A prominence account of the Northern Mam weight hierarchy

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1 Introduction: stress in Northern Mam

Mam (ISO code: mam) is a Mamean-branch Mayan language spoken by around 600,000 people in the western highlands of Guatemala. Among Mayan languages, Mam is cited as having a particularly high degree of internal dialectal variation at all grammatical levels (England 2017). Traditionally, the Mam language region is divided into three main dialect areas: Northern, Western, and Southern (e.g. Pérez Vail 2004). These groups have distinct systems of primary stress assignment; in Southern Mam varieties, stress is regularly penultimate, sand in Western Mam, stress is regularly ultimate. However, in Northern Mam, stress assignment is weight-sensitive and falls on the rightmost heaviest syllable (England 2017).

Notably, the weight hierarchy for Northern Mam stress assignment makes a distinction between syllables closed with a glottal coda (Vʔ) and other coda types (VC), where Vʔ is heavier than VC. The full weight scale for stress is thus VV > Vʔ > VC > V. The distinction between Vʔ and VC is typologically unusual; coda consonants typically behave uniformly, resulting in weight scales such as VV > VC > V (Ryan 2020, p. 124).

Evidence for the Northern Mam weight scale comes from forms such as in (1); these examples, and all subsequent data, come from original consultant work with speakers from the Todos Santos variety of Mam, a Northern Mam dialect. In Todos Santos Mam, like other Northern varieties, stress is placed on the rightmost heaviest rime type available in the word. There is no secondary stress.

(1) *Todos Santos Mam weight scale exemplars*

VV outweighs Vʔ

a.	[kuʔ.ˈwaːl]	*ku'waal*	'child'
b.	[ˈaːl.q̥͡ʔaʔn]	*aalq'a'n*	'robs'

Vʔ outweighs VC

c.	[ˈχɪʔ.ʈʂ'ɐχ]	*ji'tx'aj*	'thin person'
d.	[ʔaχ.ˈɓ̥eʔ]	*ajb'e'*	'wants'

VC outweighs V

e.	[ma.ˈsatʰ]	*masat*	'deer'
f.	[ˈʔoχ.ʈʂɐ]	*ojtxa*	'before'

When all syllables in a word are equally heavy, stress is rightmost (2). However, final light syllables never get stress; when words consist of all light syllables, stress falls on the penultimate syllable (3); avoidance of final light syllables is found in languages such as Wergaia and has been analyzed as a case of non-finality targeting final moras (Hyde 2011). There are no instances of two long vowels co-occurring in a single word, and neither are there cases of two Vʔ syllables co-occurring.

* Thanks first and foremost to our consultant Wilmer Mendoza. Thanks also to Harold Torrence, members of the UCLA Phonetics Seminar and UCLA Phonology Seminar, and the audience at the 2022 Annual Meeting on Phonology for the insightful comments and valuable feedback.

Proceedings of *AMP 2022*

(2) Stress is default rightmost if non-light syllables are of equal weight

a.	[ʔaχ.ˈlaŋ]	*ajlan*	‘rests’
b.	[man.ˈmaq^h]	*manmaq*	‘big (of animals)’
c.	[tow.ˈsant^h]	*towsant*	‘todosantero’

(3) Penultimate stress if syllables are all light

a.	[ˈme.ɓ̥ɐ]	*meb’a*	‘orphan, poor one’
b.	[ˈʂ̺ɓ̥ɪ.ʠ̥ɐ]	*shbiq’a*	‘naked’
c.	[ˈʔ̄e.wɐ]	*ewa*	‘yesterday’
d.	[χapaˈninɐ]	*japanina*	‘reason, meaning’

In this paper, we propose an analysis of Todos Santos Mam stress (and, by extension, Northern Mam stress) within the **prominence** framework, which has recently gained ground over the **coercion** (contextual moraicity) framework of ternary weight scales. Under coercion, moraic codas are compelled to yield their moras to VV’s to avoid fatal violations of constraints such as WTS (weight-to-stress). Notably, coercion makes certain pathological predictions about geminate codas and secondary stress assignment (see Section 2.2). In contrast, prominence, proposed recently by Ryan (2019, 2020), avoids these pathologies by treating all codas as moraic regardless of whether they are stressed.

