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The reality of Rukai Glides

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Abstract: Prosodic details offer valuable insight into the phonology of languages, but prosodically-grounded analysis alone does not reveal the whole picture. Benjamin Macaulay’s prosodic study into Rukai provides valuable insights into the syllable structure of the language, but phonological alternations, particularly the alternation of glides and fricatives, as well as the historical source of glides, suggests that glides still form an important part of Rukai’s phonology. Rather than doing away with glides, as Macaulay suggests, this study proposes a compromise position that acknowledges the utility of Macaulay’s prosodic analysis in many cases but keeps the glides [j] and [w] as part of the phonology of Rukai.

Keywords: Rukai; pitch; stress; glide fortition

1 Introduction

Benjamin Macaulay’s recent study, *Speaker judgments alone cannot diagnose syllable structure*, posits that phonological descriptions of syllable structure, both generally and specifically in the Formosan languages of Taiwan, overly rely on speaker judgements when making statements on syllable boundaries. In addition to that, however, the study also forefronts the utility of intonation in determining stress placement and as a tool in determining syllable boundaries. Macaulay focuses his attention on Budai Rukai, a Formosan language well-known among Austronesianists for its system of phonemic accent (Blust 1997; Li 1977; Ross 1992).¹ He argues that previous research into Rukai, particularly that of Chen (2006) and Liu (2011), is compromised by the same over reliance on speaker judgements in its formation of syllable boundary rules that he claims plagues the field as a whole. His contribution, then, is to provide a novel analysis of Rukai syllables based on acoustic analysis of his own field recordings within a framework of Autosegmental Metrical Phonology

¹ Budai is part of the Rukai language cluster. In the present study, “Rukai” is used only in reference to Budai Rukai, and not to any of the other Rukai languages and dialects, many of which have substantially different prosody.

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(AM, Pierrehumbert 1980). Ultimately, he argues for a smaller maximum syllable than previous studies and a total elimination of glides from the phonemic inventory.

Macaulay's research into the prosody of not just Rukai, but many other Formosan languages (cf Macaulay 2020, 2021), represents valuable research into an often understudied aspect of these languages. His contributions have helped shed light on parts of the phonology that, as he points out, tend to receive less detailed description and analysis and which are, at times, impressionistic. Macaulay's use of phonetic analytical methods is thus a welcome improvement on past descriptions of Formosan stress and intonation.

In responding to this article, I found myself agreeing with many of Macaulay's insights, but there are some disagreements as well as areas where I believe Macaulay's research has opened up interesting possibilities for future work of typological and theoretical interest. While Macaulay's research into Rukai prosody represents an important step forward in the rigorous study of Formosan phonology, the conclusions about syllable divisions sometimes extend beyond what the evidence suggests. First, Macaulay makes assumptions about how syllable boundaries were determined, and he assumes that studies which do not explicitly state their methods must have relied on speaker judgements. Second, his intonational, AM approach associates pitch-accent with stress and foot/syllable divisions, even though intonation peaks do not universally align with stress nor do syllable breaks universally follow intonation peaks. In this area, Macaulay's detailed phonetic recordings and analysis open up the possibility for interesting work on possible pitch-stress non-isomorphism. Finally, due to Macaulay's assumptions about the relationship between pitch-accent and syllable divisions, he is forced to awkwardly ignore what appears to be a straightforward case of glide-fortition that favors analyzing Rukai as having both vocalic sequences such as a.i and a.u as well as monosyllabic vowel-glide sequences like aj and aw.

I discuss each of these below, beginning with my thoughts on Macaulay's assumptions about other researcher's methods in §2. Next, §3 and §4 builds on Macaulay's pitch-based analysis and suggests possible pitch-stress non-isomorphism in §3 followed by a reanalysis of glide-fortition as a syllable edge cue in §4, defending earlier analyses from Chen (2006) and Liu (2011). I add a diachronic perspective to the distinction between [...ia] and [...ua] versus [...ja] and [...wa] sequences. A distinction which is still very much alive in contemporary Rukai. In the end, Macaulay and I are in agreement on the need to reanalyze CGV syllables as CV.V and the importance of pitch-tracking methods in phonological research. We are in disagreement, however, on the extension of that analysis to all CVG segments, as the segmental evidence supports analysing CVG syllables as single syllables in cases where the glide is not accented and where the glide undergoes fortition in intervocalic position after affixation.

