Stress, epenthesis, and syllables in Kanien'kéha

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Abstract

In this thesis, I examine the stress system and syllable structure of the Kanonhsionni'kéha (Northern Iroquoian) language Kanien'kéha, which have challenged both phonologists and learners alike. The main objectives can be divided into theoretical and pedagogical.

The theoretical puzzle posed by the Kanien'kéha stress system is that there are certain syllables (Ce̲, where e̲ is an epenthetic vowel that breaks up CC clusters involving a sonorant consonant) that are invisible to the metrical processes: stress placement, word-minimality-driven prothesis, and Tonic Lengthening (which results in H-L alternations). Challenging a potential analysis where syllables headed by epenthetic vowels are invisible to stress is that C[e] syllables, where [e] is an epenthetic vowel that breaks up underlying CCC clusters, are visible to metrical processes (Michelson, 1988).

The central focus of this thesis revolves around syllable structure and feet. Through an investigation of the syllable structure of Kanien'kéha, I find that Ce̲ syllables are one of a number of *nonmoraic syllables* which arise as a result of the constrained syllable structure in Kanien'kéha. Specifically, I propose that the maximal syllable in Kanien'kéha is CVX (X is the second half of a long vowel, or a laryngeal), and that nonmoraic syllables (of the shape Ce̲, C, Ch, Cs) are built in order to syllabify consonants that could not be organized into a CVX syllable. In the case of Ce̲ syllables, [e̲] is analyzed as a phonologized excrescent vowel. I show that there are three main benefits to this analysis. Firstly, the CVX syllable analysis accounts for the phonotactic patterns (i.e. the distribution of all consonants, for the profile of consonant clusters word-medially, as well as at word edges, and for the distribution of invisible epenthetic [e̲]). Second, this analysis correctly predicts that the nonmoraic syllables pattern together with respect to the metrical processes. Finally, the distribution and visibility of epenthetic [[e]] falls out of the nonmoraic syllable analysis; visible epenthetic [e] surfaces to militate against sequences of two nonmoraic syllables. I call this constraint the *Adjacency Condition* (in the spirit of Rowicka (1999)).

To incorporate nonmoraic syllables into a foot-based analysis of Kanien'kéha, I show that Kanien'kéha must be analyzed as building a novel type of trochee: a moraic syllable trochee. Moraic syllable trochees are left-headed feet that contain minimally and maximally two moraic syllables. This foot-type accounts for the stress patterns found in the language: stress canonically falls on the penultimate syllable, but nonmoraic syllables are skipped resulting in words ending in the shapes ˈHL, ˈL∅L, ˈHL∅, and ˈL∅L∅ (H = heavy, L = light, ∅ = nonmoraic). To account for the H-L alternations, and the relationships of these syllables to foot structure, I argue for a modified version of the *Head-Prominence* constraint in Mellander (2002), which states that the head of a foot must be heavier than the immediately following syllable.

The challenges posed to learners by Kanien'kéha stress and syllables are twofold. Firstly, the invisibility of syllables containing epenthetic <e> results in a stress system that is opaque to learners. This is problematic because, due to the 'polysynthetic' nature of Kanien'kéha, speakers must create new words on the fly all of the time and compute the position of stress for each of these words according to the stress rules of the language. To address this, I lay out the stress rules in Kanien'kéha, which are already subconsciously known by fluent speakers, using non-technical language. Secondly, the pronunciation of the pitch associated with stressed syllables in Kanien'kéha is often challenging for learners. This is because there are three types of stressed syllable in Kanien'kéha, each associated with a distinct pitch contour (and two of which form minimal pairs). In addressing this challenge, I present graphics displaying the differences between the three types of stressed syllables and accompany each of these graphics with plain-language descriptions. Additionally, I provide a guide to the computer program Praat (Boersma and Weenink, 2024), and how learners can use it to identify their errors and improve their pronunciation of the stressed syllables in Kanien'kéha.

Résumé

Dans cette thèse, j'étudie le système d'accentuation et la structure syllabique du kanien'kéha, une langue kanonhsionni'kéha (iroquoienne du Nord) qui a posé des défis tant aux phonologistes qu'aux apprenants. Les principaux objectifs peuvent être classés en deux catégories : théoriques et pédagogiques.

Le casse-tête théorique posé par le système d'accentuation du kanien'kéha tient au fait que certaines syllabes (Ce̲, où e̲ est une voyelle épenthétique qui sépare les groupes CC comportant une consonne sonore) sont invisibles aux processus métriques: emplacement de l'accent, prothèse dictée par la minimalité des mots et allongement tonique (qui entraîne des alternances H-L). Contestant une analyse potentielle selon laquelle les syllabes précédées de voyelles épenthétiques seraient invisibles pour l'accentuation, les syllabes C[e], où [e] est une voyelle épenthétique qui rompt les groupes CCC sous-jacents, sont visibles aux processus métriques (Michelson, 1988).

Cette thèse porte principalement sur la structure syllabique et les pieds. À travers une étude de la structure syllabique du kanien'kéha, je constate que les syllabes Ce̲ font partie d'un ensemble de *syllabes non moréiques* qui résultent des contraintes de la structure syllabique du kanien'kéha. Plus précisément, je propose que la syllabe maximale en kanien'kéha soit CVX (X étant la seconde moitié d'une voyelle longue ou une laryngale), et que les syllabes non moréiques (de forme Ce̲, C, Ch, Cs) soient construites afin de syllabifier les consonnes qui ne pouvaient pas être organisées en une syllabe CVX. Dans le cas des syllabes Ce̲, [e̲] est analysé comme une voyelle excrescente phonologisée. Je montre que cette analyse présente trois avantages principaux. Premièrement, l'analyse syllabique CVX rend compte des schémas phonotactiques (c'est-à-dire la distribution de toutes les consonnes, le profil des groupes de consonnes en milieu de mot ainsi qu'aux limites des mots, et la distribution de l'épentèse invisible [e̲]). Deuxièmement, cette analyse prédit correctement que les syllabes non moréiques s'organisent selon des schémas communs en ce qui concerne les processus métriques. Enfin, la distribution et la visibilité du [e] épenthétique découlent de l'analyse des syllabes non moréiques ; le [e] épenthétique visible apparaît pour s'opposer aux séquences de deux syllabes non moréiques. J'appelle cette contrainte la *condition d'adjacence* (dans l'esprit de Rowicka (1999)).

