Reconstructing non-contrastive stress in Austronesian and the role of the mora in stress shift, gemination and vowel shift

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Competing schools of thought on the reconstruction of Proto-Austronesian stress contend that primary stress was either regular (falling on the penultimate syllable with possible phonetic conditions that triggered stress shift to the final syllable) or lexical (falling unpredictably either on the penult or ultima). In this study, I argue that the comparative evidence supports the first position: that primary stress fell regularly on the penultimate syllable and was not lexical. Further, primary stress was repelled to the final syllable if the penultimate syllable was open and contained a schwa nucleus. Three Austronesian first-order subgroups, Malayo-Polynesian, Western Formosan, and Paiwan, are shown to directly continue the reconstructed stress system of Proto-Austronesian, with stress falling regularly on the penultimate syllable but shifting to the final syllable after a schwa.

I also argue that the inability of schwa to hold stress is a result not of quality, but rather of quantity, as it is shown that schwa was a zero-weight vowel in Proto-Austronesian. Words with a schwa in the penultimate syllable, CəCVC, are shown to be sub-minimal, containing only a single mora. Daughter languages in Malayo-Polynesian underwent multiple cases of phonologically motivated drift, including consonant gemination, the deletion of penultimate schwa in three-syllable words, and vowel shift. These sound changes are argued to be part of a phonological conspiracy whose outcome is the addition of a mora to sub-minimal words. This study therefore offers both a reconstruction of Proto-Austronesian stress as well as a phonological explanation for these various sound changes in Malayo-Polynesian.

Keywords: Proto-Austronesian, stress, phonological reconstruction, drift, sound change

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1. Introduction

In Austronesian comparative linguistics there are two main schools of thought on the reconstructed stress system of Proto-Austronesian (henceforth PAn) and often, by extension, of Proto-Malayo-Polynesian (PMP), a daughter language of PAn. The first posits a system with predictable stress placement, with primary stress placed exclusively or primarily on the reconstructed penultimate syllable (Blust 1997, 2013; Brandstetter 1916; Smith 2018a). The second posits a system of lexical stress with words unpredictably marked with primary stress either on the penult or the ultima (Pejros 1994; Ross 1992; Wolff 1991; Zorc 1978). This paper brings together a database of evidence in support of the first position, that primary stress in PAn and PMP was predictable; lexemes were stressed on the penultimate syllable with the additional observation that stress shifted to the final syllable under predictable circumstances. Triggers for stress-shift to the final syllable were (1) the presence of schwa in an open penultimate syllable and (2) morphological stress in word-class derivation as well as in vocative formation and as a marker of "closed class" words like negation, pronominals, deictics, and words with "list" or "citation" stress.[1]

Additionally, the study proposes a motivation for phonologically conditioned stress-shift after a penultimate schwa. It is proposed that schwa was, and often still is, a zero-mora vowel which did not add to the lexical mora count. The weightless schwa hypothesis has consequences for the formal representation of syllables in PAn and PMP. Where a schwa appears in an open penultimate syllable, the syllable nucleus attaches directly to the syllable head with no intervening mora. In cases where coda consonants close a schwa-syllable, however, it is argued that the presence of a coda allows for a moraic node. These conditions are not present in syllables with a vowel other than schwa, since in such syllables the vowel acts as moraic. A summary of the proposed syllable shapes in PAn and PMP is given below in Figure 1:

1. Note that phonemes called "schwa" have various pronunciations in Austronesian languages. It may be a true schwa [ə], barred-i [ɨ], or any other central vowel which ultimately reflects Proto-Austronesian *ə. Likewise, "stress" refers to the prosodic properties of the most prominent syllable in a word, which may have any number of correlates including vowel lengthening, increased pitch, and increased intensity.

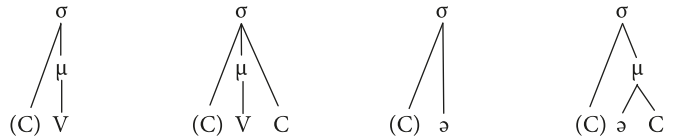

Figure 1. PAn and PMP syllable structures

As Figure 1 demonstrates, open schwa-syllables are unable to contribute to the lexical mora count. Words of the shape CəCV(C) were therefore sub-minimal (less than two moras in the right-aligned foot).[2] This led to multiple repair strategies in Malayo-Polynesian daughter languages that added an extra mora to words of this shape. Seemingly unrelated sound changes, including (i) consonant gemination,[3] (ii) the shift of schwa to a full vowel in the penultimate syllable (but not in other syllables), and iii) schwa deletion in three-or-more syllable words, are united under this hypothesis as being motivated by the same requirement that feet have, as a minimum, two moras. These changes are thus viewed as enforcing a two-mora minimum on disyllabic feet at the right edge of words. A summary of these proposed repairs is given in (1):

(1) a $(CəCVC)^{\mu} \rightarrow (CəC{:}VC)^{\mu\mu}$ (gemination)
b $(CəCVC)^{\mu} \rightarrow (CVCVC)^{\mu\mu}$ (vowel shift)
c $CV(CəCVC)^{\mu} \rightarrow (CVC.CVC)^{\mu\mu}$ (deletion)

Such repair strategies are only attested where schwa appears in penultimate syllables. This is a consequence of phonotactic restrictions on schwa, which do not allow for open schwa-syllables in word-final position. The phonotactics of schwa are explained in more detail in §2 of this paper.

The remainder of this paper focuses on the reconstruction of stress and presenting the argument for a zero-mora schwa, but first, some background on the Austronesian family, subgrouping, and reconstruction is given in §2. In §3 is an argument for the reconstruction of penultimate stress with stress shift to the final syllable if the penult was open and contained a schwa. Finally, in §4, the theory

2. Austronesian languages, by a wide margin, reflect right-aligned feet. This basic foot alignment is assumed to have existed in Proto-Austronesian due to its retention in so many daughter languages across a genetically diverse set of subgroups.

3. Gemination targets the onset of the final syllable whereby CVCV becomes CVC:V. Note that the terms "onset gemination" and the phrase "gemination of the final syllable onset", both used throughout this paper, refer to the pre-gemination syllable structure which under standard syllabification methods places the medial consonant in the onset of the final syllable, CVCV → CV.CV. It is therefore the onset of the final syllable which is the target of gemination. The term is not meant to imply a specific post-gemination syllable structure.

that schwa was weightless is proposed. This section gives evidence from multiple Malayo-Polynesian languages that certain sound changes, including gemination–schwa shift to a full vowel, and schwa deletion–are mora-addition strategies motivated by a two-mora minimum and triggered by the presence of a zero-mora schwa in penultimate syllables. The issue of variable coda weight, whereby schwa-syllables may be moraic if closed by a coda consonant, is also discussed in §4.

2. Austronesian background

With roughly 1,200 member languages, the Austronesian (An) family is the world's second largest language family, after Niger-Congo (Eberhard et al. 2021). The An languages are located throughout Island Southeast Asia and the Pacific, on the island of Madagascar off the south eastern coast of Africa, and in smaller numbers in Mainland Southeast Asia. There is widespread agreement among specialists that the An homeland was on Taiwan, and that the An presence outside of Taiwan is the result of an expansion event that occurred between four and five thousand years ago (Bellwood 1985–1986; Blust 1985–1986). Austronesian first-order subgrouping follows naturally from a Taiwan homeland hypothesis, with most proposals showing Taiwan as the most genetically diverse region containing multiple first-order subgroups and with all Austronesian languages outside of Taiwan belonging to the Malayo-Polynesian subgroup. Note that although the Austronesian languages of Taiwan do not form a single subgroup under most hypotheses, the term *Formosan* is often used to refer to all Austronesian languages of Taiwan. *Formosan* is not a subgroup, but rather, should be read as "the non-Malayo-Polynesian languages of Taiwan".

Although there are multiple competing hypotheses regarding the specifics of An subgrouping, this study's assumptions are based on Blust (1999) who posits 10 primary divisions: nine Formosan ones, plus Malayo-Polynesian. Malayo-Polynesian internal subgrouping follows Smith (2017c), who proposes nine primary branches. Both Blust (1999) and Smith (2017c) are shown in Figure 2. Note that the Philippine subgroup remains controversial; Smith did not endorse a Philippine subgroup, but rather stated that "Philippine" may be a subgroup, an innovation-defined linkage, or a group of multiple primary branches that descend directly from PMP. The specifics of the disagreements over a Philippine subgroup do not bear on the present proposal. See Blust (2020); Ross (2020); Reid (2020); Zorc (2020); and Liao (2020) for recent discussion on the topic.

Alternative proposals deal mostly with the subgrouping of Formosan languages. For instance, Ross (2009) proposed that PAn diversified into four primary divisions, Rukai, Puyuma, Tsou, and Nuclear Austronesian, rather than the 10

Figure 2. Austronesian and Malayo-Polynesian subgrouping (Blust 1999; Smith 2017c)

Austronesian	**Malayo-Polynesian**
Tsouic	Philippine
Western Plains	Western Indonesian
Northwest Formosan	Sumatran
Atayalic	Celebic
East Formosan	South Sulawesi
Bunun	Central-Eastern Malayo-Polynesian (CEMP)
Rukai	Moken
Puyuma	Chamorro
Paiwan	Palauan
Malayo-Polynesian	

divisions in Blust's 1999 proposal. Ross' proposal is based on verbal morphology. Unlike past proposals, which reconstruct the full suite of verbal voice morphology to PAn, Ross reconstructs only the optative/hortative and imperative/dependent verbal voice morphology to PAn. Other verbal voice morphology (namely realis, perfective, imperfective, and irrealis) are reconstructed only as nominalizations in PAn. These nominalizations were reanalyzed as verbal voice morphology in a later subgroup which Ross (2009) labels "Nuclear-Austronesian" (NAn). The innovation of nominalization > verbal morphology forms the foundation of the NAn subgroup. Ross' proposal does not alter the high level of genetic diversity in Taiwan as compared to regions outside of Taiwan, and it keeps most of Blust's subgroups intact, albeit with many falling under the new NAn node. The major difference is the treatment of Tsouic, which Ross splits into Tsou, a primary division from PAn, and Kanakanavu-Saaroa, which form a primary division within NAn. The breaking up of Tsouic by Ross follows a similar argument from Chang (2006), but note that in addition to Blust (1999), both Li (2008: 214) and Sagart (2014) also support a Tsouic subgroup. Regardless of the position of Tsouic, however, the present argument that stress may be reconstructed as falling principally on the penultimate syllable is unaffected. This study therefore uses Blust's earlier proposal because it is based on shared phonological innovations rather than morphological innovations, and also because the choice of one subgrouping over another has no impact on the proposals in this paper.

