Phonetic Realisation of Historical Disyllables in Central Kampong Chhnang Cham

Master's Thesis General Linguistics

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June 19, 2026

1. Introduction

Western Cham is an Austronesian language spoken in Cambodia and Vietnam, belonging to the Chamic sub-branch of Malayo-Polynesian. In Cambodia, the language is scattered across the country, but spoken especially in the central provinces of Kampong Cham, Tbong Khmum and Kampong Chhnang[1] (Eberhard et al., 2026). In Vietnam, the language is concentrated in the far south of the country, in provinces such as An Giang and Tây Ninh, as well as Ho Chi Minh city (ibid.). There are estimated to be 342,500 speakers, approximately 80% of which are located in Cambodia (ibid.). Historically, the Cham homeland spanned the coast of what is now central and southern Vietnam, though successive wars against Vietnamese dynasties sparked a diaspora into Cambodia, with Khmer manuscripts recording large migrations in the 15th and 17th centuries (Thurgood, 1999). Those who fled are now known as the Western Cham, while those who remained are known as the Eastern Cham. Beginning in the 17th century, the Mekong Delta increasingly shifted from Cambodian to Vietnamese control (Thun, 2024), resulting in the Western Cham population residing in modern Vietnam, though the Eastern Cham still refer to them as 'Cham Kur', meaning 'the Khmer Cham' (Thurgood, 1999).

Due to centuries of separation, the Western and Eastern varieties of Cham are no longer intelligible (Eberhard et al., 2026), with major phonological differences including the shift of *r to /ɣ/ in the former and *s to /tʰ/ in the latter (Headley, 1991; Brunelle & Phú, 2019). However, literature on dialectal differences within Western Cham is relatively sparse considering its wide geographical spread across the entirety of Cambodia and southern Vietnam. In terms of phonetic and phonological word structure, Friberg and Hor (1977) describe a variety of Phnom Penh, Headley (1991) describes one of Kampong Thom, and Ueki (2011) briefly describes varieties of Kampong Chhnang and Tbong Khmum[2]. Notably, Ueki (2011) mentions that for disyllabic words, the initial unstressed syllables exhibit significant variation in Kampong Chhnang, sometimes being completely dropped or fusing with the following onset to form a single syllable with a consonant cluster. This thesis therefore seeks to expand the state of knowledge on Western Cham phonetics and phonology, and explores the realisation of historical disyllables in a variety of central Kampong Chhnang (hereon referred to as CKC). In August 2025, I conducted

[1] As there is no widely used standard for romanising Khmer, these provinces are spelled as they are in Eberhard et al. (2026).
[2] At time of publication, this was part of Kampong Cham province and is referred to as such in Ueki (2011). The new Tbong Khmum province was established in 2013.

recordings at two neighbouring villages - Ou Loy and Samlor Sab. From this data, I find significant variation in phonetic production, though a common thread is the reduction of the historical initial syllable, which may variably result in its complete loss, a cluster, a voiceless sonorant, or a fortified obstruent.

This thesis is organised as follows. Chapter 2 provides background information on Western Cham phonology as a whole, and chapter 3 focuses on previous accounts of the language's syllable structure. Chapter 4 then discusses the methods used in acquiring and analysing the data, and chapter 5 presents the different realisations of historical disyllables. This is followed by a discussion and conclusion in chapter 6 with suggestions for further research.

2. Western Cham Phonology

It is thought that the history of Chamic languages in their homeland begins approximately two thousand years ago, with the settlement of what is now coastal Vietnam by Austronesian speakers (Sidwell, 2007). While initially similar to languages like Malay, Chamic phonology has since converged strongly to the typology of neighbouring Austroasiatic languages. Together, they form part of a linguistic area called Mainland Southeast Asia (MSEA), spanning approximately from southern China to peninsular Malaysia in latitude and the eastern edge of India to Vietnam in longitude (Enfield, 2018). Some common MSEA features include large vowel inventories with length and modality distinctions, implosive stops, a preference for monosyllabic or iambic words, and a restricted set of final consonants (ibid.).

Table 1 provides an overview of the Western Cham consonant inventory based on Headley (1991). Indeed, the language contains implosive stops like its neighbours - /ɓ, ɗ, ʄ/. Another areal characteristic of Western Cham is the presence of aspirated stops, though accounts differ in terms of their classification. Friberg and Hor (1977) describe aspirated stops as unitary phonemes, while Headley (1991) describes them as clusters which are optionally broken up by a short vowel. Ueki (2011) marks them as unitary phonemes in her consonant inventory, but suggests the cluster analysis may be more accurate, as she notes that some lexical items exhibit variants with an intervening vowel (ex. [thaː ~ təhaː] meaning 'old'). In the fieldwork for the current thesis, such variation was found in the word [khɛa ~ kəˈhɛa] meaning 'to think'. Therefore, they are provisionally analysed here as clusters.

Table 1: Western Cham consonant inventory based on Headley (1991)[3].

	Labial	Alveolar	Palatal	Velar	Glottal
Plosive	p	t	c	k	ʔ
Implosive	ɓ	ɗ	ʄ		
Fricative		s		ɣ	h
Nasal	m	n	ɲ	ŋ	
Approximant	w	l	j		

While all consonants in Table 1 can be found as the onset of stressed syllables, the set found in codas is more restricted. Both Friberg and Hor (1977) and Headley (1991) find that the implosives and the palatal stop and nasal are disallowed in this position. However, according to the first source, the coda series is expanded by the unique glottalised continuants /wˀ, jˀ, ɣˀ/ and aspirated /jʰ/[4]. Historically, /wˀ/ and /jˀ/ reflect the Proto-Chamic (PC) stops *p and *c[5], /ɣˀ/ reflects the PC rime *ãʔ[6], and /jʰ/ reflects *s in Khmer and Indic borrowings. Headley (1991) also records the existence of such complex rimes but is unclear as to their classification. He writes that *p and *c are regularly reflected as /uʔ/ and /iʔ/ in words like /t̤i̤uʔ/ 'alive' (PC *hudip), but does not include /uʔ/ in his consonant inventory (which it should be as he does not allow for coda clusters), nor alternatively the diphthong /iu/ in his vowel inventory. Here, I analyse the glottalised and aspirated codas as single consonants, as no other coda clusters are known in Western Cham, and inclusion of the high (semi)vowels in the nucleus necessitates

[3] Headley's (1991) original inventory was not written in IPA. The preglottalised consonants (referred to here as implosives) were written as /b, d, j/, and the palatal approximant and nasal were written as /y/ and /ñ/. He includes a sonant /r/, which I represent here as a velar fricative since that is its most common realisation. Note that I have written Headley's preglottalised palatal as an implosive stop /ʄ/ since this is the series it phonologically patterns with, though he writes that it is also produced as a preglottalised approximant [ˀj]. In the fieldwork for this thesis, [ˀj] is also the main realisation I encountered.

[4] In the original paper these are written as /wʔ, yʔ, rʔ/ and /yh/ respectively. I represent the glottal element as a superscript to avoid confusion with a cluster (which all previous authors write cannot exist as a coda). Friberg and Hor (1977), like Headley (1991), represent the velar fricative with /r/ and the palatal approximant with /y/. Note that coda /ɣ/ and /ɣˀ/ are realised as central approximants [ɨ̞] and [ɨ̞ˀ].

[5] Historically, final stops in Western Cham regularly underwent this lenition or merger into the glottal stop. The other plosives recorded in Table 2 are largely the result of later borrowings.

[6] This diachronic origin is not mentioned in Friberg and Hor (1977), but can be deduced from the reconstructed forms in Thurgood (1999). The regular Western Cham reflex of *a(:) that is nasalised or preceded by a nasal consonant is /ɨ(:)/.

triphthongs to account for words like /ɗiauʔ/ ‘sticky rice’, which would only occur in front of the coda /ʔ/. This leaves us with the inventory of final consonants found in Table 2.

Table 2: Western Cham coda inventory based on Friberg and Hor (1977).

		Labial	Alveolar	Palatal	Velar	Glottal
Plosive		p	t		k	ʔ
Nasal		m	n		ŋ	
Continuant	Plain	w	l	j	ɣ	
	Glottalised	wˀ		jˀ	ɣˀ	
	Aspirated			jʰ		h

Table 3 provides an overview of Western Cham vowels, focusing on monophthongs. Similarly to other MSEA languages, Western Cham exhibits a large inventory with nine distinctions in quality, a two-way distinction in length, and unrounded close central vowels (Enfield, 2018).

Table 3: Western Cham monophthong inventory based on Headley (1991). Red indicates that the vowel is not reported by Friberg and Hor (1977).

	Front		Central		Back	
	Short	Long	Short	Long	Short	Long
Close	i	iː	ɨ	ɨː	u	uː
Close-mid		eː	ə	əː	o	oː
Open-mid	ɛ	ɛː			ɔ	ɔː
Open			a	aː		

The language also displays a modality contrast originating from an earlier voicing opposition in onsets (Thurgood, 1999). Vowels following historically voiced consonants (excluding implosives) are breathy, while those following historically voiceless ones are modal. Friberg and Hor (1977) describe the system conservatively, with the onset voicing opposition still underlyingly present, while Headley (1991) marks the opposition solely on the vowel instead, with breathy ones taking a grave accent. Ueki (2011) does not mark them at all, and writes that breathiness was not very noticeable in her speakers.

In the CKC variety described in the current thesis, the modality contrast was indeed noticeable and accompanied by significant differences in vowel quality, with modal vowels tending to be lower at the onset, and breathy vowels tending to be higher. This was most evident in /aː/, for which the breathy form has invariably diphthongised into [ɛ̤a̤]. Breathiness is marked with subscript diaresis on the stressed vowel, avoiding confusion with tone (as may be the case with the grave accent), and indicating the stressed vowel as the primary point of manifestation for modality. As will be seen, this is significant for CKC, as the modality category conditioned by the historical first syllable spreads to the second syllable if the latter's onset is a sonorant or /ɣ/, and this is retained even if the first syllable is deleted.

Table 4 provides an overview of Western Cham diphthongs. Friberg and Hor (1977) and Headley (1991) differ in that the former includes only four centering diphthongs, while the latter adds two closing ones, /iɨ/[7] and /au/, which are restricted to appearing before final /ʔ/. Following the earlier discussion on glottalised codas, it is preferable to analyse the diphthongs unique to Headley (ibid.) as the vowel-coda combinations /iɣˀ/ and /awˀ/ instead.

Table 4: Western Cham diphthong inventory based on Friberg and Hor (1977).

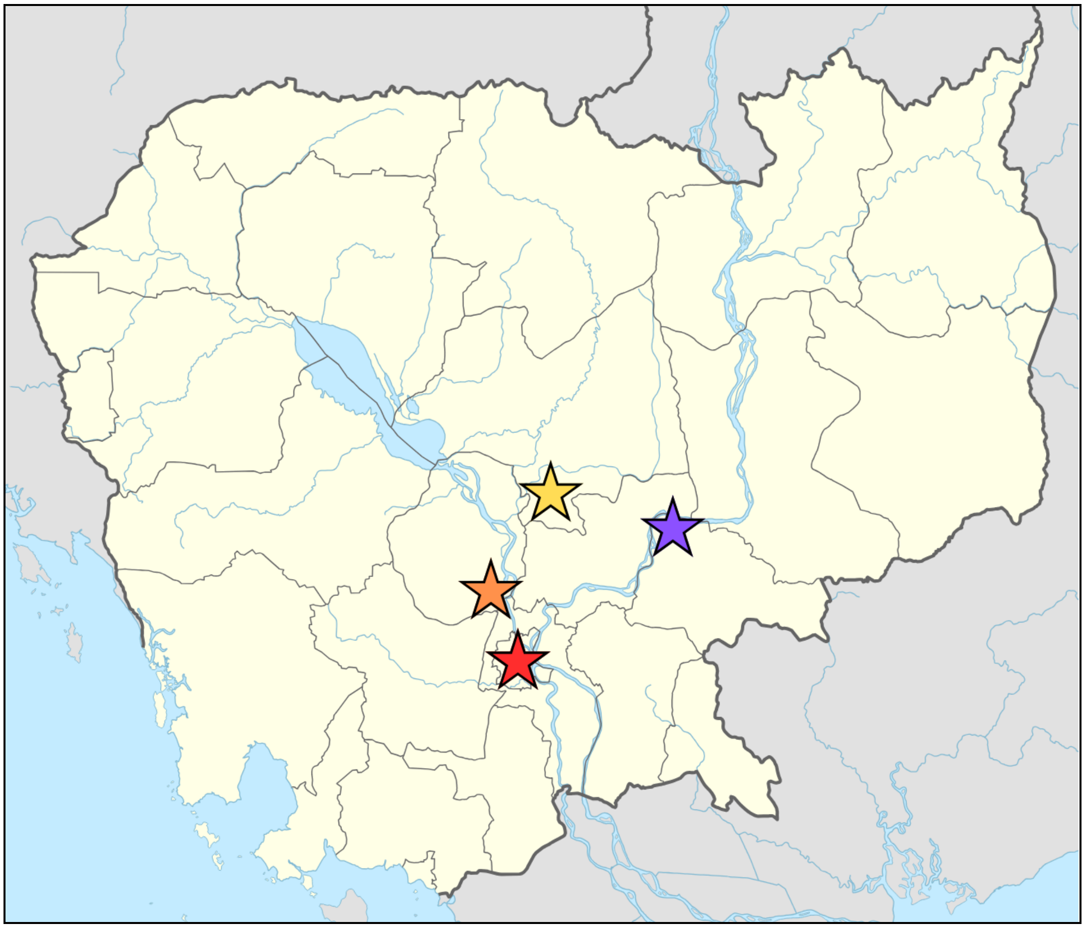
	Front	Back
Close-centering	iə	uə
Mid-centering	ɛə	ɔə

3. Previous Literature on Syllable Structure

While previous accounts of Western Cham have tackled its phonological system at large, this chapter narrows in on syllable structure as the focus of the current thesis. Figure 1 shows the locations of the different varieties discussed in the existing literature.

[7] In the original paper, this diphthong is written as /iɯ/, but the second element is specifically described as central.

