

Glottal Stop Alternations in Pngawan Atayal*

Andre GODERICH

National Changhua University of Education

There are two types of phonological alternations involving glottal stops in Pngawan Atayal. Roots with final glottal stops may either retain the glottal stops after suffixation, or else alternate them with zero, and undergo additional vowel coalescence with the suffix. Historically, this alternation comes from roots with Proto-Atayal *q vs *ʔ. In synchronic phonology, these verbs can be treated as having an underlying glottal stop, or being underlyingly vowel-final and receiving an epenthetic glottal stop in unsuffixed forms. A separate process of root-medial glottal stop alternations does not share the same origins, and may happen even in roots with historical *q. Instead, root-medial alternations depend on the phonological structure of the stem. Two types of stems will undergo glottal stop deletion in suffixed forms: (1) stems with an alternating vowel preceding the glottal stop, and (2) trisyllabic stems (including stems with derivational affixes). Unlike root-final glottal stop alternations, which involve a single segment, in root-medial alternations the glottal stop is deleted together with an adjacent vowel.

Keywords: Formosan, Atayal, phonology, historical linguistics

* This research was partially funded by NSTC grant 110-2410-H-018-031. I would like to thank Hui-chuan Huang and the two anonymous reviewers for their comments on an earlier version of this paper. Any remaining errors and inconsistencies are my own.

1. Introduction¹

Pngawan is an Atayal dialect spoken in a single village in Ren'ai Township, Nantou County. It is a very divergent dialect of Atayal (Rau 2004), and it has been influenced by various Seediq dialects that neighbor it (Li 1985). The number of Pngawan speakers is very low, and the dialect is under serious threat of extinction, although revitalization efforts by community members are currently underway.

Unlike other Atayal dialects, very few studies have been done on Pngawan, especially with respect to its phonology. Pngawan has been the subject of a small number of research papers and theses, which concentrate on its syntax (Huang L.-M. 2006), morphophonology (Chang 2012; Chen 2012), phonetics (Shih 2008), and phylogenetic affiliation (Li 1985). It has occasionally featured alongside other Atayal dialects in research on historical linguistics (Ferrell 1969; Li 1981; Goderich 2020) and sociolinguistics (Li 1982; Rau 2004).

As such, there is little research on even the most basic phonological phenomena in Pngawan. The only work completely dedicated to Pngawan phonology is Chen (2012), a master's thesis which described a few affixation-induced alternations in the language from an Optimality-theoretic perspective.

This paper discusses alternations of glottal stops, or lack thereof, in Pngawan roots following suffixation. There are at least two distinct types of glottal stop alternations in Pngawan: root-final glottal stop alternation and root-medial glottal stop deletion. Although they both involve affixation-induced alternations of glottal stops, they represent separate phonological phenomena. The origins of the glottal stops, the mechanisms of the sound changes, and the

¹ This paper uses the following abbreviations: AV (Actor Voice), PV (Patient Voice), LV (Locative Voice), NAV (Non-Actor Voice, here meaning PV or LV, see Tsuchida 1975), PA (Proto-Atayal), SR (surface representation), UR (underlying representation).

environments in which they occur are all different between the two types. Root-final glottal stop alternations are described in section 3, while section 4 details root-medial glottal stop alternations.

Throughout the paper, I make use of not just Pngawan data, but also other Atayal dialects (Matu'uwal, Squliq, and Skikun), as well as Proto-Atayal reconstructions. All data on extant Atayal dialects is from my own field notes, taken between 2013 and 2023. Proto-Atayal reconstructions are from Goderich (2020).

2. Phonological system of Pngawan

2.1 Consonants

Pngawan consonants are presented in Table 1. The phonetic values are equivalent to IPA, unless otherwise noted. The spelling of the phonemes /c/ [t̪s̪] and /y/ [j] follows spelling conventions used by Atayal speakers and researchers writing on the language.

Table 1. Pngawan consonant inventory

p	t	k	ʔ
b [b~β]		g [g~ɣ]	
	c [t̪s̪]		
	s	x	h
m	n	ŋ	
	l, r		
w	ɿ, y [j]		

Pngawan is unique among Atayal dialects in preserving Proto-Atayal *ɿ as [ɿ], meaning it has a contrast in its rhotics (the other being [r]).

The voiced obstruent phonemes /b/ and /g/ tend to be pronounced as plosives word-initially, and as fricatives in intervocalic position. They do not occur word-finally.

2.2 Vowels

Pngawan has five vowel phonemes, shown in Table 2. Unlike most other Atayal dialects, Pngawan never allows schwa [ə] in its surface representation. Stress in Pngawan is always word-final.

Table 2. Pngawan vowel inventory

i	u
e	o
a	

Pngawan does not distinguish vowel length. Some words end in phonetically long [i:] or [u:], but because of their limited distribution and phonological properties (further explained in section 3.2), they are instead analyzed as homorganic VG sequences *-iy* and *-uw*. Examples are given in Table 3.

Table 3. Final ‘long vowels’ in Pngawan

Proto-Atayal	Pngawan	Gloss
*ruŋay	.ruŋiy	‘monkey’
*wahig	wahiy	‘vine’
*qasinug	ʔasinuw	‘animal’

As demonstrated by the Proto-Atayal forms in the table, Pngawan final *-iy* sequences mainly originate from Proto-Atayal word-final **-ay* (and sometimes from **-ig*), whereas final *-uw* is the result of weakening of Proto-Atayal **-ug*.²

2.3 Syllable structure

Pngawan has a relatively simple syllable structure. All syllables have an obligatory onset and an optional coda. The only complex onsets allowed in the language are of type CG, with either <w> or <y> following an obstruent. Examples of the different syllable types can be seen in Table 4. Unlike most Atayal dialects, Pngawan allows word-internal codas, as exemplified by *nabkis* ‘old (person)’.

