Laryngeal Feet in A'ingae. Implications for Metrical Theory

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1. Introduction

In this paper, I argue that glottalization in A'ingae (or Cofán, an understudied Amazonian isolate, ISO 639-3: con) is a laryngeal feature of the metrical foot, which I will represent as $(\acute{\sigma}\sigma)^{ʔ}$. My proposal entails that traditional structures available to metrical theory (Hayes 1995) must be enriched by allowing the association of features such as glottalization to metrical constituents.

Glottal constriction has received a number of treatments in the phonological literature. Hawaiian (Austronesian), for example, is analyzed as having a segmental glottal stop (Parker Jones 2018). In many languages, however, the glottal stop does not perfectly pattern with other consonantal segments. In Cayapa (Barbacoan), the glottal stop displays exceptional behavior: CVʔ syllables are light, while all other CVC syllables are heavy (Lindskoog & Brend 1962). In Capanahua (Panoan), CVʔ syllables are open, while all other CVC syllables are closed (Safir 1979).

In yet other languages, glottalization has a more clearly prosodic character. Silva (2016), for example, argues that glottalization in Desano (Tucanoan) is best understood as a suprasegmental laryngeal feature of the root. The Danish stød has been variously referred to as laryngeal accent (Itô & Mester 2015) or a prosodic feature (Staun 2012). Finally, Harley & Harvey (in press) advance the proposal that Yaqui (or Hiaki, Uto-Aztecan) utilizes both underlying representations: an ordinary segmental glottal stop as well as a floating glottal feature realized on vowels.

In this paper, I will focus on glottalization in A'ingae. A'ingae (or Cofán, ISO 639-3: con) is an endangered Amazonian isolate spoken by the Cofán people in northeast Ecuador and southern Colombia. A'ingae is a bit like Yaqui in that phonologically, glottalization sometimes appears to be a suprasegmental feature of the vowel and sometimes a segmental glottal stop in the syllabic onset position. However, I will propose that there is only one underlying representation which accounts for both surface realizations. Specifically, I will argue that glottalization is a feature of the A'ingae metrical foot, which is variably realized on the surface as a consequence of phonological optimization.[1]

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[1] A similar analysis is advanced in Macken & Salmons (1997) and adopted by Penner (2019) for Ixtayutla Mixtec. Macken & Salmons (1997) propose that glottalization is "best analyzed as a non-segmental phenomenon associated with ... [foot] template" (p. 33). However, in Ixtayutla Mixtec, glottalization always appears on the first syllable of a trochaic foot: $CV^{ʔ}V$, $CV^{ʔ}CV$. Thus, one might reanalyze the data and say that glottalization is licensed by stress, or that glottalization is a facultative feature of the strong branch of a foot, rather than being a feature of the foot per se. Penner (2019) does not adopt the analysis of glottalization as being licensed by stress because there are other Mixtec varieties where glottalization can appear on a stressless syllable. Specifically, in Ayutla Mixtec, Zacatepec Mixtec, and Southwestern Tlaxiaco Mixtec, glottalization can occur foot-finally (i. e. in a stressless syllable), resulting in feet of the following forms: $CVCV^{ʔ}$, $CV^{ʔ}CV^{ʔ}$, $CV^{ʔ}V^{ʔ}$, and $CVV^{ʔ}$ (Penner 2019: 253). I take this to mean that glottalization in those Mixtec varieties is licensed by metrical structure, but is not a property of the metrical constituent as such. Rather, it is a property of the syllabic nucleus, since both syllables may be independently glottalized.

The rest of the paper is organized as follows. In Section 2, I describe the phonetic realization of glottalization, identify its distributional restrictions, outline its interactions with stress, and present cases of apparent glottal metathesis. In Section 3, I flesh out the proposal that glottalization is a feature of the metrical foot, and demonstrate that its properties follow from the proposal. In Section 4, I conclude.

All the data in this paper come from my own fieldwork conducted over the course of the past three years and Borman's (1976) dictionary. For my previous work on A'ingae stress and glottalization, see Dąbkowski (2019a,b, subm, in press).