Figure 1: Map of Cambodia showing the Western Cham varieties mentioned in this chapter[8]. Red is Phnom Penh of Friberg and Hor (1977), yellow is Kampong Thom of Headley (1991), orange is Kampong Chhnang of Ueki (2011), and purple is Tbong Khmum of Ueki (ibid.).



Friberg and Hor (1977) analysed a variety spoken in Phnom Penh[9], the capital city of Cambodia, focusing mainly on the vowel register system. They describe the phonological word as $(C_2V_2)C_2(C_3)V_1(C_4)$, where V_2 is regularly an unstressed /aː/, pronounced as [a ~ ʌ]. Historically, words with /ʔaː/ as C_2V_2 were very common, but this could be dropped at the time of their documentation, such as in the word 'all', where /ʔaːpi̤ːh/[10] was reduced to /pi̤ːh/. Among

[8] Map modified from *File:Cambodia location map.svg* [Image], by NordNordWest, 2009, Wikimedia Commons (https://commons.wikimedia.org/wiki/File:Cambodia_location_map.svg). CC BY-SA 3.0
[9] The location is not explicitly identified in the text, but a note at the end clarifies that the speakers are from Phnom Penh. Headley (1991) mentions the location as Châu Đốc, Vietnam, but this appears to be a mistake.
[10] All transcriptions by other authors are modified to be in line with IPA, and indicate breathiness with a subscript diaresis on the vowel as opposed to onset voicing or a grave accent.

nasal consonants, only /m/ is regularly permitted as C_2, while /n/ exists in a few words in variation with /1/, such as in 'country' /naːkạɣ ~ laːkạɣ/.

Headley (1991) explores the phonology of a male speaker in Kampong Thom province, Cambodia. He describes two main syllable patterns in native words - monosyllables with a maximal phonological structure of (C_3V_2)ˈ$C_1(C_2)V_1F$, and polysyllables with a structure of ˌˌ$C_4V_3C_3V_2F_2$ˈCV_1F_1, where F is any final consonant, and ˌˌ indicates secondary stress. While containing up to two possible vowel nuclei, Headley nevertheless describes the former as monosyllables with two types of onset clusters. The first are clusters which never exhibit an intervening vowel, in which the second member may only be /l, ɣ, h/. The second type are those with an underlying /aː/, which is produced with significant variation, and have a wider variety of second members which are /p, t, c, k, ʔ, ʆ, m, n, ɲ, ŋ, w, l, j, ɣ, s, h/. This is conceivable as a single syllable in the MSEA context because the underlying unstressed vowel is predictable, a structure given the name 'sesquisyllabic' by other authors (Thomas, 1992). Headley gives the example of 'year' /taːhun/, which in slow, careful speech may be pronounced as [tə̆ˈhun], but in more casual speech as [thun] without any perceptible vowel. In addition, he explains that /h/ has largely been lost in C_3 position except in careful speech, and notes alternation in the same position between /ɣ/ and /l/, with 'wide' /ɣaːnɨ̤ːŋ ~ laːnɨ̤ːŋ/ being pronounced as either [ɣə̆ˈnɨ̤ːŋ] or [lə̆ˈnɨ̤ːŋ].

Ueki's (2011) doctoral thesis on prosody and intonation in Western Cham also describes syllable structure. Her data draws from speakers in Kampong Chhnang (Orussey village, Kampong Tralach district) and Tbong Khmum (Krouch Chhmar district) provinces. The most common word shapes are CV(V)C and CV.CV(V)C with an unstressed initial syllable. The unstressed vowel in her data is mainly [ə], reduced from /a/. She also notes significant individual variation, such that in many cases the unstressed syllable was either dropped altogether or retained only its onset, resulting in a monosyllable with a consonant cluster (CV.CVC → CCVC). Realisation of unstressed syllables varied particularly in Kampong Chhnang. For example, /kapaʔ/ 'walk' was realised as [təpaʔ] and [pəpaʔ]; /ɣelo/ 'meat' as [meloʊ], [ɣeloʊ] and [neloʊ]; /kapaw/ 'buffalo' as [təpaw] and [paw]; and /mata/ 'eye' as [muta]. Some speakers had a greater tendency than others to drop the unstressed syllable, even in the same village, and the same speaker may produce a different variant on different occasions.

Given the relatively small amount of work done on Western Cham syllable structure in different dialects, and Ueki's (ibid.) comment that there is much variation in Kampong Chhnang, this thesis seeks to expand on the diversity of forms in central Kampong Chhnang in particular, and analyse their phonetic realisations in detail. Drawing from this, I then suggest an analysis of CKC phonological syllable structure to account for the different production strategies.

4. Methods

The data for this thesis was collected in a single trip to the fieldsite in August 2025, for which prior approval was given by the ethics committee of the UvA Faculty of Humanities. The trip lasted one day, during which I visited two neighbouring villages of central Kampong Chhnang - Ou Loy (Rolea B'ier district) and Samlor Sab (Teuk Phos district). I recorded two speakers living at each location, I1 and I2 at the former and I3 and I4 at the latter. Table 4 gives an overview of them and their recordings.

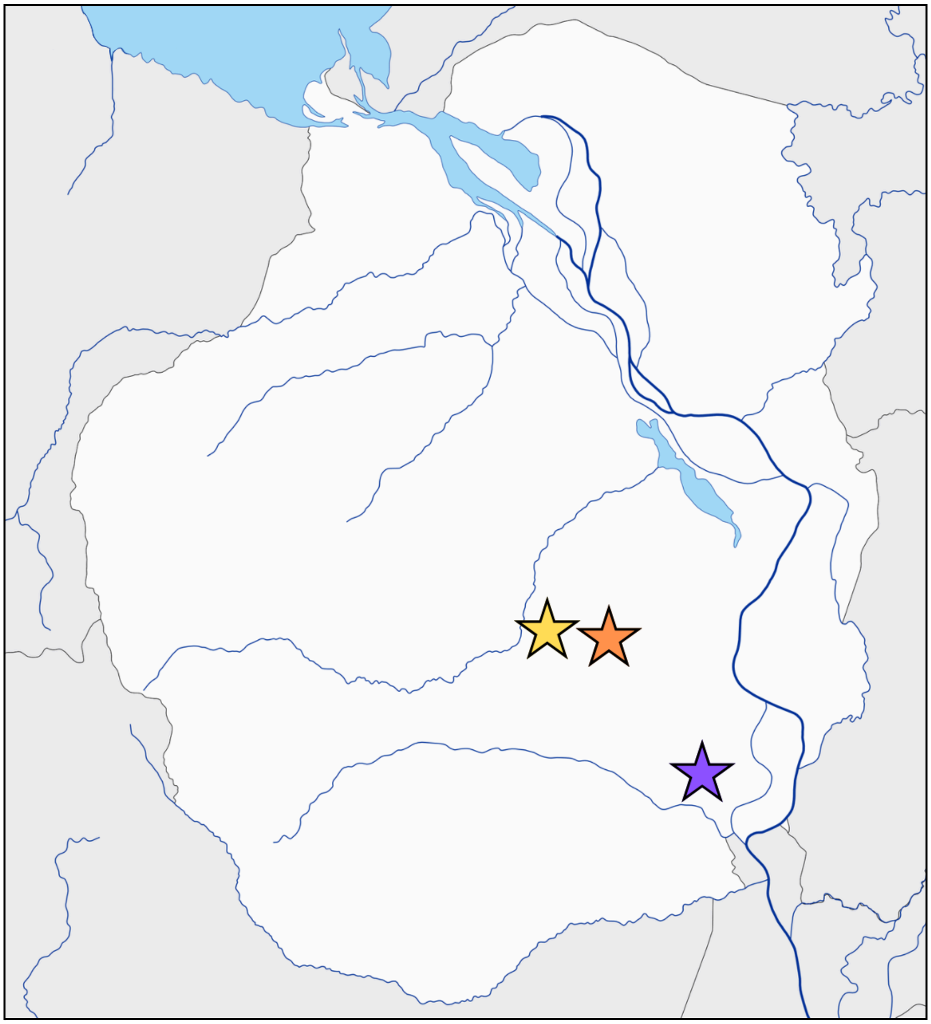
Table 5: Information for each informant, including age, location, and a note on recording quality.

Informant	Age at time of recording	Location	Notes on recording
I1	56	Ou Loy	Indoors but heavy rain caused background noise
I2	32	Ou Loy	Indoors but heavy rain caused background noise
I3	47	Samlor Sab	Outdoors with clear audio
I4	44	Samlor Sab	Outdoors with clear audio

All four were women, aged between 32 and 56 years old. I2 was a pre-existing contact who aided in recruiting the three other speakers. Notably, she specifically chose other women to be interlocutors, as she felt that the men in her area were more shy and would be less willing to be recorded. The two villages were established around the year 2000, and all speakers moved there from a village slightly to the south called Andoung Tramung, except I2 who was born in

Ou Loy to Andoung Tramung parents. Figure 2 shows the location of the two villages in Kampong Chhnang province, along with Ueki's (2011) Orussey village for comparison.

Figure 2: Map of Kampong Chhnang province with the approximate locations of Ou Loy (orange) and Samlor Sab (yellow) near the center and Orussey (purple) in the southeast[11].



I recorded a wordlist of 181 items, covering basic vocabulary which are reconstructed as disyllabic at the PC level by Thurgood (1999), or disyllabic post-PC borrowings that are widespread in the Chamic branch[12]. An additional criterion was that the list included a diverse combination of reconstructed onsets for the two syllables in terms of place and manner of

[11] Map modified from *Kampong Chhnang province (Cambodia)* [Image], n.d., d-maps.com (https://www.d-maps.com/carte.php?num_car=317430&lang=en).
[12] The PC reconstructions are marked with a single asterisk (ex. *buya 'crocodile'), while the post-PC reconstructions are marked with two asterisks (ex. **riya:ʔ 'wave').

articulation, as they may condition different phonetic realisations. Examples include *bituʔ ‘star’, *taŋaːn ‘arm’ and *lima ‘five’, which have the manner combinations stop-stop, stop-nasal and approximant-nasal respectively. Readers may refer to Appendix 1 for the full list. In a preliminary meeting, I2 had helped to reduce this list from an earlier one of 235 items to exclude borrowings and unfamiliar terms. In particular, the exclusion of borrowings eliminated the risk that my Khmer speech would influence their production. The recordings were made with a Samsung Galaxy A53 5G smartphone on the Recorder application, which I used to save recordings in the mono WAV format with a sampling rate of 44,100 Hz. The speakers were given each item in Khmer and had to translate them into Western Cham, inserted in the frame sentence /[target] pɔ̤h panojˀ ni̤ː ʔiw la̤jˀ [target]/ meaning ‘[target], this word is called [target]’. Each speaker repeated the wordlist only once, which took approximately 20 minutes. After recording, the files were transferred to my laptop, on which I conducted phonetic analysis using Praat (Boersma et al., 2026) waveforms and spectrograms, and numerical calculations in RStudio (Posit team, 2026).

While in general, the recordings were of good quality, there are slight differences among speakers depending on the environment. I1 and I2 were recorded indoors due to heavy monsoon rain, which nevertheless resulted in detectable background noise. I3 and I4 were recorded outdoors as the rain had subsided, resulting in clearer audio. Depending on the particular phonetic realisation analysed, these differences varied in relevance and will be clarified in the following chapter where necessary.

5. Analysis

In terms of the phonetic realisations of historic disyllables, six strategies were found that are described in detail in the following sections. The most diachronically conservative of these is the production of two phonetic vowels, which also appears to be the prototypical realisation recorded in previous literature on Western Cham. However, there are also more innovative strategies, including the complete deletion of the initial syllable, which depending on the exact phonological environment can result in no compensatory changes to the following consonant, devoicing of the following sonorant, or fortition of the following obstruent. The initial syllable may also be reduced into a cluster with the following consonant, or into a nasal homorganic to the following consonant if it historically began with a sonorant. Of these more innovative pathways, Friberg and Hor (1977) have recorded deletion without compensatory changes and Ueki (2011) has recorded the formation of clusters. Thus, the descriptive focus of this chapter will be on the newly described realisations. The strategies are not categorical, meaning that a single word may be realised with more than one, and as with Ueki (ibid.) there is significant individual variation.

5.1. Realisation of two phonetic vowels

One realisation of historical disyllables is with two phonetic vowels - an unstressed first one and stressed second one. For the scope of this chapter, I refrain from providing a syllabic evaluation, using the term ‘phonetic vowel’ to describe the present-day surface production, and ‘syllable’ to discuss the diachronic reconstruction. The unstressed vowel varied in height, but was consistently central, ranging among [ə ~ ɐ ~ a], with the more open realisations seeming to correlate with preceding glottal onsets. The one exception to this was when the vowel was followed by /j/, in which case it was sometimes a near-front [ɪ]. The stressed vowel displayed the full extent of the Western Cham inventory. This is one of the main word shapes recorded by previous authors, but is frequently in variation with other forms in CKC. In fact, only I1 consistently produced both vowels for the majority of the wordlist. However, there were a number of items that were consistently produced with two vowels across all four speakers, examples of which are given below with their PC reconstructions:

(1) a) [pɪˈɟɛ̤a̤] *buya ‘crocodile’
b) [təˈhaː] *tuha ‘old’
c) [kəˈmaj] *kumɛy ‘woman’
d) [kəˈʋɜt] *kawat ‘wire’
e) [haˈta̤ːj] *hudɛy ‘after’

Figure 3 and 4 show example productions of [kəˈmaj] ‘woman’ and [haˈta̤ːj] ‘after’ respectively, with their waveforms and spectrograms in Praat[13].

[13] The length distinction between modal /a/ and /aː/ before coda /w/, /j/, and possibly /l/ appears unstable. This is not relevant to the focus of the thesis, thus the vowels are transcribed with their expected reflexes - [aj] and [aw] for *ɛy and *ɔw, and [aːj] and [aːw] for *ay and *aw. In the breathy modality, *ɛy and *ɔw are reflected as [a̤ːj] and [a̤ːw], while *ay and *aw are reflected as [ɛ̤a̤j] and [ɛ̤a̤w].

Figure 3: Waveform and spectrogram of [kəˈmaj] ‘woman’ produced by speaker I1. Background noise due to rain.