The PAn consonant inventory is given in Table 1. The following orthographic conventions should be noted: (i) *C was the alveolar affricate [ʦ], (ii) *S was the alveolar fricative [s] whereas *s was a distinct fricative, likely a post-alveolar [ʃ],

(iii) *N was a lateral distinct from *l, (iv) *c, *z, and *ñ are used for [ʧ], [ʤ], and [ɲ] respectively, (v) *D was a retroflex which was restricted to word-final position and is minimally attested, (vi) *j was probably a palatalized velar rather than a strict palatal or velar consonant, and also never appeared in word-initial position, (vii) *t was probably a dental consonant, whereas all other consonants in the same column were alveolar, and finally, (viii) *R was probably a trilled alveolar, whereas *r was probably a flap.

Table 1. Proto-Austronesian consonants

	Labial	**Alveolar**	**Post-alveolar**	**Retroflex**	**Palatalized-velar**	**Velar**	**Uvular**	**Glottal**
plosive	*p/*b	*t/*d		/(*D)*	/*j [gʲ]	*k/*g	*q	(*ʔ)
affricate		*C [ʦ]	*c [ʧ]/*z [ʤ]					
fricative		*S [s]	*s [ʃ]					*h
nasal	*m	*n	*ñ [ɲ]			*ŋ		
lateral		*N [ɬ]/*l						
flap		*r						
trill		*R						

* The slash separates voiced from voiceless. So for instance /D indicates that there is no voiceless counterpart.

PAn word-shape was constrained to a canonical two-syllable, two-mora word with no consonant clusters and closed syllables only in word-final position (Blust 2013; Chrétien 1965; Dempwolff 1937; Ross 1992). The sole exception is in reduplicated monosyllables, a class of words that contain a bound monosyllabic root which only appears in reduplicated contexts. Both canonical word shape and reduplicated monosyllable word shape are given in (2).

(2) Proto-Austronesian

Canonical Word	CVCV(C)	*paqa 'thigh',	*pənuq 'full'
Reduplicated Monosyllable	CVCCVC	*dəmdəm 'dark',	*bəjbəj 'tie by winding'

The only monosyllabic words which are reconstructed to PAn are of one of two types: (1) grammatical words and particles, and (2) onomatopoetic words (with minimal attestation). Examples of monosyllabic grammatical words include *ka 'conjunctive particle, and', *maS 'and', *na 'linker marking emphatic attribution'. Some examples of onomatopoetic words include *tik 'sound of tapping or flicking'

and *bəs 'whizzing sound'. Blust (2013:539) notes that these words were phonologically bound to adjacent content words. The restriction against monosyllables therefore only stands with phonologically independent content words.

Regarding the vowels, there is consensus on their basic phonetic properties. There were four vowels in PAn, which this study separates into two types, the "main" or "full" vowels *i, *a, and *u which had no phonotactic restrictions and were free to appear in any position of the word, and *ə, which was the subject of numerous unique distributional restrictions. Some of these restrictions have been discussed in previous research (see citations below), but others are newly recognized. The restrictions are: (i) Schwa could not appear in word-final position (Blust 2000:88), (ii) Schwa could not appear in word-initial position, with only two exceptions; the numerals *əsa 'one' and *ənəm 'six', (iii) Schwa was absent from both prefixing and infixing morphology. The patient voice suffix *-ən was the only "schwa-full" affix, and (iv) Schwa could not be immediately followed by a glide, *w or *y (Mills 1975).

PMP inherited many of the same restrictions on schwa that were present in PAn, including disallowing schwa in word-final position and from both prefixing and infixing morphology. Schwa restrictions were lifted in word-initial position, however, and PMP has several examples of word-initial schwa in addition to the two PAn examples given above, including PMP *əma 'father's sister', *əmpu 'grandparent; grandchild', and *əpat 'four', among others. PMP also relaxed consonant cluster restrictions relative to PAn. Prenasalized stops were prevalent in intervocalic position in PMP and words of the shape CVCCVC were not uncommon outside of reduplicated monosyllable contexts.

With these observations one can make relatively uncontroversial generalizations about PAn word shape. (i) Content words were minimally two syllables. (ii) The vowels are divisible into two classes, the main vowels and schwa. (iii) Schwa was permitted in root-internal closed syllables, unless the syllable was closed with a glide. (iv) Schwa was permitted in open penultimate syllables unless that syllable was followed by a glide, but not other open syllables. (v) Consonant clusters were restricted to reduplicated monosyllables. Schwa was clearly a "special" vowel in PAn and PMP, and the nature of its special status will be discussed more in the following sections with special attention to schwa's interaction with stress.

3. Proto-Austronesian stress

In this section, evidence is presented that supports the reconstruction of system of stress whereby stress regularly fell on the penultimate position, but was repelled to the final syllable if the penult was open and contained a schwa nucleus. The

section begins with a quick review of past proposals that argue for a contrastive stress system, then continues to give evidence from Malayo-Polynesian first, and Formosan second, that it is more likely that Proto-Austronesian had a system of predictable stress.

3.1 Past proposals that reconstruct contrastive stress

At least two studies, Wolff (1991) and Pejros (1994), have claimed that PAn or a putative Proto-Formosan had both (1) contrastive stress and (2) a single phoneme *t that had two allophones, t [t] and C [ʦ], which were both conditioned by the position of stress in the word (recall from Table 1 that there are traditionally two separate phonemes, *t and *C, reconstructed to PAn). According to Wolff's proposal, PAn *t was realized as [t] if it appeared *anywhere* in a two-syllable word with penultimate stress or in a three-syllable word with final stress, whereas PAn *t was realized as [ʦ] if it appeared *anywhere* in a two-syllable word with final stress or in a three-syllable word with penultimate stress. The pattern can be presented schematically as in (3):

(3) If CV́CVC or CVCVCV́C then */t/ > *[t]
If CVCV́C or CVCV́CVC then */t/ > *[ʦ]

What Wolff (1991) has described in his proposal is a highly unnatural condition, since reflexes of *t are not conditioned by the position of *t relative to stress, but rather an odd combination of stress and word-length. The reader is referred to Blust (2013: 559–563) for a more detailed counterargument to Wolff's proposal which includes several counterexamples. Because of these shortcomings, Wolff's proposal is not considered a challenge to the present hypothesis.

Pejros' (1994) proposal, on the other hand, involves a more natural condition. According to Pejros, PAn *t surfaces as [ʦ] where it appears in the onset of a stressed syllable or in word-final position, whereas *t surfaces as [t] where it appears in any other position as well as in any word containing *S. Although the data are interesting, the proposal includes data that are exclusive to Tsou, which causes issues with the reconstructability of *t/*C allophony to PAn since it is found in only a single subgroup.[4] Because of this restriction to Tsou, Pejros' proposal is also not considered a problem for the current hypothesis.

4. Data in Pejros (1994) is from Tsou, but Pejros also states that Kanakanavu and Saaora also contain the same features, although the data are not provided. Even if Kanakanavu and Saaora do indeed show the same pattern, and Tsouic is considered a subgroup, then the phenomenon is still too restricted to reconstruct.

Ross (1992), attempts to reconstruct contrastive stress to PAn using comparisons between Budai Rukai and Philippine languages. Budai is unlike many Formosan languages, even other Rukai dialects, in that it has a synchronic system of contrastive stress. Ross' argument can be summarized as follows: (i) PAn stress was lexically marked as falling either on the penultimate or ultimate syllable, and can be reconstructed with cognate forms in Rukai and Philippine languages, (ii) schwa was able to bear stress in any position, including in open penultimate syllables, and (iii) unstressed vowels in penultimate syllables were deleted in PMP, giving rise to consonant clusters in many words. As demonstrated in Blust (1997), there are numerous counter examples where Budai Rukai stress does not match with Philippine cognates, calling into question the reconstructability of stress to PAn, since chance is a reasonable explanation for the similarities that exist in some Budai-Philippine comparisons. The reader may refer to this earlier work for more on these exceptions and their impact on Ross's hypothesis.

The other claims of Ross, that schwa was able to hold stress in open penultimate syllables and that unstressed penultimate syllables deleted in PMP, are unlikely because most of the evidence relies on cases where schwa was retained in stressed penultimate syllables, but deleted in stressless penultimate syllables. For example, Ross reconstructs PAn *CuqəláN 'bone' > PMP *tuqlan > Proto-Oceanic (POc) *tula and contrasts this with PAn *baqə́Ruh 'new' > PMP *baqə́Ruh > POC *paqoRu. The problem is that schwa from Ross' *CuqəláN 'bone' does not delete in many Malayo-Polynesian subgroups, which is predicted under his hypothesis: Kalamansig Cotabato Manobo *tuʔəlan* (Reid 1971), Lampung *tuhəlan* (Walker 1975, 1976), Palauan *dəʔóyl* (where schwa became Palauan *ó*; McManus 1977), and Old Javanese *tahulan (with sporadic metathesis; Blust & Trussel ongoing). The assertion that schwa is deleted or retained based on its stress is therefore not supported. Rather, schwa is often deleted in daughter languages in penultimate syllables, but its deletion does not appear to be stress-conditioned. This, in turn, suggests that schwa retention or deletion in Malayo-Polynesian languages is not a viable metric to reconstruct stress on penultimate schwa-syllables.

Finally, Zorc (1978) constitutes an important attempt to look beyond the Philippines to other Malayo-Polynesian languages for evidence that a contrastive stress system was present in PMP (Zorc uses "Proto-Hesperonesian", a subgroup that roughly corresponds to PMP). The study covers several topics. First, Zorc lays out the case for reconstructing contrastive stress to Proto-Philippine (PPh), using evidence from Northern Luzon, Central Luzon, and Greater Central Philippine languages. Second, he identifies word-final stress patterns that are conditioned by (i) the presence of schwa in a reconstructed penult, and (ii) the use of morphological stress. Third, he attempts to reconstruct both of these patterns to PMP through comparison with non-Philippine Malayo-Polynesian languages.

He draws comparisons between Malay, Toba Batak, and Philippine languages to reconstruct phonologically-conditioned and morphological stress, but looks to Madurese as a non-Philippine witness for lexically marked stress at the PMP level.

