact that in many final sequences of a heavy syllable followed by a light syllable, the heavy syllable is derived by a morpho-phonological rule of glottal stop insertion, which *creates* the final stress (Seiler 1965, 1967, 1977: 54-58) and therefore motivates the degenerate foot in final position. For example, the form /táxmuʔat-i/ 'the song, objective case' surfaces as [táxmuʔàʔ̲tì], with a glottal stop inserted before the final stop of the root (Seiler 1977: 57). Without this process we expect the stress pattern *[táxmuʔàti], which is parsed (ˈLL)(ˌLL), but glottalization forces the parse (ˈLL)(ˌH)(ˌL) instead. The process is widespread in the language. Seiler (1967: 137) claims that the motivation for the process may be "such that the suffix appended last in the word must receive a secondary stress". Seiler (1977: 57) generalizes somewhat by suggesting that glottalization ensures adjacent stresses, which serves to signal the stem/affix boundary between the heavy and the light syllable. Although we cannot confirm or refute Seiler's explanation of the process from the available information, it suggests in any case that Seiler felt confident that final syllables are genuinely stressed in such cases.

3.4. Discussion

This section has presented a case study of a language where the interpretation of the stress description affects whether the primary stress is really independent from secondary stresses. Although Hayes's interpretation of the Cahuilla stress data involves a primary/secondary stress asymmetry that favors a top-down analysis, this section has shown that it is plausible that no such asymmetry exists, in which case a bottom-up analysis is available.

Before moving on, we can address the theoretical context in which the top-down analysis of Cahuilla was proposed, since it is this context that shapes the interpretation of the data in ways that introduce primary/secondary stress asymmetries. In light of data from a large number of languages showing that patterns seeming to require degenerate feet are rare, Hayes (1995: 86-105) takes the strong position that degenerate feet are nearly always avoided by rules that build metrical structure, hence the Priority Clause (see (16) above). When constraints are generally inviolable, as in Hayes's and many other rule-based theories, the rational way to approach observed typological rarity is to determine whether it can be pushed to the logical extreme of typological absence, and in this vein Hayes ultimately proposes that secondary stress can never occupy a degenerate foot, though primary stress may do so (often through top-down parsing like in Cahuilla[24]). Thus, a few purported cases of secondary stress degenerate feet, Cahuilla among them, are given plausible reanalyses that do not require degenerate feet. Under this theory, then, primary and secondary stress are *fundamentally* asymmetric in whether they permit degenerate feet.

In contrast, the complete avoidance of degenerate secondary stress feet has not usually been taken up in OT-based work in metrical theory.[25] When well-formedness is characterized by violable constraints, it is possible to encode the markedness of a structure without assuming an outright ban. The constraint FtBin states a dispreference for degenerate feet, but it does not entail their absence since it may be overridden when higher ranked constraints conflict. However, an overall asymmetry in the markedness of foot types is derived, with binary (or non-degenerate) feet preferred, other things being equal.[26] In this context, the arguments for and against the final stress in Cahuilla seem beside the point, echoing a similar observation by Crowhurst & Hewitt (1995a). Although the presence or absence of the final stress in Cahuilla is still germane to the issue of primary/secondary stress asymmetry, the fact that the final stress would require a degenerate foot is not a compelling argument one way or another, since the theory readily admits degenerate feet as a possible, if marked, option.

We conclude from this case study that the independence of primary stress from non-primary stresses is not necessarily self-evident, nor is it a theory-neutral determination. Therefore, it is not generally possible to call a language or stress pattern 'top-down' in the absence of detailed argumentation within a particular theoretical framework.

4. Asymmetric patterns and language typology

This section now turns to a top-down case study of a different nature, revisiting the stress pattern of Yine described in the introduction. In this case, the independence of the primary stress from non-primary stresses will not be challenged. Instead, we will see that this surface asymmetry may be derived in HS top-down (as alluded to in the introduction) *or* bottom-up, by assuming an additional constraint. This illustration achieves two ends. First, it transparently confirms the general argument here: that a language cannot be labeled 'top-down' pretheoretically. And second, it delves into a key piece of argumentation for one parsing mode over the other:

24. A few cases of degenerate primary stress feet do not require top-down parsing (e.g., Auca, Hayes 1995: 182ff). It is only in cases that a primary stress degenerate foot violates the Priority Clause that top-down parsing is needed to motivate its construction.
25. An exception is the work of Hyde (2001, 2002, 2016), whose theory involves reworking the foot (primary and secondary both) as necessarily binary; ambipodal syllables are permitted to ensure both foot binarity and exhaustive parsing.
26. This is true in both HS and in parallel OT, though for different reasons. In HS, Parse-σ favors larger feet at each iteration, other things being equal (Pruitt 2010), whereas in parallel OT it is alignment constraints that favor minimizing the number of feet and therefore maximizing their size to achieve comparable satisfaction of Parse-σ. (For illustrations of the structure-minimizing properties of alignment, see e.g., Elenbaas & Kager 1999; Gordon 2002.)

that of typological predictions. Since the two parsing modes utilize different constraints, and since the metric for determining the adequacy of a constraint set is typological, evaluating whether the language under discussion should be analyzed top-down or bottom-up ultimately depends on the cross-linguistic attestation of stress asymmetries.

This section provides a description of Yine stress in 4.1 and then provides both top-down and bottom-up analyses in HS (section 4.2). Section 4.3 highlights the different typological predictions of each analysis and compares them to the known attestation of stress systems. Finally, section 4.4 collects the results of the two case studies in this paper and uses them to give a concise summary of the empirical criteria that favor a top-down Gen in Harmonic Serialism.

4.1. Yine stress pattern

Yine is a Maipurean language of Peru (Eberhard, Simons, and Fennig 2019) described by Matteson (1965). In Yine the primary stress is on the penultimate syllable, secondary stress is word-initial, and tertiary stresses appear on odd-numbered syllables counting from the left in long enough words, though the syllable immediately preceding the primary stress never receives stress. The stress pattern is thus *bi*directional. (For general discussion of bidirectional stress systems see, among others, Kager 2001, Alber 2005, Hyde 2008.) We can analyze this pattern with quantity-insensitive trochees (Hayes 1995: 201, among others). The data in (21) show the stress pattern along with the trochaic feet it entails, repeating the data from (1). The primary stress foot is right-aligned (i.e., word-final), while non-primary stress feet iterate from the left edge. (Following other work, I collapse the secondary/tertiary distinction here.)

(21) Yine data (Matteson 1965: 21)[27]

ru.(ˈt͡çi.t͡ça)	‘He observes taboo’
(ˌʧi.ja)(ˈha.ta)	‘He cries.’
(ˌsa.lwa).je.(ˈhka.kna)	‘They visit each other.’
(ˌpe.ʧi)(ˌʧhi.ma)(ˈtlo.na)	‘They say they stalk it.’
(ˌru.slu)(ˌno.ti).ni.(ˈtka.na)	‘Their voices already changed.’
(ˌsa.ple)(ˌwhi.ma)(ˌmta.na)(ˈtna.ka)	‘They say he went along screaming again.’
(ˌka.çru:)(ˌka.khi)(ˌmana).ta.(ˈtka.na)	‘They were joking together then, it is said.’

27. The data have been converted to IPA with the following exceptions: [l] and [r] represent lateral and retroflex flaps, respectively, and [h] is a “nasal spirant”. Syllabifications follow Matteson (1965), who suggests that the syllable template in Yine places all intervocalic consonant clusters into onset position. This is based on the fact that all intervocalic consonant sequences can also occur word-initially and the observation that all words end in a vowel.

4.2. Top-down and bottom-up analyses

The asymmetry in Yine is in the direction of alignment of the primary and non-primary stress feet. As described in the introduction to this paper, a top-down analysis provides a logical way to capture this difference. In HS, such an analysis would proceed as follows. At the first iteration of stress assignment, the lone right-aligned primary stress foot is built due to the ranking ALIGNHDR >> ALLFTL. At the next iteration, a secondary stress foot is built at the left edge of the word if there are at least two unparsed syllables remaining because of the ranking PARSE-σ >> ALLFTL >> ALLFTR. Additional feet are constructed in a left-aligned manner as long as there are additional pairs of syllables left unparsed.

The derivation in (22) illustrates. At the first iteration, the ALIGNHD constraint will be active in selecting an optimal candidate because primary stress feet are in the candidate set. And because ALIGNHDR outranks ALLFTL, the most right-aligned foot wins. At subsequent iterations regular iterative parsing will begin at the left edge of the word and continue rightward. Because the first iteration selected a candidate that already maximally satisfies ALIGNHDR (modulo TROCHEE and FTBIN), the ALIGNHD constraint will not affect regular parsing, which falls instead to the other constraints.