Table 4. Pngawan syllable structure

Syllable type	Example	Gloss
CV	ha.ŋa.liʔ	‘shoulder’
CVC	nab.kis	‘old’
CGVC	tu.hyaʔ	‘far’

If we subscribe to the analysis in section 2.2 treating word-final [i:] and [u:] as homorganic VG sequences, then no native words in Pngawan may end in a vowel (i.e. codas are obligatory in the final syllable). This restriction affects only full prosodic words, so clitics such as nominal case markers are not constrained by it.

² The PV/LV subjunctive suffix *-i* is pronounced as a long vowel [i:] in Pngawan, but did not have a final consonant in Proto-Atayal (Goderich 2020: 153-154). Nevertheless, there is no evidence that it is phonologically different from regular word-final *-iy* sequences in Pngawan.

3. Root-final glottal stop alternations

3.1 Data

Some Plngawan verbal roots exhibit glottal stop alternations, whereby unsuffixed forms end with a glottal stop, but in suffixed forms the glottal stop disappears, while the final root vowel and the first vowel of the suffix may undergo coalescence. Other verbs do not undergo this process, and have a root-final glottal stop in both unsuffixed and suffixed forms.

Examples of both types of verbal roots are presented in Table 5. The words in the table under (a) lack glottal stops and undergo vowel coalescence when suffixed with the Patient Voice suffix *-un* (*bakon* ‘to break (PV)’) or the Locative Voice suffix *-an* (*cabon* ‘to wrap (LV)’, *ɹuŋen* ‘to forget (LV)’), while the verb roots in (b) retain the glottal stop and keep the vowels separate throughout the paradigm.

Table 5. Examples of alternating and non-alternating root-final glottal stops

	Bare stem SR	UR		Suffixed	Gloss
(a)	[bakaʔ]	/baka/	+ -un >	[bakon]	‘to break’
	[cabuʔ]	/cabu/	+ -an >	[cabon]	‘to wrap’
	[ɹuŋiʔ]	/ɹuŋi/	+ -an >	[ɹuŋen]	‘to forget’
(b)	[betaʔ]	/betaʔ/	+ -an >	[bitaʔan]	‘to stab’
	[baʔ]	/baʔ/	+ -un >	[baʔun]	‘to know’
	[huiiʔ]	/huiiʔ/	+ -an >	[huiiʔan]	‘wet, to make s.t. wet’

Chen (2012: 116-126) briefly features vowel coalescence in one of the chapters of her thesis.³ She treats coalescing roots as vowel-final, and non-coalescing roots as having a phonemic glottal stop.

A very similar phenomenon was also described for Squliq Atayal by Li (1980: 372-373), for whom glottal stop alternation was of less interest than vowel coalescence. Chien (2001: 67-68) treated the roots with alternating glottal stops in Squliq as underlyingly vowel-final, because of a contrast between alternating and non-alternating glottal stops. Later research by Huang H.-J. (2006, 2015) reached a similar conclusion: that the alternation in Squliq is the result of glottal stop epenthesis in unsuffixed forms (more specifically, in prosodic words where the right edge of the word coincided with the right edge of the root).

3.2 Synchronic analysis

We can extend Chen's original observations with research on Squliq Atayal, and posit that the verbs in group (a) of Table 5 have underlyingly vowel-final roots. In non-suffixed forms, they undergo glottal stop epenthesis in order to conform to the restriction that prosodic words must end with a consonant (see section 2.3). When suffixed, the lack of an intervening consonant between the final root vowel and the initial vowel of the suffix allows coalescence to occur. These processes are demonstrated in Table 6 using the root /baka/ 'to break', both with and without suffixation. (Note that because glottal stop epenthesis and vowel coalescence occur in mutually exclusive environments, they do not have an ordering relationship.)

³ Chen (2012: 118-119) does not indicate final glottal stops in [bakaʔ] 'to break', [cabuʔ] 'to wrap', and [ɹuŋiʔ] 'to forget' even in phonetic transcriptions, and treats them as vowel-final. Whether or not the glottal stop is analyzed as phonemic, it should be present in phonetic transcriptions.

Table 6. Epenthesis and coalescence in the root /baka/ ‘to break’

/baka/	/baka + -un/	UR
bakaʔ	–	GS epenthesis
–	bakon	Vowel coalescence
[bakaʔ]	[bakon]	SR

On the other hand, the verbs in group (b) of Table 5 have roots ending in phonemic glottal stops. This means that neither glottal stop epenthesis nor vowel coalescence can apply, and no alternation is found in the paradigm.

There is another group of verbs in Pngawan that appear to end in a phonetically long vowel. Some examples of these verbs are presented in Table 7. The final *-iy* and *-uw* in the Actor Voice forms of these verbs are pronounced as long vowels,⁴ [i:] or [u:], respectively. These words are conventionally written with a final vowel-glide sequence (following Li 1980: 355).