Zorc's recognition that schwa may not hold stress in a penultimate syllable does not differ from the present study. The examples of situations in which stress was utilized as a morphological marker provide useful additional insights into PAn and PMP stress. The conditions that determine predictable word-final stress from Zorc (1978: 70) are listed below, with the final condition from Blust (1977; 2013: 253):

- Stress shift to the final syllable after a penultimate schwa.
- Stress shifts to the final syllable to denote a stative, with evidence from Toba Batak and Philippines.
- Stress shifts to the final syllable in vocatives (often with *-q or *-ŋ suffixation), with evidence from the Philippines, Toba Batak, and Malay/Indonesian.
- Stress is additionally word-final in "closed class" words and in words that often take list or citation intonation, like numerals (list or citation intonation in An languages often places stress on the final syllable, even if the language typically stresses the penultimate syllable in conversation; see Blust 1977 for examples from Kayan)

Zorc (1978) also attempts to reconstruct lexically-marked contrastive stress to PMP by looking to Madurese, another Malayo-Polynesian language. Zorc claims that gemination in Madurese, which is partially predictable by the presence or absence of a schwa in the penult, corresponds to final stress in Philippine languages; and therefore that contrastive stress may be reconstructed to PMP, since Philippine and Madurese represent a genetically diverse group of languages in separate primary branches. While Zorc's initial comparison is promising, with several examples of words where Philippine cognates have a vowel other than schwa in the penult and word-final stress that correspond to geminates in Madurese, Blust (2013: 555–556) was able to compile a second list with just as many examples of Philippine word-final stress failing to correspond with gemination in Madurese. So, although Zorc's study provides very important insights into the role of schwa and morphology in stress placement, it does not show definitively that a lexically-marked system of contrastive stress is reconstructable beyond the Philippines. Similarities between Philippine final stress and Madurese gemination are, rather, the product of drift.

3.2 Evidence for penultimate stress with schwa-triggered stress shift

Evidence for contrastive stress at the PAn level is often unable to withstand close scrutiny, but the evidence for a system of penultimate stress with conditioned stress-shift to the final syllable may be found in multiple primary branches of An. That evidence is discussed in this section, beginning with the Malayo-Polynesian evidence, where systems of stress-shift to the final syllable after schwa are widespread. Even in Philippine languages, where stress may be phonemic, there are numerous examples of stress shift after schwa. In those Philippine cases, stress is normally unpredictable, but its phonemic status is neutralized wherever there is a schwa in the penult. In cases where schwa has merged with some other vowel, one can still observe that historical schwa caused stress shift to the final syllable before the merger took place (Zorc 1972). Outside of the Philippines, evidence that stress is repelled to the final syllable if the penult was schwa can be found in Sumatran languages, numerous Western Indonesian languages (Central Sarawak, Kenyah, Malay), and the Sumba-Flores subgroup of Central Malayo-Polynesian. This section begins with the Philippine data before presenting the evidence from other languages.

3.2.1 *Philippine languages where stress shifts to the final syllable after a penultimate schwa*

Although many Philippine languages have a synchronic system of contrastive stress, evidence for a past system where stress was penultimate, but sometimes shifted to the final syllable, is prevalent.[5] Multiple Philippine languages neutralize stress distinctions in words with a historic schwa-penult, whereby typically unpredictable stress becomes predicable and word-final. The Philippine subgroups where schwa caused observable stress shift are Central Luzon, Northern Luzon (sometimes referred to as Cordilleran), Greater Central Philippines, Sangiric, Minahasan, and Bilic, six out of nine major Philippine subgroups according to Blust (1991). The major Philippine subgroups are indicated in Table 2. Note that there is disagreement on the validity of a Philippine subgroup as well as the interrelatedness of Philippine languages and their internal subgrouping. The list in Table 2 therefore has no structure. Rather, these are generally accepted subgroups in the Philippines whose relationship to one another is still a matter of debate.

5. Stress in Philippine languages often coincides with vowel length. In Ilocano, for example, stressed penultimate vowels are long, but stressed final-syllable vowels are not long (Hayes & Abad 1989). The same system is found in Tagalog, Bikol, and many other Philippine languages with contrastive stress systems (Zorc 1993). PMP and PAn are typically not reconstructed with vowel length distinctions, so Philippine vowel-length is a post-PMP innovation, possibly connected to the innovation of lexical stress.

Table 2. Philippine subgroups after Blust (1991)

Bashiic	Northern Luzon	Central Luzon
Inati	Kalamian	Greater Central Philippines
Bilic	Sangiric	Minahasan

Data showing the stress-final patterns in words with a reconstructed Schwa penult are included below in (4).

(4) a. PMP Kapampangan (Central Luzon)
*bəRək *abyák* 'suckling pig'
*ənəm *anám* 'six'
*təbuh *atbú* 'sugarcane'
(Forman 1971)

b. PMP Ilocano (Northern Luzon)
*dəpah *dəp:á* 'length of outstretched arms'
*təlu *tal:ó* 'three'
*təkən *tək:án* 'punting pole'
(Rubino 2000)

c. PMP Tondano (Minahasan)
*qatəluR *atəlú* 'egg'
*təlu *təlú* 'three'
*qaləjaw *ədó* 'day'
(Sneddon 1975)

d. PMP Palawan Batak (GCP) Cebuano (GCP)
*bəRas *bəgás* 'uncooked rice' *bugás* 'uncooked rice'
*qaləjaw *ʔaldáw* 'day' *adláw* 'day'
*əsa *ʔəsá* 'one' *usá* 'one'
(Wolff 1972)

Other languages where these patterns have been reported include at least Pangasinan, Balangaw, Isnag, Ibanag, Central Cagayan Agta, Ifugao (see Blust and Trussel ongoing; Healey 1960; Reid 1971), Northern Subanan (Daguman 2013: 47), Sarangani Manobo (DuBois 1976) Sangil (Sneddon 1984: 24) and Tiruray (Schlegel 1971: 7).

All Philippine language data discussed so far show stress-shift to the final syllable after a penultimate schwa. In Itbayaten, however, stress is described as falling regularly on the final syllable (Yamada 1967: 367). Like many other An languages, Itbayaten deleted schwa in open penultimate syllables. Blust (2017) describes this process in detail, and demonstrates that words of the shape *$C_1əC_2VC_3$ are

reflected by $aC_1C_2VC_3$ in Itbayaten. One interpretation of these data is that schwa deleted, causing a word-initial consonant cluster that was later divided between syllables through prothesis of a vowel, *a*: $*C_1əC_2VC_3 > *C_1C_2VC_3 > aC_1C_2VC_3$. In Bashiic, Blust (2017: 498) interprets the deletion of schwa as evidence for a past system where stress was penultimate but shifted to the final syllable when the penultimate vowel was schwa This implies that before stress shifted to the final syllable across-the-board in Itbayaten that stress was historically penultimate and only shifted to the final syllable if the penultimate vowel was schwa. If stress was final throughout the history of Itbayaten, one might expect deletion of unstressed *i, *u, and *a as well as schwa. In (5), it can be seen that two-syllable words with a schwa penult are reflected without a penultimate schwa, instead reflecting a consonant cluster which formed after schwa deletion, with additional vowel prothesis.

(5) PMP Itbayaten (Bashiic)
*bəsuR *absoy* 'satiated'
*dəpah *adpa* 'fathom'
*təlu *atlo* 'three'

(Yamada 1967)

3.2.2 *Penultimate stress with schwa-triggered stress shift in non-Philippine Malayo-Polynesian languages*

In Malayo-Polynesian languages outside of the Philippines, the situation is mostly the same. Referring back to the Malayo-Polynesian internal subgroups from Smith (2017c), languages with stress-shift to the final syllable after a penultimate schwa are found in Chamorro, the Sumatran subgroup, the Western Indonesian subgroup, and the Central-Malayo-Polynesian (CMP) subgroup. In Sumatran, for example, Adelaar (1981) reports that stress shifts from the penultimate to final syllable where the penultimate syllable was schwa in Karo and Dairi Batak, and continues to reconstruct stress shift after penultimate schwa as a feature of Proto-Batak. Gayo, another Sumatran language, follows the same stress pattern (Eades & Hajek 2006: 112–113).

Chamorro, which may represent a primary branch of Malayo-Polynesian (Smith 2017c), has a system of schwa deletion which, as in Itbayaten, suggests a past stage of the language where schwa was unable to hold stress in an open penultimate syllable. Chamorro merged PMP schwa with *u as Chamorro *u* except where schwa appeared in a deletion environment. The deletion environment in Chamorro is VC_CV(C)#. The merger of schwa with *u elsewhere allows us to order these changes. Schwa deletion must have happened before merger with *u, because *u did not regularly delete in the environment VC_CV(C)#. Schwa deletion is thus a more ancient phenomenon, motivated by the same inability for

schwa to bear stress in open penultimate syllables that was present in both PAn and PMP. Blust (2000: 90–92) also interprets the data as implying an unstressed schwa, and notes that "pre-Chamorro schwa could not bear stress, whether the language had phonemic stress that agreed in cognate forms with the stress contrasts of Philippine languages, or not".

In Western Indonesian (WIn) languages, stress-shift is found in standard varieties of Malay and Indonesian, where stress is often described as being penultimate in words with full vowels in the penultimate syllable and in words with schwa in a closed penultimate syllable, but final where schwa appears in an open penultimate syllable (Macdonald & Darjowidjojo 1967). Kenyah languages, which also fall within WIn, have been described as having penultimate stress except where the penultimate vowel was schwa, in which case stress falls on the final syllable (Blust 2014; Blust 2007b via personal communication with Antonia Soriente). Identical patterns are found in other Western Indonesian languages in Borneo, including In Mukah Melanau where Blust (1988: 178) notes that stress occurs typically on the penultimate syllable in phrasal contexts but that stress occurs on the final syllable if the penultimate syllable has a schwa nucleus. Smith (2017a) also recorded final stress where the penultimate syllable contains a schwa in Sekapan. Kayan languages also have penultimate stress, but actively shift stress to the final syllable if the penult is a schwa (Clayre and Cubit 1974 for Baram River Kayan; Smith 2017a for Data Dian Kayan, spoken in Indonesia).