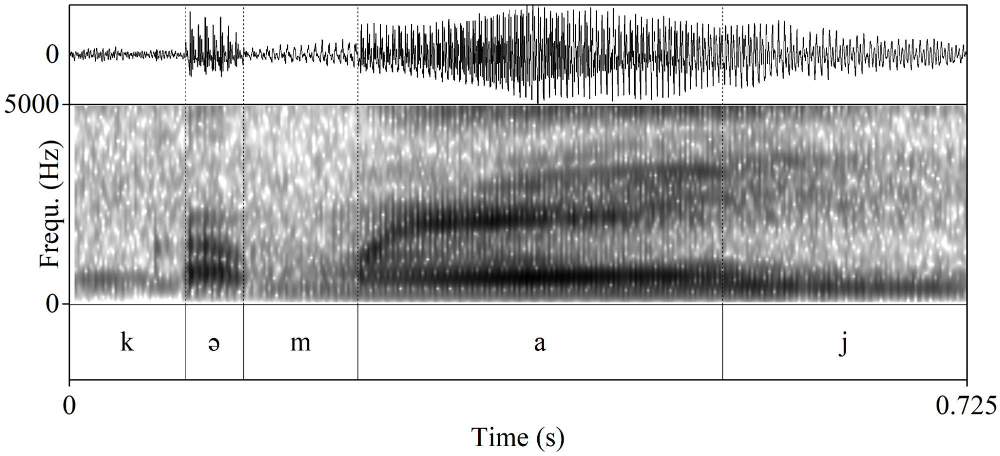
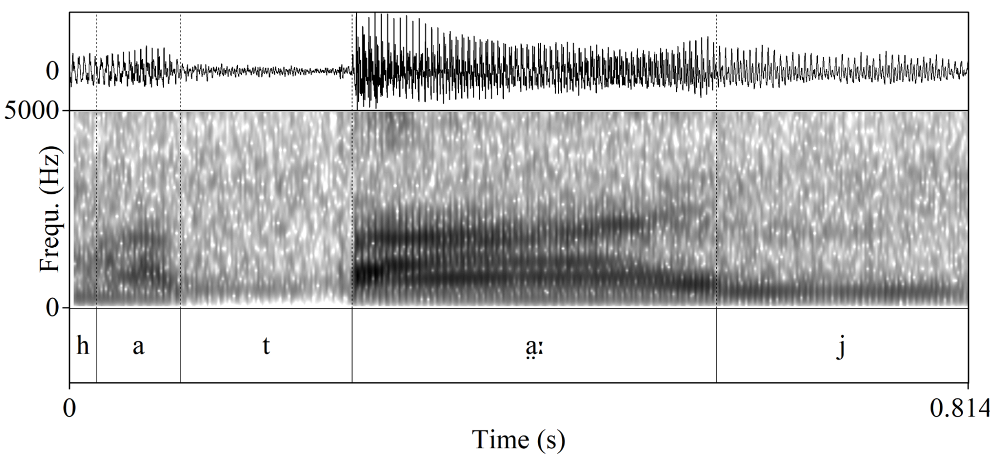


Figure 4: Waveforms and spectrograms of [haˈta̤ːj] ‘after’ produced by speaker I1. Background noise due to rain.



5.2. Deletion of initial syllable without compensation

In their CKC reflexes, certain disyllables were especially prone to the reductions described by previous authors. For example, while Friberg and Hor (1977) write that initial /ʔaː/ is optionally dropped, in CKC almost all instances of historical *ʔa have been deleted, along with almost all instances of initial syllables beginning in *h. The only exceptions were I1 once producing [ʔɐˈsaw] for ‘dog’ (PC *ʔasɔw) and [haˈɣaj] for ‘day’ (PC *hurɛy), and all speakers producing [haˈke̤ʔ ~ haˈki̤ʔ] for ‘what’ (PC *hagɛt) and the aforementioned [haˈta̤ːj] for ‘after’. Notably, initial syllables reconstructed as beginning with *s also drop, with Thurgood (1999) writing that historically, these first shifted to *h before their frequent deletion in Western Cham. As noted by Headley (1991), if the remaining syllable has a sonorant or /ɣ/ as its onset, the modality category conditioned by the initial syllable in preserved. Initial *ʔ conditions a breathy vowel, while *h conditions a modal one. Thus, in CKC one can find minimal pairs such as [mɨ̤ː] 'father' (PC *ʔama) vs. [mɜɨ̯] 'rice field' (PC *huma). Other examples of items that display this deletion are given below, including another minimal pair in modality between 2e and 2f:

(2) a)	[puj]	*ʔapuy	'fire'
b)	[cɛ̤a̤n]	*hujaːn	'rain'
c)	[nɨ̤ːʔ]	*ʔanaːk	'child'
d)	[saɨ̯]	*ʔasar	'seed'
e)	[laː]	*sula	'leaf'
f)	[lɛ̤a̤]	*ʔular	'snake'

Figure 5 and 6 show example productions of [puj] 'fire' and [lɛ̤a̤] 'snake' respectively.

Figure 5: Waveform and spectrogram of [puj] 'fire' produced by I1. Background noise due to rain.

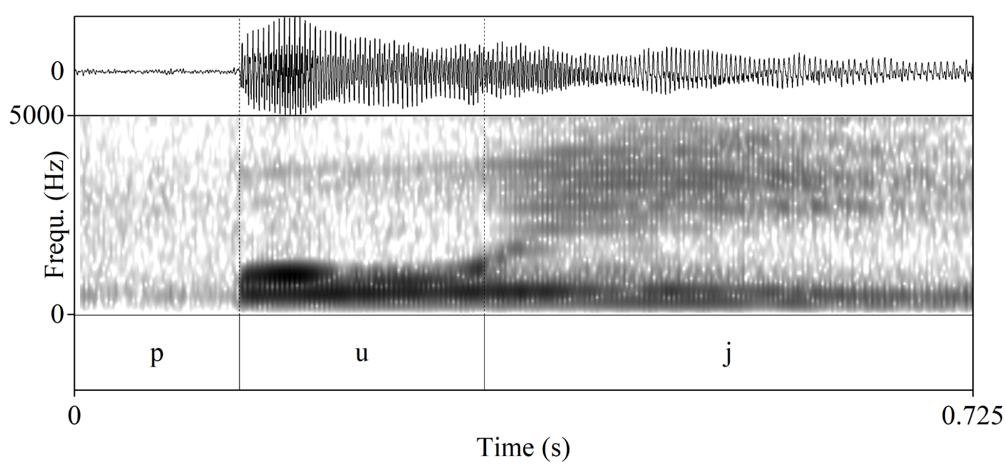
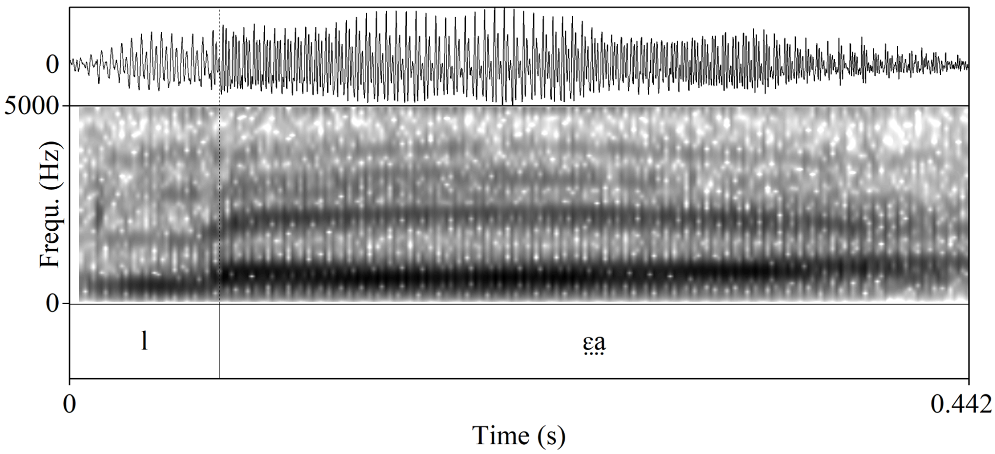


Figure 6: Waveform and spectrogram of [lɛ̤a̤] ‘snake’ produced by I1.



5.3. Deletion of initial syllable with devoicing of following sonorant

For items in which the second syllable begins in a sonorant, one notable reduction strategy is the deletion of the first syllable and compensatory devoicing of the sonorant. This is a process that has not been recorded in the existing literature. In the wordlist, this devoicing was found to occur with /l, m, n, ɲ, ŋ/, and only when the first syllable began with a stop. For /l/, the conditioning environment is further restricted to cases where the preceding onset is alveolar or palatal.

In terms of phonetic characteristics, the voiceless sonorants of CKC are similar to those in languages like Burmese, which have an unvoiced component in the beginning and a voiced component toward the end, and are longer than plain voiced sonorants when the two components are measured together (Ueta et al., 2026). In a few cases, there is also a bit of voicing at the beginning of closure, likely carried over from the previous word, which has also been reported for Burmese (Bhaskararao & Ladefoged, 1991). The voiceless component is often faint and difficult to hear in the recordings, particularly if there is background noise from the rain. This is especially true for the nasals, while the voiceless lateral can be considerably more noisy and in fact fricativised. In any case, it is identifiable as a gap in voicing between the preceding frame word and the onset, which does not occur in items with plain sonorants. The length of this gap and the voiced portion of the sonorant is not always consistent - at times they may be of roughly equal length, while for others the voiced portion is significantly shorter. For the sake of consistency, their phonetic realisation will be written as the voiceless sonorant followed by its voiced counterpart, or [l̥͡l, m̥͡m, n̥͡n, ɲ̊͡ɲ, ŋ̊͡ŋ]. Interestingly, I1 did not display this strategy at all, instead producing all relevant items with two vowels. Examples of items produced with this strategy are given below:

(3) a) [l̥͡la̤ːw] *dihlɔw ‘before’

b) [m̥͡mɜɨ̯] *tama ‘be cut (by a knife)’

c) [n̥͡nɛ̤a̤j] *binay ‘female’

d) [ɲ̊͡ɲiːʔ] *kuñit ‘tumeric’

e) [ŋ̊͡ŋɜn] *taŋaːn ‘arm’

Figures 7 and 8 show example productions of the near minimal pair [l̥͡la̤ːw] ‘before’ and [law] ‘pestle’ (PC *halɔw) respectively. In the former, the voiceless section lasts 173 ms and the voiced section lasts 59 ms. In the latter, the voiced lateral lasts 87 ms.

Figure 7: Waveform and spectrogram of [l̥͡la̤ːw] ‘before’ produced by I3, preceded by [mə̤ŋ].

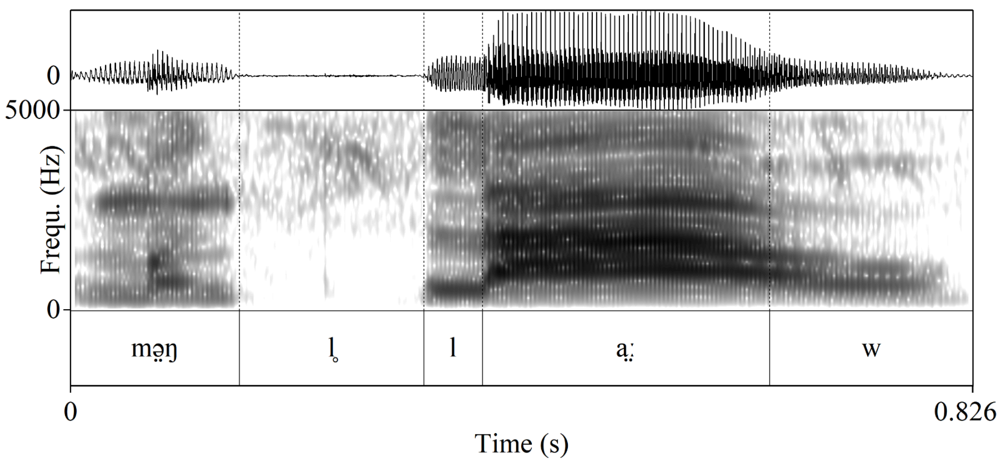
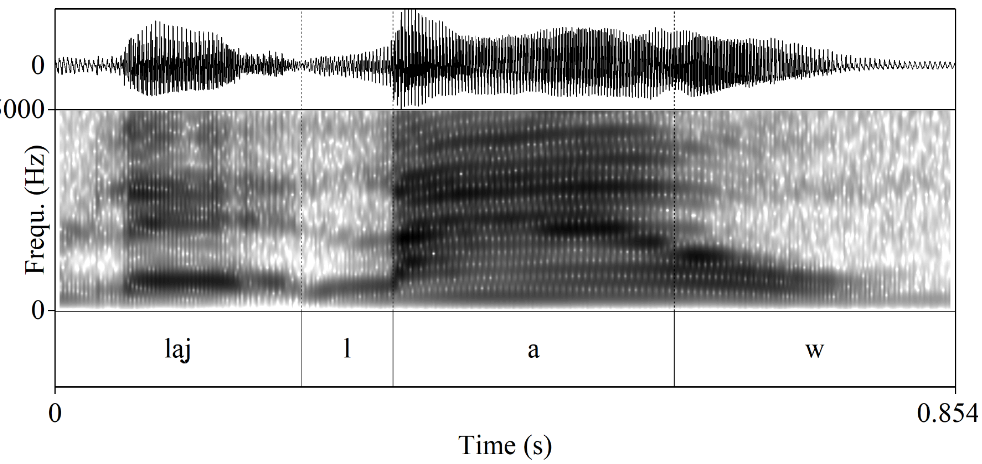


Figure 8: Waveform and spectrogram of [law] ‘pestle’ produced by I3, preceded by [la̤j].



As for the nasals, Figures 9 and 10 show example productions of the minimal pair [m̥͡mɜɨ̯] ‘be cut’ and [mɜɨ̯] ‘rice field’. In the former, the voiceless sections lasts 70 ms, and is preceded by a small amount of voicing (therefore more accurately transcribed as [ᵐm̥͡mɜɨ̯]), likely due to the voiced coda in the earlier frame word. In both cases, the voiced section of the nasal lasts around 95 ms.

Figure 9: Waveform and spectrogram of [ᵐm̥͡mɜɨ̯] ‘be cut’ produced by I4, preceded by [la̤jˀ].