Afin d'intégrer les syllabes non moréiques dans une analyse du kanien'kéha fondée sur les pieds, je démontre que cette langue doit être analysée comme formant un nouveau type de trochée : le trochée à syllabes moréiques. Les trochées à syllabes moréiques sont des pieds à tête gauche qui contiennent au minimum et au maximum deux syllabes moréiques. Ce type de pied permet d'expliquer les schémas d'accentuation observés dans la langue : l'accent tombe canoniquement sur l'avant-dernière syllabe, mais

les syllabes non moréiques sont ignorées, ce qui donne des mots terminant par les formes ˈHL, ˈL∅L, ˈHL∅, et ˈL∅L∅ (H = lourde, L = légère, ∅ = non moréique). Pour rendre compte des alternances H-L et des relations entre ces syllabes et la structure des pieds, je propose une version modifiée de la contrainte de *Head-Prominence* de Mellander (2002), qui stipule que la tête d'un pied doit être plus lourde que la syllabe qui la suit immédiatement.

Les difficultés que posent l'accentuation et les syllabes du kanien'kéha aux apprenants sont doubles. D'une part, l'invisibilité des syllabes contenant un <e> épenthétique rend le système d'accentuation opaque pour les apprenants. Cela pose problème car, en raison de la nature 'polysynthétique' du kanien'kéha, les locuteurs doivent constamment créer de nouveaux mots à la volée et déterminer la position de l'accent tonique pour chacun de ces mots selon les règles d'accentuation de la langue. Pour y remédier, j'expose les règles d'accentuation du kanien'kéha, que les locuteurs fluides connaissent déjà inconsciemment, en utilisant un langage non technique. Deuxièmement, la prononciation de la hauteur tonale associée aux syllabes accentuées en kanien'kéha pose souvent des difficultés aux apprenants. Cela s'explique par le fait qu'il existe trois types de syllabes accentuées en kanien'kéha, chacune étant associée à un contour tonal distinct (et dont deux forment des paires minimales). Pour relever ce défi, je présente des graphiques illustrant les différences entre les trois types de syllabes accentuées, et j'accompagne chacun de ces graphiques de descriptions en langage accessible. De plus, je fournis un guide sur le logiciel Praat (Boersma and Weenink, 2024) et sur la manière dont les apprenants peuvent l'utiliser pour identifier leurs erreurs et améliorer leur prononciation des syllabes accentuées en kanien'kéha.

Non-technical summary of the theoretical component

In the theoretical component of this thesis, I discuss epenthetic <e̲>, which is inserted between almost any consonant-consonant sequence involving a sonorant consonant (<n>, <r>, or <w>) (e.g. *ke̲nòn:we's* 'I like it'). Notably, epenthetic <e̲> is *invisible* to stress; stress normally falls on the second-to-last syllable of a word (e.g. *kaná:ta'* 'town'), but when the second-to-last syllable includes epenthetic <e̲>, stress falls on the third-to-last syllable instead (e.g. *énke̲ren'* 'I will put it in'). To address this, I show that epenthetic <e̲> in Kanien'kéha occurs in the exact same phonological context (i.e. adjacent to a sonorant consonant) as mini vowel fragments do in many other languages (e.g. Nuxalk (Newman, 1947)). In these other languages, consonant sequences involving sonorant consonants (e.g. kr) are pronounced with a small vowel fragment between the consonants (e.g. k^{ə}r). These vowel fragments are, essentially, a piece of the adjacent sonorant consonant. Crucially, these vowel fragments are never stressed. I argue that invisible epenthetic <e̲> in Kanien'kéha was historically one of these small vowel fragments that comes from the adjacent sonorant, and that over time they turned into 'full vowels' while retaining their invisibility to stress. Further, I argue that even though these vowel fragments have become 'full vowels', they maintain their connection to the adjacent sonorant consonant. In this way, invisible epenthetic <e̲>s are 'consonantal'. I also argue that there are many other consonantal syllables in Kanien'kéha and that these syllables are also invisible to stress. Specifically, I argue that if a consonant (or a consonant sequence) cannot fit into a V, CV, CVʔ or CVh syllable (C = consonant, V = vowel), then it must be part of a purely consonantal syllable. These consonantal syllables can take the form C (where C is any consonant — e.g. *ka-ná-**k**-ta'* 'bed'), Cs (e.g. *ió-**ks**-te'* 'it is heavy'), or Ch (e.g. *ká-**kh**-wa'* 'food'). Finally, I argue that there cannot be two adjacent consonantal syllables (e.g. CV-**C-C**-CV, CV-**C-Cs**-CV, CV-**Ce̲-Ce̲**-CV), and that in order to prevent this from happening, a different epenthetic <e͢> is inserted. This <e͢>, unlike the other epenthetic <e̲>, is *visible* to stress. That is, it can be stressed (e.g. *tek**é**khas*).

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Contribution of Author

This thesis is the original work of the author.

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Chapter 1 Introduction

1.1 Puzzles

This thesis aims to discuss the many aspects of the stress and syllable systems in Kanien'kéha. Specifically, I will discuss some of the puzzles these systems present for theoretical phonology as well as the challenges posed to Kanien'kéha learners.

Upon first glance, the Kanien'kéha stress system and syllable structure seem quite straightforward. However, as soon as we start looking closer, this does not seem to be the case. For example, stress (marked with a grave accent or acute accent) generally counts syllables from the right edge of the word, falling on the second-to-last (penultimate) syllable. The acute accent represents a high tone while the grave accent represents a falling tone (the derivation of which will be described shortly). See the examples in (1).

(1) Penultimate stress

a.	/ka-nel-ũ/	→	[gané:lũ]	*kané:ron*	'she (animal) is pregnant'
b.	/ak-kahl-aʔ/	→	[ak^{h}gà:laʔ]	*akkà:ra'*	'my glasses'
c.	/io-wil-aʔ/	→	[owí:laʔ]	*owí:ra'*	'baby animal' [1]

However, there are certain syllables that seem to be skipped by the stress placement system, resulting in stress falling on the antepenult or pre-antepenult. These syllables are headed by [e̲], which is underlined for illustrative purposes in this thesis. The syllables with [e̲] are bolded in (2). The asterisk * indicates the relevant form is incorrect.