(22) Top-down analysis of Yine (ˌru.slu)(ˌno.ti).ni.(ˈtka.na) ‘their voices already changed’

	/ru.slu.no.ti.ni.tka.na/	TROCHEE	FTBIN	PARSE-σ	ALHDR	ALLFTL
	1st iteration					
a.	ru.slu.no.ti.ni.tka.na			7 W	L	L
b.	(ˈru.slu).no.ti.ni.tka.na			5	6 W	L
c. →	ru.slu.no.ti.ni.(ˈtka.na)			5	1	5
d.	ru.slu.no.ti.ni.tka.(ˈna)		1 W	6 W	L	6 W
e.	ru.slu.no.ti.ni.(tka.ˈna)	1 W		5	L	5
	2nd iteration					
f.	ru.slu.no.ti.ni.(ˈtka.na)			5 W	1	5
g. →	(ˌru.slu).no.ti.ni.(ˈtka.na)			3	1	5
h.	ru.slu.no.(ˌti.ni)(ˈtka.na)			3	1	8 W
	3rd iteration					
i.	(ˌru.slu).no.ti.ni.(ˈtka.na)			3 W	1	5 L
j. →	(ˌru.slu)(ˌno.ti).ni.(ˈtka.na)			1	1	7
k.	(ˌru.slu).no.(ˌti.ni)(ˈtka.na)			1	1	8 W

This analysis shows that an ALIGNHD constraint can overcome the general foot alignment preferences when higher ranked, yielding a bidirectional pattern when parsing is top-down. In contrast, if feet must be built at a lower, non-primary stress level before being promoted to primary stress, then the ALIGNHD constraint cannot be active in selecting which foot to build at the first, or any, iteration. This is demonstrated in (23). Here, the satisfaction of ALIGNHD (and HD(PWD) as well is limited by the fact that Gen does not produce feet with primary stress and can only promote an existing secondary stress foot to primary. Thus, ALIGNHDR only becomes active to select among existing feet. The result is similar in character to MalakMalak (section 1): a unidirectional stress pattern that appears to iterate left-to-right, with the rightmost foot selected as primary: *(ˌru.slu)(ˌno.ti)(ˈni.tka).na.

(23) Bottom-up Yine derivation with same constraints: wrong outcome[28]

	/ru.slu.no.ti.ni.tka.na/	FTBIN	PARSE-σ	HD(PWD)	ALHDR	ALLFTL
	1st iteration					
a.	ru.slu.no.ti.ni.tka.na		7 W	1		
b.	ru.slu.no.ti.ni.(ˌtka.na)		5	1		5 W
c. →	(ˌru.slu).no.ti.ni.tka.na		5	1		
	2nd iteration					
d.	(ˌru.slu).no.ti.ni.tka.na		5 W	1		L
e. →	(ˌru.slu)(ˌno.ti).ni.tka.na		3	1		2
f.	(ˌru.slu).no.ti.ni.(ˌtka.na)		3	1		5 W
	3rd iteration					
g.	(ˌru.slu)(ˌno.ti).ni.tka.na		3 W	1		2 L
h. →	(ˌru.slu)(ˌno.ti)(ˌni.tka).na		1	1		6
	4th iteration					
i.	(ˌru.slu)(ˌno.ti)(ˌni.tka).na		1	1 W	L	6
j.	(ˌru.slu)(ˌno.ti)(ˌni.tka)(ˌna)	1 W	L	1 W	L	12 W
k. →	(ˌru.slu)(ˌno.ti)(ˈni.tka).na		1		2	6
l.	(ˈru.slu)(ˌno.ti)(ˌni.tka).na		1		6 W	6

28. PARSE-σ outranks HD(PWD) for this particular derivation, though the relevant losing candidates to justify this ranking are not included in (23). See footnote 17.

An additional constraint is therefore needed in order to derive the bidirectional pattern of Yine with a bottom-up Gen. This can be achieved with ALIGNWDR, which favors *some* foot aligned to the right edge of the word, irrespective of whether it is the primary stress. This constraint is usually defined as a member of the generalized alignment family (McCarthy and Prince 1993) as in (24). It was discussed by McCarthy and Prince (1993) when the generalized alignment schema was first introduced and has been used in numerous subsequent analyses by many authors.