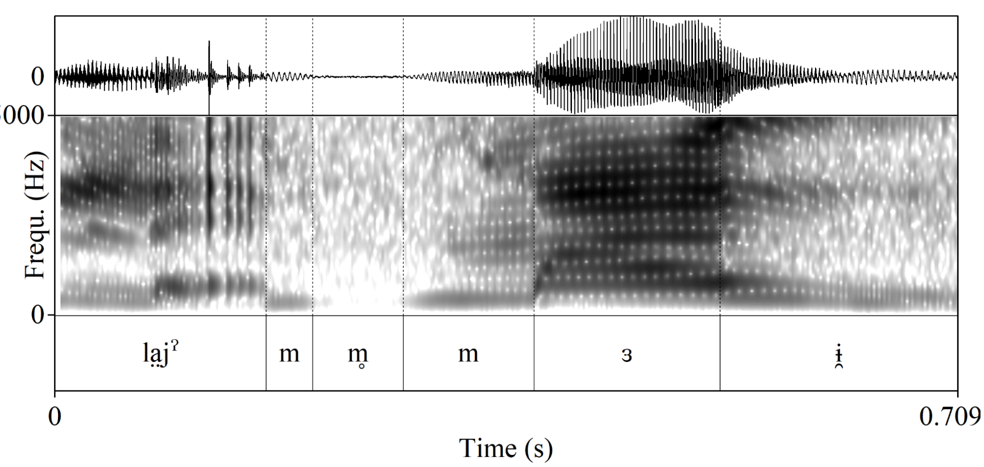
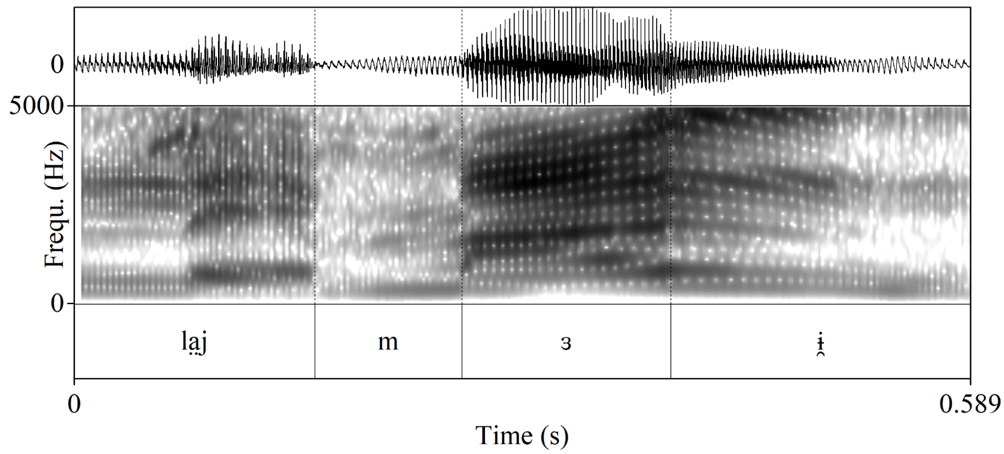


Figure 10: Waveform and spectrogram of [mɜɨ̯] 'rice field' produced by I4, preceded by [la̤j].



To measure the difference in length between the voiceless and voiced components, all viable tokens of voiceless sonorants were annotated with Praat TextGrids and tabled using the script in Appendix 2. As the voiceless component is audibly faint, they were only considered in tokens at the end of the frame sentence. Bleeding of voicing from the preceding frame word was also included as part of the voiceless portion. Tokens produced at the beginning of the frame sentence had only their voiced components measured. The data was then analysed in RStudio and Microsoft Excel to calculate their mean closure length across the three speakers who produced them, as shown in Table 6. Overall, these sonorants had an average length of 215 ms[14]. The voiceless components lasted 1.46 times as long as the voiced ones, with average values of 127.92 ms and 87.64 ms respectively. By surface phoneme, this voiceless advantage was greatest in [n̥͡n] and smallest in [ɲ̊͡ɲ], though the latter only had four tokens for which the voiceless component could be measured, which may have skewed the results.

Table 6: Mean closure length (ms) for voiceless sonorants across all speakers

Phoneme	Voiced component	Voiceless component	Voiced-to-Voiceless component ratio
l̥͡l	89.58	118.59	1 : 1.32
m̥͡m	89.66	143.01	1 : 1.60
n̥͡n	88.03	154.02	1 : 1.75

[14] Calculated only based on tokens for which both components were measured.

ɲ̊͡ɲ	81.35	102.67	1 : 1.26
ŋ̊͡ŋ	85.43	114.44	1 : 1.34
Average	87.64	127.92	1 : 1.46

5.4. Deletion of initial syllable with fortition of following obstruent

For items in which the first syllable begins in a stop and the second begins in a stop or /s/, a typologically unusual reduction strategy is the deletion of the first syllable and compensatory fortition of remaining onset. As with sonorant devoicing in Section 5.3, this process has not been recorded in previous literature. For stops, this fortition is realised as gemination, with the closure being held for roughly twice the usual length. While difficult to perceive in isolation, it is identifiable in the frame sentence as a longer closure phase between the preceding word and the onset release - usually around 200-300 ms as opposed to 100-150 ms. As for /s/, the fortition is realised as a geminated voiceless fricative [sː], while unstrengthened /s/ is realised either as a singleton voiceless fricative [s] or a voiced approximant [ð̞̆][15]. [sː] is noticeably noisier than [s ~ ð̞̆], and the voicing of the latter creates the most distinct strength opposition among all the obstruents. Examples of items produced with this strategy are given below:

(4) a) [pːɛ̤a̤w] *kabaw 'water buffalo'
b) [tːaj] *batɛy 'banana'
c) [cːṳh] *tujuh 'seven'
d) [kːe̤ː] *pagi 'tomorrow'
e) [ʔːai̯] *baʔar 'paper'
f) [sːaw] *tasɔw 'breast'

Figures 11 and 12 show example productions of the minimal pair [pːɛ̤a̤w] 'water buffalo' and [pɛ̤a̤w] 'snail' (PC *ʔabaw) by I2. In this case, geminate [pː] maintains closure for 281 ms, while singleton [p] maintains closure for 159 ms.

[15] The voiceless realisations of /s/, both singleton and geminate, are frequently dental in CKC.

Figure 11: Waveform and spectrogram of [pːɛ̤a̤w] ‘water buffalo’ produced by I2, preceded by [ʔiw]. Background noise due to rain.

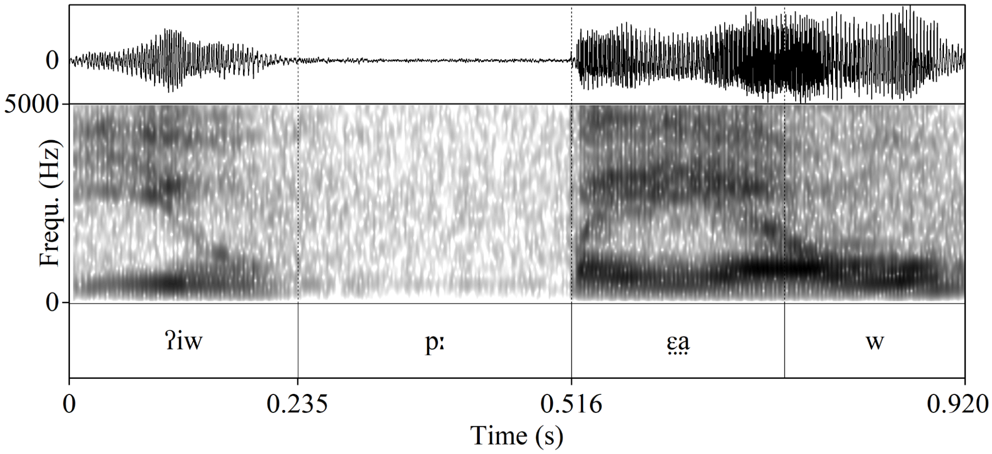
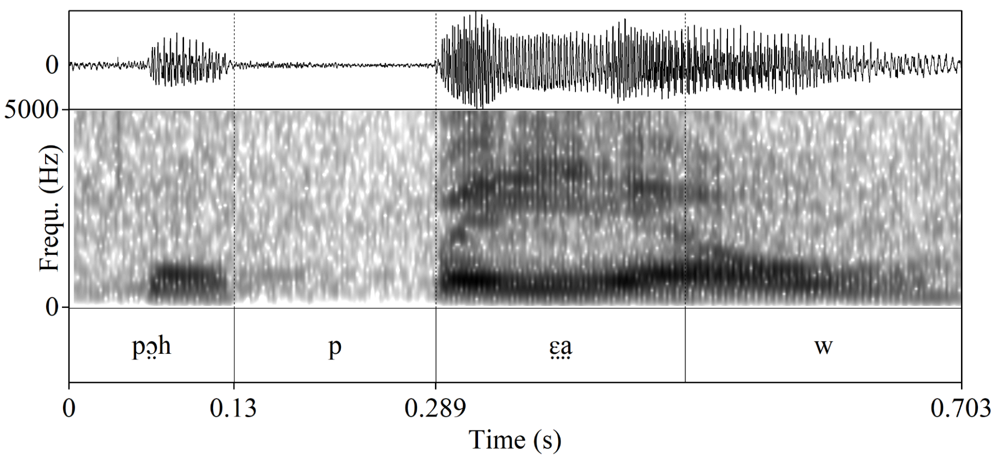


Figure 12: Waveform and spectrogram of [pɛ̤a̤w] ‘snail’ produced by I2, preceded by [pə̤h]. Noise during closure is a result of rain.



As for the fricative contrast, Figures 13 and 14 show example productions of the minimal pair [sːaw] ‘breast’ and [ð̞aw] ‘dog’ by I4. In this case, geminate [sː] maintains closure for 172 ms, while singleton [ð̞] maintains closure for 70 ms. Note also the vocal fold vibration and formants present throughout the production of [ð̞].

Figure 13: Waveform and spectrogram of [sːaw] 'breast' produced by I4, preceded by [la̰jˀ].

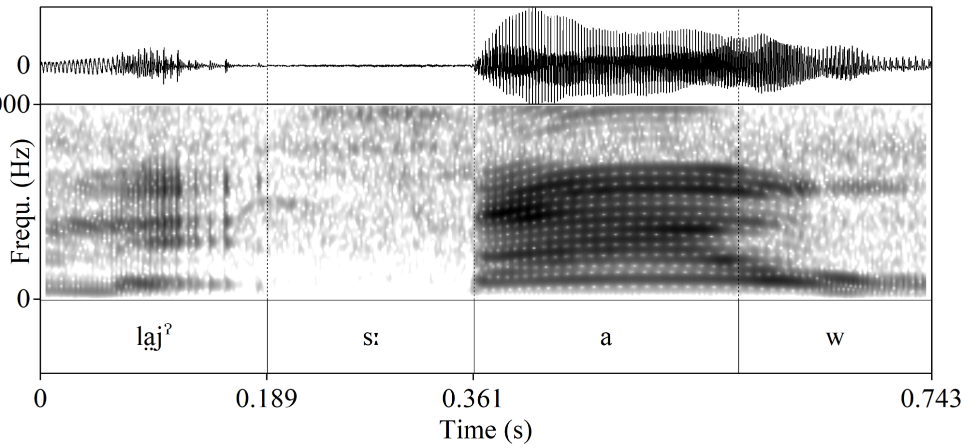
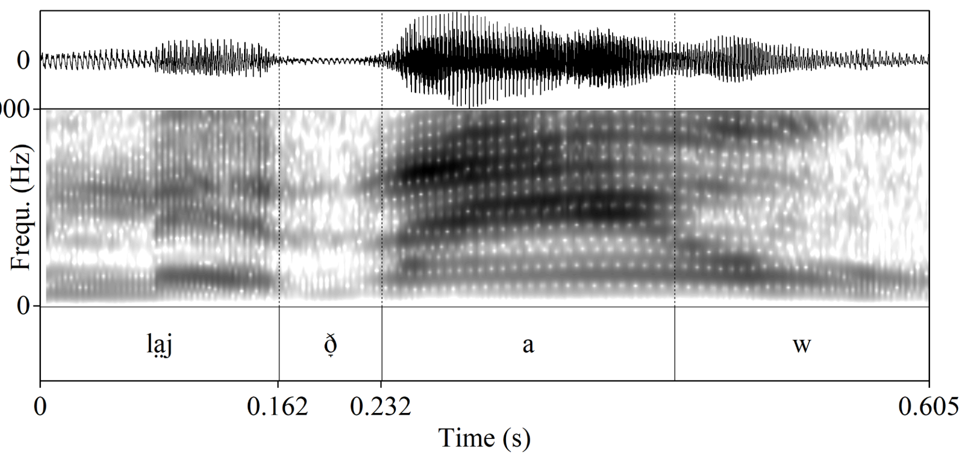


Figure 14: Waveform and spectrogram of [ð̥aw] 'dog' produced by I4, preceded by [la̰j].



Though evidence from the wordlist is sparse, a few items suggest that the geminate stops can also form part of larger onset clusters. The three words 'pigeon' (PC *katrɔw), 'divide' (PC *ma/bapha), and 'sell' (PC *pə-blɛy) are reconstructed with word-medial clusters. When reduced to having a single vowel, the initial syllable is deleted, and the first member of the medial cluster is lengthened. This is particularly notable in 'sell' [pːla̰ːj] of I2 and I3, which forms a minimal pair with the morphologically related word 'buy' [pla̰ːj] as shown in Figures 15 and 16. In this case, geminate [pː] maintains closure for 387 ms, while singleton [p] maintains closure for 162 ms. It is worth noting that I4 displayed only a small difference in closure length between these words, and in fact a difference in the opposite direction from what is expected (124 ms for 'sell' and 137 ms for 'buy').

Figure 15: Waveform and spectrogram of [pːla̤ːj] 'sell' produced by I2, preceded by [ʔiw]. Background noise due to rain.