The Mam facts initially seem to contradict a prominence account; if all codas are equally moraic, and all consonantal moras are equally prominent, there should be no inherent reason for Vʔ to be heavier than VC. However, we show based on experimental results that (at least in medial position), /Vʔ/ sequences are phonetically realized as lengthened and glottalized vowels, rather than a sequence of V followed by a [ʔ] release. We argue based on these results that /Vʔ/ are given a type of vocalic prominence. In particular, /Vʔ/ is realized with duration between that of /VV/ and /VC/, accounting for the relative weight hierarchy of VV > Vʔ > VC (> V).

The rest of this paper is organized as follows. Section 2 outlines the theoretical and typological predictions of the competing frameworks for ternary stress, and discusses why a prominence framework of ternary stress systems is preferred. In Section 3, we present evidence that Vʔ in Todos Santos Mam is actually lengthened and prominent, in keeping with the predictions of a prominence account. In Section 4, we outline a prominence-theoretic account, based in Optimality Theory (OT; Prince & Smolensky 1993/2004).

2 Theories of ternary weight: coercion vs. prominence

2.1 *Coercion: contextual moraicity through constraint ranking* In theories of weight, ternary weight scales of VV > VC > V have historically been analyzed using contextual moraicity, or *coercion*. Under coercion, each vowel always has a mora, so V is monomoraic and VV is bimoraic. However, a consonantal coda is moraic when stressed and non-moraic in other environments (Morén 1999, 2000; Rosenthal & van der Hulst 1999). As such, the ranking of VV > VC > V is reduced to $\mu\mu > \mu$. Ternary stress arises when Weight-to-Stress (WTS), a constraint demanding that heavy ($\mu\mu$) syllables bear stress, outranks Weight-by-Position (WbyP), a constraint penalizing non-moraic codas. When a word has no VV syllables, VC syllables can be bimoraic, and receive stress over V syllables. When VV is present, WTS >> WbyP demands that VC syllables “shed” their codas’ moraicity, thus avoiding a fatal violation of WTS.

Ryan (2020, pp. 126-126) gives an example of how a coercion theory of ternarity works in Kashmiri (Morén 2000 and citations therein). The rest of this subsection briefly restates that analysis. In Kashmiri, primary stress is weight-sensitive and non-final (excepting monosyllables, where culminativity demands that stress be realized). Among non-final syllables, stress falls on the left-most heaviest rime type available, graded on the scale VVC > VV > VC > V. Some exemplar words are provided in (4).

(4) Kashmiri exemplar words

Default stress is initial when nonfinal syllables are equal in weight

a.	ˈp^{h}i.ki.ri	‘understood
b.	ˈjəm.bɨr.zal	‘narcissus’
c.	ˈbaː.laː.dər	‘balcony

VC outweighs V
d. ʃoˈkɨr.vaːr ‘Friday’

VV outweighs VC
e. vuʃˈnaː.vun ‘to warm’

VVC outweighs VV
f. boːˈdeːs.var ‘Lord’

A coercion account requires the following OT constraints, all of which are commonly assumed in metrical phonology:[1]

(5) Constraints invoked in the Kashmiri coercion analysis
a. NONFINALITY: Assign a violation to any candidate with final stress
b. WEIGHT-BY-POSITION (WbyP): Assign a violation to any syllable with a non-moraic coda.
c. WEIGHT-TO-STRESS PRINCIPLE (WTS): Assign a violation to any heavy (bi- or tri-moraic) syllable which does not bear stress.
d. ALIGN(σ́, L, PrWd, L) (ALIGN-L): Stress is aligned to the leftmost syllable in the word.

ALIGN-L and NONFINALITY work to assign stress to the leftmost non-final syllable. As described above, ternarity is achieved by the ranking WTS >> WbyP. As a result, VC syllables are monomoraic when unstressed, but bimoraic when stressed. When a non-final VV syllable is present within the word, it receives stress, but at the same time, WTS compels all other codas to be monomoraic. Some tableaux (repeated from Ryan 2020, p. 126) are given below.