(24) ALIGN(PWD,R,FT,R) (ALIGNWDR): Assign one violation mark for every PWd whose right edge is not aligned with the right edge of some foot.

When ranked above ALLFTL, the dominant general alignment constraint in Yine, ALIGNWDR favors the building of a foot at the right edge before regular left-to-right iteration proceeds. When it is time to assign primary stress, the ranking of ALIGNHDR >> ALIGNHDL favors promoting the lone rightmost foot to primary. This derivation is shown in (25).

(25) Bottom-up derivation of Yine stress with ALIGNWD

	/ru.slu.no.ti.ni.tka.na/	ALWDR	PARSE-σ	HD(PWD)	ALHDR	ALLFTL
	1st iteration					
a.	ru.slu.no.ti.ni.tka.na	1 W	7 W	1		L
b. →	ru.slu.no.ti.ni.(ˌtka.na)		5	1		5
c.	(ˌru.slu).no.ti.ni.tka.na	1 W	5	1		L
	2nd iteration					
d.	ru.slu.no.ti.ni.(ˌtka.na)		5 W	1		5
e. →	(ˌru.slu).no.ti.ni.(ˌtka.na)		3	1		5
f.	ru.slu.no.(ˌti.ni)(ˌtka.na)		3	1		8 W
	3rd iteration					
g.	(ˌru.slu).no.ti.ni.(ˌtka.na)		3 W	1		5 L
h. →	(ˌru.slu)(ˌno.ti).ni.(ˌtka.na)		1	1		7
	4th iteration					
i.	(ˌru.slu)(ˌno.ti).ni.(ˌtka.na)		1	1 W	L	7
j. →	(ˌru.slu)(ˌno.ti).ni.(ˈtka.na)		1		1	7
k.	(ˈru.slu)(ˌno.ti).ni.(ˌtka.na)		1		6 W	7

The principal conceptual difference between the bottom-up analysis of Yine and the top-down analysis presented just before it is that the bottom-up analysis treats the word-final foot as a product of a high-ranked preference for *some* foot to be aligned with the right edge of the word, even before it is known that it will bear the primary stress. That is, the bottom-up derivation will not treat the primary stress as exceptional but will derive the alignment asymmetry among feet before the primary stress is even assigned. The ALIGNWD constraint thus takes the place of ALIGNHD in the ranking for motivating the 'lone' foot, though it does not replace it entirely. At a later iteration this foot will only be assigned the primary stress because the dominant ALIGNHD constraint matches the ALIGNWD constraint in its direction (i.e., both right-aligning in this case). Thus, the fact that the rightmost foot is exceptional is technically unrelated to its status as the primary stress foot.[29] This will be an important factor in comparing the typological predictions of each analysis just below, because despite this difference, there is no straightforward way to use the Yine data itself to distinguish among these alternatives. Both permit the bidirectional pattern of Yine to be derived and result in identical metrical representations. It is therefore only possible to judge the top-down and bottom-up analyses on the basis of their typological predictions, to which the next section now turns.

4.3. Typological predictions

The top-down analysis of Yine does not require ALIGNWD, since ALIGNHD is available to similar effect and it refers directly, and appropriately in this case, to the primary stress foot. But ALIGNWDR is crucial in the bottom-up analysis because it introduces an asymmetry among stresses, which correlates later in the derivation with primary stress assignment. To compare the bottom-up and top-down analyses, then, we must ask whether ALIGNWD in general and ALIGNWDR in particular are justified constraints, which we will do by looking at their typological predictions and comparing them to the known typology.

Without ALIGNWD, the top-down analysis makes the prediction that all bidirectional stress systems will have primary stress on their 'lone' foot, because without ALIGNWD, an ALIGNHD constraint that conflicts with general parsing (ALLFTL/R) is the way to motivate a separate foot with opposite directionality from the rest of the stress pattern. For illustration of this point, a simplified predicted typology of unidirectional and bidirectional languages is given in (26), assuming quantity-insensitive trochaic feet and underparsing.[30]

29. Interestingly, Hayes (1995: 201) describes a bottom-up analysis of Yine with two foot construction rules that precede the End Rule, similar to the bottom-up analysis with ALIGNWD presented here. It can be inferred from a consideration of his theory that analyzing Yine top-down would confer no advantage: since the End Rule does not build feet, two separate foot construction rules (one non-iterating at the right, another iterating from the left) would be needed anyway. This is another way that a theoretical framework may dictate a choice between top-down and bottom-up analyses.