(2) Stress skips Ce̲

a.	/ɤ̃-k-l-ɤ̃ʔ/	→	[ɤ́**ge̲**lɤ̃ʔ]	*[ɤ̃**gé̲**lɤ̃ʔ]		*énkeren'*	'I will put it in'
b.	/io-nraht-ʔ/	→	[ó**ne̲**lah**de̲**ʔ]	*[o**ne̲**láh**de̲**ʔ]	*[o**né̲**lah**de̲**ʔ]	*ónerahte'*	'leaf'

Stress is on the antepenultimate or pre-antepenultimate syllables because it does not count the syllables with Ce̲ (C = consonant) in the forms in (2). For example, in (2a), the stress placement process counts the final syllable [lɤ̃ʔ], skips the penultimate syllable [ge̲], and lands on the antepenult [ɤ̃]. Note that it is not the case that the vowel [e] can never be stressed, as can be seen in the example in (1a).

It has been argued that the [e̲] heading the invisible syllables is epenthetic (Michelson, 1983, 1988, 1989). We can see evidence for this with the first person subjective pronominal prefix, which surfaces as [k-] when preceding obstruents but as [ke̲-] when preceding sonorant consonants. This is shown in (3).

[1] The prefix /io-/ appears in front of many nouns. When the noun is pronounced in isolation, the /i/ is deleted.

(3) Invisible [e̲] is epenthetic

a.	/**k**-kawe-s/	→	[k^{h}gá:wes:]	*kká:wes*	‘I paddle’ [2]
b.	/**k**-lũko-as/	→	[ge̲lṹgwas:]	*kerónkwas*	‘I scrape it’

In (3b), epenthetic [e̲] is inserted to break up the illicit */kl/ sequence, whereas it is not inserted to break up the licit /kk/ sequence. If the [e̲] were underlying (i.e. part of the prefix), then we would expect it to be present in (3a), as there is no reason for it to delete there; [gek] is a licit sequence in the language, and before epenthesis the prefix /k-/ is in the same position with respect to stress in both words in (3).

One possible reason for why Ce̲ syllables are invisible to stress placement is that syllables headed by epenthetic vowels cannot be stressed (as proposed by Alderete (1995)). However, there is another epenthetic [e], which I represent as boxed ([e]), that is in fact visible to stress.[3] The following examples show the concatenation of prefixes to the verb root /-njak-/ ‘to get married’.

(4) Visible epenthetic [e]

a.	/wa**k-nj**ak-s/	→	[wag[é]njaks]	*wakéniaks*	‘I get married’
b.	/waʔ-lo-**nj**ak-ʔ/	→	[wahónjake̲ʔ]	*wahóniake’*	‘he got married’ [4]

In (4a) we can see that epenthetic [e] is inserted between the prefix /wak-/ and the verb root /-njak-/ to militate against the illicit *[knj] sequence, whereas there is no [e] in (4b). Further, the epenthetic [e] is stressed in (4a). This means that the invisible epenthetic [e̲] cannot be invisible purely due to its epenthetic nature, as we would expect that the epenthetic [e] in (4a) would also be invisible. There must be another reason for the invisibility of Ce̲ syllables.

The only difference between invisible epenthetic [e̲] and visible epenthetic [e] has to do with the environments these occur in. The invisible epenthetic [e̲] breaks up CC clusters that include a sonorant consonant (OR, RO, or RR — O = obstruent, R = sonorant).[5] Some examples are shown in (5).

[2] Stops are aspirated when immediately preceding other stops. See section 2.2.1 for more details.

[3] Alderete (1995) accounts for the visibility of epenthetic [e]. However, his analysis faces other challanges. See Chapter 4 for more details.

[4] The liquid surfaces as [h] when outside of the stem, and non-word-initial. The other rule at play here makes /ʔh/ sequences surface as just [h].

[5] Cʔ sequences are also broken up by invisible [e̲]. This will be discussed in section 3.6.

(5) [e̲] and clusters with sonorant consonants

a.	/te-**k-l**ik-s/	→	[dége̲liks:]	*tékeriks*	'I put two things together'
b.	/ie-k-iaʔt-i**nk**ʌ̃h-s/	→	[jegjaʔdíne̲gʌ̃hs:]	*ietia'tínekenhs*	'I let it out (an animal)' [6]
c.	/io-**wl**-aʔ/	→	[ówe̲laʔ]	*ówe̲ra'*	'wind'

The distribution of invisible epenthetic [e̲], however, presents a new set of questions pertaining to syllable structure. Two of these questions are: (1) does Kanien'kéha have complex onsets? and (2) what constitutes a coda in Kanien'kéha? Since any CC cluster containing a sonorant consonant is broken up with the invisible epenthetic [e̲], rising sonority OR, as well as falling sonority RO clusters are dispreferred in Kanien'kéha (not to mention flat sonority RR clusters). Given that OR clusters are the most common complex onsets cross-linguistically, and RO clusters are the most common coda–onset sequences cross-linguistically, a potential conclusion one could draw from the invisible epenthetic [e̲] patterns is that Kanien'kéha does not have complex onsets nor coda-onset clusters. This analysis, however, is challenged by the OO clusters in the language, which often surface intact intervocalically.

(6) OO clusters

a.	/iah te-**s-k**-atawʌ̃-s/	→	[jah des:gadá:wʌ̃s:]	*iah teskatá:wens*	'I don't swim anymore'
b.	/waʔ-**k-k**o-ʔ/	→	[wà:k^{h}goʔ]	*wà:kko'*	'I picked it'

Although most of the literature assumes that these OO clusters are coda-onset clusters, they do not pattern like coda-onset clusters cross-linguistically. While most languages that have OO coda-onset clusters place restrictions on the exact profile of these clusters, there do not seem to be any such restrictions on OO clusters in Kanien'kéha. For example, in English OO coda-onset clusters, there are sequencing constraints; e.g. [kt] is a licit coda-onset sequence such as in *actor* but [tk] is not as there is no word like **atcor*. In contrast, there are no sequencing constraints in OO clusters in Kanien'kéha. This is shown in (7), in which /kt/ and /tk/ are perfectly licit.