2 Speaker judgements and methodology

Macaulay's arguments seem to be constructed around the assertion that grammatical descriptions are much more reliant on speaker-judgements of syllable boundaries than they seem. In constructing this reality, he does not provide citations of grammars that specifically state that speaker judgements played the major role in determining syllable boundaries, and can only show that many scholars may have taken speaker judgements into consideration or that some scholars are not clear on how they made their syllable boundary decisions. The major works cited by Macaulay which reference Formosan language phonology – Pan (2012) for Saaroa, Chang (2006) for Paiwan, Teng (2008) for Puyuma, and Rau (1992) for Atayal – , for example, do not specifically state that speaker judgements provided the core of the evidence used to make claims about syllable structure. Rather, the deficiency of these descriptions is that they make no statement on how they made their syllable boundary decisions. It is true that these and other works would be improved if exact methodologies on syllable analysis were provided, and we should expect no less than complete methodological transparency in the scientific study of language. However, it is not reasonable to make assumptions about how syllable boundary decisions were made by other scholars in the absence of a clearly stated methodology. Perhaps some of these descriptions truly did simply ask informants to make syllable boundary decisions and then restated the informants insights as fact. That would clearly be a serious shortcoming. But is it fair to assume that that was the case in all of these descriptions? I do not believe that such an assumption is warranted.

3 Pitch-accent and stress

Stress and pitch-accent are sometimes presented as mutually exclusive, languages are either stress-accented or pitch-accented, but languages where both stress and pitch-accent manifest are well-studied, for example, Uspanteko (Bennett and Henderson 2013), Danish (Basbøll 2015) and many others. In most cases, if stress and pitch are present in a single language then pitch-accent is in fact stress-aligned, meaning that high tone bearing syllables are also stressed syllables (and in the case of Uspanteko this overrides otherwise fixed-stress patterns where they conflict with the realized position of pitch-accent).

In Philippine languages with distinct accent systems, for example, accent is intricately tied to vowel length, suggesting a true isomorphism of accent and stress. In Ilocano, Tagalog, Bikol, and many other Philippine languages, accented

penultimate syllables have long vowels, but accented final syllables do not. There are no long vowels that do not also bear accent (Hayes and Abad 1989; Zorc 1993). In such a system, analyzing the pitch-accent peaks as isomorphic with stress is the obvious solution. But what about systems where pitch and stress may not align?

Ito and Mester (2016: 473) define a constraint within Optimality Theory (OT, Prince and Smolensky 1993), WORD PROMINENCE TO WORD HEAD ($W_{D}PROM_{TO}W_{D}HD$), as requiring the main prominence of a prosodic word (if such a main prominence occurs) to coincide with the prosodic head of the prosodic word, i.e., the head syllable of the head foot. The violable nature of such constraints predicts that some systems will allow violations of $W_{D}PROM_{TO}W_{D}HD$. Although Ito does not utilize violations in her analysis of Japanese, she leaves open the possibility of violations in future research, also citing Kiparsky (2003) as having proposed such an analysis for Ancient Greek. One consequence of supposed $W_{D}PROM_{TO}W_{D}HD$ violability is the possibility that one type of prominence, pitch-accent, may not align with other, stress-correlated prominences like intensity or length. In such a system stress may appear on one syllable but pitch accent on another. Such stress-pitch nonisomorphism is rare, but is found in analyses of Latvian (Steinbergs 2009), Ponapean (Rehg 1981, 1986), in reconstructed Proto-Micronesian (Rehg 1993), and modern Kiribati (Blevins and Harrison 1999).

In Ponapeic languages, for example, stress falls on the final vowel of the prosodic word and every alternating syllable before that, but high pitch is located on the penultimate syllable. Ponapean and Mokilese, two Ponapeic languages, demonstrate the nonisomorphism of accent and stress. Stressed syllables in both are correlated with intensity peaks, and vowels in stressed syllables are resistant to reduction (via raising) and syncopation. Unstressed syllables, i.e., those which bear pitch-accent, may reduce or delete in Mokilese. Regh (1993) provides a direct comparison of Ponapean and Mokilese, reprinted here in Table 1.²

In a more distantly related, but still Micronesian language, Kiribati, a similar system is analyzed by Blevins and Harrison (1999: 217). They describe the prosodic

Table 1: Ponapeic pitch and stress pattern.