30. Underparsing refers to the absence of monosyllabic feet on 'leftover' syllables, which is controlled by the ranking of PARSE-σ and FTBIN. HS, unlike parallel OT, predicts that monosyllabic feet should be possible in both unidirectional and bidirectional stress systems (Hyde 2012; see also Pruitt 2012: Ch 5), though only certain unidirectional patterns are robustly attested with them (Hyde 2014).

(26) (Simplified) Predictions of top-down parsing (without AlignWd)

Foot Alignment — Primary stress alignment

a. Unidirectional Left-to-Right, Leftmost primary

(ˈσσ)(ˌσσ)(ˌσσ)σ

AllFt**Left** — AlignHd**Left**
AllFt**Right** — AlignHd**Right**

b. Unidirectional Right-to-Left, Rightmost primary

σ(ˌσσ)(ˌσσ)(ˈσσ)

AllFt**Right** — AlignHd**Right**
AllFt**Left** — AlignHd**Left**

c. Bidirectional: Primary at Left and Secondaries Right-to-Left

(ˈσσ)σ(ˌσσ)(ˌσσ)

AlignHd**Left**
AllFt**Right** — AlignHd**Right**
AllFt**Left**

d. Bidirectional: Primary at Right and Secondaries Left-to-Right

(ˌσσ)(ˌσσ)σ(ˈσσ)

AlignHd**Right**
AllFt**Left** — AlignHd**Left**
AllFt**Right**

The attestation of language types (26)a and (26)b is uncontroversial: (26)a is seen in Pintupi (Hansen and Hansen 1969; section 1), (26)b is the pattern of Cavineɲa[31] (Key 1968). Additional languages instantiating each type are described in Gordon (2002), among others. The bidirectional pattern in (26)c is found in Garrwa[32] (Furby 1974), and (26)d is the pattern of Yine.[33]

31. Tacanan, Bolivia (Eberhard, Simons & Fennig 2019).
32. Yanyi, Northern Territory (Eberhard, Simons & Fennig 2019).
33. These attestations refer, of course, to the quantity-insensitive trochaic versions of each pattern as illustrated here. Whether the equivalent patterns with different foot types (e.g., quantity-sensitive and/or iambic) are attested is another matter, and considerable literature has amassed throughout the history of metrical theory discussing typological asymmetries between trochees and iambs, quantity-insensitive vs. quantity-sensitive systems, etc. I set aside these issues here.

In contrast, when AlignWd is included in the constraint set, as required for the bottom-up analysis of Yine, the correlation between the lone foot and the primary stress seen in (26)c and (26)d is no longer guaranteed. An analysis with AlignWd predicts the language types in (26) *plus* those in (27), where the lone foot and the primary stress are no longer coextensive.

(27) Additional (simplified) predictions of bottom-up parsing (with AlignWd)

	Foot Alignment	Primary stress alignment
a. Bidirectional: Foot at Left and Right-to-Left, Rightmost primary		
(ˌσσ)σ(ˌσσ)(ˈσσ)	AlignWd**Right**	AlignHd**Right**
	|	|
	AllFt**Left**	AlignHd**Left**
	|	
	AllFt**Right**	
b. Bidirectional: Foot at Right and Left-to-Right, Leftmost primary		
(ˈσσ)(ˌσσ)σ(ˌσσ)	AlignWd**Left**	AlignHd**Left**
	|	|
	AllFt**Right**	AlignHd**Right**
	|	
	AllFt**Left**	

The inclusion of AlignWd in the constraint set predicts the language types in (27), essentially no matter the parsing method—with bottom-up or top-down parsing in HS and in parallel OT as well (Kager 2005). In other words, the possibility of separating the lone foot and primary stress, as in the examples in (27), is fundamentally entailed when AlignWd is included, so we should now ask whether such systems are attested. If so, this supports AlignWd as a valid constraint, meaning the top-down analysis of Yine is not required and therefore Yine is not a top-down language, despite the fact that its primary stress is independent from its non-primary stresses on the surface. On the other hand, if no languages instantiate the patterns in (27), this would constitute evidence against AlignWd and therefore against a bottom-up analysis of Yine (and other bidirectional systems).