When VV is available, it receives stress and VC’s are non-moraic, as in the winning candidate (6a). (6c-d) incur fatal violations of WTS because VCs are moraic. Finally, (6b) loses as it has stress on a weak syllable.

(6) *Stress assigned to VV in the presence of non-moraic VC’s*

vuʃnaːvun ‘to warm’	WTS	WbyP	ALIGN-L
a. ☞ vuʃˈnaːvun		**	*
b. ˈvuʃnaːvun	*!	**	
c. ˈvuʃ$_{\mu}$naːvun	*!	*	
d. vuʃ$_{\mu}$ˈnaːvun	*!	*	*
e. vuʃˈnaːvun$_{\mu}$	*!	*	*

In (7) on the following page, the input has no VV syllables, and therefore codas do not need to yield up moraicity. Candidate (7a) wins because although stress is not initial, the leftmost *moraic* VC syllable is stressed, while at the same time, all other VCs are moraic. All other candidates either incur fatal violations of WbyP (7b,d,e) or fail to stress any heavy syllable entirely (7b).

Notably, while languages like Kashmiri are amenable to a coercion analysis, many languages are *not,* due to pathologies inherent in the coercion framework, particularly concerning geminate codas and secondary stress assignment. In response, Ryan (2019, 2020) argues for a *prominence* theory of weight. This is expounded upon in the next subsection.

[1] One further constraint, PEAKPROMINENCE (PKPROM) is invoked by Morén (2000), to break ties between VVC and VV syllables, although that will not be discussed here. For simplicity, NONFINALITY is also not shown in the exemplar tableaux. Ryan (2020) also decides not to use feet for typographical convenience, a decision we maintain in this review.

(7) *Codas keep their moraicity in the absence of VV*

ʃokɨrvaːr ‘Friday’	WTS	WbyP	ALIGN-L
a. ☞ ʃoˈkɨr$_{\mu}$vaːr$_{\mu}$	*		*
b. ˈʃokɨrvaːr$_{\mu}$		*!	
c. ˈʃokɨr$_{\mu}$vaːr$_{\mu}$	**!		
d. ʃoˈkɨrvaːr$_{\mu}$	*	*!	*
e. ʃoˈkɨr$_{\mu}$vaːr		*!	*

2.2 *The pathologies of contextual moraicity and a prominence-based solution* One issue with the coercion analysis is exemplified by Chickasaw (Gordon 2004). In Chickasaw, primary stress falls on any VV in the word; otherwise, primary stress is final. Secondary stress falls on all remaining heavies (VC, VV, etc.) as well as the final syllable, so long as it is not already primary-stressed. Example words from Gordon (2004) are given in (8). The remainder of this section briefly reviews Ryan (2020, pp. 127-128).

(8) *Chickasaw exemplar words*
- a. noˌtakˈfa ‘jaw’
- b. ˌokˌfokˈkol ‘type of snail’
- c. ˌhattaˈkat ‘man’
- d. tʃoˈkaːˌno ‘fly’
- e. ˌʃimmaˈnoːˌliʔ ‘Seminole’
- f. taˈlaːˌnomˌpaʔ ‘telephone’
- g. ˈsałkoˌna ‘earthworm’

Primary stress in Chickasaw displays VV > {VC, V}, whereas secondary stress displays {VV, VC} > V; the entire language is thus sensitive to the weight scale VV > VC > V. A coercion analysis of Chickasaw does not work, however. First, for VV to attract stress away from VC’s, VCs must only be monomoraic (see, e.g., a tableau such as (6)). However, if VC’s are only monomoraic, there is no explanation for why secondary stress assignment *does* treat VC’s as heavy (i.e. bimoraic); compare (8f), with secondary stress on a heavy penult, with (8g), lacking stress on a light penult. In summary, one pathology with coercion is the conflict in moraicity with regard to primary and secondary stress assignment.

The second pathology is that coercion requires VG syllables (syllables with geminate codas) to be non-moraic, since allowing VG’s to be bimoraic would potentially attract primary stress. This generally goes against the typology (geminate codas are known to attract stress), and in the case of Chickasaw, makes the wrong predictions for forms like (8c,e) where VG’s attract secondary stress.