Ponapean	Mokilese	Gloss
m ^w é'ŋe	m ^w r'ŋe	eat
mé'se	m'jjoa	face (3sg)
,ará'mas	ar'maj	person
,apé're	ap'roa	shoulder (3sg)

² I represent pitch-accent or pitch-peaks with an accent, á, and stress with the IPA, 'a or a.

system of Kiribati as containing a trimoraic foot, which "...is characterized by an intensity or loudness peak on the penultimate mora and a pitch peak on the antepenultimate mora." The prosodic system of Kiribati is essentially identical to that of Ponapeic, without the historical loss of final syllable vowels that has resulted in the synchronic word-final stress of Ponapeic languages, and this system of pitch accents falling on the immediately pre-stress syllable is reconstructed to Proto-Micronesian (Rehg 1993). Some examples of Kiribati pitch and stress patterns from Blevins and Harrison (1999) are reprinted here in example 1.

(1) **Pitch and Stress in Kiribati**

á'arna	'name (3sg)
ká'mea	'dog'
má'tu:	'to sleep'
bú'kin	'end of'

The Micronesian data presented here are certainly interesting, but the existence of pitch-accent and stress nonisomorphic languages bears special significance to the discussion of Rukai. Macaulay analyzes the pitch-accented syllable as the stressed syllable, following the intuitive association of increased pitch with stress and the assumption that stress and pitch accent always align, yet at least some of the data presented in his study contain tantalizing evidence for pitch-stress nonisomorphism. To be clear, the following discussion is based on my own impressionistic interpretations of the data presented by Macaulay. There are relatively little data to go on, and I am sure that Macaulay has access to more than what he presented in his study. I also acknowledge that Macaulay undoubtedly has a much deeper understanding of Rukai prosody than I do, and he likely has satisfying explanations for these differences. However, it may still be worthwhile to acknowledge that (i) pitch-accent and stress are not universally aligned, and therefore (ii) identifying pitch-accented syllables is not synonymous with identifying stressed syllables. In the following discussion, I will provide a limited analysis of vowel length as presented by Macaulay. To begin, I present four tokens of *taúpuŋu* in Figure 1 and a single token of *laimai* in Figures 2 and 3.

These four tokens of *taúpuŋu* have roughly equal vowel lengths. When comparing the accented and unaccented penultimate and antepenultimate vowels, there is essentially no segmental phenomena to suggest that the accented syllable should not also be analyzed as the stressed syllable, and Macaulay's suggested revision, from *táwpuŋu* to *taúpuŋu* seems fundamentally correct.

Two tokens of *laimai* have roughly equal vowel lengths as well, with the added note that one token has the first person singular genitive enclitic =*li*. The vowel *i* in =*li* is longer than the other vowels (possibly due to phonetic lengthening in final position). There is no segmental evidence to suggest that the palatal glides of Chen's

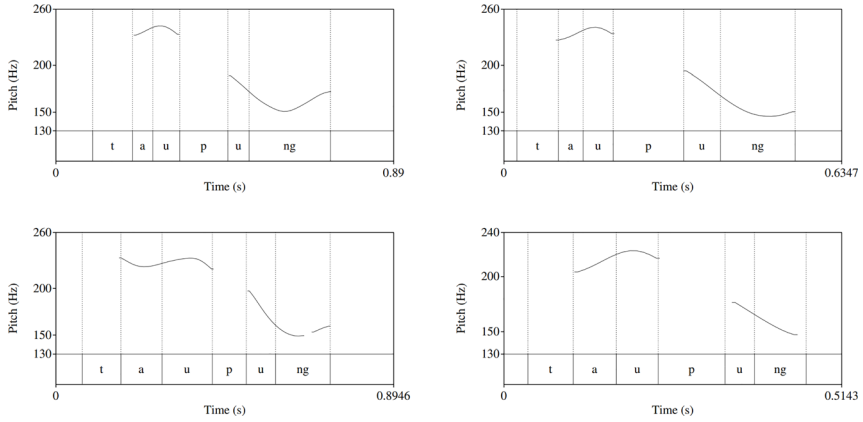


Figure 1: Pitch tracks of four tokens of *taupu* ‘dog’ from the target article.