2. Distribution

The glottal stop is contrastive in A'ingae, as is demonstrated by the existence of numerous minimal pairs. Some of the minimal pairs involve lexical roots, such as (1-3a-b). The examples use the practical orthography, except the glottal is represented as in the IPA.[2] Still, most minimal pairs in the language are morphologically complex, like (4-6a-b). This is a result of the fact many of the language's functional morphemes begin with glottal stops. Preconsonatally and word-finally (e. g. 2, 4), *n* and *m* represent vowel nasality and/or prenasalization of the of the following consonant; they are not codas. Syllable boundaries are represented with a full stop.

(1)	a.	*chí.ga*	god	"god"	(4)	a.	*án.-mba*	eat-SS	"having eaten"
	b.	*chíʔ.ga*	not want	"not want"		b.	*án-ʔ.mba*	eat-N	"yuca"
(2)	a.	*ú.mba*	up	"up"	(5)	a.	*tsá.=ma*	that=ACC	"that"
	b.	*úʔ.mba*	fill up	"fill up"		b.	*tsá-ʔ.ma*	that-FRST	"but"
(3)	a.	*ká.ni*	yesterday	"yesterday"	(6)	a.	*í.=ngi*	bring=1	"I brought"
	b.	*káʔ.ni*	enter	"enter"		b.	*í-ʔ.ngi*	bring-VEN	"come to bring"

2.1. Phonetic properties

The phonetic realization of glottalization is variable. It ranges from glottal closure to creakiness. In Figure 1, the glottal stop is realized as a glottal closure and followed by an aspirated alveolar stop /ʔt^{h}/. The two together can be seen on the spectrogram as a long pause. In Figure 2, the glottalization is realized with creaky voice. The creaky realization is not restricted to the glottalized syllable; it can extend across the rest of the word.

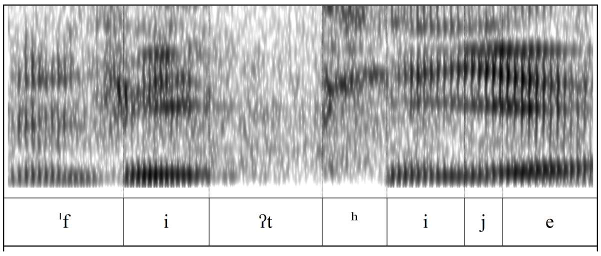

Figure 1: *fiʔ.thi.-ye* 'kill-INF.'

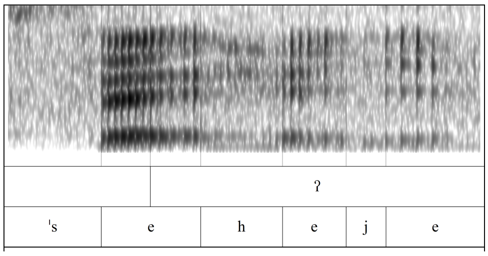

Figure 2: *séʔ.je.-ye* 'cure-INF.'

2.2. Prosodic character

Previous literature treats the glottal stop as phonologically an underlying segment like other consonants (Repetti-Ludlow et al. 2019, Fischer & Hengeveld in press). Yet, the glottal stop has many phonological

A'ingae provides an unequivocal case of glottalization as a facultative feature of the metrical foot. First, there can be only one glottalization per foot. Second, the position of glottalization is underlyingly undetermined; on the surface, glottalization can surface in the first or in the second syllable of the foot.

[2] In practical orthography, the glottal stop is represented with an apostrophe.

properties which make the analysis implausible. I will argue that the glottal stop is best understood as a prosodic feature.

First, the glottal stop is associated most frequently with the syllabic nucleus (1-6). If it were treated segmentally, it would have to be analyzed as a coda. This is undesirable as the analysis would make the glottal stop the only coda in a language which otherwise lacks codas. The glottal stop sometimes appears in the onset position, but it does so only in a very small class of words (to be considered in subsection 2.3). If the glottal stop were a regular segment, this restriction would be unexpected.[3]

Second, within a morphological stem of the relevant size,[4] the glottal stop is culminative. This is to say, there can be only one glottal stop per a morphological stem. While the property of culminativity is not restricted to metrical structure (Hyman 2006), it is expected of it.

Third, the glottal stop is never word-final. The glottal stop can surface in the penultimate syllable (7-9a), antepenultimate syllable (7-9b), or earlier, but it can never surface in the final syllable (7-9c). The special case of monosyllabic roots will be discussed in Section 3.1. The orthographic *û* represents /ɨ/.