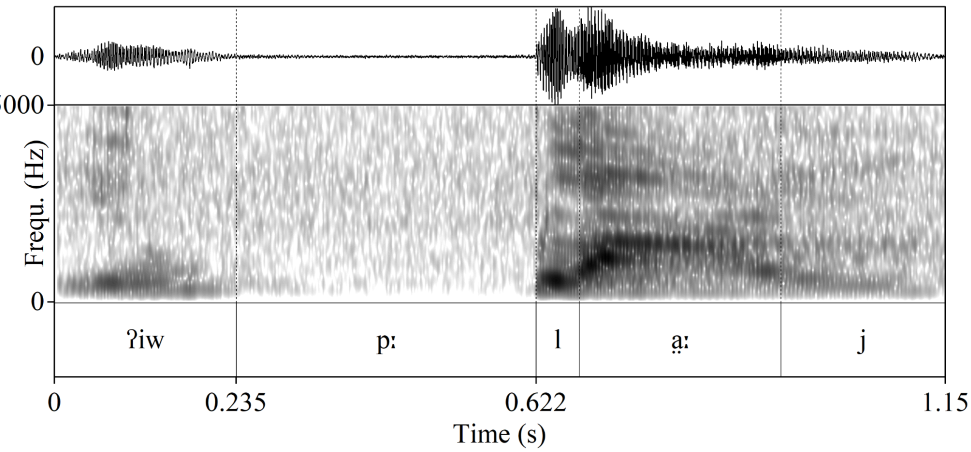
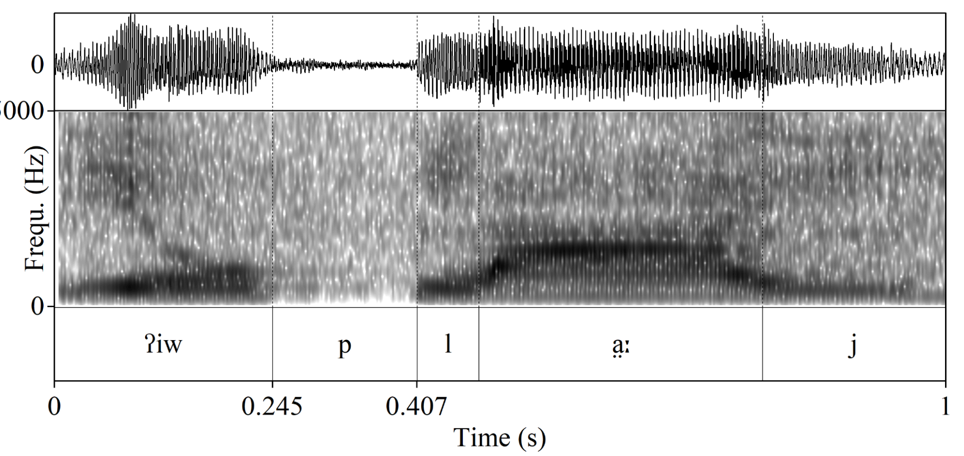
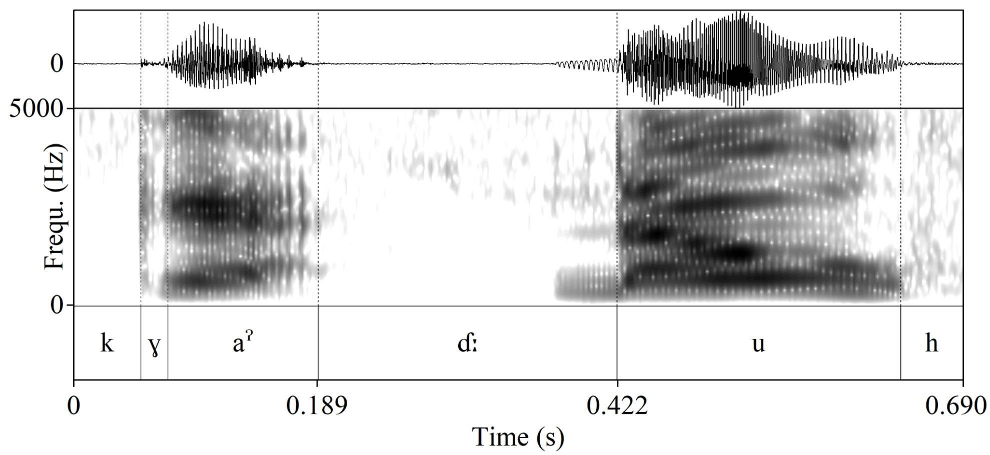


Figure 16: Waveform and spectrogram of [pla̤ːj] 'buy' (PC *blɛy) produced by I2, preceded by [ʔiw]. Background noise due to rain.



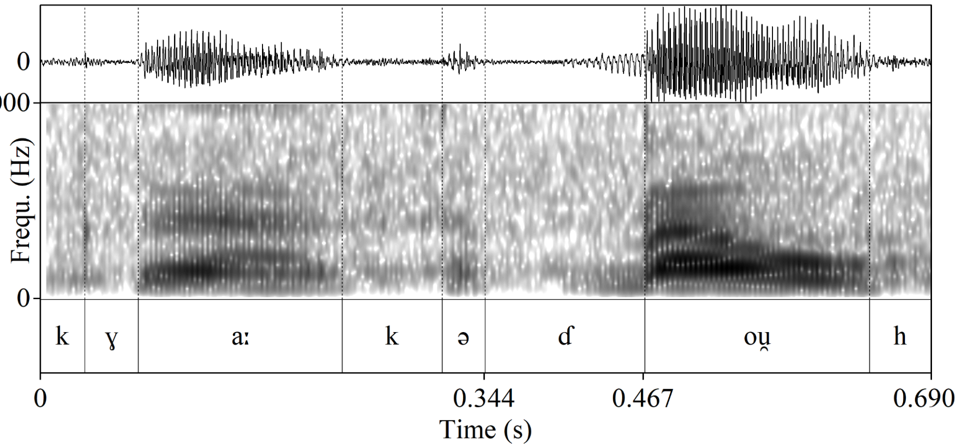
While the fortition opposition is quite clear for plain stops and /s/, it is not entirely clear whether it also exists among implosives. They are rarer in the wordlist, and no intended item is unambiguously realised as a singleton word-initial implosive. Nevertheless, there are some clues that point to a strength distinction indeed existing. Firstly, the implosives that are produced in diachronic environments where geminate stops are expected also tend to have much longer closures, especially in contrast to word-medial implosives following unstressed syllables. Secondly, for the item 'turtle' (PC *kura), the word informants produced was always followed by [kəˈɗou̯h ~ ɗːuh][16] meaning ‘shell’, likely to distinguish it from a homonym meaning ‘monkey’. When ‘shell’ was produced with two vowels, as by I1, ‘turtle’ was pronounced as [kɣaː] with a long vowel lasting 158 ms. However, when ‘shell’ contained only one vowel, as with the other three informants, ‘turtle’ was pronounced as [kɣaˀ] with a shorter, glottalised vowel, likely in anticipation of a geminated onset. Figures 17 and 18 show example productions of these two variants. In the first figure, [kɣaˀ] has a vowel lasting 109 ms, while in the second, [kɣaː] has a vowel lasting 162 ms. Likewise, the length of stop closure differs significantly between the two variants. In [ɗːuh], it lasts 233 ms, while in [kəˈɗou̯h], the implosive closure lasts 123 ms.

Figure 17: Waveform and spectrogram of [kɣaˀ ɗːuh] ‘turtle’ produced by I3.



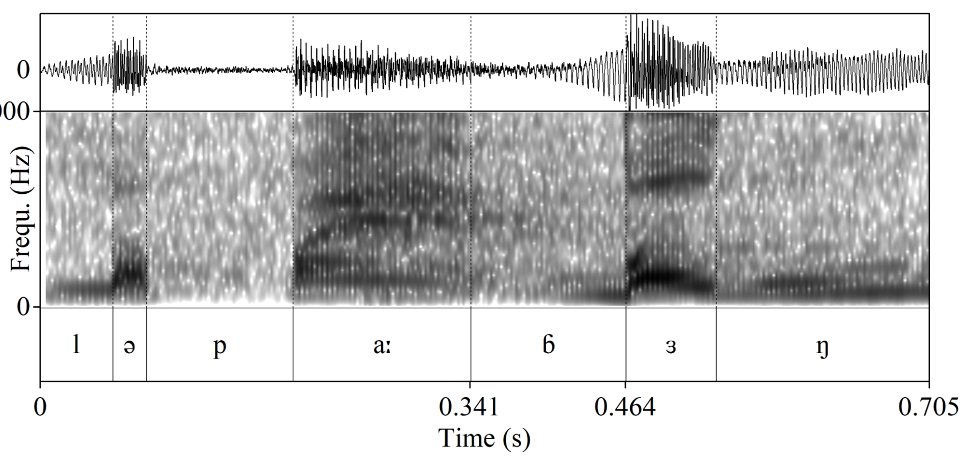
[16] Here, [u̯] is transcribed instead of [w] as it is considered part of the preceding vowel. In CKC, breaking of high vowels frequently occurs in open syllables and before glottal codas. It is also recorded by Ueki (2011), though in her description, native speakers consider the process characteristic of people who live “close to the Mekong”, which would exclude Kampong Chhnang. However, she notes that one of her informants from the province indeed used diphthongised forms and suggested they may be spreading.

Figure 18: Waveform and spectrogram of [kɣaː kəˈɗo̯uh] 'turtle' produced by I1. Background noise due to rain.



That the closure length of [ɗːuh] is unusual for word-initial implosives is hinted by the fact that while recording, I2 used the phrase [ləˈpaː ɓɜŋ] meaning 'hungry to eat', wherein there is a clear example of a singleton implosive following a long vowel. This is illustrated in Figure 19. While in this phrase, I2's [aː] was slightly shorter than in I1's [kɣaː kəˈɗo̯uh] (139 ms as opposed to 162 ms), the closure of the implosive was very similar, lasting about 123 ms as well. This difference from [ɗːuh] suggests that there is indeed a length contrast among implosives in CKC, though the scarcity of examples means that additional research is required to confirm it.

Figure 19: Waveform and spectrogram of [ləˈpaː ɓɜŋ] 'hungry to eat' produced by I2. Background noise due to rain.



To analyse the difference in closure length, all viable tokens of word-initial singleton and geminate obstruents were annotated and tabled using the script in Appendix 3. Only tokens that appeared at the end of the frame sentence were used, as closure could be accurately measured as the voiceless period following the frame word (or non-vocalic voiced period in the case of [ð̞])[17]. The data was then analysed to calculate their mean closure length across the four speakers, as shown in Table 7. Overall, the geminate obstruents were held almost twice as long as the singleton ones, with some variation among the different phonemes. It was not possible to accurately measure the length of singleton /ʔ/ as it was produced as a creaky transition between the preceding word and following vowel. This was not an issue with geminate [ʔː], which exhibited no creak for its duration. Note also that [ʔː] is considerably shorter than the other geminate voiceless stops, with an average closure of 206.45 ms compared to the overall mean of 251.95 ms. As for /s/, both the geminate and singleton forms are significantly shorter than their counterparts in other obstruents, being about 50 ms less than the overall mean in both cases. However, the relational difference between the pair is in fact the greatest among all obstruents, with [sː] being on average 2.61 times longer than [s ~ ð̞].

Table 7: Mean closure length (ms) for singleton and geminate obstruents across all four speakers

Phoneme	Singleton	Geminate	Singleton-to-Geminate Ratio
p	134.58	275.98	1 : 2.05
t	143.86	256.58	1 : 1.78
c	141.42	248.47	1 : 1.76
k	123.04	271.37	1 : 2.21
ʔ	-	206.45	-
ɓ	109.49[18]	259.75	1 : 2.37
ɗ	131.78[19]	235.99	1 : 1.79
s	76.88	200.32	1 : 2.61

[17] Some tokens produced by I2 were excluded as she paused before production, making measurement difficult.
[18] Singleton [ɓ] is only represented by two tokens of [ɓɜŋ] 'eat' produced by I2, which was not on the wordlist.
[19] Singleton [ɗ] is only represented by one token of [ɗuəl] 'heel' by I3 and two tokens of [ɗɑh] 'far' produced once each by I2 and I4, which was not on the wordlist.

Average	127.62	251.95	1 : 1.97

To test the significance of the closure length difference, the data was run through a mixed-effects statistical model in RStudio[20]. This found that the geminate obstruents had a higher average closure length than the singleton ones, and that it was statistically significant (estimated geminate-singleton difference = 127.69 ms; 95% confidence interval = 115.37 .. 140.13 ms; p from zero = 6.67×10^{-36}). Therefore, we can conclude that geminate obstruents are indeed considerably longer than singleton ones.

5.5. Reduction of initial syllable into a cluster

In a number of items, former initial syllables have collapsed, producing clusters between the word-initial consonant and the onset of the second syllable. For a few words, particularly those reconstructed with bilabial or velar stop onsets and a medial *l, this strategy appears to be the regular outcome across all speakers, as well as in other dialects of Western Cham. This suggests that it is a change that has happened once before in the speech ancestral to the different modern varieties. However, there are also instances of clusters between two stops or a stop and a sonorant which have not been recorded in other varieties, indicating that some newer reductions unique to CKC also follow this pattern. However, they are relatively rare, and more often the informants produced them with two vowels, devoicing, or as geminates. Examples of items produced with this strategy are given below, with the clusters in 5a and 5d previously being recorded by Friberg and Hor (1978):

(5) a) [pl̤ɛ̤a̤n] *bulaːn 'month'
b) [pʰtɔu̯ʔ] *bituʔ 'star'
c) [cɓuəj] **c/tuɓuay 'mouth'
d) [kliːʔ] *kulit 'skin'
e) [tɣa̤h] *darah 'blood'

Figures 20 and 21 show example productions of [pʰtɔu̯ʔ] 'star' and [kliːʔ] 'skin' respectively. In the former, the two consonants are connected by a period of aspiration most

[20] The model was based on 281 observations and included two random predictors - speaker (4) and word (96), for which random slopes were included. The words were divided into the within-speaker predictor of onset length type (singleton or geminate). The dependent variable was onset closure length in milliseconds.

visible between 48 and 90 ms. Tentatively, this is analysed as an allophonic voiceless transition and not a separate consonant as before vowels. The latter would necessitate a cluster with three members [pht], which would be less economical, especially considering there is no evidence that such a cluster contrasts with a two-member onset like [pt].

Figure 20: Waveform and spectrogram of [p^{h}tɔu̯ʔ] ‘star’ produced by I3.