In the Lesser Sunda Islands, similar stress-shift after schwa patterns are attested in Kéo, Manggarai, and Ngadha, all three members of the Western-Central Flores division of Sumba-Flores, a major subgroup within CMP. Baird (2002: 53) provides the following description of stress in Kéo: "Stress in Kéo is predictable: it typically falls on the penultimate syllable of the word. The exception to this is in disyllabic words in which there is a schwa in the first syllable, in which case stress fall on the ultimate syllable". The same is true for Ngadha (Djawanai 1977: 14) and Manggarai (Blust 2008). Some examples of final-stress from these languages are shown in (6) and (7).

(6)

PMP	Long Wat Kenyah	PMP	Long Wat Kenyah
*duha	*lúəh* 'two'	*təlu	*təláw* 'three'
*bulu-n	*búlun* 'body hair'	*təbuj	*təbáw* 'sugarcane'.

(Blust 2014)

(7)

PMP	Ngadha
-	*bəta* [bətʰːá] 'broken, as a string'
-	*bəka* [bəkʰːá] 'have pity on'
*səpaq	*səpa* [səpʰːá] 'chew leaves'

(Djawanai 1977: 14)

Stress-shift after a penultimate schwa is a major feature of Malayo-Polynesian languages and is present in multiple primary branches. There are, however, some subgroups without stress shift, namely, Celebic and Palauan, which both have penultimate stress regardless of the historical vowel. In both, schwa shifted to either *o* or *e*, shifting it from a "mora-less" to a "mora-full" vowel. These examples can be explained as a process of stress regularization after the elimination of inherited schwa. In these subgroups, stress falling regularly on the penultimate syllable is therefore an innovation, whereas languages where stress is penultimate but shifts after a penultimate schwa retain this feature from PMP.

3.2.3 *Formosan languages*

In order to reconstruct this stress system beyond PMP, corroborating evidence from *Formosan* languages is required. The synchronic stress systems of Formosan languages are diverse, with some languages displaying penultimate stress, some final, and at least one displaying contrastive stress. Tsouic, Western Plains, Paiwan, and most Rukai dialects have a default penultimate stress system. Budai Rukai has a phonemic stress system, but other Rukai languages do not (Li 1977). Northwest and East Formosan have word-final stress and other Formosan subgroups (Bunun for example) have conflicting reports of stress in the literature, possibly due to the great dialect variation that exists within Bunun. Despite their synchronic diversity, however, there are at least two types of evidence that modern Formosan languages descend from a proto-language where schwa could not bear stress in open penultimate syllables: (1) subgroups that maintain a system of stress-shift after penultimate schwa and (2) subgroups where penultimate schwa deletes, but other vowels do not. Type-one subgroups are Western Plains and Paiwan, in which shift stress to the final syllable if schwa appeared in the penult. Type-two subgroups are East Formosan (Amis), Northwest Formosan (Saisiyat), Atayal, and Puyuma.

Thao is a Western Plains language which, according to Blust (2003b, 2013), has penultimate stress except in words that historically had schwa in an open penultimate syllable. In these words, stress falls on the final syllable and schwa was typically deleted, but retained in some words. The data in Table 3 are from Blust (2013: 656), with supplemental evidence from the *Austronesian Comparative Dictionary* (ACD) (Blust & Trussel ongoing). Stress markings have been added in accordance with Blust's description.

Paiwan, another primary branch of Austronesian, also has a system of regular stress with stress-shift to the final syllable after a schwa penult. Chen (2004, 2006) provides a thorough description of central Paiwan phonetics. See the examples of stress shift after schwa (8) and note that the acoustic correlates of stress are longer duration, higher pitch, and greater intensity:

Table 3. Schwa deletes in open penultimate syllables and stress shifts to the final syllable

	PAn	**Thao**	
*ə in open penult	*təbuS	*tufúsh*	'sugarcane'
	*kəRiw	*klhíw*	'hemp'
	*kəRət	*klhít*	'cut; sever'
full-vowel in open penult	*bukəS	*fúkish*	'head hair'
	*RaməC	*lhámic*	'root of tree or grass'
	*ŋipən	*nípin*	'tooth'
*ə in closed syllable	*ləmləm	*ma-rúmrum*	'dim; unlit'
	*qaRəm	*qálhum*	'pangolin'
	*dakəp	*sákup/sápuk*	'catch; seize'

(8) Central Paiwan (Chen 2004: 81)
cəvús 'sugarcane'
tsəmál 'thunder'
qurəpús 'cloud'

Central Paiwan is thus similar to Thao in that stress regularly falls on the penultimate syllable, except where the penultimate syllable is schwa, in which case, stress shifts to the final syllable. Unlike Thao, Paiwan did not undergo the additional deletion of unstressed penultimate schwa. Also unlike Thao, Paiwan maintains stress shift as a synchronic property of its phonology.

Thao and Paiwan provide examples of Formosan subgroups that directly continue the proposed stress system of PAn. They combine with Malayo-Polynesian to provide direct evidence from three primary branches of An. Other Formosan languages do not have stress systems that allow for a direct investigation into stress shift. In Northwest and East Formosan, for example, stress falls regularly on the final syllable, regardless of the quality of the penult. It is impossible, then, to compare the stress pattern of words that reflect a penultimate schwa versus those which reflect a main vowel in the penult; both will have word-final stress. There is, however, indirect evidence that even languages with synchronic word-final stress descend from an ancestor that had penultimate stress except when the penult was open and had a schwa. That evidence is discussed next.

Two languages, Amis and Atayal, delete schwa in open penultimate syllables, creating consonant clusters. Huang (2018: 271), for example, states that "Proto-Austronesian (PAn) *ə in the final syllable has become /u/ in the final syllable in all Atayal dialects" and, further, that "Squliq words with apparent consonant clusters before final syllables are reconstructed with a schwa between CC in Proto-

Atayalic". Stated differently, schwa merged with *u in the final syllable, but deleted in the penultimate syllable. One may point out that Atayal has across-the-board word-final stress, and that the deletion of penultimate schwa follows from a recent stress-shift event and not a property of PAn stress. It should be noted, however, that of unstressed penultimate vowels, only schwa deletes – full vowels in this position never delete even though they are also unstressed.

Amis, like Atayal, has regular word-final stress but also reflects a historical change where schwa deleted in open penultimate position but main vowels did not. This implies that schwa was unstressed in penultimate syllables before East Formosan languages shifted stress to the final syllable across the board. Several examples from Amis are listed in (9), from Fey (1986).

(9)

	PAn	Amis	
a	*baqəRuh	*faʔloh*	new
	*pahəku	*pahko*	edible fern
	*Səmay	*hmay*	cooked rice
b	PAn	Amis	
	*kəmkəm	*kəmkəm*	to chew something hard
	*bəjbəj	*fədfəd*	bound with lots of string
	*baŋəS	*faŋəs*	skin

(Fey 1986)

There are some apparent exceptions to this pattern, listed in the ACD (Blust & Trussel ongoing), that appear to show schwa retention in the penult. Some examples are Amis *fəcol* 'satiated' from PAn *bəsuR, *səma* 'tongue' from PAn *Səma, and *təfos* 'sugarcane' from PAn *təbuS. These differences are the product of differing transcription techniques, however, as these words are sourced from Blust (1994-1995). The schwa from Blust's fieldnotes is a realization of the release of the word-initial consonant. This is according to Maddieson and Wright (1995), who point out that wherever schwa appears in the penultimate syllable of an Amis word that it is not a true vowel, but a consonantal release. Chen (1987) calls this release 'aspiration'. Thus, what appear at first to be unconditioned exceptions to penultimate schwa deletion are in reality variations in the transcription of the initial consonant release. To demonstrate this point, identical words from the central dialect are compared in (10) between Maddieson and Wright (1995) and Blust (1994–1995).

(10) Amis

Orthography	Maddieson and Wright (1995)	Blust (1994–1995)
ccay 'one'	[tstsaj]~[tsᵊtsaj]	*tsətsáj*
spat 'four	[spat]~[sᵊpat]	*səpát*

Historically, then, it is likely that Amis deleted all open penultimate schwas, creating clusters in word initial position where the first consonant has an audible release into the second. This, in turn, suggests that schwa deleted in penultimate position as an unstressed vowel before stress shifted to the final syllable in Proto-East Formosan.

Still other Formosan languages delete schwa, but in a restricted context. Puyuma, a primary branch of Austronesian according to both Blust (1999) and Ross (2009), deleted penultimate schwa in the environment VC_CV(C)#. Some examples of these words are shown in (11).

(11)

sPAn	Tamalakaw Puyuma	
*ləmək	*a-lmək*	'soft and flexible'
*qaŋəRu	*HaŋRu*	'odor of salted meat'
*qaəŋəSəR	*HaŋsəR*	'stinking of urine'

(Tsuchida 1980)

Puyuma does not allow for complex onsets, so the retention of schwa in the penultimate syllable of two syllable words may be motivated by the ban on complex onsets; If a word of the shape CəCVC underwent unstressed schwa deletion it would have created an illicit cluster: CCVC.

Saisiyat, A Northwest Formosan language, is like Puyuma in that it disallows complex onsets and therefore only deleted penultimate schwa in the environment VC_CV(C)#. Also like Puyuma, a schwa that is outside of the deletion environment in root words may delete with affixation, for example, *kæhma* 'tongue', from /ka-həma/ as shown in (12). One may draw the same conclusion from these Saisiyat data that were drawn from the Puyuma data, namely, that schwa was historically unstressed in open penultimate syllables, which resulted in its eventual deletion.

(12)

PAn	Saisiyat (Taai dialect)	
*Səma	*kæ-hma*	'tongue'
*kəRiw	*ka-kLiw*	'hemp'
*lisəqəs	*Liʔʃiʃ*	'nit'

(Li 1978)

3.4 Summary of stress reconstruction

To review, Western Formosan and Paiwan show direct evidence for stress shift after a penultimate schwa. Several other Formosan languages, Amis from East Formosan, Atayal and Saisiyat of Northwest Formosan, and Puyuma, deleted schwa where it appeared in open penultimate syllables. In the case of Amis and Atayal, deletion occurs across the board, that is, no additional conditions need to be met for penultimate schwa deletion. Puyuma and Saisiyat have the additional requirement that penultimate schwa deleted only in three-syllable words (either as part of a root or through affixation). I argue that schwa deleted in this position because, unlike the main vowels, schwa was always unstressed where it appeared in open penultimate syllables. This section has shown that evidence for stress-shift after schwa and penultimate schwa deletion is found in most Formosan subgroups, plus Malayo-Polynesian. This further implies that schwa was inherited from PAn without stress, a pattern that is maintained in Thao and Paiwan, and that schwa deletion in the penultimate syllables of other languages was a consequence of phonologically motivated drift. Table 4 provides a summary of this evidence.