		σʔσ]$_\omega$			σʔσσ]$_\omega$			*σʔ]$_\omega$
(7)	a.	*ṹʔ.kha*	break	b.	*áʔ.ta.-ye*	dawn-INF	c.	———
(8)	a.	*áʔ.tse*	hummingbird	b.	*cháʔ.ndi.-tshi*	cold-ADJ	c.	———
(9)	a.	*á.fe-ʔ.nga*	give-AND	b.	*ka.sá.ra-ʔ.je*	marry-IMPV	c.	———

The fact that the glottal stop is never word-final also supports the first observation that it is not a coda. We would first expect codas to be allowed in a word-final position before being allowed in word-medial position. Although languages which allow word-internal but ban word-final codas exist, they are typologically less common.

Fourth, the distribution of the glottal stop in morphological roots is entirely predictable. In disyllabic roots, the first syllable is glottalized (10-12a). In trisyllabic roots, the second syllable is glottalized (10-12b). The first syllable is never glottalized in trisyllabic roots (10-12c).

		[σʔσ]$_\surd$			[σσʔσ]$_\surd$			*[σʔσσ]$_\surd$
(10)	a.	*inʔ.jan*	want	b.	*á.kheʔ.pa*	forget	c.	————
(11)	a.	*jáʔ.ñu*	now	b.	*ú.maʔ.ndu*	macaw	c.	————
(12)	a.	*dṹʔ.shû*	child	b.	*ká.seʔ.te*	hello	c.	————

Fifth, the glottal stop attracts stress in a way which cannot be reduced to syllabic weight. Specifically, stress is assigned to the syllable which contains the second mora to the left of the glottal stop. Since A'ingae has no long vowels or codas (as I argue that the glottal stop is not a coda), only diphthongs make for heavy syllables. This special stress assignment triggered by the glottal stop is most easily seen by comparing stress on bare verbal roots with inflected verbs.

[3] However, in Grassfields Bantu languages an unequivocally segmental glottal stop is limited to coda position (Larry Hyman, p.c.).

[4] The analysis presented in this paper pertains only to a relatively narrow morphosyntactic domain, which corresponds roughly to roots for nouns and the verbal inflectional domain (i. e. verb roots inflected with verbal inflectional morphology) for verbs. This verbal inflectional morphology includes valence-changing suffixes such as the reciprocal *-khu* 'RCPR' and the passive *-ye* 'PASS,' aspectual suffixes such as the precumulative *-ji* 'PRCM,' as well as associated motion suffixes. In (i), the verbal inflectional stem is given in parentheses [ ].

(i) [*panza -khu -ye -jí*] *-ʔfa -ya -mbi*
hunt -RCPR -PASS -PRCM -PLS -IRR -NEG
"They$_{\text{PLS}}$ will$_{\text{IRR}}$ not$_{\text{NEG}}$ be about$_{\text{PRCM}}$ to be$_{\text{PASS}}$ hunted by each other$_{\text{RCPR}}$."

The suffixes within the verbal inflectional domain can appear only on verbs. The suffixes outside of that domain, such as the plural subject *-ʔfa* 'PLS' and the negation *-mbi* 'NEG' are more promiscuous in that they can appear on verbal and nominal predicates. The analysis presented in this paper pertains only to the inner verbal inflectional domain.

	⌣⌣]+		−⌣]+		⌣−]+	
(13)	a. *fé.tha*	open	b. *fû́i.te*	help	c. *fû́.ndûi*	sleep
(14)	a. *fe.thá.-ji*	open-PRCM	b. *fûi.té.-ji*	help-PRCM	c. *fû.ndû́i.-ji*	sweep-PRCM
(15)	a. *fé.tha-ʔ.je*	open-IMPV	b. *fû́i.te-ʔ.je*	help-IMPV	c. *fû.ndû́i-ʔ.je*	sweep-IMPV

By default, stress falls on the penultimate syllable of the word. This is the pattern seen with bare, underlyingly stressless roots (13a-c). Observe that stress falls on the penultimate syllable regardless of whether the word contains two light syllables (13a), a heavy syllable followed by a light syllable (13b), or a light syllable followed by a heavy syllable (13c).