To circumvent these two pathologies, Ryan (2019, 2020) proposes a theory where stress is attracted to prominent syllables. Under this theory, vocalic moras are more prominent than consonantal (coda) moras, and codas have uniform moraicity. The driving constraint under this framework is VV-TO-MAIN, which penalizes any long vowel (VV) lacking primary stress. The fundamental advantage of this constraint is its phonetic/perceptual grounding: vowels, and especially long vowels, are more prominent (phonetically salient) than coda consonants and are therefore better hosts for stress. All other constraints are readily adopted from coercion.[2] For Chickasaw, the following constraints are active:

(9) Constraints invoked in the Chickasaw prominence analysis
- a. VV-TO-MAIN (VV→MAIN): Assign a violation for every long vowel which does not bear primary stress.
- b. WEIGHT-TO-STRESS PRINCIPLE (WTS): Assign a violation to any heavy (bimoraic) syllable which does not bear stress.

[2] Undominated WbyP is not shown for simplicity, following Ryan (2020), p. 127.

c. ALIGN(σ́, R, PrWd, R) (ALIGN-R): Stress is aligned to the rightmost syllable of the prosodic word.
a. ALIGN(σ́, R, PrWd, R) (ALIGN-R-MAIN): Main stress is aligned to the rightmost syllable of the prosodic word.

(10) *When no VV is present, primary stress is final*

notakfa ‘jaw’	VV→MAIN	WTS	ALIGN-R-MAIN	ALIGN-R
a. ☞ noˌtak$_\mu$ˈfa				*
b. noˈtak$_\mu$ˌfa			*!	*
c. notak$_\mu$ˈfa		*!		
d. ˌnoˌtak$_\mu$ˈfa				**!*

As is seen above in (10), coda consonants are always moraic, so VC’s always surface as bimoraic. In the absence of VV, which would otherwise attract primary stress, stress assignment is left up to the two alignment constraints, which pick (10a) as the optimal candidate.

(11) *VV→MAIN selects VV when present*

tʃoka:no ‘fly’	VV→MAIN	WTS	ALIGN-R-MAIN	ALIGN-R
a. ☞ tʃoˈka:ˌno			*	*
b. tʃoˌka:ˈno	*!			*

In (11) above, we see that when a VV is present, it may attract stress away from the ultima. This is achieved by the ranking VV→MAIN >> {ALIGN-R-MAIN, ALIGN-R}. Ryan (2020, p. 128) notes how (10a) and (11a) have the same moraic profiles ($\sigma_\mu\sigma_{\mu\mu}\sigma_\mu$), but unique stress profiles due to their syllable shapes.

(12) *Geminates do not shift primary stress but can attract secondary stress*

hattakat ‘man’	VV→MAIN	WTS	ALIGN-R-MAIN	ALIGN-R
a. ☞ ˌhat$_\mu$taˈkat$_\mu$				**
b. ˈhat$_\mu$taˌkat$_\mu$			*!*	**

Lastly in (12) above, we see that geminate consonants can be targeted for secondary stress, since they are not contextually specified as non-moraic. At the same time, they do not attract primary stress away from the ultima. Overall, a prominence theory of weight can account for the two pathologies of coercion while still carrying over much of its Optimality-theoretic machinery. It also incorporates psycholinguistically motivated constraints, as VV-TO-MAIN builds on the finding that vowels (especially long vowels) are more prominent than coda consonants.

3 A prominence profile for Mam’s VV > Vʔ > VC > V

3.1 *A prominence profile for Mam’s VV > Vʔ > VC > V* Mam is sensitive to the same VV > VC > V weight scale as Kashmiri and Chickasaw, but with the added complication that Vʔ is heavier than all other types of consonantal codas (VC) but not as heavy as long vowels (VV).