Table 4. Summary of the evidence for stress shift after schwa

Type of evidence	Primary Subgroup
Final stress after penultimate schwa is directly attested	Thao (Western Plains)
	Paiwan
	Malayo-Polynesian
Schwa deletes in open penultimate syllables	Amis (East Formosan)
	Atayalic
Schwa deletes sporadically or in VC_CV	Saisiyat (Northwest Formosan)
	Puyuma
Ambiguous	Tsouic
	Rukai
	Bunun

If PAn and PMP had predictable stress, this implies that Philippine stress systems are innovative. Overall, this fits into much of what we already know about Philippine stress. Philippine contrastive stress has not been shown to correspond regularly to lexical stress systems outside of the Philippines, nor does it correspond regularly to segmental phenomena outside of the Philippines. The main driving force behind Philippine lexical stress innovation appears to be the

elimination of schwa with the maintenance of historically schwa-conditioned final stress, combined with lexicalization of words with derived stress-final patterns (especially stative/adjectival verbs) followed by the extension of morphological stress as a class-changing strategy to the rest of the lexicon. Indeed, Zorc (1972) has shown that only a fraction of final-stress words cannot be explained as following naturally from these conditions. For example, the PPh *púnuq 'tree stump'/*punúq 'full' minimal pair is transparently derived from the stative stress pattern that places stress on the final syllable in *punúq 'full'. Near minimal pairs like *kítah 'see'/*kitá 'we' show a difference between regular stress and "closed class" stress, and items like *qitə́m 'black' or *pulá 'red' again show final-syllable stress as derivational morphology indicating stative/adjectival verbs, now lexicalized. This is not to say that there are not truly interesting forms. The near-minimal pair *ásu 'dog'/*qasú 'smoke', for example, defies analysis, and stress-final lexemes like *qabú 'ashes' or *likúd 'back' do not easily follow from the predictable conditions outlined above. But importantly, these words don't regularly correspond to words in other languages that may be used to reconstruct lexically marked final stress, and the majority of final-stress words in Philippine languages with contrastive stress are readily explained. It is not surprising that Philippine languages with lexical stress would have innovated such a pattern from a proto-language which had predictable stress. Once schwa was eliminated from the phonology of major languages via merger with some other vowel, lexical stress was immediately introduced as a part of Philippine language grammars.

The full stress pattern that is reconstructed for PMP is given in (13). The evidence for morphological stress is so far restricted to Malayo-Polynesian languages. Thus, (13a) and (13b) may be further reconstructed to PAn, but (13c) cannot be.

(13)	a. Regular stress	CV́CV(C)	
	b. Schwa-conditioned final stress	CəCV́(C)	
	c. Closed class stress	(CV)CV́(C)	
	Stative verb formation	CV́CV(C)	→ CVCV́(C)
	Vocative formation	CV́CV(C)	→ CVCV́(C) + (-q/-ŋ)
	List intonation	CV́CV(C)	→ CVCV́(C)

4. Why stress shift? An argument for a zero-mora schwa

In the previous several sections, it was argued that comparative evidence supports a PAn and PMP stress system where stress was penultimate but shifted to the final syllable if the penultimate vowel was schwa. In this section, it is argued that the

motivation for stress shift was a product of the moraic value of schwa. That is to say, schwa was, and often still is, a zero-mora vowel. It did not contribute to the lexical mora count and weightless vowels were unable to hold stress. The weightless status of schwa is evidenced by subgroup-wide parallel developments in An that can all be described as adding a mora to words with a schwa in the penult. These are, (1) the gemination of final-syllable onsets after a penultimate schwa, (2) vowel shifts that eliminate schwa from the penultimate syllable, and (3) the deletion of schwa in three-or-more-syllable words.

Although weightless syllables and vowels are not as common as their weighty counterparts, they are by no means unheard of. Cho and King (2003), for example, parse consonants that violate the Sonority Sequencing Principle (SSP) into "semisyllables", which have no vowel and no mora, in Georgian and Polish clusters. Kager (1989) analyzes "schwa syllables" in Dutch, i.e., super-light syllables with a schwa nucleus, as nonmoraic. Féry (2003) extends this analysis to German. The analysis that schwa may occupy a nonmoraic syllable follows naturally from the observation that schwa is cross-linguistically prone to unique processes, particularly regarding syllabicity and weight (van Oostendorp 2003).

A weightless schwa-syllable can have consequences for word-shape as well. For example, a two-syllable word with one light syllable and one zero-mora schwa-syllable may violate a mandatory two-mora word minimum, even though it contains two syllables. This is attested in Malayalam, where gemination is triggered to repair a subminimal word of the shape CVCə (Cyran 2001; Namboodiripad et al. 2015). In Malayalam, if an English monosyllable with a short vowel is borrowed, it is realized with a phonemically short vowel: English *bus* > Malayalam /bas/<ə>, [basːə]. In a word like 'bus', the short vowel contributes a single mora to the word, but the final schwa-syllable does not. The result is automatic gemination of the final-syllable onset as a last-resort repair strategy to fix the illicit subminimal word. Weightless vowels, therefore, not only exist – they sometimes trigger word-minimum repair strategies such as gemination.

4.1 Variable weight

Before giving a detailed overview of evidence that schwa was a weightless vowel, it is also necessary to address a limitation on the impact of schwa on the lexical mora count in An. The phenomena associated with a weightless schwa, stress shift, gemination, schwa deletion, and vowel shift, only occur when schwa is in an open penultimate syllable. For example, in virtually all An languages, underlying /CVCəC/ surfaces as [CVCəC] and does not undergo any of the repair strategies typically associated with a penultimate schwa. Furthermore, stress only shifts to the final syllable if schwa is in an open syllable. In closed penultimate syllables,

like those in the reduplicated monosyllable *bəjbəj 'to wind; tie up', stress does not shift, nor does schwa in closed penultimate syllables trigger any repair strategies. Finally, under the weightless-schwa hypothesis, reduplicated monosyllables like PAn *bəjbəj would have no moras whatsoever, which would of course also violate a two-mora minimum.

The answer to these problems, it would seem, is that the coda in these words is contributing to syllable weight. This brings up an interesting question, however: if codas contribute to syllable weight when the nucleus is a schwa, do they also contribute to syllable weight when the nucleus is a main vowel? There is no evidence that closed syllables were treated as heavy across-the-board in PAn or PMP. In Ilocano roots, for example, stress is sensitive to the quality of the vowel; it predictably never falls on a penultimate schwa. The presence or absence of a coda, on the other hand, is irrelevant for stress placement in a root (Smith 2020). Similarly, in some varieties of Malay and Indonesian, stress avoids penultimate schwa, but is not attracted to closed syllables with a full vowel. Additionally, stress remains on the penultimate syllable if schwa in the penult is closed with a coda (14).[6]

(14) Indonesian (Macdonald & Darjowidjojo 1967)

CV	Cə	CəC
táman 'garden'	*təmán* 'friend'	*támpat* 'place; location'
láma 'long time'	*ləmáh* 'weak'	*lámbah* 'valley'

In these Indonesian examples the presence or absence of a coda is only relevant where the vowel is schwa, a case of variable coda weight. In Indonesian, then, if a syllable has a weightless vowel the coda is able to share a mora with the nucleus, attaching directly to the mora. If a syllable has a full vowel, however, the coda attaches directly to the syllable head. It is therefore necessary to acknowledge a property of codas in Austronesian languages: codas contribute to syllable weight, but only if the syllable is otherwise degenerate, i.e., if the vowel is a schwa and therefore weightless. This is a type of variable coda weight (Rosenthall & van der Hulst 1999), a principle described in some languages, but not previously applied to Austronesian.

Other languages reflect a similar phenomenon. Recall from §3.2.3 that Thao deleted schwa in open penultimate syllables and shifted stress to the final syllable,

6. Stress in Malay and Indonesian is a contentious issue, on which Kaufman and Himmelmann (2021) provide a thorough overview. Some working on Malay, for example, contend that Malay is a "no stress language", whereas others contend that stress is strictly phrasal. However, despite the disagreements of stress there is still robust evidence for "prominence avoidance" on schwa of the type discussed here that are absent if the schwa is in a closed syllable.

but that schwa in a closed penultimate or closed final syllable did not delete and stress remained in penultimate position. In Amis, schwa deleted in open penultimate syllables, but was retained in closed syllables, again suggesting that the coda supported schwa but not other vowels. In Philippine languages as well, Zorc (1972) pointed out that although stress shifts to the final syllable after penultimate schwa in an open syllable that there was no pattern of stress shift if schwa was in a closed syllable.

Other types of phenomena, like those that target coda consonants, often have exceptions when the coda closes a schwa-syllable. One such case is Merap, where word-final voiceless consonants lost articulation features and collapsed together as glottal stop, as shown in (15):

(15)

Proto-Kayanic	Merap	
*siap	*hɛa̰ʔ*	'chicken'
*əpat	*paːʔ*	'four'
*anak	*nayə̰ʔ*	'child'

(Smith 2017b)

If codas closed a schwa syllable, however, the articulation features of the coda consonant are retained, as shown in (16):

(16)

Proto-Kayanic	Merap	
*kələb	*klap*	'turtle'
*siŋət	*hŋia̰t*	'to sting'
*utək	*tua̰k*	'brain'

(Smith 2017b)

This may be a result of codas being linked directly to the mora in word-final schwa syllables, but to the syllable head in other word-final syllables. Taken together, the requirement of schwa to be supported by a coda consonant in order to hold stress, its restriction in word-final position to only closed syllables, its retention in closed but not open syllables in languages that deleted schwa and its interaction with coda consonants in cases like Merap, support an analysis whereby schwa syllables share a mora with coda consonants wherever they are available. The fact that no similar phenomena are found with codas that close syllables with a full vowel suggests that coda weight was variable, and only surfaced in cases where the syllable was otherwise degenerate.