Table 7. Examples of VG-final verbs in Pngawan

	AV	NAV	Gloss
(a)	ʔ<um>axiy	ʔaxay-an (LV)	‘to roast’
	s<um>iliy	silay-un (PV)	‘to whip’
(b)	y<um>uw	yug-an (LV)	‘to change’
	ʔ<um>buw	ʔabg-an (LV)	‘to soak’

If we treat forms like those in Table 7 as vowel-final, then we have no way to explain why they do not undergo glottal stop epenthesis in their AV forms. Vowel length is not phonemic in Pngawan (or any other Atayal dialect, see Li

⁴ Recall that the segment written as <y> is a semivowel (IPA [j]).

1980: 354), so positing underlying long vowels would not work here. Instead, we treat these words as consonant-final, following Huang H.-J. (2015: 62), who states that while word-final homorganic vowel-glide sequences may be phonetically realized as long vowels (according to Li 1980: 355), they nevertheless behave as regular VC sequences due to the consonantal nature of glides, meaning that these roots still end in a consonant.

This approach is corroborated by both synchronic and diachronic data. As can be seen from the NAV forms in Table 7, the final homorganic VG sequences in the AV forms may alternate with (a) heterorganic VG sequences, or (b) with (V)C sequences. Since there are no occurrences of vowel coalescence in the NAV forms of these verbs, we can surmise that its application is blocked by the intervening consonant, much like roots with a final glottal stop. Additional diachronic and comparative evidence is presented in section 3.3.

We may analyze the alternation in Table 7b synchronically as simply a change of underlying /g/ > [w] in word-final position. This is fully justified in that /g/ can never appear word-finally in Pngawan. However, a similar analysis of the roots in Table 7a runs into a problem: while word-final *-ay* is exceedingly rare across the Pngawan lexicon, it is found in a few words, such as *kakumay* ‘caterpillar’, *hanray* ‘table’ (a loan from Japanese 飯台 *handai* ‘dinner table’), and most noticeably, the intensifier *cubay* ‘very’, a highly frequent lexical item in Pngawan. This alternation is more readily explained using a diachronic approach, given in section 3.3. Our goal here is to demonstrate that these roots are not vowel-final, and can thus be excluded from the glottal epenthesis rule. A synchronic analysis of verbal roots with the *-iy* to *-ay-* alternation is outside the scope of this study.

We may divide the above verbal roots into three categories, here labeled as classes A to C for convenience:

- Class A: vowel-final roots that undergo glottal stop epenthesis (Table 5a),
- Class B: verbs with a non-alternating root-final glottal stop (Table 5b),
- Class C: verbs with a final homorganic vowel-glide sequence in AV (Table 7).

The difference between classes A and B is in the presence or absence of a phonemic glottal stop at the end of the root: class B verbs have a phonemic glottal stop which occurs throughout the verbal paradigm, whereas class A verbs do not, and instead epenthesize a glottal stop word-finally. Thus, the distinction between class A and class B verbs is neutralized in their non-suffixed forms (both end in a glottal stop), and emerges only after suffixation: with class B verbs retaining their glottal stops, and class A verbs undergoing vowel coalescence. Class C verbs may initially appear similar, in that their unsuffixed forms end in a phonetically long vowel. However, that is simply a phonetic realization of a phonological homorganic vowel-glide sequence, which means these roots are consonant-final and thus do not need to undergo glottal stop epenthesis, unlike class A verbs.

3.3 Diachronic origins of the alternations

The three verb classes identified in section 3.2 have their origins in regular Proto-Atayal verbs. A comparison of Plngawan class B verbs (non-alternating final glottal stops from Table 5b) with other Atayal dialects shows that these roots originate from Proto-Atayal forms with final *q. Table 8 shows a comparison of these Plngawan roots with cognates in Matu'uwal and Squaliq Atayal, both of which preserve Proto-Atayal *q (see Goderich 2020 for an extensive analysis of this and other sound changes). It demonstrates that

whenever we see a non-alternating root-final glottal stop in Pngawan, we expect to see /q/ in dialects that preserve it.⁵

Table 8. Comparison of class B Pngawan verbs with other Atayal dialects

Pngawan	Matu'uwal	Squliq	Gloss
betaʔ	—	betaq	'to stab'
buʔ	buuq	buq	'juice, to squeeze'
huiʔ	huwiq	huziq	'wet'

In a similar fashion, Pngawan class A verbs that undergo either glottal stop epenthesis in unsuffixed forms or vowel coalescence in suffixed forms originated from fully regular verbs with no such alternation. The evidence for this lies in Matu'uwal Atayal cognates, which have a non-alternating glottal stop throughout the paradigm. Table 9 shows the stems and NAV forms of Pngawan class A verbs and their Matu'uwal cognates side by side. The Proto-Atayal forms of these verbs as reconstructed by Goderich (2020) follow the Matu'uwal pattern in having non-alternating phonemic glottal stops in the root.

⁵ H.J. Huang (personal communication) notes that this is not necessarily true for other Atayal dialects, such as Squliq. For example, while Squliq preserves Proto-Atayal *q as /q/, and has vowel coalescence in suffixed forms of vowel-final roots, it also has a number of verbal roots that have a glottal stop in both suffixed and unsuffixed forms (see Chien 2001: 68 for examples).