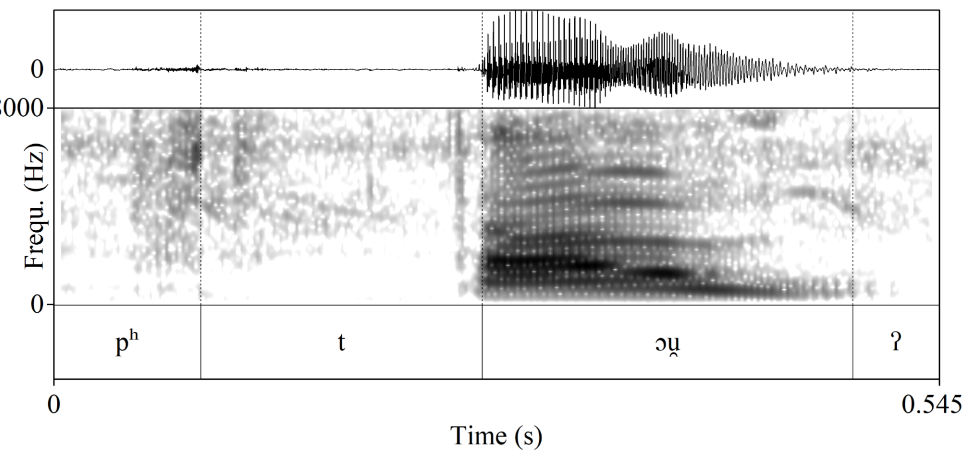
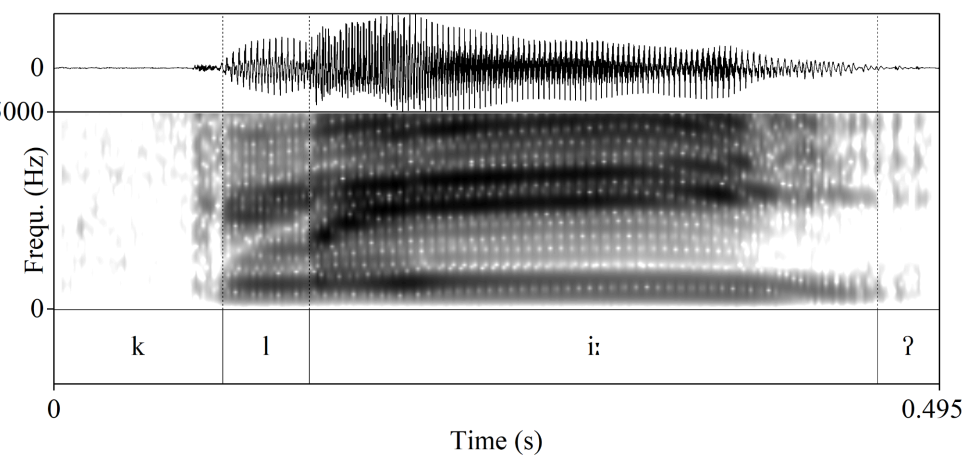
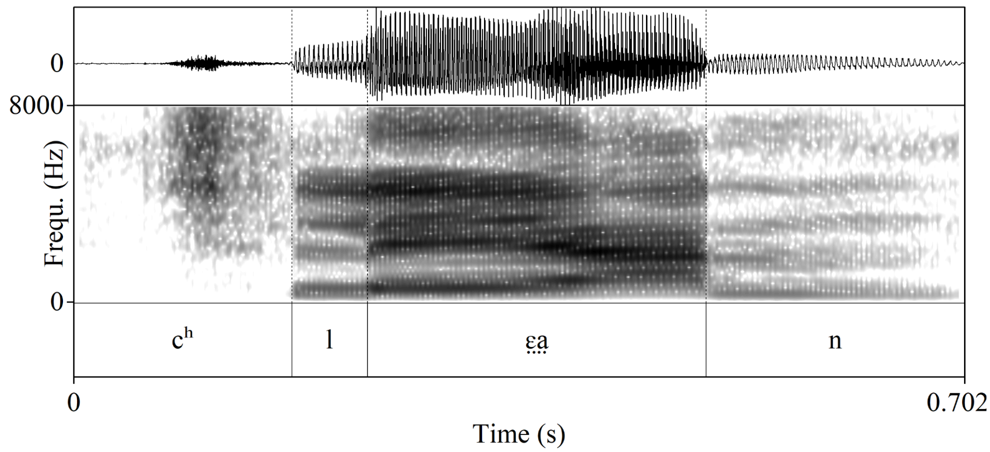


Figure 21: Waveform and spectrogram of [kliːʔ] ‘skin’ produced by I3.



In terms of clusters where the second member is a lateral approximant [l], onset stops are usually unaspirated, as seen in Figure 21. However, an exception appears to be when the onset is a palatal stop, in which case it is phonetically aspirated [c^{h}]. This cluster is rare in the recordings and has not been noted in other varieties of Western Cham, but occurs in I3’s production of ‘road’ (PC *jalaːn) as [c^{h}l̤ɛ̤a̤n] and I4’s production of ‘tongue’ (PC *dilah) as [c^{h}l̤a̤h]. Figure 22 illustrates an example of the former. A significant amount of voiceless noise can be seen before the transition into [l], lasting 115 ms. In other contexts, /c/ contains a much shorter noisy component before release, lasting an average of 33 ms in I3's productions of [cɛ̤a̤n] 'rain' and [cɛ̤a̤w] 'green'.

Figure 22: Waveform and spectrogram of [cʰlɛ̤a̤n] 'road' produced by I3.



5.6. Reduction of initial syllable with sonorant into a nasal

For items in which the first syllable begins in *r, *l or a nasal, a common reduction strategy is for the syllable to reduce to a nasal. For *r and *l, this nasal is homorganic to the following consonant, while for word-initial *m, it either remains [m] or reduces further to a homorganic nasal[21]. In items where the following consonant is already a nasal, this reduction produces a geminate. As these geminate nasals have a different diachronic origin from the geminate obstruents in Section 5.4, they are discussed here instead with the homorganic nasals. Examples of items produced with this strategy are given below, with 6 showing nasals preceding a separate consonant, and 7 showing geminate nasals:

(6) a)	[mpṳʔ]	*mabuʔ	'drunk'
b)	[nð̩am]	*masam	'sour'
c)	[ntaːʔ]	*rətaːk	'bean'
d)	[ɲɟɛ̤a̤ʔ]	**riyaːʔ	'wave'
e)	[ŋkaj]	*lakɛy	'man'

[21] Other word-initial nasals are quite rare in words inherited from PC (and in PC itself). Initial palatal *ñ changed to /c/ in 'mosquito' [cʰəˈmə̤ʔ ~ m̥͡mə̤ʔ] and /j/ in 'breath' [ɟəˈʋɛ̤a̤], both of which are recorded for other dialects (Friberg and Hor, 1978).

(7) a) [mːɨ̤ː] *lima ‘five’

b) [nːa̤m] *ranam ‘love (v.)’

c) [ɲːi̤m] *mañam ‘weave (v.)’

d) [ŋːi̤ːʔ] *laŋit ‘sky’

Figure 23 shows an example production of [ŋkaj] ‘man’ by I4, while figures 24 and 25 show example productions of the minimal pair [mːɨ̤ː] ‘five’ and [mɨ̤ː] ‘father’. In this case, geminate [mː] lasts 211 ms, while singleton [m] lasts 71 ms.

Figure 23: Waveform and spectrogram of [ŋkaj] ‘man’ produced by I4.

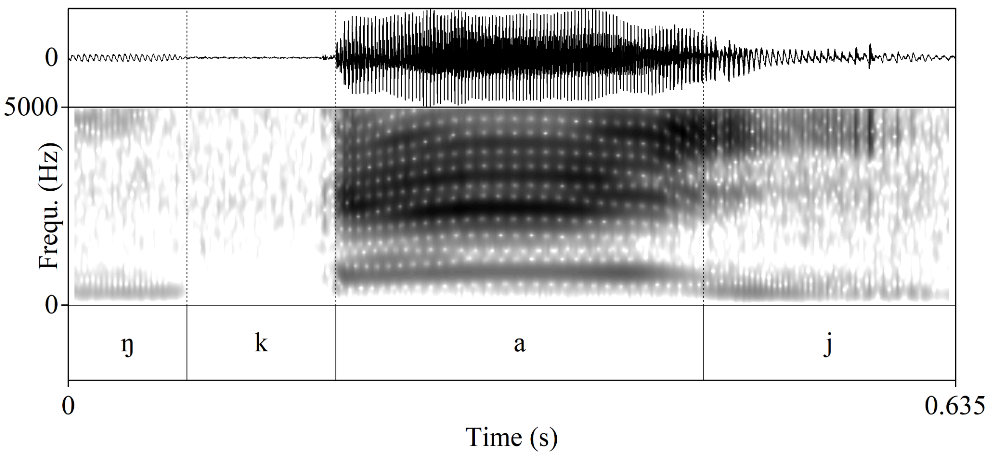


Figure 24: Waveform and spectrogram of [mːɨ̤ː] ‘five’ produced by I4.

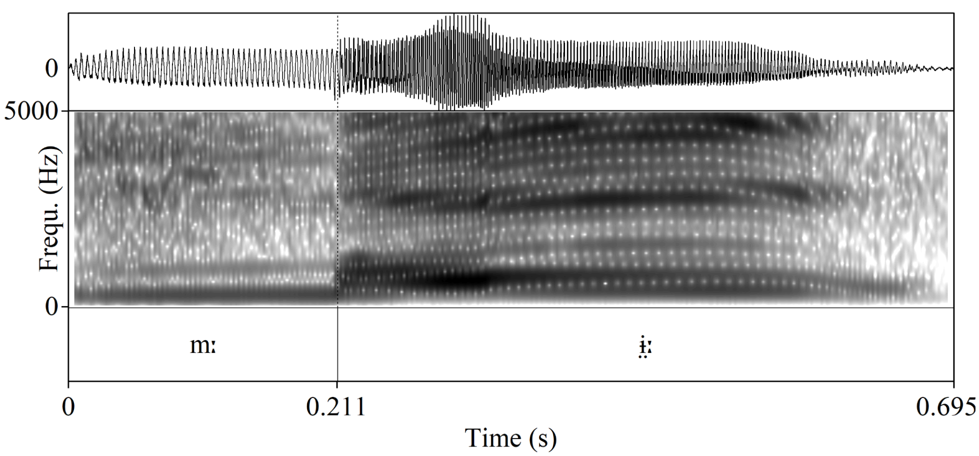
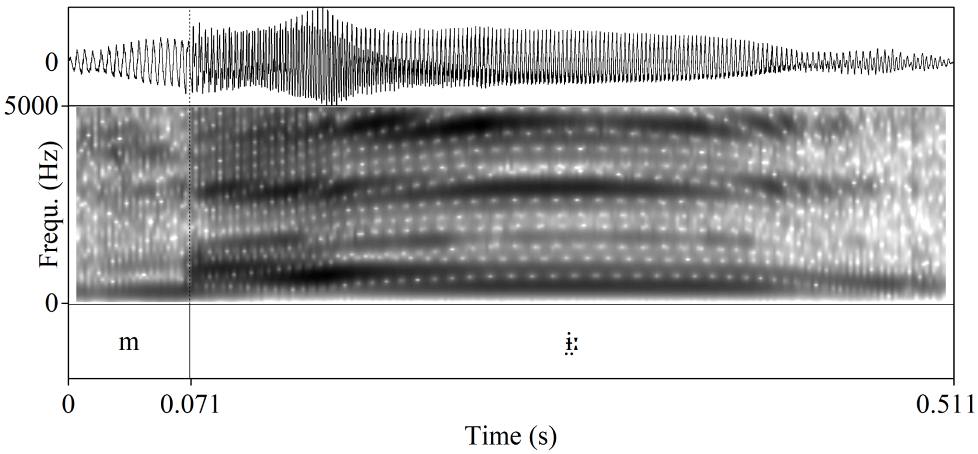


Figure 25: Waveform and spectrogram of [mɨ̤ː] 'father' produced by I4.



To analyse the difference in closure length, all tokens of word-initial singleton and geminate nasals were annotated and tabled using the script in Appendix 4. The data was then analysed to calculate their mean length across all four speakers, as shown in Table 8. Overall, the geminate obstruents were held 2.3 times as long as the singleton ones, and by phoneme this difference was highest in /m/ and lowest in /n/. As the wordlist contained no examples of word-initial singleton [ɲ], length comparison for the palatal nasal pair was not possible.

Table 8: Mean closure length (ms) for singleton and geminate sonorants across all four speakers

Phoneme	Singleton	Geminate	Singleton-to-Geminate Ratio
m	91.60	231.47	1 : 2.53
n	99.04	205.25	1 : 2.07
ɲ	-	194.58	-
ŋ	86.72	210.13	1 : 2.42
Average	93.05	213.97	1 : 2.30

To test the significance of the closure length difference, the data was run through a mixed model in RStudio[22]. This found that the geminate nasals had a higher average closure length than the singleton ones, and that it was statistically significant (estimated geminate-singleton

[22] The model was based on 146 observations and included two random predictors - speaker (4) and word (32), for which random slopes were included. The words were divided into the within-speaker predictor of onset length type (singleton or geminate). The dependent variable was onset closure length in milliseconds.

difference = 122.28 ms; 95% confidence interval = 107.53 .. 136.26 ms; p from zero = 1.57×10^{-15}). Therefore, we can conclude that geminate nasals do indeed have a considerably greater length than singleton ones.

Interestingly, there was one case in which reduction of initial *r produced a geminate lateral. I1 once produced ‘flesh’ (PC *ralɔ) as [lːɔ̤ː], which all other speakers produced as [nlɔ̤ː] instead. This [lː] lasted 242 ms, almost twice as long in comparison to the singleton [l] she produced in words like [laː] ‘leaf’ and [lɛ̤a̤] ‘snake’, which averaged at 134 ms.

6. Discussion and Conclusion

The data paint a picture of a Western Cham variety quite aberrant in comparison to those described in the previous literature. The reduction of initial syllables has sparked a wide array of compensatory changes including onset devoicing, gemination and clustering. This leaves CKC with an unusual surface consonant inventory (see Appendix 5 for table) and many short but phonologically complex words, albeit in variation with more conservative forms.