[6] RO clusters do not occur across morpheme boundaries. However, there are instances of morpheme-internal epenthesis, some of which break up RO clusters. We can tell that the morpheme-internal cases are still the invisible epenthetic [e̲] for three reasons. Firstly, it patterns with the other invisible epenthetic [e̲]s with respect to its interactions with the metrical processes (such as its invisibility to stress). Secondly, the invisible vowel always takes the form [e̲]. Thirdly, it always occurs adjacent to a sonorant consonant. See section 3.4 for more details.

(7) No sequencing constraints in OO clusters

a.	/a-**k-t**ahko-ʔ/	→	[ak^{h}dáhgoʔ]	*aktáhko'*	'I ought to take it out'
b.	/ɤ̃-s-k-a**tk**ahtho-ʔ/	→	[ɤ̃s:gat^{h}gáhthoʔ]	*enskatkáhtho'*	'I will see it again'

Sequencing constraints are also common in complex onsets cross-linguistically, challenging a potential complex onset analysis of OO clusters in Kanien'kéha.

The only CC clusters in Kanien'kéha that seem to behave like coda-onset sequences do cross-linguistically are GC sequences (G = glottal/laryngeal — /h/ and /ʔ/). For example, while OO clusters can occur word-initially further undermining the coda-onset analysis (8a), GC clusters cannot.

(8) Word-initial CC clusters

a. Word-initial OO

/**t-k**a-ʔwaʔl-a/	→	[t^{h}gaʔwà:la]	*tka'wà:ra*	'meat pie'

b. *#hC

/**hs**-nũhweʔ-s/	→	[ze̲nṹ:weʔs:]	*senòn:we's*	'you like it'

c. *#ʔC[7]

GC sequences, however, contribute their own complications. For example, when GC sequences are underlyingly preceded by a stressed vowel, the stressed vowel lengthens and takes on a falling tone (indicated the grave accent), and the laryngeal deletes.[8] The falling tone contrasts with the default high tone associated to the stressed syllable in Kanien'kéha (indicated with the acute accent).

(9) GC sequences and stress

a.	/io-ka**hl**-aʔ/	→	[ogà:laʔ]	*okà:ra'*	'eye'
b.	/ka-ʔ**s**le/	→	[gà:ze̲le]	*kà:sere*	'car'

The distribution of visible epenthetic [e̲] provides more puzzles relevant to the syllable structure of the language. It is inserted to break up underlying sequences of three consonants (CCC→Ce̲CC).

[7] In contrast to /hC sequences, /ʔC/ clusters are unable to be underlyingly word-initial due to morphological restrictions. Specifically, there are no morphemes that have ʔC at the left edge and can also be word-initial, nor are there morphemes made up of solely a /ʔ/ that can be word-initial.

[8] This is not the case for hO sequences. See section 3.6 for more details.

(10) CCC examples

a.	/te-**k-kh**a-s/	→	[deg[é]khas:]	*tekékhas*	'I attach two things together'
b.	/wa**k-ks**-a-waʔk-ũ/	→	[wag[ɛ]ks:awà:gũ]	*wakeksawà:kon*	'I'm holding the dish'

The majority of the literature argues that visible [ɛ] is inserted to break up what would be complex onsets and complex codas (e.g. Hagstrom, 1997; Rawlins, 2006; Elfner, 2016). However, this analysis incorrectly predicts that OO clusters should not occur at the left edge, which, as shown in (8a), is not the case. Further, it incorrectly suggests that there should not be consonant clusters at the right edges of words (see (5a)). In fact, based purely on the profile of strings at the edges of words, the CCC sequences in the underlying representations in (10) should be licit. This is because OO clusters are permitted at the left edges of words, suggesting that OO complex onsets are licit, and O singletons are permitted at the right edges of words, suggesting that obstruents are licit codas. If this were the case, then the CCC sequence in (10b) could be syllabified as [Vk.ksV] (V = vowel), and there would be no need for epenthesis.

The puzzles described thus far don't only present challenges for theoretical phonology but for language learners as well. This is for two reasons. Firstly, due to the 'polysynthetic' nature of Kanien'kéha (Michelson, 2016), what would be sentences in English are often said as single words in Kanien'kéha. This means that Kanien'kéha speakers (and learners especially) are producing words they've never heard before all of the time (just like English speakers are uttering sentences they've never heard before).[9] Consequently, learners cannot simply memorize what the stress placement is for each word they produce, but must actively compute it for each new word. The stress-epenthesis interactions, then significantly complicate this computation process as learners must be aware of which vowels are epenthetic and how the stress system interacts with them. Secondly, as described briefly above, stressed syllables in Kanien'kéha are always associated with tone. This tone is either high or falling (Michelson, 1988; Renard, 2023*b*). These tonal profiles can even form minimal pairs (e.g. [ogá:laʔ] *oká:ra'* 'story' vs [ogà:laʔ] *okà:ra'* 'eye'). This poses a potential challenge to many Kanien'kéha learners, as most learners only speak English (an toneless language) and thus are not accustomed to paying attention to pitch in the way that Kanien'kéha requires.

The goal of this thesis is to address the puzzles discussed thus far, with three chapters (2, 3, and 4) focusing on the puzzles for theoretical phonology and one chapter (5) focusing on the pedagogical puzzles. In the rest of this section, I will provide an overview of this thesis. I will start by summarizing the theoretical components, then will turn to the pedagogical components.

[9] See Crippen (2019) for a discussion of the pattern space in 'polysynthetic' languages, and the number of possible words and combinations. The numbers he presents show clearly the impossibility of simply memorizing each word.