Table 9. Comparison of Pngawan class A verbs with Matu’uwal Atayal

Pl stem	Pl NAV	MI stem	MI NAV	Gloss
/baka/ + -un >	bakon	/bəkaʔ/ + -un >	bakaʔun	‘to break’
/cabu/ + -un >	cabon	/cabuʔ/ + -un >	cabuʔun	‘to wrap’
/ɽuŋi/ + -an >	ɽuŋen	/ʔuŋiʔ/ + -an >	ʔuŋiʔan	‘to forget’

The alternation in class C verbs arose due to two separate sound changes that affected only the right edge of the word. One is a change from Proto-Atayal *-ay > Pngawan -iy, and the other is a change from Proto-Atayal *-g > Pngawan -w (Goderich 2020: 130-133).⁶ The /ay/ sequence and the consonant /g/ can still be observed in the NAV forms of the verbs in Pngawan (see section 3.2). We can also find these segments in other Atayal dialects which did not undergo these changes. Cognates from Matu’uwal and Skikun Atayal are given in Table 10. Both dialects preserve Proto-Atayal word-final *-ay and *-g (although Skikun merged *g into *x word-finally), and so these verbs are regular in both dialects.

Table 10. Comparison of Pngawan class C verbs with other Atayal dialects

Pngawan	Matu’uwal	Skikun	Gloss
s<um>iliy	s<um>ilay	s<əm>ilay	‘to whip’
ʔ<um>buw	ʔ<um>ubug	mə-bux	‘to soak’

⁶ Goderich (2020: 132) actually says that Proto-Atayal *-g > Pngawan /w/ before /a/, and following other vowels it gets deleted, and the vowel lengthened. Here, we hold that word-final -iy and -uw in Pngawan are in fact VC sequences and not long vowels, based on their phonological behavior.

Thus, historically speaking, Pngawan verbs of classes A, B, and C all originated in completely regular Proto-Atayal verbal roots. Later, after a series of phonologically conditioned sound changes, some of the verbs became irregular. These irregular verbs would likely have to be individually memorized by speakers.

Moreover, there may be evidence that class A verbs are treated by Pngawan speakers as regular, while class B verbs are irregular and memorized on a case-by-case basis: etymologically class B verbs may sometimes be “regularized” and given class A alternations. This phenomenon is discussed further in section 3.4.

3.4 Variation

There is additional variation in the NAV forms of some Pngawan roots. In some cases, the same root may have a glottal stop or vowel coalescence in suffixed forms. This variation may be between different speakers, or sometimes even with different forms for the same speaker. Examples of these variants can be seen in Table 11.

Table 11. Pngawan verbs with variant NAV forms

AV	NAV1	NAV2	Gloss
pataunaʔ	pat.unaʔ-an (LV)	pat.unan (LV)	‘to spit’
t<un>ʔuiʔ	tuiʔ-an ⁷ (LV)	tui.en (LV)	‘to fill (with water)’
s<um>amiʔ	samiʔ-un (PV)	samyun (PV)	‘to blame’
g<un>.iahuʔ	gahuʔ-un (PV)	gaa.hon (LV)	‘to lose one’s catch’

⁷ For an explanation of why the *first* glottal stop gets deleted in this root, see section 4.

Here, the first three verbs have variant forms with the same suffix added (PV *-un* or LV *-an*, depending on the verb), but the last verb is special. For /gun.ɪahuʔ/, a term used in hunting roughly meaning ‘to lose one’s catch’, a single speaker produced PV and LV forms that utilize different derivational strategies. In the PV /ga.ɪhuʔun/ (+ *-un*), a root-final glottal stop is present, whereas in the LV /ga.ɪahon/ (+ *-an*), there is no glottal stop in the root and instead we see vowel coalescence (since we know that the final vowel of the root is /u/, we can deduce that the suffix must be LV *-an* based on the resulting coalesced vowel /o/). This is extremely unusual: we would normally expect to see the same behavior in different forms of the same root, since the deciding factor here should be the historical origin of the final glottal stop.

It was not possible to ascertain the origin of all the verbs in Table 11. The root of /pata.ɪunaʔ/ ‘to spit’ is unambiguously related to Proto-Atayal *tə.ɪunaq ‘phlegm, spittle’ (cf. Matu’uwal *tunaq*, Skikun *yunaq*), and thus the glottal stop is derived from a historical *q. The verb /gun.ɪahuʔ/ ‘to lose one’s catch’ may be related to Matu’uwal *mahuq*, Squliq *məhuq* ‘to fall (of fruit); to shed fur’, however this is less certain. I have been unable to find cognates for the other two verbs in the table. My hypothesis is that these verbs most likely originated from forms that historically had a final *q.

The most likely source of these discrepancies is confusion of uncommonly used forms of irregular verbs, and their subsequent regularization. Because class A verbs (historical final *ʔ) exhibit coalescence upon suffixation, but class B verbs (historical *q) do not, we can deduce that the loss of phonemic word-final glottal stops and subsequent vowel coalescence must have preceded the merger of *q into *ʔ (Goderich 2020: 133). After the merger of *q and *ʔ occurred, there was no longer any way for speakers to distinguish class A and class B verbs from their AV forms alone, since both end in glottal stops in their surface realizations. Class A verbs here appear to be the default to which class B are

sometimes regularized, especially in forms that are less often used, as seen in Table 11. In other words, despite the seeming regularity of form, we may consider class B verbs irregular. With no cues in the synchronic phonology, the speakers have no choice but to rely on brute force memorization of the paradigms of these roots on an individual basis, and they may occasionally misremember or overgeneralize.