If weight scales are rooted in prominence, as predicted by Ryan’s analysis, Mam Vʔ should be phonetically more prominent than VC (and V) syllables, whose prominence is presumably realized (at the minimum) by vowel duration, especially because the most prominent syllables cross-linguistically are long vowels. More generally, glottal codas show variability vis-à-vis weight cross-linguistically, and may pattern with VCs, be heavier than VCs, or be lighter than VCs. For example, Vʔ < VC in Hupa, Ngalakan, and Capanahua, whereas in Cahuilla and Huehuelta Tepehua (as in Northern Mam), Vʔ > VC. Ryan’s account predicts the variable position of Vʔ in weight hierarchies should fall out from their language-specific phonetic realizations.

To give a concrete example, Gordon & Luna (2004) find, based on a dictionary corpus study, that stress in Hupa is gradiently sensitive to weight effects according to the following hierarchy: VV ≳ VC ≳ V ≳ Vʔ (where ‘ʔ’ refers to a glottal consonant that can be [ʔ] or [h], and ≳ means that the difference is significant but gradient). Ryan (2019, p. 90) notes that one approach to the extra-light status of Hupa’s Vʔ’s is to analyze them as laryngealized, or “checked” vowels.

Mam shows the opposite pattern, where Vʔ > VC. As such, Mam Vʔ should have a distinct phonetic realization from that which is posited for Hupa. In fact, we find evidence of this; in an acoustic-phonetic study of Mam vowels (Kuo & Elkins 2022), we find that Mam Vʔ are realized as glottalized vowels with vowel duration intermediate between that of VV and V(C). Subsections 3.2 and 3.3 restate the procedure and relevant findings from that study.

3.2 *Vowel length and glottalization in Todos Santos Mam* Mam has a 5-vowel system /a i e o u/, along with a phonemic length contrast evidenced by (near-)minimal pairs (England 1983). According to England, Mam’s /Vʔ/ sequences interact with vowel length, such that Vʔ often have no glottal release, and that Vʔ vowels are lengthened relative to their V(C) counterparts;[3] she also notes that Vʔ syllables are realized with falling pitch.

Kuo & Elkins (2022) conducted the first acoustic study of vowels in Todos Santos Mam, which is also a Northern Mam dialect, with the goal of (i) testing whether Todos Santos Mam has a phonemic length contrast, and (ii) whether Vʔ is realized as a glottalized vowel, cued by length and/or vowel quality/pitch. Here, we report a subset of findings that are relevant to the role of Vʔ in stress assignment, focusing on duration differences caused by a glottal coda; full results are reported in Kuo & Elkins (2022).

3.3 *Items and procedure* A male speaker of Todos Santos Mam was recorded reading a wordlist over Zoom. The wordlist contained 128 mostly monosyllabic items distributed across the five vowel qualities; the breakdown of stimuli by vowel quality is given in Figure 1 below. Items were balanced to the extent possible based on limited dictionary resources from Sitler (2002) and personal fieldwork.

	short	**long**
/a/	19	10
/e/	12	7
/i/	15	15
/o/	13	10
/u/	11	16

	Vʔ	**V(V)(C)**
/a/	9	20
/e/	7	12
/i/	10	20
/o/	5	18
/u/	15	12

Figure 1. The number of short vs. long, and glottalized vs. modal vowels, by quality, included in the experimental wordlist

Overall, Vʔ in medial position is primarily realized as a lengthened vowel with falling pitch and no glottal release. This is qualitatively demonstrated in Figures 2 and 3; Figure 2 shows a production of the word [noʔʂ] <no’x> ‘insect’, with a Vʔ syllable, and Figure 3 shows a production of the word [moʂ] <mox> ‘beetle’, with no glottal coda.

Vowel duration was measured from the onset to the offset of periodic waveforms. Differences in duration were statistically confirmed using logistic mixed effects regression in *lme4* (Bates et al. 2015), with duration as the dependent variable, item as a random effect, and main effects of **syllable type** (VV vs. Vʔ vs. V), vowel quality, onset type, and coda type. The significance of syllable type was tested using model comparison with the *anova* function in R.

Overall, we find a significant effect of syllable type on duration ($p < 2.2 \times 10^{-16}$). Results are illustrated in Figure 4. Here, we see that across all five vowel categories, Vʔ syllables have longer duration than V(C) syllables. In most cases, the duration of Vʔ is between that of V(C) and VV, though we see that for the vowel /o/, Vʔ and VV have approximately the same duration.