The precumulative aspect (14) *-ji* 'PRCM' does not assign stress but counts towards the phonological word, so stress is likewise penultimate in (14a-c). As in (13a-c), stress is assigned to the penultimate syllable of the word regardless of the prosodic shape of the stem.

A different, weight-sensitive, pattern emerges with a preglottalized suffix. The imperfective aspect (15) *-ʔje* 'IMPV' has an initial glottal stop, which means that stress is assigned to the penultimate syllable of the stem if both syllables of the stem are light (15a) and if the penultimate syllable is heavy but the last syllable is light (15b), but to the last syllable of the stem if the last syllable is heavy (15c). To reiterate, the generalization about the interaction of glottalization and stress in A'ingae can be stated as in (16).

(16) GLOTTALIZATION-STRESS INTERACTION
Stress falls on the glottalized syllable if heavy and on the preceding syllable otherwise.

Although (15a-c) are morphologically complex forms, the generalization holds of bare roots of all lexical classes as well. The antepenultimate stress in (10b-12b), for example, results from the glottalization of the penultimate syllable. Were the penultimate syllable not glottalized, we would expect default stress on the penultimate syllable.

Sixth and last, the glottal stop is deleted whenever the lexical properties of a suffix require deletion of stress. This is independent of whether the deleted stress is on the glottalized syllable or not. I take this to mean that the glottal stop is treated by the phonological grammar of A'ingae as a prosodic feature, not a segment. For example, the verb *áfase* 'offend' has lexically specified word-initial stress (17a). The passive suffix *-ye* 'PASS' is *dominant*, which means that is has the idiosyncratic lexical property of deleting preceding stress (Halle & Vergnaud 1987). It does not assign morphological stress, so the output stress is assigned by default to the penultimate syllable. When the passive suffix *-ye* 'PASS' attaches, it deletes the lexical stress and default stress is assigned to the penultimate syllable (17b).

(17)	a. *á.fa.se*	offend	b. *a.fa.sé.-ye*	offend-PASS

Now let us consider a glottalized verb, such as *séʔje* 'cure.' The verb *séʔje* 'cure' is stressed on the first syllable (18a). When passivized with *-ye* 'PASS,' that stress is deleted and default stress is supplied to the penult (18b). Importantly, observe that stress deletion is accompanied by the deletion of glottalization. In (19), we see that the dominant *-ye* 'PASS' deletes glottalization along with stress, even if glottalization is not on the stressed syllable.

(18)	a. *séʔ.je*	cure	b. *se.jé.-ye*	cure-PASS
(19)	a. *á.kheʔ.pa*	forget	b. *a.khe.pá.-ye*	forget-PASS

In interim summary, we saw that the glottal stop has many properties typical of prosodic structure, which makes segmental analysis implausible. Specifically, the glottal stop is associated with the nucleus, it is culminative, nonfinal, distributionally restricted in phonological words, and predictable in morphological roots. Moreover, the glottal stop is closely tied to stress: it attracts stress to the syllable containing the penultimate mora before it and undergoes deletion whenever stress undergoes deletion.

2.3. Segmental realization

I have argued that A'ingae glottalization is a prosodic feature typically realized in the syllabic nucleus. Nevertheless, the glottal stop can be realized as an onset as well in both morphological roots (20-24a) and morphologically complex forms (20-24b). Conspicuously, glottalization is realized as a segmental onset in the name of the language (20b). At first sight, this is a challenge to the proposal I have put forth.

Observe, however, that whenever the glottal stop is realized as an onset (20-24a-b), it alternates in some morphologically related forms with the more expected nucleus realization as well (20-24c). I will refer to this alternation as apparent glottal metathesis, as my account will not propose actual metathesis.