4. Root-medial glottal stop alternations

4.1 Data

Apart from root-final glottal stop alternations, a separate process occurs in Pngawan, with root-medial glottal stops being deleted after suffixation in some roots. Table 12 shows examples of root-medial glottal stops, with the stems on the left,⁸ prefixed or infix forms in the center, and suffixed forms on the right. Note that not all root-medial glottal stops are deleted after suffixation. The data are grouped as follows: (a) CVC.ʔVC syllable structure in AV, (b) trisyllabic AV with CV.ʔV.CVC syllable structure, (c) trisyllabic AV with CV.CV.ʔVC syllable structure, (d) non-alternating root-medial glottal stops.

⁸ Most verbal stems can be easily determined from examining their AV (prefixed or infix) and NAV (suffixed) forms, however I hold that the verbs in (a) have a (CV)CʔVC root structure in the synchronic grammar of Pngawan, in order to explain why they differ from group (d). In the case of /taʔu.iiʔ/ ‘to fill with water’ the negative/imperative AV form /taʔu.iiʔ/ was used to determine the initial stem vowel.

Table 12. Examples of alternating and non-alternating root-medial glottal stops

	Stem	Pre-/infixes	Suffixed	Gloss
(a)	/kasʔaŋ/	masʔaŋ	kasaŋ-un	‘to scold’
	/lʔiŋ/	l<un>ʔiŋ	liŋ-un	‘to hide s.t.’
	/sʔan/	s<un>ʔan	san-an	‘to raise (e.g. animals)’
(b)	/paʔilis/	maʔilis	palis-an	‘to be hurt’
	/kaʔihuɿ/	maʔihuɿ	kihui-an	‘to lie; to cheat’
	/taʔuiʔ/	t<un>ʔuiʔ	tuiʔ-an/tuɛn	‘to fill with water’
	/taʔariŋ/	taʔariŋ	tariŋ-an	‘to begin’
(c)	/pahuʔil/	mahuʔil	pa-pahil-un ⁹	‘to ripen’
	/palaʔaŋ/	malaʔaŋ	palaŋ-an	‘to snap (of rope)’
	/ʔuɿaʔil/	ʔ<un>ɿaʔil	ʔuɿil-un	‘to bully’
	/saɿaʔiŋ/	s<un>ɿaʔiŋ	saɿiŋ-un	‘to envy’
(d)	/caʔis/	c<um>aʔis	caʔis-un	‘to sew’
	/paʔes/	paʔes	paʔes-an	‘to divide land’
	/paʔas/	maʔas	paʔas-un	‘to be happy; to celebrate’

What is striking about this alternation is that unlike root-final glottal stops in section 3, root-medial glottal stops that descend from Proto-Atayal *q can also

⁹ The form /pa-pahil-un/ has both Ca-reduplication and a *-un* suffix (PV). I have not been able to elicit a form with only a suffix.

get deleted. Proto-Atayal reconstructions for some words from Table 12 are presented in Table 13, with cognates from Matu’uwal and Squliq Atayal given for comparison. While the words in group (a) have a glottal stop in Proto-Atayal, group (b) has Proto-Atayal *q corresponding to Pngawan /ʔ/ as attested by Matu’uwal and Squliq Atayal reflexes. This means that, diachronically speaking, root-medial glottal stop deletion is a completely separate phenomenon from root-final glottal stop alternation.

Table 13. Cognates of Pngawan roots with medial glottal stops

	Proto-Atayal	Pngawan	Matu’uwal	Squliq	Gloss
(a)	*masəʔaŋ	masʔaŋ	masʔaŋ	s<əm>əʔaŋ	‘to scold’
	*s<um>əʔan	s<un>ʔan	s<um>ʔan	s<əm>əʔan	‘to raise (e.g. animals)’
	*-ʔariŋ	taʔariŋ	mənaʔariŋ	təʔariŋ	‘to begin’
(b)	*qilis	maʔilis	—	mətəqilis	‘to be hurt’
	*mahuqil	mahuʔil	mahuqil	məhuqil	‘to ripen’
	*l<um>əqiŋ	l<un>ʔiŋ	l<um>qiŋ	l<əm>əqiŋ	‘to hide s.t.’
	*c<um>aqis	c<um>aʔis	c<um>aqis	s<əm>aqis	‘to sew’
	*q<um>aʔis	paʔes	q<um>ais	q<əm>es	‘to divide land’
	*maqas	maʔas	maqas	məqas	‘to be happy; to celebrate’

The cognates in other dialects show that at least some of the glottal stops in each of the four groups in Table 12 originate from Proto-Atayal *q. Section 4.2 will go into greater detail with each of the four groups in the data, and attempt to provide an explanation of the glottal stop deletion phenomenon.

4.2 Analysis

The data on root-medial glottal stops in Table 12 were split into four groups, based on the environment in which the glottal stops occurred. This section will largely follow the same structure, with CVC.ʔVC stems in AV discussed in section 4.2.1, both types of trisyllabic stems put together in section 4.2.2, and non-alternating glottal stops in section 4.2.3.

4.2.1 Glottal stops preceded by consonants

4.2.1.1 Origin of the alternation

This section discusses glottal stops that appear in AV forms of the shape CVC.ʔVC but get deleted in suffixed forms. These can be infix with the standard Austronesian AV infix *-um-*, or in the case of /masʔaŋ/ ‘to scold’, the first consonant of the root is replaced with /m/ in a process known as *pseudo nasal substitution* (Blust 2013: 244). The data are replicated in Table 14, with Proto-Atayal roots given for reference.