[3] England’s (1983) grammar was based on Ixtahuacán Mam, which is fairly representative of Northern Mam dialects.

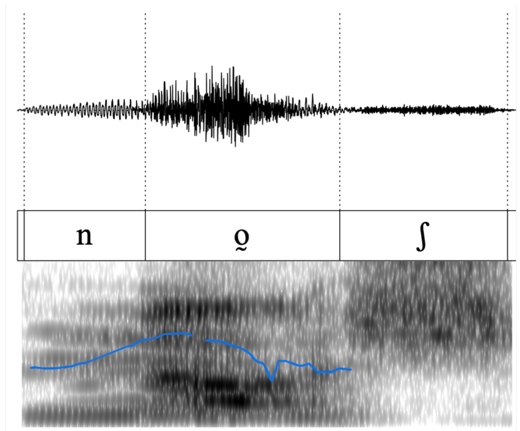

Figure 2. A production of the word [noʔʂ] <no'x> 'insect'

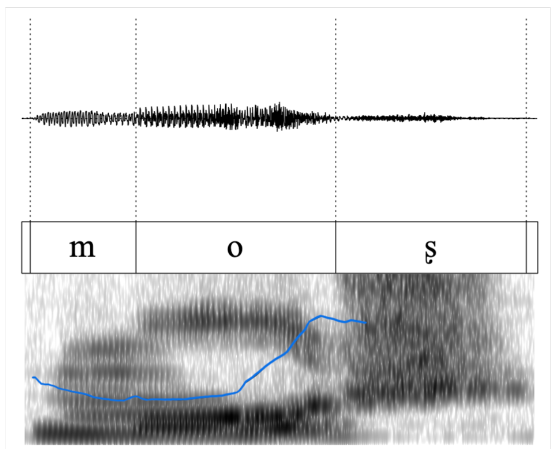

Figure 3. A production of the word [moʂ] <mox> 'beetle'

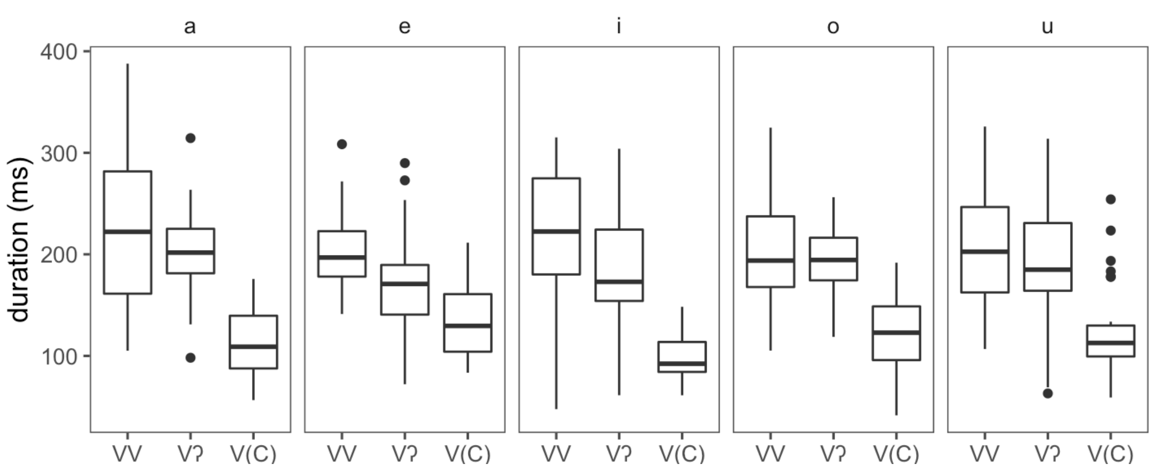

Figure 4. Vowel duration by vowel and syllable type

Finally, it should be noted that /Vʔ/ is realized as a glottalized and lengthened vowel in medial position, but as a modal vowel followed by a full [ʔ] release in absolute word-final position. An example of /Vʔ/ in word-final position is given in Figure 5, for the word [ts'aʔʰ] <tz'a'> 'it returns'. Compared to the production in Figure 3 ([noʔʂ] <no'x> 'insect'), the production in Figure 5 has a relatively shorter vowel, rising pitch, and aspiration that is characteristic of stop releases in Mam (in Mam, all final stops are allophonically aspirated). This observation, taken together with the findings so far, suggests that glottalized vowels are an allophonic realization of underlying /Vʔ/ sequences, as summarized in (13).