4.2 Interaction of stress, gemination, and schwa in Malayo-Polynesian

Gemination after a penultimate schwa, *CəCV(C) > CəC:V(C) is a widely recognized property of Malayo-Polynesian. Gemination effectively added a mora to the word, satisfying a two-mora minimum that could not otherwise be achieved with schwa in the penult. There are, however, misunderstandings about how gemination interacts with stress in the literature, and this section attempts to answer a pressing question about gemination in Malayo-Polynesian languages. That is, are stress-shift and gemination conjoined elements of a single strategy, or are they alternative strategies driven by the metrical properties of schwa? Put differently, do final-syllable onsets lengthen *only if stress is regularized such that it always falls on the penultimate syllable regardless of vowel quality* or do final-syllable onsets geminate *along with stress shift to the final syllable*? It is concluded that both strategies are robustly attested in the Malayo-Polynesian subgroup. This is interpreted as evidence that gemination was not motivated by stress, i.e., the primary function of gemination was to eliminate subminimal words from the lexicon. The effects that gemination has on stress are secondary.

Explicit arguments regarding the relationship between stress shift and final-syllable onset gemination are not common in the literature. Generally speaking, however, it is often implied that gemination of final syllable onsets only occurs where the stress pattern regularizes, such that stress falls only on the penult even if the vowel is schwa (for example Blust 1995, 2017; Mills 1975; Sneddon 1984). According to these analyses, gemination is motivated by the inability of schwa to hold stress and not its moraic status. Mills argues for this pattern only in the South Sulawesi group, and Sneddon extends this analysis to Sangiric. Blust (1995: 132), however, makes the further generalization that schwa's unique properties were dealt with using only one of two strategies. He states that stress-shift and gemination are "…*alternative* strategies for coping with the extrasystematic shortness of schwa in relation to the other vowels rather than conjoined elements of a single strategy" (emphasis original). These studies all imply that, wherever gemination occurs, stress must regularize to the penult, and, wherever gemination does not occur, schwa must repel stress to the final syllable. This view is summarized below in (17). In (17a), gemination results in stress regularization. In (17b), a lack of gemination results in stress remaining on the final syllable after a schwa. In (17c), a pattern where gemination does not result in stress regularization is ruled out.

(17) a. CV́CVC b. CV́CVC c. *CV́CVC
CəC:VC CəCV́C *CəC:V́C

This analysis links gemination to penultimate stress in such a way as to imply that where stress shifts to the final syllable, the motivation for gemination is lost,

which may pose a problem for an analysis where gemination is motivated by mora count. There is abundant evidence, however, that refutes these claims. Evidence is found in languages where schwa in a penultimate syllable is associated with both gemination and stress shift to the final syllable. Previous studies tend to ignore such languages, but they form crucial evidence that the gemination of final-syllable onsets was not part of a stress-regularization strategy. The following sections demonstrate the two different types of gemination patterns: type-one, gemination that does not result in stress regularization (geminate final-syllable onsets with word-final stress); and type-two, gemination that does result in stress regularization (geminate final-syllable onsets with penultimate stress).

4.2.1 *Type one: Gemination with stress shift after schwa*

In some languages, a pattern of final-syllable onset gemination is observed, but stress does not regularize itself to the penultimate syllable. Examples of such languages are found throughout Island Southeast Asia (ISEA), including the Philippines, Borneo, and Lesser Sunda Islands. In Ilocano, for example, singleton consonants are regularly reflected as geminate where they appear in the environment ə_V(C)#. Additionally, although gemination would theoretically resolve the inability of schwa to be stressed under previous analyses, primary stress remains on the final syllable. Several examples are shown in (18):

(18)

PMP	Ilocano	
*dəpah	*dəpːá*	'length of outstretched arms'
*dəŋəR	*dəŋːág*	'hear; listen'
*təkən	*təkːán*	'punting pole'

Gemination and stress shift did not automatically occur after "full" penultimate vowels in Ilocano, for example, PMP *kaka 'elder sibling' > Ilocano *káka*, PMP *kutu 'head louse' > Ilocano *kúto*, and PMP *likaw 'curve; bend' > Ilocano *líkaw*. In these cases, primary stress is penultimate and gemination does not occur. In fact, primary stress *never* falls on the syllable preceding a geminate consonant in Ilocano. Other Northern Luzon languages that show the same pattern of gemination after schwa include Isnag, Ibanang, Ga'dang, and Central Cagayan Agta (Healey 1960) and others.

Tiruray provides additional evidence from the Philippines for a process of final-syllable onset gemination with stress shift to the final syllable. In Tiruray, a historical geminate consonant is reflected with fortis reflexes and singleton consonants with lenis reflexes. Blust (1992: 14) makes the following observations concerning these consonants:

- PMP *-k- became Tiruray *g except* when appearing in the onset of a final syllable after a penultimate schwa, in which case it remains *k*.
- PMP *-b- became Tiruray *w except* when appearing in the onset of a final syllable after a penultimate schwa, in which case it remains *b*.
- PMP *-d/*j- became Tiruray *r except* when appearing in the onset of a final syllable after a penultimate schwa, in which case it remains *d*.

Examples of differential reflexes after schwa are numerous, and include Tiruray *fagəw* from *pakəhu 'edible fern' but *bəkah* from *bəkas 'to spring, of a trap', *lawuʔ* from *labuq 'to drop something' but *təbək* from *təbək 'to stab', and *farəy* from *pajay 'rice plant' but *fədəw* from *qapəju 'gall'. Tiruray has already been established as a stress-shift-after-schwa language as per Schlegel's (1971) description. Subsequent sound change has eliminated geminate consonants, but the differential reflexes after schwa show that gemination must have been part of the historical phonology of Tiruray.

Examples of gemination with word-final stress are found in many languages outside of the Philippines as well. In the dialect of Kayan spoken in Data Dian gemination is observed after a penultimate schwa but not after other vowels (Smith 2017a). As noted earlier in §3.2.2, Kayan usually has penultimate stress, but, in examples with a schwa in the penult, stress is word-final. In Sekapan, another Western Indonesian language of Borneo, final-syllable onsets automatically lengthen after a penultimate schwa, and stress is shifted to the final syllable (Smith 2017a). In the Sumba-Flores subgroup of CMP, once again we find evidence that stress shift and gemination have co-occurred. Walker (1982: 6) gives two examples where a penultimate schwa causes gemination in Hawu. Regarding Ngadha, Djawanai (1977: 6) states that "The schwa /ə/ is usually very short and causes the lengthening of the following consonants…". Some examples from both Data Dian Kayan and Sekapan are shown in (19) and (20):

(19) Data Dian Kayan (Smith 2018b)
təpaʔ [təpːáʔ] 'pound rice' *səpun* [səpːún] 'great grandparent',
mətaŋ [mətːáŋ] 'ask' *dənaʔ* [dənːáʔ] 'slow'

(20) Sekapan (Smith 2017a)
bəbaw [bəbːáw] 'tall' *pətəbeᵲ* [pətəbːéᵲ] 'to meet'
məjat [məjːát] 'to pull' *məgəm* [məgːə́m] 'strong'

4.2.2 *Type two: Gemination after schwa and strict penultimate stress*

Languages of this type are those languages more typically referenced in literature on gemination in Austronesian. In such languages, stress regularizes itself to the penultimate syllable after gemination: *CəCV́(C) > Cə́C:V(C). Like type-one lan-

guages, languages with stress-regularization after gemination are found throughout ISEA, with examples from Sulawesi, Borneo and the Philippines (Philippine examples are from Sama-Bajaw, a group of languages that originate from Borneo and are part of the Greater Barito group).

Buginese, Makasarese, and Tae', three relatively well described South Sulawesi languages, all reflect an earlier system where the onsets of final syllables lengthen after schwa in an open penultimate syllable. In Makasarese and Tae', schwa has merged with *a, creating a phonemic distinction in words where gemination was historically predictable, but Buginese retains schwa unchanged. Makasarese, Buginese, and Tae' are all described as having strict penultimate stress with no cases of stress shift after a penultimate schwa (cf. Jukes 2020 for Makasarese). This implies that after gemination stress was able to regularize to the penultimate syllable.

A similar system is found in Sama-Bajaw, languages which belong to the Greater Barito group of Borneo (part of the larger Western Indonesian group), but are spoken in coastal areas outside of the traditional Barito homeland (Blust 2007a). Sama-Bajaw languages are unique among Greater Barito languages in that they show gemination of final syllable onsets after schwa. Examples of gemination are from Abaknon and Yakan, both spoken in the Philippines. Both have also merged schwa with other vowels, which implies an ordering relationship: schwa must have triggered gemination first before the vowels merged. These languages place stress on the penultimate syllable in all cases. Data from Makasarese, Yakan, and Abaknon are organized in (21), (22), and (23) below.

(21)

a. PMP	Makasarese	b. PMP	Makasarese
*balu	*bálu* 'widow'	*bəlaq	*bál:a* 'splitting'
*panaq	*pána* 'shoots'	*təlu	*tál:u* 'three'

(Cense, A.A. 1979)

(22)

PMP	Abaknon	
*bəli	*bál:i*	'to buy'
*dəpah	*dáp:a*	'fathom'
*pənuq	*pán:oʔ*	'full'

(Blust & Trussel ongoing)

(23)

PMP	Yakan	
*zəlaq	*dél:aʔ*	'tongue'
*dəpah	*dép:e*	'fathom'
*pəñu	*pén:u*	'sea turtle'

(Brainard & Behrens 2002)

One last example of gemination with regular penultimate stress is from Kelabit, a language of the Western Indonesian group spoken in Borneo. Blust (2006, 2018) has written much on the topic of gemination and stress and the historical phonology of Kelabit. In Kelabit, stress regularly falls on the penultimate syllable of the word. If the penultimate-syllable vowel is schwa, the following onset geminates and stress remains on the penultimate syllable. Not all consonants in Kelabit are available for gemination, however, and words with /r/ in the onset of a final syllable after a penultimate schwa show no gemination and stress shifts to the final syllable.