(20)	a.	*á.ʔi*	person	"person"
	b.	*á.ʔi.=ngae*	person=MANN	"A'ingae"
		á.ʔi.=ma	person=ACC	"person"
		á.ʔi.-na.khû	person-COLL	"people"
	c.	*áiʔ.-ña*	person-CAUS	"domesticate"
		áiʔ.-vu	person-?	"body"
		ái-ʔ.pa	person-N	"Secoya"
(21)	a.	*tû́.ʔi*	tomorrow	"tomorrow"
	b.	*tû́.ʔi.=tsû*	tomorrow=3	"tomorrow"
	c.	*tû́iʔ.=ve*	tomorrow=ACC2	"day after tomorrow"

(22)	a.	*kû́.ʔi*	drink	"drink"
	b.	*kû́.ʔi.-mbi*	drink-NEG	"does not drink"
	c.	*kû́iʔ.-ña*	drink-CAUS	"make drink"
(23)	a.	*já.ʔi*	later	"later"
	c.	*jáiʔ.=ngae*	later=MANN	"eventually"
(24)	a.	*tsá.ʔu*	house	"house"
	b.	*tsá.ʔu.=ma*	house=ACC	"house"
		tsá.ʔu.=ni	house=LOC	"in a house"
	c.	*tsáuʔ.-ña*	house-CAUS	"build a house"
		tsáu-ʔ.pa	house-N	"nest"

Many of these forms are synchronically non-compositional. Nevertheless, the alternation is seen with productive morphology as well. For example, (24b) *tsáʔu=ma* 'house=ACC' shows productive inflectional case morphology and (24c) *tsáuʔ-ña* 'house-CAUS' shows productive causativization. Thus, the apparent glottal metathesis is active in the language, not just a reflex of an erstwhile process.

Note that whether a functional morpheme is a clitic or a suffix does not correlate with apparent glottal metathesis in any immediate manner. For example, the glottal stop appears in an onset position in both *áʔi=ma* 'person=ACC' and *áʔi-nakhû* 'person-COLL,' even though the accusative *=ma* 'ACC' is a clitic while the collective *-nakhû* 'COLL' is a suffix (20b).

3. Analysis

To capture the distributional facts of the A'ingae glottalization and its interaction with stress, I put forth the proposal in (25).

(25) THE CORE PROPOSAL: $(\acute{\sigma}\sigma)^{ʔ}$
Glottalization is a (facultative) feature of the trochaic foot. In the underlying representation of a morphological root, glottalization is not linearized.

Thus, the presence of glottalization can be optionally specified for a metrical foot. I will represent the underlying glottal feet with a superscripted glottal stop $(\acute{\sigma}\sigma)^{ʔ}$. This abstract representation captures the idea that at the level of a morphological root's underlying representation, glottalization is not associated with either of the glottal foot's syllables. so its surface position is a consequence of phonological optimization.

Now I will demonstrate how this accounts for the distributional properties of glottalization from section 2. First, recall that glottalization is never word-final (7-9). I adopt an Optimality Theoretic approach (McCarthy & Prince 1986, Prince & Smolensky 1993) and capture the pattern with a GLOTTALNONFINALITY constraint (26).

(26) GLOTTALNONFINALITY, or: NONFINʔ
Glottalization is not final in a prosodic word.

Also recall that in trisyllabic roots on the immediately posttonic syllable (10-12b). I take this to mean that glottalization prefers to surface in the second syllable (or the right edge) of the glottal foot, and capture the pattern with an ALIGNMENT constraint (27).

(27) ALIGN(ʔ, FOOT-R), or: ALIGNʔ)
Glottalization is right-aligned with a metrical foot.

Disyllabic words with glottalization violate ALIGN(ʔ, FOOT-R) but avoid glottalization at the end of the word, which shows that ALIGN(ʔ, FOOT-R) is outranked by GLOTTALNONFINALITY (28).[5]

(28)	(*injan*)$^{\text{ʔ}}$:	NONFINʔ »	ALIGNʔ)
☞ i.	(*ínʔ.jan*)		*
ii.	(*ín.janʔ*)	*	———
	want		

Trisyllabic words have enough syllables for violations of GLOTTALNONFINALITY not to be a problem. Thus, the surface position of glottalization is governed by ALIGN(ʔ, FOOT-R), as demonstrated in (29).[6]

(29)	(*uma*)$^{\text{ʔ}}$*ndu*:	NONFINʔ »	ALIGNʔ)
i.	(*úʔ.ma*)*ndu*		*
☞ ii.	(*ú.maʔ*)*ndu*		
iii.	*u*(*máʔ.ndu*)		*
iv.	*u*(*má.nduʔ*)	*	———
	macaw		

Now, recall the interaction of glottalization and stress. Namely, stress falls two syllables before the glottal stop, unless the immediately preceding syllable is heavy, in which case stress falls on the glottalized syllable. The generalization is seen most transparently in forms with preglottalized suffixes (15).