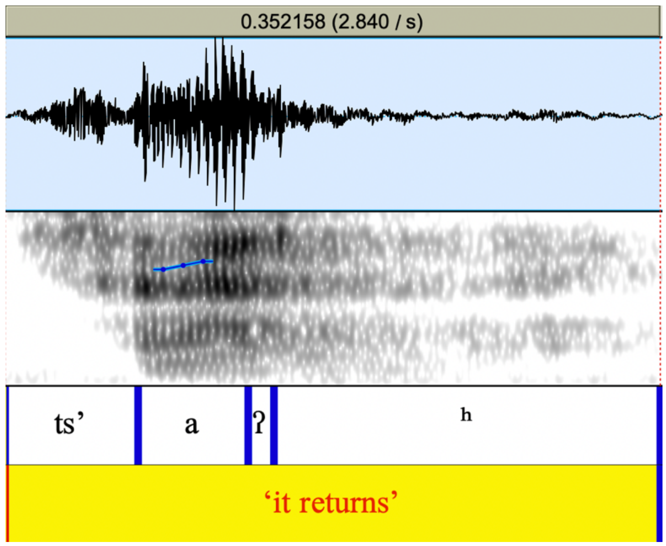

Figure 5. A production of the word [ts'aʔh] <tz'a'> 'it returns', with a word-final Vʔ

(13) Allophony of glottalized vowels in Todos Santos Mam

/Vʔ/

[V̰̂ˑ] word-medial

[Vʔ] word-final

The following section introduces a prominence account of the Mam weight scale based on the foregoing experimental findings. The account rests on this added prominence of glottalized vowels contributed by their moraic glottal codas.

4 A prominence analysis of Todos Santos Mam weight

With the result in hand that Vʔ's in Mam are more prominent than VC's but less prominent than VV's, we can analyze the four-way weight scale in Todos Santos Mam within a prominence framework. This analysis borrows from the Chickasaw analysis presented in Section 2, with a similar OT constraint set:[4]

(14) Constraints invoked in the prominence account of Todos Santos Mam

a. VV-TO-MAIN (VV→MAIN): Assign a violation for every long vowel which does not bear primary stress.

b. Vʔ-TO-MAIN (Vʔ→MAIN): A Vʔ syllable bears primary stress.

[4] Like Ryan (2020), we are also assuming an undominated WbyP constraint; we leave it out of exemplar tableaux to follow for convenience.

c. WEIGHT-TO-STRESS PRINCIPLE (WTS): Assign a violation to any heavy (bimoraic) syllable which does not bear stress.
d. ALIGN(σ́, R, PrWd, R) (ALIGN-R): (Primary) stress is aligned to the rightmost syllable of the prosodic word.
e. NONFINALITY(μ) (NONFIN): Assign a violation to any candidate where the final mora is stressed.

The new critical constraint we are proposing to capture the special prominence profile of Vʔ's is seen in (14b): Vʔ→MAIN. This constraint is violated whenever main stress does not fall on a glottalized vowel. Also of note is the formulation of NONFINALITY in (14e), which accounts for the fact (discussed in Section 1) that although Mam stress is generally right-aligned, stress avoids final *light* syllables.[5] A similar approach is taken by Hyde (2011) to account for weight-sensitivity at in final syllable position. The rest of this section fleshes out our proposed analysis.

First, we examine forms with no VV, where stress is allowed to be final thanks to the work of the alignment constraint:

(15) *In the absence of VV, stress is final if the ultima is heavy*

manmaq ‘big (of animals)’	VV→MAIN	WTS	Vʔ→MAIN	NONFIN	ALIGN-R
a. ☞ man$_{\mu}$ˈmaq$^{h}{}_{\mu}$		*			
b. ˈman$_{\mu}$maq$^{h}{}_{\mu}$		*			*!