In addition to type-one and type-two gemination patterns, there are multiple additional cases of gemination of the onset of final syllables in words with an open schwa penult that cannot be easily analyzed as having stress shift or stress regularization. Most of the cases occur in languages that have shifted stress to the final syllable; but, even in such languages, penultimate schwa may still trigger gemination. In other cases descriptions of stress are insufficient. Some such cases include Talaud and Sangir of the Sangiric group, Idaan Begak of the Northeast Sabah group, most Southwest Sabah languages (which show fortis reflexes of consonants after schwa but lenis reflexes after other vowels), Kambera which is part of CMP, and the Sri Lanka dialect of Malay. These are exemplified in (24)–(27):

(24)

PMP	Talaud	
*baqəRu	*bakːu*	'new'
*təlu	*talːu*	'three'
*əpat	*apːata*	'four'

(Sneddon 1984)

(25)

PMP	Idaan Begak	
*təbuh	*təbpu*	'sugarcane'
*zəlay	*dəlːay*	'job's tears'
*dəpah	*rəpːa*	'fathom'

(Goudswaard 2005)

(26)

	PMP	Kambera	
a.	*pija	*pira*	'how many'
	*ujuŋ	*uru*	'nose'
	*tuba	*tuwa*	'derris root'
b.	*qapəju	*ka-pidu*	'gall'
	*qaləjaw	*lodu*	'day'
	*təbuh	*tibu*	'sugarcane'

(Klamer 1998)

(27)

Standard Malay	Sri Lanka Malay	
kəcil	*kicːil*	'small'
təman	*tumːan*	'friend'
pənuh	*punːu*	'full'

(Adelaar 1991)

4.2.3 *Possible motivations for type-one and type-two stress responses to gemination*

So far it has been shown that gemination after a penultimate schwa occurs throughout Malayo-Polynesian. The above sections also show that gemination, although widespread, results in separate stress patterns even in closely related languages. Type-two languages, where gemination results in the regularization of stress to the penultimate syllable, have a straightforward explanation. Under standard analyses of geminate structure, the resulting geminate consonant is split between both syllables, thereby providing both a coda for the previous syllable and an onset for the following syllable: CəC$_j$.C$_j$VC. Coda consonants may contribute to syllable weight if the vowel is a zero-mora schwa, as already discussed. In such languages the geminate structure provides a mora to the penult resulting in stress regularization.

Type-one languages, on the other hand, are more difficult to generalize. There are instead multiple explanations which may explain the stressing of a final syllable after a geminate, including at least (i) a moraic requirement on the syllable nucleus, (ii) lexicalization of stress pre-gemination, (iii) a superheavy syllable ban, and (iv) moraic onset geminates. Each of these possibilities is discussed here.

i. *Moraic requirement*

In most cases, gemination that results in typical split-geminate structures of the shape …əC$_j$.C$_j$V… results in the regularization of stress to the penultimate syllable due to the variable-weight principles already discussed. If, however, language-specific requirements maintain that only syllables with a moraic vowel may bear stress, then even words with split-geminate structures may fail to regularize stress to the penult. Alternatively, if variable coda weight ceases to be an active process in the language, the presence of a coda in the schwa penult may still fail to add the necessary mora to the word. Testing these possibilities may prove difficult, however. For example, most languages that have stress-shift to the final syllable after a penultimate schwa allow for schwa to bear stress in the final syllable, that is, -əCəC words may be stressed as -əCə́C since the final-syllable schwa has coda support. If schwa were simply unable to hold stress, its ability to do so in these words may pose a problem. One may then argue that stress must fall on some syl-

lable and that the final syllable becomes default in these cases. Such an explanation is again possible, but it is not clear which languages might fit into this type.

ii. *Lexicalization*
It is also possible that in some languages stress patterns became lexicalized before subsequent gemination. This analysis is weakened by the overall predictability of stress, even after gemination. Note that Hayes (1995) has already proposed that rules may be redundant, at least in English, deriving surface forms from lexical entries that are already marked for stress. Such cases, if they exist at all, will be difficult to analyze with available data. This explanation is therefore logically possible but does not seem to have much promise as an area for future research.

iii. *Superheavy ban*
As noted earlier, many Philippine languages have a requirement that stressed penultimate syllables have a long vowel, whereas stressed final syllables have a short vowel. Kaufman and Himmelmann (2021) regard this primarily as a vowel-length distinction, whereby long vowels in the penult attract stress. They note that closed penultimate syllables in many Philippine languages cannot also have long-vowels, i.e., a superheavy syllable ban. In Ilocano, for example, it is not only words such as *dəp:á* 'a fathom' that predictably stress the ultima, but any word with a penultimate coda such as *bitbít* 'to carry in the hand' and *dugmón* 'nest of the wild boar'. In words with a schwa-triggered geminate, əC.CV, the length and stress requirement on the penult will clash with a superheavy syllable ban, forcing stress to remain on the final syllable.

iv. *Moraic onsets*
Moraic onsets, while rare, are offered as a viable syllable structure by Topintzi (2008, 2010). Gemination, in Topintzi's view, may be of two types: the more familiar split-geminate type (…$VC_j.C_jV$…) and the moraic-onset type (…V.C:V…). In some cases, a moraic-onset hypothesis offers a viable solution for phenomena associated with stress-placement and word-minimum requirements. A good example comes from Kiput, a language of Borneo which Blust (2002, 2003a) shows enforces a two-mora minimum by lengthening onsets in word-initial position. In (28), words with a monomoraic underlying representation (UR) are realized with a geminate onset but words with a two-mora UR are realized without onset lengthening.

(28) Kiput

monomoraic UR		bimoraic UR	
/lay/	→ [lːay] 'dry season'	/laːy/	→ [laːy] 'male'
/say/	→ [sːay] 'meat; flesh'	/saːy/	→ [saːy] 'frog'

(Blust 2002: 388)

Another example of mora-bearing onsets comes from Marshallese, where stress is word initial but is attracted to heavy syllables wherever they are present (Zewen 1977). Topintzi (2008: 170–172) pointed out that where a medial consonant is geminate, stress appears in the syllable immediately *after* the geminate, suggesting that the extra mora is in the onset, not the coda, as in Marshalese *jibbúŋ* 'morning' (not ***jíb.buŋ*) and *emmér* 'to be ripe' (not ***ém.mer*)

In summary, there are multiple possible explanations for why stress may remain on the final syllable after gemination in type-one languages. A ban on superheavy syllables in Philippine languages where stress and vowel length are codependent in penultimate syllables makes sense if schwa triggers gemination and creates a closed penult, since CVːC syllables would be illicit. Such an explanation cannot work everywhere, however, since penultimate syllable length is a strictly Philippine phenomenon among western Austronesian languages. Moraic onset geminates may explain some cases of final stress, especially in languages that have independent evidence for such structures. However, generalizing this analysis to all languages with final-syllable stress in words with a schwa penult and final-syllable onset gemination is not desirable, since moraic onset structures are themselves rare. In cases outside of the Philippines where the superheavy syllable ban has no force, and where independent evidence for moraic onsets is absent, alternative explanations such as stress lexicalization, vowel-mora requirement, or the loss of variable coda weight, may play some role in the observed stress patterns. With such a varied stress reaction to gemination, it is most likely that gemination arose in multiple parallel developments after the breakup and diversification of Malayo-Polynesian languages. The contrasting stress systems that emerged after gemination, stress-shift to the final syllable in some languages, stress regularization in others, show that stress was not the motivation for gemination. The motivation for gemination was, rather, to add a mora to words which were sub-minimal due to the presence of a weightless schwa in the open penultimate syllable. The secondary effects that this has on stress must be analyzed as independent occurrences, perhaps each with their own explanations and histories.

4.3 Schwa-shift as a mora addition strategy

A second means by which languages may add a mora to words with a weightless penultimate schwa syllable involves shifting schwa to a full vowel, thus adding a mora directly to the penultimate syllable nucleus. Many Austronesian languages have eliminated schwa in all positions via shift or merger, and still others, like Malay, have eliminated schwa from the final syllable only, but left schwa in the penult unchanged. Such cases are not discussed at length here because when schwa shifts to a full vowel in all positions, or a closed/final syllable, it cannot be claimed that this was a mora addition strategy. Where schwa shifts in the final syllable, for example, stress is unaffected, the weight of the penultimate syllable is unaffected, and the lexical mora count is unaffected. The only cases where mora-addition may be singled out as the most likely motivation for schwa-shift are cases where schwa shifts to a full vowel in open penultimate syllables but remains unchanged in all other positions. Cases where this happens are found in the Eastern Malayo-Polynesian (EMP) subgroup, and are discussed in detail below.

EMP is a daughter of CEMP, and includes the South Halmahera-West New Guinea subgroup (SHWNG), and Oceanic (Oc). Oc shifted *ə to *o in all positions, whereas SHWNG reflects *ə as /o/ in the penult but not in the ultima. One possible interpretation of this is that the changes happened separately in Proto-SHWNG and POc, but Blust (1978: 211–212) points to another possibility: "… PAn *e [schwa] unconditionally yielded POc *o, but only penultimate *e [schwa] yielded Proto-SHWNG *o. In view of the other evidence to be considered, it is perhaps simplest to assume that penultimate *e [schwa] first shifted to *o in a language ancestral to the SHWNG and Oceanic groups, and that last-syllable *e [schwa] then followed this development in Proto-Oceanic, but merged with *a in SHWNG." As more data has become available, it has become clear that *ə became *o in penultimate position, but was left unchanged in the final syllable in Proto-SHWNG, although it did eventually merge with *a in several SHWNG languages. Some examples from Ma'ya (29), Taba (30), and Buli (31) demonstrate this.

(29)

	PMP	Ma'ya		PMP	Ma'ya
a.	*təlu	*tol* 'three'	b.	*qinəp	*wenef* 'to sleep'
	*qatəluR	*tol* 'egg'		*bituqən	*tuen* 'star'
	*dəŋəR	*don* 'to hear'		*qitəm	*mat-'metem* 'black'

(Remijsen 2001)

(30)

	PMP	Taba		PMP	Taba
a.	*dəpa	*lof* 'a fathom'	b.	*ənəm	*onam* 'six'
	*təlu	*tol* 'three'			

(Remijsen 2001)

(31) PMP Buli
*qatəp *yataf* 'roof'/ *fa-yatf-o* 'cover with thatch'
*dəŋəR *loŋa* 'to hear'
*Rəbək *opa* 'to fly'

(Blust & Trussel ongoing)

Both Oc and SHWNG have stress on the historically penultimate syllable,[7] with SHWNG languages further deleting most word-final vowels (Remijsen 2001: 111–113). The shift of *ə to *o in penultimate, but not in other positions, is expected if the change occurred to enforce a two-mora minimum. Words of the shape CoCVC and CVCəC have two moras, but words of the shape CəCVC have only one. What occurred in Malayo-Polynesian, in this view, is a classic conspiracy. Two seemingly unrelated changes, (i) the gemination of final-syllable onsets after a penultimate schwa and ii) schwa shift to a full vowel only in penultimate syllables with no change in final syllables, effectively eliminate subminimal words from the grammars of Malayo-Polynesian languages. The main difference between gemination and penultimate schwa shift in Malayo-Polynesian is frequency. Gemination occurred in numerous parallel innovations in Malayo-Polynesian languages, but penultimate schwa shift is only attested once, in PEMP. Nevertheless, it provides crucial evidence that these changes are motivated by the same two-mora requirement, and that this requirement reveals itself in reflexes of PMP words of the shape *CəCV(C).