	◡◡]+	−◡]+	◡−]+
(15)	a. *fé.tha-ʔ.je* open-IMPV	b. *fûi.te-ʔ.je* help-IMPV	c. *fû.ndûi-ʔ.je* sweep-IMPV

Preglottalized suffixes, such as the imperfective aspect (15) -*ʔje* ‘IMPV,’ require glottalization immediately to their left. Thus, they differ from morphological roots where glottalization surfaces based on the interaction of GLOTTALNONFINALITY and ALIGN(ʔ, FOOT-R).

To capture this fact, I propose that the underlying representation of glottalization in suffixes differs from the underlying representation of glottalization in morphological roots. Specifically, at the level of the input, glottalization is linearized in suffixes, but not in roots. Accordingly, I will represent glottalization in suffixes with a regular type glottal stop -ʔσ. Since glottalization is a property of a metrical foot, a regular type glottal stop -ʔσ is a partial representation of a metrical foot: It represents the position of glottalization, but not the foot’s left or right boundary. To create a well-formed metrical representation, the rest of the foot is supplied in the output.

[5] I assume that the foot binary is ensured by a high-ranking FOOTBINARITY constraint. The FOOTBINARITY constraint is not shown in the tableaux.

[6] Interestingly, in (29), not only is the position of the glottalization determined by the GLOTTALNONFINALITY and ALIGN(ʔ, FOOT-R), but the position of the binary foot is also determined by these two constraints.
Most A’ingae roots with underlying stress are bisyllabic, so the position of the foot is straightforwardly determined by FOOTBINARITY. Almost all trisyllabic roots with underlying stress are glottalized, so the position of the foot is determined by GLOTTALNONFINALITY and ALIGN(ʔ, FOOT-R), as in (29). Thus, it is possible that FOOTBINARITY, GLOTTALNONFINALITY, and ALIGN(ʔ, FOOT-R) determine the position of the foot in a root and there is no need for an any constraint such as ALIGNMENT(FT-L, WORD-L), which ensures that all feet are left-aligned.
Possible exceptions include trisyllabic non-glottalized verbs with word-initial stress such as *áfase* ‘offend,’ *kúndase* ‘tell,’ and *áfupuen* ‘lie.’ However, all such verbs are diachronically derived from disyllabic verbs with initial stress, here *áfa* ‘speak’ and *kúnda* ‘let know.’ Thus, it is possible that they are best analyzed as lexically listed with word-initial exceptional stress, as opposed to deriving their stress with a constraint such as ALIGN(FOOT-L, WORD-L).

Given this assumption about the underlying representation of glottalization in functional morphemes, ALIGN(ʔ, FOOT-R) captures the stress as attracted by preglottalized suffixes in (15a-b), shown in (30-31).

(30)	*fetha-ʔje*:	NONFINʔ »	ALIGNʔ)
☞ i.	(*fé.thaʔ)je*		
ii.	*fe(tháʔ.je)*		*
	open-IMPV		

(31)	*fûite-ʔje*:	NONFINʔ »	ALIGNʔ)
☞ i.	(*fû́i.teʔ)je*		
ii.	*fûi(téʔ.je)*		*
	help-IMPV		

To capture the presence of the glottal stop in the stressed syllable of (15c), I propose that a MARKEDNESS constraint prohibits the cross-linguistically dispreferred light-heavy trochee (◡–), given in (32).[7]

(32) *LIGHTHEAVY, or: *(◡–)
The right branch of a trochee is light.

*LIGHTHEAVY ranks above ALIGN(ʔ, FOOT-R), which correctly predicts (15c), the winner of (33).