Above, both (15a,b) incur violations of WTS because each have a syllable with a moraic coda (VC) which does not receive stress; however candidate (15a) ultimately wins because its competitor (15b) does not have the ideal right-aligned stress.

Next, we see a case of stress retracting to the penult if the ultima is light and cannot bear stress (although not shown in the following tableau, we assume that high-ranking DEP-μ/C constraints rule out augmenting ultimas via lengthening or epenthesis).

(16) *Stress retraction if the ultima is light*

meɓ̥a ‘orphan, poor one’	VV→MAIN	WTS	Vʔ→MAIN	NONFIN	ALIGN-R
a. ☞ ˈmeɓ̥ɐ					*
b. meˈɓ̥a				*!	

Above, we see that (16a), with penultimate stress, is the winner because it avoids a violation of NONFIN. Its competitor (16b), fails because although it satisfies ALIGN-R, it allows stress to coincide on a right-aligned weak syllable, which in Todos Santos Mam is illicit.

(17) *VV attracts primary stress if present*

kuʔwaːl ‘child’	VV→MAIN	WTS	Vʔ→MAIN	NONFIN	ALIGN-R
a. ☞ kuʔ$_{\mu}$ˈwaːl$_{\mu}$		*	*		
b. ˈkuʔ$_{\mu}$waːl$_{\mu}$	*!	*			*

[5] One of the authors would like to thank an anonymous reviewer for the Chicago Linguistics Society's 58th meeting (CLS58), for pointing out this possibility in an earlier version of this project.

Next, we consider words where there is a VV syllable present in (17) above. Here, highly ranked VV→MAIN takes effect. First, a violation of VV→MAIN causes (17b) to lose; (17a), with stress on the heaviest syllable of the word (its VV), wins. This tableau also showcases the ranking in prominence of VV > Vʔ; once instantiated, VV will attract stress over Vʔ in all instances.

Finally, we look to the tableau below in (18), which shows relative prominence of Vʔ > VC. As we can see, stress is attracted to the Vʔ syllable in (18a) thanks to the ranking of Vʔ→MAIN >> ALIGN-R; candidate (18b) loses because although it has rightmost stress, its Vʔ syllable is unstressed in favor of a lighter VC.

(18) Vʔ→MAIN compels Vʔ > VC

χiʔʈʂ'aχ 'thin person'	VV→MAIN	WTS	Vʔ→MAIN	NONFIN	ALIGN-R
a. ☞ ˈχɪʔ$_{μ}$ʈʂ'ɐχ$_{μ}$		*			*
b. χɪʔ$_{μ}$ˈʈʂ'aχ$_{μ}$		*	*!		

In sum, the above constraint rankings quite parsimoniously derive the four-way weight hierarchy of VV > Vʔ > VC > V in Todos Santos Mam within a prominence framework in Optimality Theory.

5 Discussion and conclusion

Todos Santos Mam's four-way weight hierarchy of VV > Vʔ > VC > V is derivable within the prominence framework (Ryan 2019, 2020), so long as we permit an additional prominence-driven constraint Vʔ→MAIN that assesses violations for candidates that have Vʔ's but do not stress them. This constraint is phonetically motivated: in particular, Kuo & Elkins (2022) conduct the first acoustic-phonetic experiment into a Northern Mam variety, Todos Santos Mam, and find that /Vʔ/ are realized as glottalized vowels with duration between that of /VV/ and /V(C)/ syllables. Assuming that vowel length is a primary correlate of prominence, the relative ranking of Vʔ within the Mam weight hierarchy falls out naturally from its phonetic realization.

Overall, results support the idea that the variable position of glottals in weight hierarchies falls out from language-specific phonetic realizations. For Northern Mam varieties, the glottal lengthens the vowel, thus contributing to vowel prominence intermediate between VC and VV. In other languages, such as Hupa, Ngalakan, and Capanahua, where VC > Vʔ (the opposite pattern to Mam), the prediction is that these Vʔ sequences are realized as checked or reduced vowels (i.e. phonetically non-prominent). Future work should test whether this hypothesis is born out cross-linguistically.

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