The language types in (27) have been the subject of considerable discussion in the OT metrical literature already (Kager 2001, McCarthy 2003, and other references below). In parallel OT the discussion has emerged not from a concern with AlignWd, per se, but the use of gradient alignment constraints like AllFtL/R for deriving stress vs. the *Lapse-based Rhythmic Licensing Theory of Kager (2001). But since the typological issues overlap with what we are discussing here, that literature proves quite relevant. Yet whether the languages in (27) do indeed exist is not immediately obvious from surveying this literature. Kager (2001) argues that all bidirectional stress systems have primary stress on the lone foot, claiming that patterns like those in (27) do not exist. Portions of Kager's arguments are echoed by several others, including McCarthy (2003)[34] and Alber (2005).

Nonetheless, reports of counterexamples are not difficult to find, particularly for the pattern in (27)a. Indonesian (Cohn 1989, Cohn 1993, Cohn & McCarthy 1994) and Spanish (Harris 1983, Harris 1989, Roca 1986) are the most often cited potential examples of a left-aligned non-primary-stress (which is referred to in the literature as the "initial dactyl" by Prince 1983 and others, referencing the sequence of stress-unstressed-unstressed). There are extant rejoinders to these examples, but there are also rejoinders to the rejoinders. In Indonesian the controversy surrounds the fact that the relevant forms are Dutch loans and might therefore represent stress preservation rather than a productive pattern, though Cohn (1993: 374, fn. 1) seems to dismiss this suggestion. For Spanish, Kager (2001) argues that morphological complexity may play a role in creating the pattern, but Hyde (2008; also Hyde & McCord 2012) argues that this cannot be the whole explanation. The balance of evidence seems to favor the admission of the initial dactyl pattern and therefore a constraint like ALIGNWDL to motivate it, no matter the parsing method (top-down, bottom-up, or in parallel).

As for the pattern in (27)b, which would utilize high-ranked ALIGNWD*Right* and is therefore specifically predicted by the bottom-up analysis of Yine, things are less clear. Cases of the Indonesian- and Spanish-type, but where the secondary stress foot must be final, are generally reported not to exist (Prince 1983; Hyde 2008).[35] Nonetheless, a possible example may be found in English words that exhibit (leftward) primary stress retraction, e.g., *désignàte*, where the primary stress seems to have drifted further to the left than strictly necessary to satisfy the requirements of NONFINALITY and FTBIN (which would be satisfied by **de(síg)nate*, for example). This is described by Pater (2000: 241f, fn. 5) as possible evidence for a constraint demanding some foot (head) at the right edge of a word.

The upshot of this brief foray into the typology of bidirectional stress systems is that a constraint like ALIGNWD is probably required in Con to account for attested stress patterns. And if this constraint is admitted, Yine can easily be analyzed top-down *or* bottom-up in Harmonic Serialism, despite the surface asymmetry it exhibits between primary and non-primary stresses.

4.4. Discussion

We have now examined two case studies of languages that have previously motivated top-down analyses, and I have shown in each case that there are reasons to be skeptical of such characterizations in any general sense. In short, the identifica-

34. Interestingly, McCarthy (2003) uses the absence of clear cases of languages like (27) to argue against the typical gradient formulations of ALLFTL/R, presupposing that constraints like ALIGNWDL/R are necessarily present in Con. What I am doing here is the opposite, presupposing ALLFTL/R and instead evaluating whether an ALIGNWD constraint is justified. See also Kager (2005), who similarly observes that these languages only arise when ALIGNWD is included.
35. Prince (1983: 49) discusses only the strict mirror image of the initial dactyl, the final anapest, noting that no such cases are known.

tion of surface asymmetries between primary and non-primary stresses is typically not theory-neutral (as in Cahuilla), and may also depend on a particular structural analysis (as in Tübatulabal, discussed in the introduction). Further, establishing a surface asymmetry of this sort is not sufficient for calling the language 'top-down', since bottom-up analyses might be available with different constraints (as in Yine).

However, the issues illuminated by these case studies do point to a positive conclusion: we are able to provide the following informal[36] criteria for motivating a top-down analysis in Harmonic Serialism.

(28) Criteria to establish that a top-down analysis is required in HS

a. Primary and secondary stress must display an asymmetry in construction.[37]

b. The asymmetry must not also be found among secondary stresses in some language.