1.1.1 Summary of the theoretical component

As described above, the main theoretical puzzle analyzed in this thesis centers around the relationship between syllable structure and stress. More accurately, however, it is about the interactions between the metrical processes (stress placement, word-minimality effects, Tonic Lengthening) and syllable structure. The specific patterns under focus in this thesis will be sketched out in more detail in Chapter 3. As an entry to the patterns and analysis in this section, I will start with the relationship between one metrical process — stress placement — and three types of syllables: syllables containing an underlying vowel, syllables containing the invisible epenthetic [e̲], and syllables containing the visible epenthetic [e̅].

Recall that syllables with underlying vowels, Ce̲ syllables, and Ce̅ syllables behave differently in reference to stress placement. While stress placement counts syllables with underlying vowels and Ce̅ syllables (where [e̅] breaks up underlying CCC sequences), it does not count Ce̲ syllables (where [e̲] breaks up underlying CC clusters involving a sonorant consonant). This is shown in (11), which repeats forms from the previous section where the penult either includes an underlying vowel, the invisible epenthetic [e̲], or visible epenthetic [e̅].

(11) Stress and syllables

a. Underlying vowel

/ka-nat-aʔ/	→	[ga**ná:**daʔ]	*kaná:ta'*	'town'

b. Invisible [e̲]

/ɤ̃-k-l-ɤ̃ʔ/	→	[ɤ́**ge̲**lɤ̃ʔ]	*énkeren'*	'I will put it in'

c. Visible [e̅]

/te-k-kha-s/	→	[de**g**e̅́khas:]	*tekékhas*	'I attach two things together'

Stress falls on the penult in (11a) and (11c), as it counts all syllables with underlying vowels or the epenthetic [e̅]. On the other hand, stress falls on the antepenult in (11b) because the penultimate syllable [ge̲] contains epenthetic [e̲] and is thus invisible to stress placement.

The variable visibility of epenthetic [e] to stress placement (as well as unique interactions with the other metrical processes) has prompted a considerable amount of phonological research with proposals putting the burden of explanation on the representation of the invisible epenthetic [e̲] (Michelson, 1988, 1989; Piggott, 1995, 1998; Rowicka, 1998, 1999, 2001; Mellander, 2002, 2003; Garvin et al., 2019; Vancaeyzeele, 2022), on the timing of the insertion of epenthetic [e̲] (Postal, 1968; Elfner, 2016; Lamont, 2024), and on the absence of epenthetic [e̲] in the underlying representation (Alderete, 1995; Ikawa, 1995; Hagstrom, 1997; Rawlins, 2006; Houghton, 2013; Adler, 2016; Adler and Zymet, 2021). Despite the wide variety of

approaches to accounting for variably visible epenthetic [e], lacking in the previous literature is a comprehensive theoretical examination of syllable structure. Since syllable structure is necessarily implicated in analyses of stress (which targets syllables or subsyllabic units (Hayes, 1995; Hyde, 2025)) and epenthesis (which most often occurs to repair ill-formed syllable structure (Itô, 1989; Hall, 2011)), my analysis of the previously described patterns will start in Chapter 3 with an investigation into the syllable structure in Kanien'kéha.

I will argue within a Moraic Theory (Hayes, 1989) analysis that, in addition to CV, CVV, and CVC moraic syllables, Kanien'kéha builds a host of nonmoraic syllables. These nonmoraic syllables will take the form C[e] (where, as mentioned above [e] is the invisible epenthetic vowel), Cs, Ch, or C. The invisible epenthetic [e], more specifically, will be analyzed as phonologized excrescence, thus providing some reason why it could be nonmoraic. Some examples of strings that involve both moraic and nonmoraic syllables are shown in (12).

(12) Moraic and nonmoraic syllables

a. C[e]



b. Cs [10]



c. C



This analysis will account for a number of things. Firstly, it will account for the phonotactics of consonant clusters, which no other sources have attempted to do (barring Rowicka (1999)).[11] Secondly, it will account for the behaviour of C[e] syllables: since they are nonmoraic unlike other CV sequences which are moraic, they will naturally behave differently with respect to metrical processes. I will also show that this analysis correctly predicts that other nonmoraic syllables (Cs, Ch, C) pattern with C[e] syllables. Lastly, this

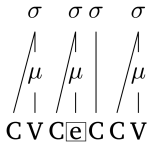
[10] Ch syllables will be represented in the same way as Cs syllables are in (12b). C? sequences pattern with OR sequences.

[11] Some sources attempt to account for phonotactics on a micro scale. For example, some argue that OR sequences are broken up because rising sonority coda-onset clusters are prohibited. These sources, however, ignore the fact that RO clusters are also broken up. See Chapter 3 for more details.

analysis will provide a clear reason for the visible epenthetic [e͟] and its weighted nature; wherever visible epenthesis occurs, I will show that it is preventing a sequence of two adjacent nonmoraic syllables (of any shape). That is, when the morphology creates sequences that would otherwise be syllabified with adjacent nonmoraic syllables, *moraic* (visible) epenthesis occurs. I will call the constraint motivating moraic epenthesis the *Adjacency Condition*, defined in Chapter 3. An example of the Adjacency Condition in action is shown in (13), in which the first two Consonants in the CCC sequence cannot be syllabified into the following onset nor the preceding coda (constraints for which will be provided in Chapter 3).

(13) Moraic epenthesis

a. Moraic epenthesis



b. Moraic epenthesis fails to apply, violation of the Adjacency Condition



In the trees in (13), we can see the role of moraic epenthesis. Without moraic epenthesis (in (13b)), there are two nonmoraic syllables in a row, violating the Adjacency Condition. With moraic epenthesis in (13a), there is no violation. This will account for all instances of visible epenthetic [e͟], as well as the constraints on number of consecutive consonants, and profile of clusters at the edges of words.

This analysis of syllable structure and the variably visible epenthetic [e] in Kanien'kéha that I will put forward is a significant departure from the previous literature, which assumes that the only piece of Kanien'kéha syllable structure that is distinct from the world's languages is the invisible epenthetic [e̲]. On the contrary, I will analyze both epenthetic [e]s as a microcosm of the broader nonmoraic-syllable ridden landscape of Kanien'kéha.