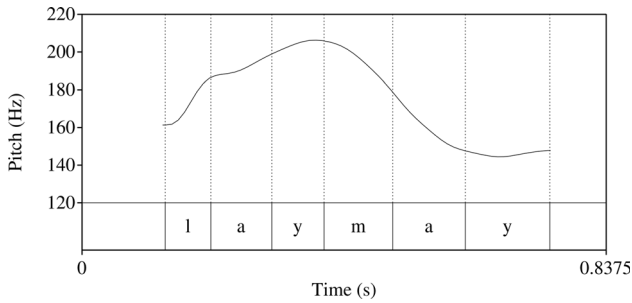


Figure 2: Pitch track of a production of *laima* ‘clothes’ from the target article.

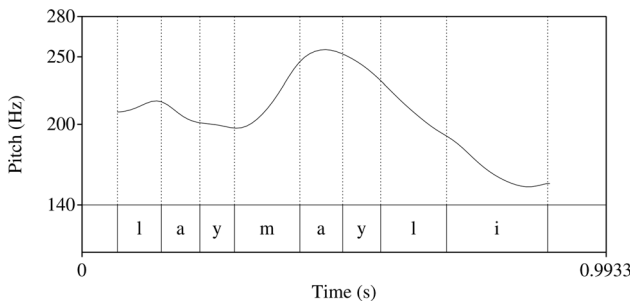


Figure 3: Pitch track of a production of *laimai = li* ‘my clothes’ from the target article.

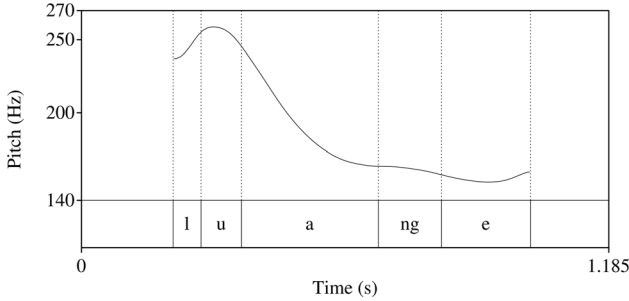


Figure 4: Pitch track of a production of *lúʔaŋə* ‘cow’ from the target article.

analysis are not actually high-front vowels, and the ability of /y/ to hold pitch-accent also supports Macaulay’s reinterpretation of *láymay* as *laímai* (or as *laímay*, since there is similarly no reason to propose that the final segment cannot possibly be a glide).

The most interesting data appear in Macaulay’s reanalysis of CGV syllables. The only example with a pitch track is from *lúʔaŋə* ‘cow’, reprinted here in Figure 4.

This word reflects Proto-Austronesian (PAN) *qaNuaŋ ‘large ruminant species’, which may have had a penultimate stress pattern as *qaNuaŋ (Smith 2023) but in Rukai that stress seems to have shifted to the final syllable. In Tona Rukai, for example, stress is recorded as word-final with the previously stressed penultimate vowel *u having shifted to a glide, *w (Tona Rukai *Nwáŋə* ‘cow’, data from Li 1977). This development is mirrored in other Formosan languages, where the historical *u has further undergone glide fortition, for example in Takituduh Bunun *qanváj* ‘deer’.³ The segmental data presented by Macaulay appears to agree with these earlier works. The penultimate vowel /a/ is significantly longer than the pitch-accented segment /u/ (or /w/), and this length may be the true indicator of stress position in that word. Macaulay analyzes this word as *lúʔaŋə*, but an analysis that recognizes how pitch and stress may be nonisomorphic may be better suited to capture both the pitch and length facts. Thus, my reanalysis of this word is *lúʔa:ŋə*, which acknowledges Macaulay’s pitch measurements as well as the length differences.

If stress truly is on a separate syllable than pitch accent in this word, the pitch accent may better reflect the older Proto-Austronesian stress placement as

³ This word may ultimately be a borrowing, since the expected reflex of PAN *l in all dialects of Rukai is /l/. The apparent stress shift is therefore not a result of any historical process that affected directly inherited words. The synchronic analysis, which demonstrates the length of /a/ when compared to /u/, remains valid.

Table 2: Original CGV syllables with current reanalysis.