Table 14. Alternating Cʔ glottal stops, with Proto-Atayal roots

PA root	PI stem	PI AV	PI NAV	Gloss
*kasəʔaŋ	/kasʔaŋ/	masʔaŋ	kaŋ-un	‘to scold’
*ləqiŋ	/lʔiŋ/	l<un>ʔiŋ	liŋ-un	‘to hide (s.t.)’
*səʔan	/sʔan/	s<un>ʔan	san-an	‘to raise (e.g. animals)’

The common pattern here is the presence of a *ə vowel in Proto-Atayal, which is reflected in various ways in Plngawan, depending on the environment in which it occurs. When it was both preceded and followed by a syllable (i.e. in the environment VC_CV), it was deleted in Plngawan. Subsequent

resyllabification led to a CVC.CVC structure in these words. In case of /l<un>ʔiŋ/ ‘to hide’ and /s<un>ʔan/ ‘to raise’ the structure is additionally evidenced by the form of the AV infix: Pngawan (uniquely among Atayal varieties) assimilates the nasal of *-um-* to the following consonant, and the form preceding a glottal stop is [un].

In the AV forms of these words, the glottal stop occurs in the onset of the ultimate syllable. When suffixed, the glottal stop moves to the penultima, where it was historically preceded by *ə. This alternation must be conditioned by a historical sound change whereby a glottal stop in the onset of the penultimate syllable and a preceding schwa were both deleted. This sound change is formalized in Figure 1.

$$*əʔ \rightarrow \emptyset / _ _ \text{VCV}$$

Figure 1. Schwa–glottal stop syncope

Since Pngawan does not allow schwa to occur in the surface representation, any instances of Proto-Atayal *ə needed to be repaired. In AV forms in Table 14, deleting the vowel was sufficient, but in suffixed forms it would have led to a consonant cluster in many stems. Here, Pngawan chose a uniform strategy (removal of both schwa and glottal stop), even in cases where deleting just the schwa would have been sufficient. This sound change would have occurred after the merger of *q into /ʔ/, since it affects words with Proto-Atayal *q as well as those with Proto-Atayal *ʔ.

4.2.1.2 Diachronic implications

The posited sound change can also explain the absence of glottal stops in the Pngawan reflexes of some Proto-Atayal roots with *q in the penultima. Table 15 shows some reconstructed Proto-Atayal forms with *q in the onset of the penultimate syllable, and their reflexes in Pngawan and Matu’uwal Atayal.

The data are split into two groups, with group (a) deleting the *q in PIngawan, and group (b) preserving it as /ʔ/.

Table 15. Reflexes of Proto-Atayal penultimate syllable *q in PIngawan

	Proto-Atayal	PIngawan	Matu'uwal	Gloss
(a)	*bVqəniʔ	baniʔ	baqniʔ	'bone'
	*wVqanux	wanux	waqanux	'cow, deer'
	*-caqərug	macaruw	mancaqrug	'to stand (AV)'
(b)	*guqiluh	gaʔiloh	guqiluh	'banana'
	*cVquliq	ciʔuliʔ	cuquliq	'people, others'
	*tVqu.ɪaq	tiʔu.ɪaʔ	tuquwaq	'bird snare'

The third-to-last vowel is uncertain in many Proto-Atayal reconstructions. Even where it is reconstructed, it may not accurately reflect the proto-phoneme in question due to the complicated nature of changes of Proto-Atayal *ə. Using the rule in Figure 1 we can now adjust the Proto-Atayal reconstructions in group (a) of Table 15, putting *ə in the third-to-last syllable with greater confidence. Since *ə in the penultimate syllable is regularly reflected as /a/ in PIngawan, the sequence of sound changes from Proto-Atayal to PIngawan may have looked something like the demonstration in Figure 2.

*bəqəniʔ > **bəʔəniʔ > **bəniʔ > baniʔ

Figure 2. Sound changes from Proto-Atayal *bəqəniʔ to PIngawan /baniʔ/

Conversely, the reconstructions in group (b) must have a cardinal vowel preceding *q, because PIngawan still reflects a glottal stop in that position. This

is also helpful, in that we can exclude *ə from the list of candidates, and try to reconcile the different vowels in Pngawan and Matu'uwal in other ways.

4.2.2 Trisyllabic stems

Alternating glottal stops in trisyllabic stems, reproduced in Table 16, can be subdivided into two groups based on where in the stem the glottal stop occurs: in the onset of the penultimate syllable (a), or in the onset of the ultima (b). These stems are not necessarily monomorphemic: e.g. /maʔilis~palisan/ 'to be hurt' is derived from the noun /ʔilis/ 'wound' using the nominalizing prefix *pa-*. However, stems with derivational morphemes appear to function just like monomorphemic stems with regard to glottal stop alternation.

Table 16. Alternating glottal stops in trisyllabic stems

	Stem	AV	NAV	Gloss
(a)	/paʔilis/	maʔilis	palis-an	'to be hurt'
	/kaʔihui/	maʔihui	kihui-an	'to lie; to cheat'
	/taʔuiiʔ/	t<un>ʔuiiʔ	tuiiʔ-an/tuien	'to fill with water'
	/taʔariŋ/	taʔariŋ	tariŋ-an	'to begin'
(b)	/pahuʔil/	mahuʔil	papahil-un	'to ripen'
	/palaʔaŋ/	malaʔaŋ	palaŋ-an	'to snap (of rope)'
	/ʔuaʔil/	ʔ<un>.iaʔil	ʔu.il-un	'to bully'
	/sa.iaʔiŋ/	s<un>.iaʔiŋ	saiŋ-un	'to envy'

The origins of the alternating stops in group (a) are diverse: /maʔilis/ 'to be hurt' is related to Proto-Atayal *qilis 'wound', but /taʔariŋ/ 'to begin' reflects Proto-Atayal *-ʔariŋ, with *ʔ in the root. On the other hand, the glottal stops seen in group (b) should all be from Proto-Atayal *q, because otherwise we

would expect to see coalescence of two root vowels surrounding a Proto-Atayal glottal stop: cf. Proto-Atayal *baʔis ‘partner, spouse’ > PIngawan *bes* (Goderich 2020: 131).