(33)	*fûndûi-ʔje*:	*(◡–),	NONFINʔ »	ALIGNʔ)
i.	(*fú.ndûiʔ)je*	*		———
☞ ii.	*fû(ndû́iʔ.je)*			*
	sweep-IMPV			

Finally, the current proposal naturally captures the fact that stress-deleting suffixes delete glottalization as well. If glottalization is a property of the metrical foot, it follows naturally that it will also be targeted by a deletion mechanism which targets stress.[8]

In interim summary, I have proposed that A'ingae glottalization is a non-linearized property of the metrical foot (σ́σ)^{ʔ}. Its distribution and effects on stress emerge from a ranking of GLOTTALNONFINALITY,

[7] Heavy-heavy trochees are likewise unattested. Thus, *LIGHTHEAVY can be broadened to say that, in general, heavy syllables cannot appear in the weak branch of a trochee.

[8] Stress deletion triggered by individual morphemes, or dominance, can be modeled with relative ranking of FAITHFULNESS and ANTIFAITHFULNESS constraints. FAITHFULNESS constraints require that the output match the input in some dimension. ANTIFAITHFULNESS require a difference between the input and the output. Here, the relevant constraints are MAXIMALITY(STRESS) and ANTIMAXIMALITY(STRESS), which require the preservation and deletion of metrical structure, respectively (Alderete 1999, 2001). The dominant *-ye* 'PASS' ranks ANTIMAXIMALITY(STRESS) above MAXIMALITY(STRESS), which deletes the input stress and allows the default penultimate stress to surface via The Emergence of The Unmarked (McCarthy & Prince 1994). If glottalization is a property of the metrical foot, it follows naturally that it will also be targeted by the deletion requirement enforced by ANTIMAXIMALITY(STRESS). For a detailed analysis of morpheme-specific phonology in A'ingae, see Dąbkowski (2019b, subm, in press).
The fact that glottalization is deleted along with stress by dominant suffixes is a strong argument in favor of the present analysis, i. e. glottalization being a facultative feature of the foot. If glottalization did not supervene on the foot, but were, say, only aligned with it, there would be no clear reason why a stress-deleting suffix should delete glottalization as well. To capture the A'ingae pattern, one would have to additionally propose that either (a) dominant suffixes are specified as deleting glottalization in addition to stress, or (b) stray glottalization (i. e. glottalization which is not aligned with a foot) undergoes deletion.
Option (a) is purely stipulative—adopting it would mean that the deletion of stress and the deletion of glottalization are not linked in any principled way. This predicts the existence of suffixes which delete stress but do not delete glottalization and suffixes which delete glottalization but do not delete stress. Neither prediction is borne out in A'ingae; all A'ingae suffixes which delete stress also delete glottalization. Furthermore, while morphophonological processes which delete stress are typologically common, morphophonological processes which delete specifically glottalization are—to the best of my knowledge—cross-linguistically unattested.
Option (b) does not in general hold in A'ingae. For example, in (15), the imperfective suffix *-ʔje* 'IMPV' has stray glottalization, but that glottalization is not deleted in the output. Instead, a metrical foot is supplied to create well-formed metrical structure. Thus, a further stipulation would be need to capture in what environments exactly stray glottalization is supplied with metrical structure and where it is deleted. Thus, pursuing either option (a) or (b) would entail further analytical complexities which are avoided if glottalization is taken to be a feature of the metrical foot.

ALIGN(ʔ, FOOT-R), and *LIGHTHEAVY. Finally, treating glottalization is a property of the metrical foot naturally captures the fact that stress-deleting suffixes delete glottalization as well.

3.1. Glottal monosyllables

Now I will turn the final puzzle which pertains to the appearance of segmental glottal stops in the onset position. I proposed that glottalization is a property of trochaic foot. The examples I have given so far are minimally disyllabic, but all that is needed to host a trochee are two morae, not two syllables. Thus, my account predicts the existence of roots which consist of one diphthong (a heavy syllable) and are listed in the lexicon with a glottalized metrical foot. This is to say, roots of the following metrical shape are predicted to exist: $(\sigma_{\mu\mu})^{ʔ}$.

I argue that this prediction is also borne out. Specifically, I propose that words where the glottal stop surfaces between two vowels in an onset position are underlyingly such roots (20-24a) and glottalization surfaces between the two vowels to avoid a violation of GLOTTALNONFINALITY.[9]

(20)	a. *á.ʔi*	person	"person"
(21)	a. *tű̂.ʔi*	tomorrow	"tomorrow"
(22)	a. *kű̂.ʔi*	drink	"drink"
(23)	a. *já.ʔi*	later	"later"
(24)	a. *tsá.ʔu*	house	"house"

	*a*V	*i*V	*û*V	*e*V	*u*V
V*a*		*ia*			*ua*
V*i*	*ai*		*ûi*		*ui*
V*û*					
V*e*	(*ae*)	(*ie*)			*ue*
V*u*	*au*	(*iu*)			

Figure 3: A'ingae diphthongs.