In terms of the voiceless sonorants, the mean ratio between the voiced and voiceless components was found to be 1 : 1.46, with an average total length of 215 ms. In comparison, voiceless nasals in Burmese are reported to have an average length of 185 ms for men and 229 ms for women, with the voiceless component comprising a much higher share than in CKC, at a ratio approaching 1 : 3 (Bhaskararao & Ladefoged, 1991).

In terms of the geminate obstruents and nasals, the former were found to be an average of 1.97 times longer than their singleton counterparts, while the latter were 2.3 times longer than the singletons. Both are typologically remarkable in that they only appear in word-initial position, whereas in other languages geminates tend to occur word-medially (Ridouane & Hallé, 2008). Nevertheless, there are a few other languages in Southeast Asia that also display similar patterns. Nyaheun, a West Bahnaric language spoken in Laos, has geminate obstruents that appear only word-initially (Sidwell & Jacq, 2003), resulting from the reduction of unstressed syllables. These largely parallel CKC in diachronic development, with the deleted and remaining syllable both beginning in an obstruent. However, reduction of initial *ʔ and *h also result in a geminate, whereas in CKC these are most often deleted without compensation. As for geminate nasals in Nyaheun, they instead originate from stop-nasal combinations across unstressed syllables, patterning differently from CKC where they instead produce voiceless nasals. Example words which exhibit these processes are given below (geminate obstruents in 8 and geminate nasals in 9), along with their reconstructed forms in Proto-West Bahnaric (ibid.)[23].

(8) a)	/pːuac/	*trpuac	‘finger’
b)	/tːaːk/	*hntaak	‘bean’
c)	/sːaːw/	*psaaw	‘son-in-law’

(9) a)	/mːaː/	*cmaa	‘right’
b)	/nːan/	*pnar	‘wing’
c)	/ɲːɨə/	*kɲɨɨ	‘ginger’

Geminate consonants also exist in Pattani Malay, spoken in Thailand, similarly resulting from word-initial syllable reduction (Hajek & Goedemans, 2006). As in CKC, there is synchronic variation between the geminated and unreduced forms, and in most cases either one may be used. However, they are reported to last three times as long as singletons, a much greater difference than in CKC. Hajek and Goedemans (ibid.) also note that the reduction that triggers gemination predominantly affects /ɨ/, which differs from others in the Pattani vowel inventory in that it largely avoids stress and is never phonetically lengthened in open syllables. The consonant combinations that result in geminates are less specific than in CKC, with most pairings resulting in the lengthening of the second member. The most apparent exception are cases where the second consonant is /r/ or /ɣ/, in which case an optional cluster may be formed. It is notable that in CKC and Nyaheun, these rhotic(-like) phonemes are also excluded from gemination - there were no instances of [ɣː] in the recordings for this thesis, nor do Sidwell and Jacq (2003) include /rː/ in the Nyaheun inventory. Example words which exhibit gemination are given below, along with the unreduced forms they vary with.

(10)	a)	[mːatɔ ~ pɨmatɔ]	‘jewellery’
	b)	[dːadu ~ sɨdadu]	‘police’
	c)	[ɟːalɛ ~ bɨɟalɛ]	‘to walk’

[23] While the Proto-West Bahnaric reconstructions do not show any vowel in the initial unstressed syllable, this is because it does not contrast for quality and is analysed as epenthetic. In most daughter languages, it surfaces as [a] or a schwa-like vowel. Also note that the original Nyaheun forms have gemination indicated by doubling, but are indicated here with a colon for consistency.

The overall number of tokens per speaker with each reduction strategy can be seen in Table 9[24]. The category ‘Other’ encompasses marginal strategies (which are clarified in Appendix 1) and instances where the strategy was not clear[25]. Note the large difference in tokens with two phonetic vowels between I1 and the other three speakers.

Table 9: Number of wordlist tokens per speaker, using each reduction strategy

Informant	Two phonetic vowels	Deletion without compensation	Sonorant devoicing	Obstruent gemination	Clustering	Reduction to nasal	Other	Total
I1	230	93	0	5	18	5	25	376
I2	39	111	44	50	15	70	63	392
I3	73	106	31	41	27	56	50	384
I4	34	109	32	54	18	76	60	383
Total	376	419	107	150	78	207	198	1535

Considering the synchronic variation present in CKC, providing an analysis of syllable structure is rather challenging. One possibility would be to accommodate for it with an underlying representation where the consonant of the more conservative production is accounted for. The unstressed vowel need not be included, as at least in the lexemes analysed in this thesis, it does not contrast for quality and can be analysed as epenthetic. Thus ‘bone’ (PC *tulaːŋ), produced as [təˈlaːŋ] or [l̥͡laːŋ], could have a single underlying form /tlaːŋ/ with two distinct surface forms. Moreover, while I2 first pronounced ‘husband’ (PC *pusaːŋ) as [sːaːŋ], she then explicitly described it as actually being [pʰsaːŋ] with a [pʰ] sound, and no mention of an intervening vowel. While anecdotal, I2’s reflection suggests two significant points - that there is no underlying vowel in word-initial clusters, and that at least in ‘husband’, the geminate onset does not exist underlyingly either. A representation like /psaːŋ/ could therefore account for all realisations encountered in the recordings, namely [pəˈsaːŋ], [pʰsaːŋ], and [sːaːŋ].

[24] These include instances in the recordings where the words were produced outside their intended frame sentence.
[25] Most commonly these were tokens with word-initial stops that were likely geminated, but as they appeared at the beginning of the frame sentence or were preceded by a pause, I could not confirm this. Many are also combinations involving /ʔ/ as the second consonant, which could either be analysed as having two-vowels or being a cluster, as /ʔ/ often manifests as creak.

However, these conclusions are complicated by another comment from I2, who upon hearing the two-vowel forms produced by I1, remarked that they are in the 'written language' and not the 'spoken language'. This suggests that CKC may be an instance of diglossia as proposed by Ferguson (1959), where two language varieties exist in a single community - a primary form used in everyday conversation, and a divergent, highly codified form used for most written and formal spoken purposes. Brunelle (2009) proposes such an analysis for Eastern Cham of Vietnam, with a colloquial variety associated with reduction into monosyllabic forms, and a formal variety associated with sesquisyllabic forms. However, the speakers recorded for this thesis occasionally switched forms in the same sentence, blurring the line between 'spoken' and 'written' language. Nevertheless, one could imagine that in productions where more effort or emphasis was placed, the 'written' form with less reduction was chosen.

Given I2's observations, there is ample grounds for future research on CKC. It would be of particular interest to investigate whether other speakers have a similar view of their linguistic ecology. If they indeed agree that the language is diglossic, it may be necessary to propose two phonological systems to account for the 'spoken' and 'written' forms, each with their own phoneme inventories and syllable structures. Identifying specific social groups the two speech varieties may be associated with would also be valuable, particularly in relation to age and gender. Of the four speakers in this thesis, the oldest, I1, produced by far the most two-vowel tokens, while the two youngest, I2 and I4, produced the least. And since this thesis only draws on women's speech, it would be worthwhile to compare the present findings with men's speech of the same villages, and see if there are any significant differences.

Finally, marginally attested contrasts such as gemination of /l/ and especially of the implosives deserve further study. I have yet to come across reference to the latter in another Southeast Asian language, though outside this region they are attested in Fulfulde of Mali (Cissé et al., 2011), and Konso and Oromo of Ethiopia (Orkaydo, 2013; Lloret-Romanyach, 1988). However, in these languages they only appear word-medially, and as such CKC still provides a remarkable typological profile, with potential to broaden the state of knowledge on phonology and phonetics at large.

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Appendix 1: Elicitation Wordlist

* = Proto-Chamic reconstruction by Thurgood (1999)
** = Reconstructed to after the breakup of Proto-Chamic by Thurgood (ibid.)

English	Khmer	Proto-Chamic	Notes
Geographical features			
1. Land	ដី	*tanah	Reflex of *tanah does not seem to occur in CKC. Informants produced [lɔu̯ʔ] instead.
2. Stone	ថ្ម	*batɔw	
3. Ashes	ផេះ	*habɔw	
4. Hole	រណ្ដៅ	*luba:ŋ	Often produced in a compound with [kɣo̯:k]
Materials			
5. Iron	ដែក	*bəsɛy	
6. Wood	ឈើ	*kayɔw	
7. Oil	ប្រេង	*miña:k	
8. Charcoal	ធ្យូង	*hadaŋ	
9. Cotton	អំបោះ (intended CKC word corresponds to កប្បាស in Khmer)	*kapa:s	Reflex appears to refer only to the plant and not the material. My lack of clarity meant that all informants except I1 produced [cih] instead, meaning ‘(cotton) thread’
Water			
10. Wave	រលក	**riya:ʔ	

11. Ocean	សមុទ្រ	*tasiʔ	
Weather			
12. Wet	ទទឹក	*basah	Informants produced [ˀjɑːʔ] instead.
13. Rain	ភ្លៀង	*hujaːn	
14. Sky	មេឃ	*laŋit	
15. Star	ផ្កាយ	*bituʔ	
16. Wind	ខ្យល់	*ʔaŋin	
17. Hot	ក្តៅ	*paɗiaʔ	
18. Cold	ត្រជាក់	**laʔən	
Time			
19. Day	ថ្ងៃ	*hurɛy	
20. Month	ខែ	*bulaːn	
21. Night	យប់	*malam	
22. Tomorrow	ស្អែក	*pagi	
23. Before	មុន	*dihlɔw	Pronounced as [təˈla̤ːw ~ l̥͡la̤ːw]. Note that *h is lost.
24. After	ក្រោយ	*hudɛy	
25. Old	ចាស់	*tuha	
26. New	ថ្មី	*bahrɔw	Reduced to [pha̤ːw] with an initial cluster for all speakers. Note that *r is lost.
Plants			
27. Root	ឫស	*ʔughaːr	
28. Leaf	ស្លឹក	*sula	

29. Sap	ជ័រ	*gətak	
30. Flower	ផ្កា	*buŋa	
31. Seed	គ្រាប់	*ʔasar	
32. Thorn	បន្លា	*durɛy	
33. Ripe	ទុំ	*tasaʔ	
34. Unripe	ខ្ចី	*muda	
Fruits and Small Plants			
35. Papaya	ល្ហុង	**(li)huŋ	
36. Coconut	ដូង	*laʔur	
37. Banana	ចេក	*batɛy	
38. Rattan	ផ្ដៅ	*haway	
39. Rice plant	ស្រូវ	*paday	
52. Rice field	ស្រែ	*huma	
40. Sugarcane	អំពៅ	*təbɔw	
41. Bean	សណ្ដែក	*rəta:k	
42. Cucumber	ត្រសក់	*timun	
43. Tuber	ដំឡូង	*hubɛy	
Animals			
44. Female	ញី	*binay	
45. Male	ឈ្មោល	*tanɔ	
46. Tail	កន្ទុយ	*ʔiku	Always preceded by [la:], which appears to be a reflex of *sula ‘leaf’
47. Beak	ចំពុះ	*tuɓuac	

48. Pigeon	ព្រាប	*katrɔw	
49. Wing	ស្លាប	*saya:p	CKC reflex is [chɛawˀ]. Displays infrequent strategy of reducing medial *ya: into [ɛa]. Onset reflex is irregular. Excluded from analysis.
50. Dog	ឆ្កែ	*ʔasɔw	
51. Chicken	មាន់	*manuʔ	
52. Fish	ត្រី	*ʔika:n	
53. Shrimp	បង្គា	*huda:ŋ	
54. Snail	ខ្យង	*ʔabaw	
55. Turtle	អណ្ដើក	*kura	Produced as first member of compound [kɣa: kəˈɗou̯h] ~ [kɣaˀ ɗ:uh].
56. Leech	ឈ្លើង	*lintah	
57. Crocodile	ក្រពើ	*buya	
58. House gecko	ជីងចក់	*cicaʔ	
59. Snake	ពស់	*ʔular	
60. Elephant	ដំរី	*lama:n	
61. Tiger	ខ្លា	**rimɔ:ŋ	
62. Pig	ជ្រូក	*babuy	
63. Horn	ស្នែង	**tuki	
64. Cow	គោ	*ləmɔ	
65. Buffalo	ក្របី	*kabaw	

66. Rat	កណ្ដុរ	*tikus	
67. Ant	ស្រមោច	*sidəm	
68. Honeybee	ឃ្មុំ	**huni	
69. Mosquito	មូស	*ñamuk	
70. Earthworm	ជន្លេន	*lanaŋ	
71. Louse	ចៃ	*kutɔw	
Body Parts			
72. Flesh	សាច់	*ralɔ	
73. Fat	ខ្លាញ់	*ləmaʔ	
74. Blood	ឈាម	*darah	
75. Skin	ស្បែក	*kulit	
76. Body hair	រោម	*bulɔw	
77. Bone	ឆ្អឹង	*tulaːŋ	
78. Breath	ដង្ហើម	*ñawa	
79. Eye	ភ្នែក	*mata	
80. Nose	ច្រមុះ	*ʔiduŋ	
81. Mouth	មាត់	**c/tuɓuay	
82. Tongue	អណ្ដាត	*dilah	
83. Tooth	ធ្មេញ	*gigɛy	
84. Neck	ក	*takuay	
85. Breast	ដោះ	*tasɔw	
86. Liver	ថ្លើម	*hatay	
87. Chest	ទ្រូង	*dada	

88. Abdomen	ក្បាលពោះ	*tiyaːn	CKC reflex is [tɛan]. Displays infrequent strategy of reducing medial *yaː into [ɛa]. Excluded from analysis.
89. Arm	ដៃ	*taŋaːn	While the most common reduction strategy was devoicing to [ŋ̊͡ŋɜn], there were two tokens from I4 where it appears voicing from the previous word spread through the onset's entirety. This produced a long velar nasal, divided into an initial portion of lower intensity, and a final portion with high intensity. These two tokens were excluded from analysis.
90. Armpit	ក្លៀក	*paʔaːk	Always preceded by what appears to be a reflex of *lubaːŋ 'hole', which is pronounced [pɛ̤a̤ŋ ~ pəŋ]
91. Nail	ក្រចក	*kukɔw	
92. Little finger	កូនដៃ	*cadɨaŋ	I2 and I3 used the phrase [ni̤ːʔ ŋ̊͡ŋɜn] (literally 'child of the arm/hand') instead
93. Heel	កែងជើង	**kaɗual	Only produced by I3 and I4, others used the Khmer borrowing [kaɛɲ]