While an analysis of the syllabification in Kanien'kéha as including nonmoraic syllables will provide some ideas as to why these syllables are invisible to metrical processes, it will not provide the full solution. For instance, if nonmoraic syllables are invisible to foot formation, and therefore stress placement, are nonmoraic syllables still footed? And if so, what position in the foot do they occupy? In Chapter 4, I will show that in order to account for the stress placement system of Kanien'kéha, it is necessary to propose a new type of foot. Specifically, I will argue that Kanien'kéha builds *moraic-syllable trochees*, left headed feet that contain minimally and maximally two moraic syllables (i.e. syllables that dominate at least one mora). These feet respect the binarity constraint defined in (14).

(14) Ft-Bin-σ_{μ}: A foot contains two weighted syllables. A weighted syllable is a syllable that dominates at least one mora.

Since only weighted syllables are counted by the binarity constraint in (14), this constraint will allow for the weighted syllables to contribute to foot well-formedness, but will ensure that the nonmoraic syllables do not. In other words, just like the number of moras do not affect the well-formedness of a syllabic trochee, the number of nonmoraic syllables will not improve or degrade the well-formedness of a moraic-syllable trochee. This type of foot will straightforwardly account for the stress patterns in Kanien'kéha by capturing the intuition in Michelson (1988) that stress falls on the penultimate visible (or, as per my analysis, moraic) syllable. We can see how the binarity constraint in (14) combined with an alignment constraint ensuring that the right edge of the foot is aligned with the right edge of the word will account for the stress patterns in Kanien'kéha in (15), in which footings of various word shapes are shown.[12]

(15) Footing

a. No nonmoraic syllables

/ka-nat-aʔ/	→	[ga(ná:daʔ)]	*kaná:ta'*	'town'

b. Nonmoraic ultima

/io-kwil-ʔ/	→	[(ó:gwile̲ʔ)]	*ó:kwire'*	'sapling', 'tree'

c. Nonmoraic penult

/ʌ̃-k-l-ʌ̃ʔ/	→	[(ʌ́ge̲lʌ̃ʔ)]	*énkeren'*	'I will put it in'

d. Nonmoraic ultima and antepenult

/io-nlaht-ʔ/	→	[(óne̲lahde̲ʔ)]	*ónerahte'*	'leaf'

Since the foot will always be aligned with the right edge of the word, and the binarity constraint will not count nonmoraic syllables, the result is a bisyllabic foot in (15a), a trisyllabic foot in (15b) and (15c), and a tetrasyllabic foot in (15d). These will all be licit moraic-syllable trochees because they all contain minimally and maximally two weighted syllables, thus satisfying the above binarity constraint. For example, the form in (15d) contains two weighted syllables ([o] and [lah]) and two nonmoraic syllables ([ne̲] and [de̲ʔ]). The total number of syllables will not factor into the evaluation of the foot, just like the total number of syllables does not matter when evaluating whether a foot violates Ft-Bin-μ.

Just like moraic trochees are constrained in the number of syllables they contain by binarity-external constraints, so are syllables and moras in moraic-syllable trochees. The number of moras in moraic-syllable

[12] Another crucial assumption in these footings is that discontinuous feet are not permitted. I will discuss this assumption in Chapter 4.

trochees will be limited to four by constraints on the number of moras in a syllable. The number of syllables in a foot will also be limited to four by the Adjacency Condition (described above). I will discuss the implications for allowing such large feet in Chapter 4.

This moraic-syllable trochee analysis, coupled with the above described syllable analysis, will account for the puzzles that the Kanien'kéha stress patterns present to theoretical phonology. The following section will summarize the pedagogical component of the thesis and how the topics of stress and epenthesis are dealt with therein.

1.1.2 Summary of the pedagogical component

After proposing theoretical analyses to account for the relationship between stress and various types of syllables, I will discuss and address some potential challenges that the stress system poses for Kanien'kéha learners, who are largely adult L1 English speakers, in Chapter 5. These challenges will include the relationship between stress and the epenthetic vowel <e>,[13] and the relationship between stress and pitch, which many Kanien'kéha learners and teachers have expressed to me as an explicit challenge they face. I will discuss these briefly, in turn, here.

As described at the outset of this thesis, stress in Kanien'kéha counts syllables from the end of the word, falling on the second-to-last syllable (e.g. (16)). However, there are certain syllables with epenthetic <e̲> that are skipped by the stress placement process, resulting in stress falling on the third-to-last (e.g. (17)) or even fourth-to-last syllable (e.g. (18)).

(16) *kaná:ta'* 'town'

(17) *énke̲ren'* 'I will put it in'

(18) *óne̲rahte̲'* 'leaf'

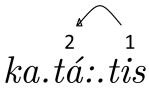
Althought learners could memorize where stress falls in many words, this is not always feasible. This is because, in order to speak Kanien'kéha, it is necessary to construct new words frequently. In this way, one must also be able to compute the stress placement process for each new word, in the way that first language speakers subconsciously do all of the time. The first section of Chapter 5 will guide the reader through this computation process, and how the ostensibly complex stress placement system can be encapsulated in a small number of regular phonological rules.

I will do so by showing that stress placement can be understood as a consistent process that counts syllables from the end of the word, finding the second-to-last syllable. I will also show how this basic

[13] Recall from Chapter 2 that <> is used to mark when the writing system is used.

stress placement process interacts with epenthetic <e>. Specifically, I will show that there are two types of epenthetic <e>, one of which is counted by the stress placement system like any other vowel (represented as boxed <e>), and one of which is skipped (represented as underlined <e>). This is shown in the following graphics, in which the stress placement system counts from the end of the word to find the second-to-last syllable and stress it, skipping syllables with epenthetic [e]. A period '.' is used to mark the boundaries between syllables.

(19) No epenthetic vowel

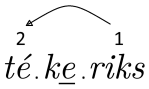


(20) Epenthetic [e]

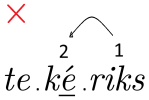


(21) Skipping epenthetic [e]

a.