Original	Macaulay	Pitch-Stress nonisomorphism	Gloss
lwá.ŋə	lú.a.ŋə	lú.'a:.ŋə	COW
mu.swá.nə	mu.sú.a.nə	mu.sú.'a:.nə	2SG.OBL

reconstructed by Smith (2023). The implications of such a historical decoupling of stress and pitch remain to be fully investigated. It is not clear, however, if this vowel length observation will hold true with other words that Macaulay has reanalyzed from CGV to CVV, since pitch tracks are not supplied for all such words. Only two words are found in Macaulay's list that may be reanalyzed upon further analysis, listed here in Table 2.

4 Segmental correlates of syllable divisions

4.1 Word-final glides

Based on his data, some pre-final syllable divisions may require reanalysis as per his proposal. However, the glide-fricative alternations of final syllable glides in my view rule out a reanalysis of word final [aj] and [aw] as [a.i] and [a.u]. Macaulay's analysis of Rukai as a "glideless" language runs counter to not only synchronic evidence, but also runs counter to diachronic evidence which reinforces the original analyses with word-final glides.

Proto-Austronesian (henceforth PAN) had four vowels, *a, *i, *u, *ə and two glides, *w and *y [j]. The glides were free to appear in any position, although *y was quite rare in word-initial position.⁴ Of importance to the present discussion is the presence of glides word-medially and word-finally. The glide-strengthening process, which is described as a process affecting glides in word-final position such that glides /j/ and /w/ become /ð/ and /v/ after suffixation with a low-vowel initial suffix, also affected inherited glides in word-initial and medial position. Some examples of historical glide fortition are shown here in Table 3. Note that there are no examples of *y → ð in word-initial position due to a lack of valid y-initial reconstructions.

⁴ The glide *y may have been banned from word initial position, since there is only one y-initial word listed in the Austronesian Comparative Dictionary (ACD, Blust et al. 2023), *ya 'nominative case marker for singular common nouns'. PAN *ya may have been *ia, which would leave no y-initial reconstructions.

Table 3: Examples of historical glide fortition in word-initial and medial positions.

PA _N	Rukai	English
**kawayan	kavaðanə	bamboo species
**qayam	aða-aðamə	bird

Inherited high-vowels *i and *u were unaffected by fortition, as already evidenced by words like *luanə* ‘cow’ (instead of **lvanə). This is a particularly important feature of Rukai, since the fortition environment that is introduced via suffixation follows the same pattern: historical full vowels do not trigger glide fortition but historical glides do. First, example (2a) shows noncontroversial full-vowels not alternating with /v/ or /ð/ and (2b) shows glides in the same environment which do alternate.

(2) **Contrast between non-alternating vowels and alternating glides**

- a. bu|ubu|u-a ‘teach (imperative)’ → [bu|ubu|uwa]
 pi|i-a ‘choose’ (imperative) → [pi|i]ja
- b. qa|qaw-a ‘wait (imperative)’ → [qa|qava]
 sa-tu-apuj-anə ‘material for fire’ → [satuapuðanə]

Example (2b) contrasts directly with the following examples in (3), which has non-alternating full vowels in identical environments as the alternating glides.⁵

(3) **Non-alternating full vowels in intervocalic positions**

- vai-a ‘rise, of the sun’ (imperative) → [vaija]
 suakai-a ‘support’ (imperative) → [suakaija]

The non-alternating vowels in (3) directly parallel the non-alternating vowels in (2a). Interestingly, wherever the data is available we can see that the alternating glides descend from PA_N glides. The stem *apuj* in (2b), for example, is from PA_N *Sapuy ‘fire’, and so are the other alternating examples cited by Macaulay, *patsaj* (← PA_N*pa-aCay ‘kill’) and *baj* (← PA_N*bəRay ‘give’). In contrast, the non-alternating vowels descend from PA_N full vowels which had, due to historical changes, come to appear in intervocalic position in Proto-Rukai. The best example from the available data is *vai* from example (3), which reflects PA_N*waRi ‘sun’ (Blust et al. 2023).

These insights lend significant strength to the analysis of Rukai as distinguishing the vowels /i/ and /u/ from the glides /j/ and /w/, at least in word-final position. Under this analysis, Rukai inherited glides from PA_N. In medial position, those glides all

⁵ Unfortunately, I was unable to find any examples of /au-a/ in either Chen (2006) or Liu (2011).

underwent fortition to /ð/ and /v/, leaving only reflexes of PAN word-final glides as surface glides in unaffixed words. The synchronic alternations as well as the diachronic reality of Rukai glide alternations suggests that Rukai still distinguishes between glides and vowels in word-final position.