This analysis receives support from the fact that the two vowels in each case constitute a legal diphthong of the language.[10] The seven regular diphthongs of the language are given in Figure 3. The three marginal diphthongs are given in parentheses ( ). The diphthongs which I propose appear in the underlying forms of (20-24a) are underlined.

Thus, the underlying form of (22a) is one bimoraic syllable with an associated glottal foot. The glottal stop surfaces wedged between the two vowels because of the high-ranked GLOTTALNONFINALITY (34).[11]

(34)	$(k\hat{u}i)^{ʔ}$:	NONFINʔ »	ALIGNʔ)
☞ i.	(*kű̂.ʔi*)		*
ii.	(*kű̂iʔ*)	*	
	drink		

Of course, additional support for this analysis comes from the fact that the proposed underlying diphthongs do indeed sometimes surface as diphthongs (22c). The final question I address is what is what is responsible for the apparent glottal metathesis observed in (22a) and (22b).

(22) a. *kű̂.ʔi* drink b. *kű̂.ʔi.-mbi* drink-NEG c. *kű̂iʔ.-ña* drink-CAUS

I propose that the difference between (22b) and (22c) can be understood as consequence of cyclic phonological evaluation. Specifically, I propose that derivational suffixes such as the causative *-ña* 'CAUS' are phonologically evaluated with the root, whereas inflectional suffixes and clitics are not.

[9] My analysis is draws on Repetti-Ludlow et al.'s (2019), who also propose that roots such as (20-24a) are underlyingly diphthongal. Repetti-Ludlow et al. (2019) propose that glottalization is underlyingly word-final and undergoes metathesis to avoid non-finality: /*tsauʔ*/ → [*tsaʔu*] 'house.'

[10] Exceptions include *váʔû* 'deadly nightshade,' *áyuʔu* 'dream,' and *íyûʔû* 'scold.'

[11] The tableau (34) does not show the candidate (*kű̂ʔ.i*), with glottalization in the nucleus of the first syllable and an onsetless second syllable. The candidate (*kű̂ʔ.i*) incurs no GLOTTALNONFINALITY violations and one ALIGN(ʔ, FOOT-R) violation. I propose that (*kű̂.ʔi*) wins over (*kű̂ʔ.i*) due to the activity of the constraint ONSET, which disprefers onsetless syllables (McCarthy & Prince 1994).

(35)	a. [(*kûi*)ˀ]	b. [(*kûi*)ˀ *-ña*]	c. [[(*kûi*)ˀ] *-mbi*]
	(*kû́.ʔi*)	(*kûiʔ*)*ña*	[(*kû́.ʔi*) *-mbi*]
			(*kû́.ʔi*)*mbi*
	drink	drink-CAUS	drink-NEG

When the root spells out by itself, the glottal stop ends up between the two vowels because of the high-ranked GLOTTALNONFINALITY (35a). The derivational *-ña* 'CAUS' is spelled out with the root, so foot-final glottalization does not violate GLOTTALNONFINALITY in (35b). The inflectional *-mbi* 'NEG' attaches after the root's spell-out, i. e. after GLOTTALNONFINALITY already had a chance to apply. Thus, glottalization's position is resolved to be intervocalic and it remains so even after an inflectional suffix attaches (35c).

4. Conclusion

In conclusion, I propose that glottalization plays a typologically novel role in grammar of A'ingae: It is not a segment, a feature of the vowel, the root, or the word, but rather a feature of a metrical constituent. My analysis proposes that the surface position of glottalization is determined by GLOTTALNONFINALITY, ALIGN(ʔ, FOOT-R), and *LIGHTHEAVY. Thus, I account for the limited distribution of glottalization, its interaction with stress, and its susceptibility to deletion by dominant suffixes. Finally, I propose that derivational—but not inflectional—morphemes undergo phonological evaluation with the root, which accounts for the cases of apparent glottal metathesis.

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