94. Knee	ជង្គង់	*taʔut	Always preceded by [kɑʔ], literally ‘head’. This made measurement of the onset difficult when reduced (presumably to a geminated glottal stop).
Senses			
95. Think	គិត	*saniŋ	All informants produced [khɛa ~ kəˈhɛa] instead
Health			
96. Pain	ឈឺ	*padiʔ	
97. Itchy	រមាស់	*gatal	
98. Cough	ក្អក	*batuk	
99. Live	រស់	*hudip	
100. Die	ស្លាប់	*matay	
Actions			
101. Come	មក	*maray	CKC reflex is [mɛ̰a̰j] with irregular loss of *r. Included in analysis as a token with singleton word-initial nasal.
102. Go out	ចេញ	**təbiat	
103. Pinch	ក្តិច	*katit	
104. Squeeze	ច្របាច់	**cupa/et	
105. Lose	បាត់	*lahiãʔ	
106. Divide	ចែក	*ma/bapha	

107.	Play	លេង	*maʔin	
108.	Love	ស្រឡាញ់	*ranam	
Communication				
109.	Write	សរសេរ	*surat	
110.	Paper	ក្រដាស	*baʔar	
Transportation				
111.	Road	ផ្លូវ	*jalaːn	
112.	Walk	ដើរ	*labaːt	*l irregularly changed to /k/ across Western Cham, leading to the forms [kəˈpɛ̤a̤ʔ ~ pːɛ̤a̤ʔ] in CKC.
113.	Right side	ខាងស្តាំ	**hanuãʔ	
Handicrafts				
114.	Winnowing basket	ចង្អេរ	**caŋuar	
115.	Weave (cloth)	ត្បាញ	*mañam	
116.	Rope	ខ្សែពួរ	*talɛy	
117.	Wire	លួស	*kawat	
Food				
118.	Dry in sun	ហាល	**jaɓu	
119.	Mortar	ត្បាល់	*ləsuŋ	
120.	Pestle	អង្រែ	*halɔw	
121.	Cooked	ឆ្អិន	*tasaʔ	
122.	Cook (rice)	ដាំ	*tanaʔ	
123.	Fire	ភ្លើង	*ʔapuy	

124.	Smoke	ផ្សែង	*ʔasap	
125.	Cooked rice	បាយ	*lasɛy	
126.	Salt	អំបិល	*sira	
127.	Fish sauce	ទឹកត្រី	*masin	
128.	Sesame	ល្ង	*laŋa	
129.	Ginger	ខ្ញី	*liya	I1 used the Khmer borrowing [kʰɲɛj] instead
130.	Tumeric	រមៀត	*kuñit	
131.	Garlic	ខ្ទឹមស	*lasun	Reflex exists but does not mean ‘garlic’. I1 said it refers to shallots, I2 said scallion leaves.
132.	Chew	ទំពារ	*mamah	
133.	Hungry	ឃ្លាន	*lapa	
134.	Thirsty	ស្រេកទឹក	*mahãw	Not used by I2, who only uses the phrase [ləˈpaː məˈɲṳm] (literally ‘hungry to drink’) instead.
135.	Drink	ផឹក	*minum	
136.	Flat tasting	សាប	*tabaːr	
137.	Sour	ជូរ	*masam	
138.	Spoiled	ខូច	*maʔih	
139.	Areca nut	ផ្លែស្លា	*pinaːŋ	
140.	Wine	ស្រា	**ʔalak	Not relevant to this thesis, but the CKC reflex appears to have a glottalised nasal coda [la̤ŋˀ].

141. Drunk	ស្រវឹង	*mabuʔ	
Society			
142. Man	ប្រុស	*lakɛy	
143. Woman	ស្រី	*kumɛy	
144. Person	មនុស្ស	**manus	
145. Person	អ្នក/នាក់	*ʔuraːŋ	
146. Father	ឪពុក	*ʔama	
147. Older sibling	បង	*(sa)ʔay	
148. Younger sibling	ប្អូន	*ʔadɛy	
149. Child	កូន	*ʔanaːk	
150. Grandchild	ចៅ	*cucɔ	
151. Nephew/niece	ក្មួយ	**kəmuan	
152. Husband	ប្ដី	*pusaːŋ	
153. I	ខ្ញុំ	*hulun	
154. What	ស្អី	*hagɛt	
155. Name	ឈ្មោះ	*ʔaŋan	
156. Country	ប្រទេស	**nagar	
157. King	ស្ដេច	*pataw	
158. Fight	វាយគ្នា	*masuh	
159. Drum (large)	ស្គរធំ	*sagər	Reflex only refers to the large drums used in mosques. The smaller drums used at weddings are instead called [pəˈnɛ̤a̤], likely of the same etymology as

			Malay *rebana*.
160. Buy	ទិញ	*blɛy	Not reconstructed as disyllabic, but included as it forms a minimal pair with ‘sell’.
161. Sell	លក់	*pə-blɛy	
House			
162. Roof	ដំបូល	*babuŋ	Often produced as the first member in the compound [pṳŋ kḁwˀ]
163. Ladder	ជណ្តើរ	*rəña:n	*r irregularly changed to /k/ across Western Cham, leading to the forms [kəˈɲa:n ~ ɟ͡ɲa:n] in CKC.
164. Fence	របង	*paga:r	
165. Pillow	ខ្នើយ	*bantal	
166. Fan	ផ្លិត	*dadit	
167. Leg (of table)	ជើង	*kakay	All informants except I2 produced [lɛ̤:] instead
Numbers			
168. Five	ប្រាំ	*lima	
169. Seven	ប្រាំពីរ	*tujuh	
170. Hundred	(មួយ)រយ	*ratus	
171. Thousand	(មួយ)ពាន់	*ribɔw	
Descriptives			
172. Straight	ត្រង់	*tapat	

173. Sharp	មុត	*haluaʔ	The Khmer word I produced corresponds to two different ones in CKC - [luəʔ] meaning ‘sharp’ and [tə'mɜɨ̯ ~ m̥͡mmɜɨ̯] meaning ‘to be cut’. I was not aware of this, and so I1 and I2 produced the former, while I3 and I4 produced the latter.
174. Inside	ក្នុង	*dalam	Similarly to ‘arm’, two tokens from I4 have voicing spread through the onset’s entirety, but divided into an initial portion of lower intensity, and a final portion with high intensity. These two tokens were excluded from analysis.
175. Outside	ក្រៅ	**liŋiaw	
176. Far	ឆ្ងាយ	*ʔata:s	
177. Thin	ស្តើង	*lipih	
178. Thick	ក្រាស់	*kapa:l	
179. Narrow	ចង្អៀត	*ganiat	
Colours			
180. White	ស	*putih	
181. Green	បៃតង	*hijaw	

Appendix 2: Praat Script for Measuring Voiceless Sonorant Length

(with separate voiceless and voiced components)

```
form
  word Speaker
endform

writeInfoLine: "Speaker", tab$, "Word", tab$, "Onset", tab$, "closdur_vd (ms)", tab$, "closdur_vl (ms)"

sound = selected ("Sound")
textgrid = selected ("TextGrid")
selectObject: textgrid
num_intervals = Get number of intervals: 1 ; on the first tier
for interval from 1 to num_intervals
  selectObject: textgrid
  label$ = Get label of interval: 1, interval
  if label$ <> ""
    start = Get start time of interval: 1, interval
    end = Get end time of interval: 1, interval
    length = (end-start) * 1000
    if left$ (label$, 2) = "l̥" or left$ (label$, 2) = "m̥" or left$ (label$, 2) = "n̥" or left$ (label$, 2) = "ɲ̊"
    … or left$  (label$, 2) = "ŋ̊"
                        j = Get interval at time: 2, start-0.005
                  label2$ = Get label of interval: 2, j
                        if label2$ <> ""
                        start2 = Get start time of interval: 2, j
                        end2 = Get end time of interval: 2, j
                        length2 = (end2-start2) * 1000
                        else
                                length2 = 0
                        endif
                else
                        length2 = 0
                endif
          if left$ (label$, 2) = "l̥"
                onset$ = "l̥͡l"
              elsif left$ (label$, 2) = "m̥"
                onset$ = "m̥͡m"
              elsif left$ (label$, 2) = "n̥"
                onset$ = "n̥͡n"
              elsif left$ (label$, 2) = "ɲ̊"
                onset$ = "ɲ̊͡ɲ"
              elsif left$ (label$, 2) = "ŋ̊"
                onset$ = "ŋ̊͡ŋ"
              endif
    appendInfoLine: speaker$, tab$, label$, tab$, onset$, tab$, fixed$ (length, 2), tab$, fixed$ (length2, 2)
  endif
endfor
removeObject: textgrid
removeObject: sound
```

Appendix 3: Praat Script for Measuring Obstruent Length

```
form
  word Speaker
endform

writeInfoLine: "Speaker", tab$, "Word", tab$, "Length type", tab$, "Onset", tab$, "Closure (ms)"

sound = selected ("Sound")
textgrid = selected ("TextGrid")
selectObject: textgrid
num_intervals = Get number of intervals: 1 ; on the first tier
for interval from 1 to num_intervals
  selectObject: textgrid
  label$ = Get label of interval: 1, interval
  if label$ <> ""
    start = Get start time of interval: 1, interval
    end = Get end time of interval: 1, interval
    length = (end-start) * 1000
    if left$ (label$, 2) = "pː" or left$ (label$, 2) = "tː" or left$ (label$, 2) = "cː" or left$ (label$, 2) = "kː"
    … or left$ (label$, 2) = "ʔː" or left$ (label$, 2) = "ɓː" or left$ (label$, 2) = "ɗː" or left$ (label$, 2) = "sː"
            lengthtype$ = "geminate"
      if left$ (label$, 2) = "pː"
        onset$ = "pː"
      elsif left$ (label$, 2) = "tː"
        onset$ = "tː"
      elsif left$ (label$, 2) = "cː"
        onset$ = "cː"
      elsif left$ (label$, 2) = "kː"
        onset$ = "kː"
      elsif left$ (label$, 2) = "ʔː"
        onset$ = "ʔː"
      elsif left$ (label$, 2) = "ɓː"
        onset$ = "ɓː"
      elsif left$ (label$, 2) = "ɗː"
        onset$ = "ɗː"
      elsif left$ (label$, 2) = "sː"
        onset$ = "sː"
      endif
    else
      lengthtype$ = "single"
      if left$ (label$, 1) = "p"
        onset$ = "p"
      elsif left$ (label$, 1) = "t"
        onset$ = "t"
      elsif left$ (label$, 1) = "c"
        onset$ = "c"
      elsif left$ (label$, 1) = "k"
        onset$ = "k"
      elsif left$ (label$, 1) = "ʔ"
        onset$ = "ʔ"
      elsif left$ (label$, 1) = "ɓ"
        onset$ = "ɓ"
      elsif left$ (label$, 1) = "ɗ"
        onset$ = "ɗ"
```

```
        elsif left$ (label$, 1) = "s"
          onset$ = "s"
        endif
      endif
    appendInfoLine: speaker$, tab$, label$, tab$, lengthtype$, tab$, onset$, tab$, fixed$ (length, 2)
    endif
endfor
removeObject: textgrid
removeObject: sound
```

Appendix 4: Praat Script for Measuring Nasal Length

```
form
  word Speaker
endform

writeInfoLine: "Speaker", tab$, "Word", tab$, "Length type", tab$, "Onset", tab$, "Closure (ms)"

sound = selected ("Sound")
textgrid = selected ("TextGrid")
selectObject: textgrid
num_intervals = Get number of intervals: 1 ; on the first tier
for interval from 1 to num_intervals
  selectObject: textgrid
  label$ = Get label of interval: 1, interval
  if label$ <> ""
    start = Get start time of interval: 1, interval
    end = Get end time of interval: 1, interval
    length = (end-start) * 1000
    if left$ (label$, 2) = "mː" or left$ (label$, 2) = "nː" or left$ (label$, 2) = "ɲː" or left$ (label$, 2) = "ŋː"
          lengthtype$ = "geminate"
      if left$ (label$, 2) = "mː"
        onset$ = "mː"
      elsif left$ (label$, 2) = "nː"
        onset$ = "nː"
      elsif left$ (label$, 2) = "ɲː"
        onset$ = "ɲː"
      elsif left$ (label$, 2) = "ŋː"
        onset$ = "ŋː"
      endif
    else
      lengthtype$ = "single"
      if left$ (label$, 1) = "m"
        onset$ = "m"
      elsif left$ (label$, 1) = "n"
        onset$ = "n"
      elsif left$ (label$, 1) = "ɲ"
        onset$ = "ɲ"
      elsif left$ (label$, 1) = "ŋ"
        onset$ = "ŋ"
      endif
    endif
  appendInfoLine: speaker$, tab$, label$, tab$, lengthtype$, tab$, onset$, tab$, fixed$ (length, 2)
  endif
endfor
removeObject: textgrid
removeObject: sound
```

Appendix 5: Surface Phonological Inventory of Spoken CKC

Phonemes in red are marginally attested in the data, and those in brackets are not attested but expected based on the patterns discussed in this thesis.

		Labial	Alveolar	Palatal	Velar	Glottal
Plosive	Singleton	p	t	c	k	ʔ
	Geminate	pː	tː	cː	kː	ʔː
Implosive	Singleton	ɓ	ɗ	ʄ		
	Geminate	ɓː	ɗː	(ʄː)		
Fricative	Singleton		s		ɣ	h
	Geminate		sː			
	Glottalised				ɣˀ	
Nasal	Singleton	m	n	ɲ	ŋ	
	Geminate	mː	nː	ɲː	ŋː	
	Voiceless	m̥͡m	n̥͡n	ɲ̊͡ɲ	ŋ̊͡ŋ	
Approximant	Plain	w	l	j		
	Geminate		lː			
	Voiceless		l̥͡l			
	Glottalised	wˀ		jˀ		
	Aspirated			jʰ		