4.2 Word-medial glides and long vowels

Rukai probably does not have underlying CGV sequences, as Macaulay made clear in his analysis of pitch-accent in syllables that were previously analyzed as CGV. However, Rukai does allow glides in word-final coda position. This brings up a further possibility, that is, that Rukai may allow glides in *any* coda position, not just word-final coda position.

It is difficult to say for sure whether Macaulay's reanalysis of CVG.CV as CV.V.CV is truly necessary. The suspected glides appear adjacent to a following consonant so there is no opportunity to test the syllabicity of these segments via suffixation to see if they alternate with /v/ or /ð/. Pitch-accent therefore plays a crucial role in solving this problem. Below in Tables 4 and 5, two sets of CVG and CV: reanalysis are shown. In Table 4, pitch-accent on the glide or on the second mora of the supposed long vowel, as analyzed by Macaulay, offer a compelling case for reanalysis. In Table 5, the appearance of the pitch-accent on the initial mora, are ambiguous.

Macaulay's reanalysis of syllable boundaries in the examples in Table 4 are well-supported because the location of the pitch accent on the second mora of the long vowel or on the glide of the diphthong violates syllable integrity under

Table 4: Examples of well-supported VG.CV and V: CV to V.V.CV reanalysis.

Original	Macaulay	English
ga.láw.gaw	ga.la.ú.ga.u	finger
ká:.ɕaw	ka.á.ɕa.u	big
láj.maj	la.í.ma.i	clothing

Table 5: Examples of ambiguous VG.CV and V: CV to V.V.CV reanalysis.

Original	Macaulay	English
dá:.nə	dá.a.nə	house
ki.sá: u	ki.sá.a. u	borrow
táw.θu	tá.u.θu	tail

Table 6: Various reanalyses of Rukai Syllables.

Original	Macaulay	Current
CGV	C'V.V	C'V.V/C'V.V
CVG	C'V.V/CV.V'	C'VG/CV.V'
CV:	C'V/CV.V'	C'V:/CV.V'

the original analysis.⁶ However, he continues to extend this reanalysis to all VG and V: sequences, even when pitch accent is at the beginning of the vocalization (or, on the first mora). Such a reanalysis is not required under any standard definition of the syllable. Rather, his reanalysis of a syllable like /táw/ as /tá.u/ appears to be motivated by internal logic; Macaulay analyzes Rukai as a diphthong-less language, therefore these must be V.V syllables. In his treatment of long vowels, he similarly extends his originally well-grounded analysis to all long vowels. Thus, a syllable like /dá:/ is reinterpreted as /dá.a/. Pitch-accent on the second mora of a long vowel does necessitate splitting the syllable, but splitting the syllables of all long vowels even where pitch-accent does not support such a reanalysis seems to be an overreach.

A possible alternative to Macaulay's reanalysis is to acknowledge that second-mora pitch accent necessitates splitting long vowels and VG sequences into two syllables, but allow for VG sequences and long vowels where the pitch-accent is on the initial mora. VG segments likely exist in word-final position, so this reanalysis resolves syllable integrity while allowing an already existing syllable structure to surface in non-final positions. Like word-final vocalic sequences which have both V.V and VG underlying forms, there is no reason that I see to deny both possible underlying forms for non-final vocalic sequences (Table 6).

5 Conclusions

Macaulay has provided much needed pitch-tracking data for Budai Rukai, as well as a thoughtful and transparent reanalysis of syllable divisions based on that new data. Rukai does not appear to have true monosyllabic GV sequences, and certain VG sequences may also be reanalyzed as V.V.

In this commentary, I have attempted to build on Macaulay's arguments. There are some indicators that pitch-accent and stress may be nonisomorphic, at least

⁶ Although stress placement may be determined by moras, it is the syllable that bears stress. One therefore does not expect to see a single heavy syllable where stress or pitch-accent is realized on the second mora (Hayes 1995). It is standard practice in such cases to split the vowel into two syllables.

in cases where previous GV sequences were reanalyzed as V.V sequences and the second vowel is significantly longer than the first, suggesting an accented initial short syllable followed by a lengthened stressed second syllable: $\acute{V}.V\text{:}$. I also put forward additional support for the original analysis of word-final vocalic sequences as containing both V.V and VG syllables. This defense of the original analysis pushes back on some of Macaulay's claims, and further extends to V: and VG segments in medial position.

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