Both groups have the exact same alternation, the only difference being the position of the glottal stop. In both cases, the alternation involves syncope rather than vowel coalescence that we see with root-final glottal stops. This is apparent when we look at stems where the glottal stop is surrounded by two different vowels: /ʔuaʔil + -un/ > /ʔu.ilun/ ‘to bully’ (cf. /ɽuŋiʔ + -an/ > /ɽuŋen/ ‘to forget’). We do NOT see coalescence with root-medial glottal stops, but rather deletion of the glottal stop and the adjacent vowel, much like with post-consonantal glottal stops in section 4.2.1. The deleted vowel appears to be consistently the vowel preceding the glottal stop, with the exception of /paʔilis + -an/ > /palis-an/ ‘to be hurt’.

These longer stems conform to a length of three syllables in both their AV and NAV forms, so the total number of syllables can be thought of as a surface target. In AV, this target is reached by:

1. pseudo nasal substitution (/kaʔihuɿ/ > /maʔihuɿ/ ‘to lie’),
2. vowel syncope (/sajaʔiŋ + -um-/ > /s<un>ɿaʔiŋ/ ‘to envy’),
3. bare stem AV (/taʔariŋ/ ‘to begin’).

Neither pseudo nasal substitution nor bare stem AV change the number of syllables in the stem, which remains at three. Vowel syncope removes one syllable after infixation (which adds a syllable), so the total number of syllables likewise arrives at three. The choice between these strategies is lexically determined: for each given verbal stem, only one strategy is used, encoded in the stem itself.

In suffixed NAV forms, the target for words in Table 16 is reached through syncope, which deletes the root-medial glottal stop together with an adjacent vowel.

4.2.3 Non-alternating glottal stops

Not all root-medial glottal stops alternate after suffixation. Some verbs still keep their glottal stops in NAV forms. These verbs, forming group (d) as introduced in section 4.1, are reproduced in Table 17 together with their stems in Proto-Atayal and Plngawan Atayal.

Table 17. Non-alternating root-medial glottal stops

Proto-Atayal	Stem	AV	NAV	Gloss
*caqis	/caʔis/	c<um>aʔis	caʔis-un	‘to sew’
*paqas	/paʔas/	maʔas	paʔas-un	‘to be happy; to celebrate’

These words have stems of the shape CVʔVC, where the glottal stop is in the onset of the final syllable, and both vowels are cardinal. They do not satisfy the alternation requirements of either having a weak vowel (< Proto-Atayal *ə) preceding the glottal stop, or having a trisyllabic stem.

As can be seen in Table 17, all the words in this group have glottal stops derived from Proto-Atayal *q. This is an obligatory requirement, because Proto-Atayal *ʔ in the same intervocalic environment was deleted, and the two vowels coalesced (Goderich 2020: 131).

5. Conclusion

Plngawan Atayal exhibits a variety of complex synchronic alternations, including alternations of glottal stops in the roots of some words (but not others)

after they are suffixed with a Non-Actor Voice suffix. Glottal stop alternation can occur both at the right edge of a stem (root-final glottal stops), and in the middle of a stem (root-medial glottal stops). The origins and mechanisms of these alternations are distinct, and were addressed separately.

Root-final glottal stops appear in both AV and NAV form of verbs if they are reflexes of Proto-Atayal *q. In contrast, verbal roots that in Proto-Atayal ended with *ʔ can be analyzed synchronically as vowel-final in Pngawan. These verbs undergo glottal stop epenthesis in AV, and vowel coalescence with the suffix in PV and LV forms. This synchronic alternation, or lack thereof, hinges on the diachronic origins of the glottal stops. Synchronically, it can be represented as the presence or absence of a phonemic root-final glottal stop. Regularization of some verb forms reflecting Proto-Atayal *q into alternating glottal stops suggests that roots coming from historical *q are treated as irregular and memorized individually by the speakers.

Root-medial glottal stops behave differently from root-final ones. Here, the alternating behavior is related not to the diachronic origins of the glottal stops, but rather the environment in which they occur. Two separate environments for alternation have been identified: (i) glottal stops occurring after an alternating vowel (a reflex of Proto-Atayal *ə), and (ii) glottal stops in trisyllabic stems. In both these environments, root-medial glottal stops are deleted when the stem is suffixed. Unlike root-final glottal stops, where the resulting vowel hiatus is repaired by coalescence, root-medial glottal stops are deleted together with an adjacent vowel. Although both processes resolve the same issue—vowel clusters—they do it in different ways, which further supports the hypothesis that they happened at different times. A possible motivation for choosing vowel deletion over coalescence is that it may be related to regular vowel syncope in the language. Future research on the language could concentrate on syncope in Pngawan.

The root-medial alternation environments can also provide an explanation for several cases of Proto-Atayal *q being completely absent from a root in Pngawan, instead of being reflected as /ʔ/. They provide additional evidence for reconstructing *ə in the third-to-last syllable: a position for which evidence is scant and reflexes are often conflicting.