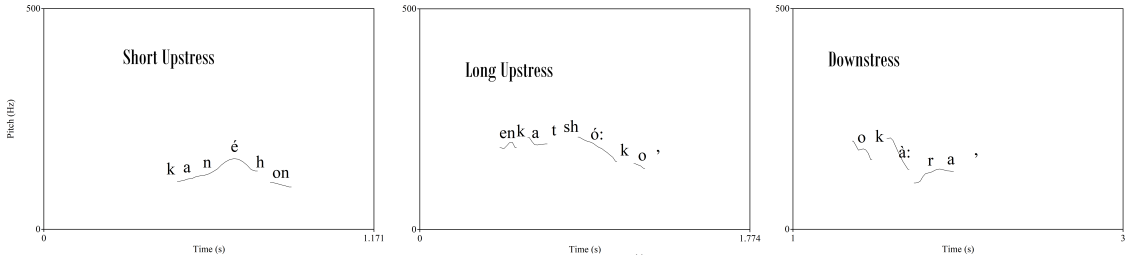
b.



While the stress placement system counts each syllable in (19) and (20), placing stress on the second-to-last syllable, the syllable with epenthetic [e] is skipped in (21a) resulting in stress falling on the third-to-last syllable. If the syllable with epenthetic [e] were not skipped, it would result in the incorrect stress placement in (21b).

While the first section of Chapter (5) will provide information on stress placement in Kanien'kéha, the second section will provide information on the relationship between stress and pitch in the language. Specifically, I will describe the differences between the various types of stressed syllables in Kanien'kéha (briefly mentioned above). I will provide graphics like those in (22) to highlight the differences between stressed syllables —Short Upstress, Long Upstress, Downstress — in individual words. In the following graphics, time (measured in seconds) is on the X axis, while pitch (measured in Hertz) is on the Y axis.

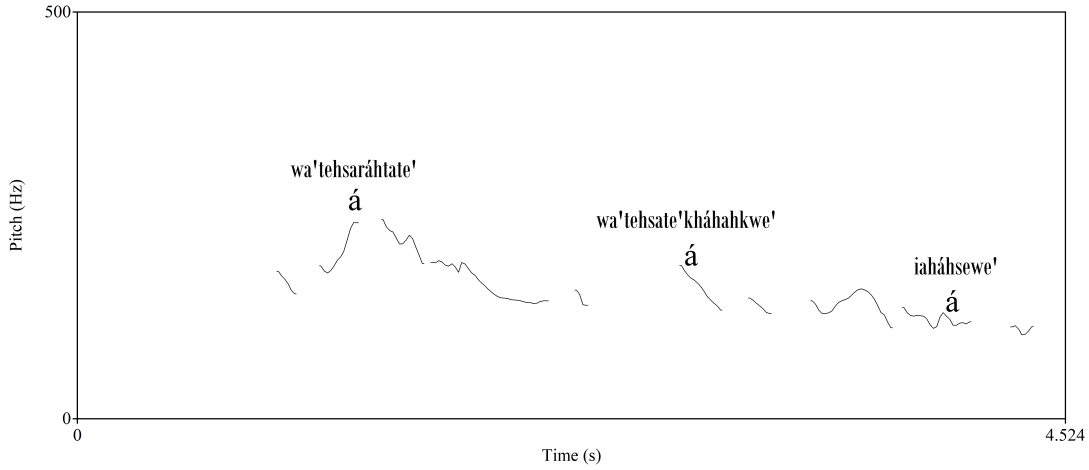
(22) *kanéhon* ‘skin’, ‘hide’ *enkatshó:ko’* ‘I will smoke’ *okà:ra’* ‘eye’



Then, I will discuss how these within-word pitch patterns operate in multi-word contexts, such as whole utterances (i.e. intonation). I will provide and describe graphics for pitch patterns in full utterances as well, such as the question in (23) in which there are three verbs with Short Upstress.[14] The exact locations of the Short Upstressed vowels is indicated by the written word and stressed vowel written above it.

(23) *wa’tehsaráhtate’ káton wa’tehsate’kháhahkwe’ tsiontenhninòn:tha’ iaháhsewe’?*

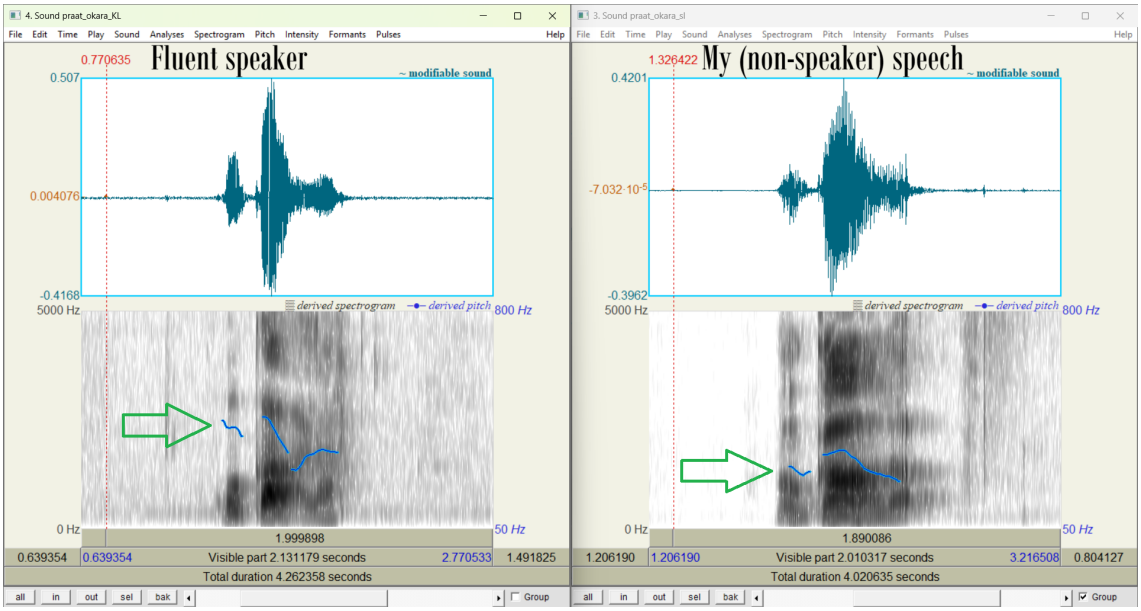
‘Did you run or walk to the store?’