4.4 Schwa deletion in three-or-more-syllable words

The final sound change associated with penultimate schwa is the deletion of schwa in words with three or more syllables (*CVCəCVC became CVCCVC). Schwa-deletion in these words is in complementary distribution with gemination. To summarize, in languages where schwa deletes in three-or-more-syllable words, gemination is only attested in reflexes of two-syllable words, or of three-syllable words that were reduced to two-syllables via some other sound change. In these languages, three-or-more-syllable words never underwent gemination of the final syllable onset. The reason for this complementary distribution is simple. After schwa deletes in a three-or-more-syllable word, a new foot may be constructed on the remaining two syllables, creating a well formed two-mora foot, eliminating the motivation for gemination: $CV(CəCVC)^{\mu} \rightarrow (CVCCVC)^{\mu\mu}$. This is the case throughout the Philippines where schwa deletion in this environment is nearly

7. But see Lynch (2000) for an argument that POc stressed the penultimate *mora*, with codas acting as moraic segments.

universal. Ilocano (32) provides examples which are paralleled in many other Malayo-Polynesian languages. Words in (32a) show the expected stress-shift after schwa pattern along with gemination of the final syllable onset, whereas words in (32b) show penultimate schwa deletion in three-syllable words removing the motivation for gemination.

(32)

	PMP	Ilocano		PMP	Ilocano
a.	*dəpah	*dəpːá* 'a fathom	b.	*qaŋəlit	*aŋlít* 'foul odor'
	*dənəR	*dəŋːág* 'hear; listen'		*qaləjaw	*aldáw* 'day'
	*təkən	*təkːán* 'punting pole'		*lisəqah	*lisʔá* 'nit'

(Rubino 2000)

There are therefore three changes which all appear to eliminate a zero-mora schwa syllable from penultimate position, repairing otherwise degenerate right-aligned feet: (1) the gemination of final syllable onsets, (2) the shifting of schwa to a full vowel in the penultimate syllable but not in other syllables, and (3) the deletion of schwa from penultimate position in three-or-more syllable words where such deletion has the effect of moving the antepenult into penultimate position, creating a new well-formed foot at the right edge.

5. Conclusion

This study has gathered together evidence in support of the hypothesis that PAn stress fell regularly on the penultimate syllable, but that this stress shifted to the final syllable if the penultimate syllable was open and contained a schwa nucleus. This position has been argued in other works, but the present hypothesis combines the observation that schwa did not hold stress with a theory on the weightlessness of schwa. This motivates not only stress shift, but gemination of final syllable onsets, the shift of schwa to a full vowel in penultimate syllables, and the deletion of schwa from the penultimate syllable of three-or-more-syllable words. Evidence for these claims is found across primary divisions in An subgroups. Western Plains, Paiwan, and Malayo-Polynesian directly continue a system where stress was regularly penultimate, but shifted to the final syllable if the penult was open and its vowel was schwa. Further, East Formosan and Atayalic, two first order Formosan subgroups, deleted schwa, but not other vowels, in open penultimate syllables. This suggests that schwa was unstressed in the ancestor to these languages, PAn. Other Formosan subgroups, Northwest Formosan and Puyuma, show deletion of schwa in penultimate syllables only in the environment VC_CV(C)#. These languages disallow word-initial clusters, and the

inability of schwa to delete in disyllables likely stems from this restriction. These languages nevertheless also support the hypothesis that schwa was unstressed in open penultimate syllables.

In Malayo-Polynesian, this study has collected evidence for a subgroup-wide conspiracy to add a mora to words with schwa in an open penult. Mora addition could take the form of gemination, as is the case in a large number of Malayo-Polynesian languages where the onset of final syllables lengthened after a penultimate schwa: *CəCV(C) > CəC:V(C). A less often cited, but important, parallel sound change occurred in Eastern Malayo-Polynesian, where SHWNG languages reflect a vowel shift that affected penultimate schwa, but left schwa in other (closed) syllables unchanged. In these cases, schwa shifted to a full vowel, *o, thereby adding a mora to the word: *CəCV(C)$^{\mu}$ > Co$^{\mu}$CV(C)$^{\mu}$. The reason schwa could trigger both gemination and penultimate vowel shift stems from its weightlessness. Both sound changes succeeded in adding a mora to the word, albeit by two separate means; a classic example of a phonological conspiracy. The recognition of this conspiracy in the development of Malayo-Polynesian languages explains why three-syllable words with a schwa penult in many languages show no evidence of gemination, even if gemination is triggered in two-syllable words with a schwa penult. Deletion of schwa from this position in three-or-more-syllable words also eliminated a degenerate foot, thereby removing the motivation for gemination or vowel shift.

Not all Malayo-Polynesian languages repaired subminimal words, of course. Languages of the Sumatran group, such as Batak, show no signs of gemination or penultimate vowel shift. In these languages, however, schwa remains unable to hold stress on its own. The existence of some subgroups that did not repair subminimal words demonstrates that PMP itself allowed subminimal words. The requirement that words and feet be minimally two moras eventually came to outweigh faithfulness to the underlying form in many subgroups as the product of phonologically motivated drift. The history of the metrical development of An languages is, therefore, largely a history of increased enforcement of a two-mora minimum stemming from the inability of schwa to participate in the formation of a minimal word.

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Abbreviations

ACD	Austronesian Comparative Dictionary (Blust & Trussel ongoing)
An	Austronesian
CEMP	Central-Eastern Malayo-Polynesian
CMP	Central Malayo-Polynesian
EMP	Eastern Malayo-Polynesian
ISEA	Island Southeast Asia
MP	Malayo-Polynesian
NAn	Nuclear Austronesian
Oc	Oceanic
PAn	Proto-Austronesian
PEMP	Proto-Eastern Malayo-Polynesian
PMP	Proto-Malayo-Polynesian
POc	Proto-Oceanic
PPh	Proto-Philippines
SHWNG	South Halmahera-West New Guinea
WIn	Western Indonesian

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Résumé

Des écoles de pensée concurrentes sur la reconstruction de l'accent proto-austronésien soutiennent que l'accent primaire était soit régulier (tombant sur l'avant-dernière syllabe avec des conditions phonétiques possibles qui entraînent le décalage de l'accent vers la syllabe finale), soit lexicale (tombant de manière imprévisible sur la pénultième ou sur la dernière syllabe). Cette étude démontre que les preuves comparatives soutiennent la première position, à savoir que l'accent primaire tombait régulièrement sur l'avant-dernière syllabe et n'était pas lexical. Par ailleurs, l'accent primaire était repoussé vers la syllabe finale si la syllabe pénultième était ouverte et contenait un cheva. Trois sous-groupes austronésiens de premier ordre (le malayo-polynésien, le formosan occidental et le paiwan) ont des systèmes d'accentuation remontant au système reconstruit du proto-austronésien, l'accent tombant généralement sur l'avant-dernière syllabe mais avec un décalage vers la syllabe finale après un cheva. On démontre aussi que le cheva ne peut recevoir l'accent non en raison de sa qualité, mais plutôt de sa quantité, car il est démontré que le cheva était une voyelle de poids zéro en proto-austronésien. Les mots présentant un cheva dans l'avant-dernière syllabe, CəCVC, sont considérés sous-minimaux, ne contenant qu'une seul more. Les langues filles du malayo-polynésien ont subi de multiples cas de dérive phonologiquement motivée, notamment la gémination des consonnes, la suppression du cheva pénultième dans les mots à trois syllabes et le décalage des voyelles. Ces changements sonores font partie d'une conspiration phonologique dont le résultat est l'ajout d'une more à des mots sous-minimaux. Cette étude propose donc à la fois une reconstitution de l'accentuation proto-austronésienne ainsi qu'une explication phonologique de ces différents changements phonologiques en malayo-polynésien.

Abstrakt

Konkurrierende Denkschulen zur Rekonstruktion von proto-austronesischer Betonung behaupten, dass die primäre Betonung entweder regelmäßig war (auf die vorletzte Silbe mit möglichen phonetischen Bedingungen, die eine Betonungsverschiebung zur letzten Silbe auslösen) oder lexikalisch war (unvorhersehbar entweder auf die vorletzte oder die Ultima fallend). In dieser Studie wird gezeigt, dass die vergleichende Evidenz die erste Position stützt, dass die primäre Betonung regelmäßig auf die vorletzte Silbe fiel und nicht lexikalisch war. Außerdem wurde die primäre Betonung bis zur letzten Silbe abgestoßen, wenn die vorletzte Silbe offen war und einen Schwa-Kern enthielt. Es wird gezeigt, dass drei austronesische Untergruppen erster Ordnung, Malayo-Polynesisch, Westliches Formosa (Formosa-Sprache) und Paiwan, das rekonstruierte Stresssystem des Proto-Austronesischen direkt fortsetzen, wobei die Betonung regelmäßig auf die vorletzte Silbe fällt, sich jedoch nach einem Schwa auf die letzte Silbe verschiebt. Es wird auch gezeigt, dass die Unfähigkeit von Schwa, Betonung zu halten, nicht auf Qualität, sondern eher auf Quantität zurückzuführen ist, da Schwa im Proto-Austronesischen ein Vokal mit Nullgewicht war. Wörter mit einem Schwa in der vorletzten Silbe, CəCVC, sind subminimal und enthalten nur eine einzige Mora. Tochtersprachen im Malayo-Polynesischen erlebten mehrere Fälle von phonologisch motivierter Abweichung, einschließlich Konsonanten-Gemination, Streichung des vorletzten Schwa in dreisilbigen Wörtern und Vokalverschiebung. Es wird gezeigt, dass diese Lautveränderungen Teil einer phonologischen „conspiracy" sind, deren Ergebnis das Hinzufügen einer Mora zu subminimalen Wörtern ist. Diese Studie bietet daher sowohl eine Rekonstruktion der proto-austronesischen Betonung als auch eine phonologische Erklärung für diese verschiedenen Lautänderungen im Malayo-Polynesischen.

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