The findings described in this paper can also be used in Pngawan language education. Correct and concise descriptions of synchronic phonological phenomena are helpful in the compilation of dictionaries and educational materials. Being able to group verbs into separate classes (ideally, based on the phonological shape of the citation form) instead of memorizing the various voice forms on a case-by-case basis, can reduce the mental overhead of learners and at the same time simplify the instructor's job.

References

- Blust, Robert. 2013. *The Austronesian Languages (Asia-Pacific Linguistics Open Access Monographs)*. Canberra: College of Asia and the Pacific, Australian National University.
- Chang, Yiying Ann. 2012. Pronominal ordering in Plngawan Atayal. In Enrico Boone, Kathrin Linke and Maartje Schulpen (eds.), *Proceedings of ConSOLE XIX*, 177-190. Retrieved from <https://www.universiteitleiden.nl/en/events/series/sole#console-xix-2011> (March 1, 2024).
- Chen, Joyce Yi-Jie. 2012. *Affixation Induced Phonological Variations in Plngawan Atayal*. Hsinchu: National Tsing Hua University thesis.
- Chien, Yu-chang. 2001. *A Phonological Perspective of the Atayal Writing System: The Case of the Taoshan Dialect* (in Chinese). Hsinchu: National Hsinchu Teachers College thesis.
- Ferrell, Raleigh. 1969. *Taiwan Aboriginal Groups: Problems in Cultural and Linguistic Classification*. Taipei: Academia Sinica.
- Goderich, Andre. 2020. *Atayal Phonology, Reconstruction, and Subgrouping*. Hsinchu: National Tsing Hua University dissertation.
- Huang, Hui-chuan J. 2006. Squliq Atayal syllable onset: Simple or complex? In Henry Yungli Chang, Lillian M. Huang and Dah-an Ho (eds.), *Streams Converging into an Ocean: Festschrift in Honor of Professor Paul Jen-Kuei Li on His 70th Birthday*, 489-505. Taipei: Institute of Linguistics, Academia Sinica.

- _____. 2015. Syllable types in Bunun, Saisiyat, and Atayal. In Elizabeth Zeitoun, Stacy F. Teng and Joy J. Wu (eds.), *New Advances in Formosan Linguistics*, 47-74. Canberra: Asia-Pacific Linguistics, College of Asia and the Pacific, the Australian National University.
- Huang, Lillian M. 2006. Case marking system in Plngawan Atayal. In Henry Yungli Chang, Lillian M. Huang and Dah-an Ho (eds.), *Streams Converging into an Ocean: Festschrift in Honor of Professor Paul Jen-Kuei Li on His 70th Birthday*, 205-238. Taipei: Institute of Linguistics, Academia Sinica.
- Li, Paul Jen-kuei. 1980. The phonological rules of Atayal dialects. *Bulletin of the Institute of History and Philology, Academia Sinica* 51.2: 349-405.
- _____. 1981. Reconstruction of Proto-Atayalic phonology. *Bulletin of the Institute of History and Philology, Academia Sinica* 52.2: 235-301.
- _____. 1982. Male and female forms of speech in the Atayalic group. *Bulletin of the Institute of History and Philology, Academia Sinica* 53.2: 265-304.
- _____. 1985. Linguistic criteria for classifying the Atayalic dialect groups. *Bulletin of the Institute of History and Philology, Academia Sinica* 56.4: 699-718.
- Rau, Der-Hwa Victoria. 2004. Lexical similarity, sound change and intelligibility of Atayalic dialects. In John Bowden and Nikolaus Himmelmann (eds.), *Papers on Austronesian Subgrouping and Dialectology*, 37-96. Canberra: Pacific Linguistics, Australian National University.
- Shih, Cindy Peiru. 2008. *Interrogative Constructions in Plngawan Atayal*. Taipei: National Taiwan Normal University thesis.
- Tsuchida, Shigeru. 1975. *Reconstruction of Proto-Tsouic Phonology*. New Haven, Connecticut: Yale University dissertation.

[2023 年 4 月 7 日收稿；2023 年 7 月 15 日第一次修訂；2023 年 9 月
6 日第二次修訂；2023 年 9 月 18 日接受刊登]

Andre Goderich

Department of English, National Changhua University of Education

國立彰化師範大學英語學系

goderich@gm.ncue.edu.tw

萬大泰雅語中的喉塞音轉換

郭育賢

國立彰化師範大學

萬大泰雅語具有兩種喉塞音演變現象。喉塞音結尾的詞根，或者加綴後保留喉塞音，或者將之刪略並將詞根結尾的元音與詞綴元音合併。該演變起源於原始泰雅語*q 與*ʔ結尾的詞根。從共時音韻學的角度而言，該演變可視為深層形式以有無喉塞音做區分，若深層形式無喉塞音（即元音結尾的詞根）則須在表層形式進行喉塞增音。詞根中的喉塞音演變現象與上述演變來源不同，連原始泰雅語*q 的詞根亦然會發生；反之，詞根中的喉塞音演變則取決於詞幹的音韻結構，加綴後會丟失喉塞音的詞幹有兩種：一、喉塞音前的元音為演變元音，二、長達三個音節的詞幹（包括有衍生詞綴的詞幹）。詞根結尾的喉塞音演變只關係到喉塞一音，然而詞根中的演變，刪略對象不僅是喉塞音本身，亦會帶動鄰近的元音。

關鍵詞：台灣南島語、泰雅語、音韻學、歷史語言學