The criterion in (28)a is a necessary (though not sufficient) condition for a stress pattern to potentially *require* (not just allow) a top-down analysis, and it technically applies in any derivational model, not just HS. Although the Cahuilla case study emphasizes that the criterion in (28)a cannot be ascertained in a theory-neutral way, it still highlights the importance of establishing such an asymmetry in order to argue for a top-down analysis. If primary and non-primary stresses obey the *same* general requirements for alignment and foot type, then the general stress constraints can be entrusted to put a foot in the correct place for later primary stress assignment in a bottom-up analysis, and a top-down analysis gains no traction over the bottom-up one. But if primary-stress-specific requirements appear to *override* those of secondary stresses, then a top-down analysis may be needed, since only with a top-down analysis may the primary stress constraints dictate footing. This is precisely the issue that arises with the different interpretations of Cahuilla's stress pattern described in section 3. The interpretation of the data determines whether the primary and secondary stresses show an asymmetry, and therefore, whether the pattern points toward a top-down analysis.

The criterion in (28)b, however, is a limiting factor on the conclusions we are able to draw from any given asymmetric pattern, and it derives from the fact that bottom-up analyses may be (and often technically are) available for asymmetric patterns using additional constraints. Specifically, as we can infer from the illustrations earlier in this section, an asymmetry in primary and secondary stresses can be

36. An anonymous reviewer requests that these criteria be stated more formally, but given the non-trivial argumentation required to establish both criteria (as Cahuilla showed for (28)a and Yine for (28)b), I believe the criteria best serve their function when viewed heuristically.

37. For the asymmetry to motivate a top-down analysis it must involve different procedures (i.e., different rules or constraints) for assigning primary and non-primary stresses, rather than being the result of a subsequent process that affects primary and secondary stresses differently. Compare languages where the primary stress syllable is lengthened (Hayes 1995: 84 cites Icelandic and Wargamay as examples). This results in an asymmetry, but does not require the procedures for primary and secondary stress foot construction to differ.

derived bottom-up when the grammar is permitted to follow two different parsing generalizations—one for the foot that will become the primary stress, and one for all other feet. In the bottom-up analysis of Yine, for example, parsing was motivated both by ALIGNWDR and by PARSE-σ (along with ALLFTL). However, in so doing, we predict the dissolution of any formal relationship between the primary stress's exceptional behavior and the fact that it is the primary stress. Unless the rankings are connected through some as-yet-unknown mechanism, or the derivations have foresight, the establishment of an exceptional foot and the assignment of that foot as the primary stress are predicted by bottom-up analyses of asymmetries to be, typologically-speaking, a coincidence. This means that top-down arguments can be made by establishing a primary/secondary stress asymmetry in one language that *only* occurs between primary and secondary stresses—and never *among* secondary stresses—in the known typology of stress systems.[38] In the case of bidirectional systems, the typological evidence seems to point to the existence of languages where secondary stresses *do* show asymmetries in alignment, so patterns like Yine do not offer evidence for a top-down analysis, even though its asymmetry happens to correlate with primary vs. non-primary stress. But with this criterion now made explicit, it should be possible to examine other cases of primary stress independence to determine whether any such asymmetries are indeed typological, rather than language-specific. Implicit in this discussion is the fact that finding a language that satisfies the criteria in (28) dictates not only that a top-down analysis is required, but also that a top-down *Gen* (with the characteristics identified in section 2.2) must be chosen over a bottom-up Gen for a complete analysis of primary stress in HS.

5. Conclusion

Previous literature shows that the concept of a 'top-down' language has sometimes been used as an empirical category, but by examining two typical cases we have seen that the interpretation of the data and its relationship to language typology are just as important as the pattern itself in establishing that a top-down analysis is required. Therefore, the primary conclusion of this paper is that individual languages are neither top-down nor bottom-up, as these terms should be reserved to describe categories of analysis. At the same time, we made precise the characteristics of a stress pattern that would motivate a top-down analysis—and therefore a top-down definition of Gen—in Harmonic Serialism: the primary stress must be shown to be independent on some dimension not just within a particular language but also within the attested typology of stress systems. Ideally, these criteria will guide future discussions of primary and secondary stress asymmetries and their implications for derivational models of stress assignment.

38. Ultimately, not unlike Hayes's (1995) decision to draw a typological distinction between primary and secondary stress with respect to degenerate feet.

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