Acknowledging that, for learners, it is not always useful to just see that, for example, Downstress falls in pitch more steeply than Long Upstress, in the final section of Chapter 5, I will provide an overview of Praat (Boersma and Weenink, 2024), and how learners can use it to adjust one’s pitch when speaking, with the goal of improving one’s accent. Specifically, I will show how one can use Praat to compare one’s pitch to that of a fluent speaker. Such a comparison is shown in (24), in which the pitch is indicated by the blue line (pointed at by the green arrows).

[14] *káton* is a particle meaning ‘or’, not a verb, so it is not marked on the graphic in (23).

(24) Visual comparison of pitch



Using the audio in combination with the visuals provided by Praat, one can compare their pronunciation of various pitch contours to those of a fluent speaker, and adjust accordingly. Accompanying pictures such as the one in (24), I will provide detailed descriptions as to how one can use these to improve one's own accent.

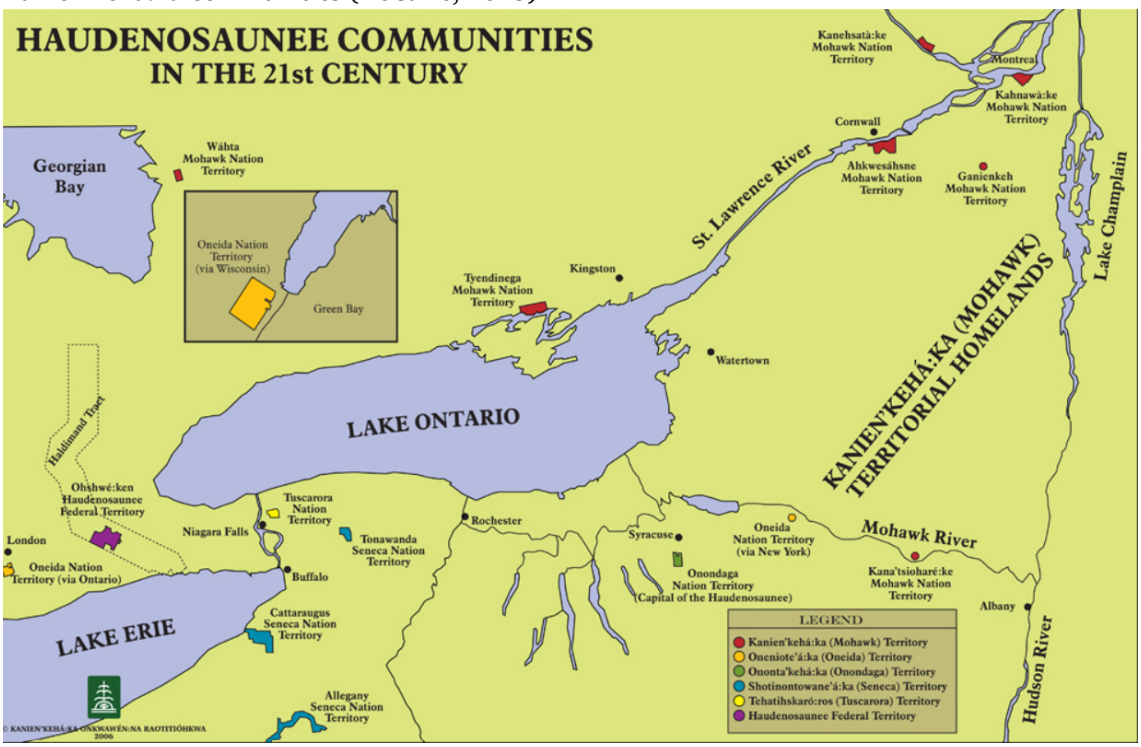
1.2 People and language background

1.2.1 Kanien'kehá:ka people

The people who speak Kanien'kéha are called the Kanien'kehá:ka (People of the Flint). They are often referred to by the exonym *Mohawk*, which also refers to the language they speak (Fenton and Tooker, 1978, p. 478).[15] Kanien'kehá:ka people historically lived in territory extending from the Mohawk valley up to modern day Montreal, but due to a variety of factors (including violent and overt colonial pressure; see e.g. Green (2009); Stacey (2016); DeCaire (2023)) they now live in various urban centres as well as eight communities across Southern Ontario, Southern Quebec, and Northern New York State. These communities are the following: Ohswé:ken (Six Nations), Kenhtè:ke (Tyendinaga), and Wáhta in Southern Ontario; Kahnawà:ke and Kanehsatà:ke in Southern Quebec; Ganienkeh and Kana'tsioharè:ke in Northern New York State, and Ahkwesáhsne which straddles the borders of Ontario, Quebec, and New York. A map showing these communities in relation to other Haudenosaunee communities is shown in (25).

[15] I will use the terms Kanien'kéha and Kanien'kehá:ka because these are the terms used by the community.

(25) Kanien'kehá:ka communities (DeCaire, 2023)



The Kanien'kehá:ka nation are the easternmost piece of the Haudenosaunee confederacy, a confederacy consisting of six nations (Onöndowa'ga:' (Seneca), Gayogo̱hó:nǫ' (Cayuga), Onoñda'gegá' (Onondaga), Onʌyote'a·ká· (Oneida), Kanien'kehá:ka (Mohawk), and, as of the early 1700s, Tuscarora) (DuVal, 2024). Since the Kanien'kehá:ka nation is the easternmost of the confederacy, they are often referred to as the Keepers of the Eastern Door.

Kanien'kehá:ka are a ceremonial people, who place strong emphasis on the importance of expressing gratitude to the natural world. All ceremonies revolve around giving thanks, such as the Thanksgiving ceremony and the Condolence ceremony (DuVal, 2024). These ceremonies are deeply connected to the Kanien'kéha language. As quoted in Green (2009, p. 27), Kanien'kehá:ka knowledge says

> "it is our responsibility to acknowledge and give thanks to them [all things in the natural world] that they are still doing their jobs as he [the creator] has instructed. He gave us our language to be able to do this as a way to communicate with them. He gave us ways of speaking to them out of respect and gratitude: certain words, phrases and concepts that are unique to our language. These are what we call our original instructions, and they are what differentiate us from all others. This knowledge is expressed through and contained within our language, and the recognition and renewal of these relationships is what maintains our survival as human

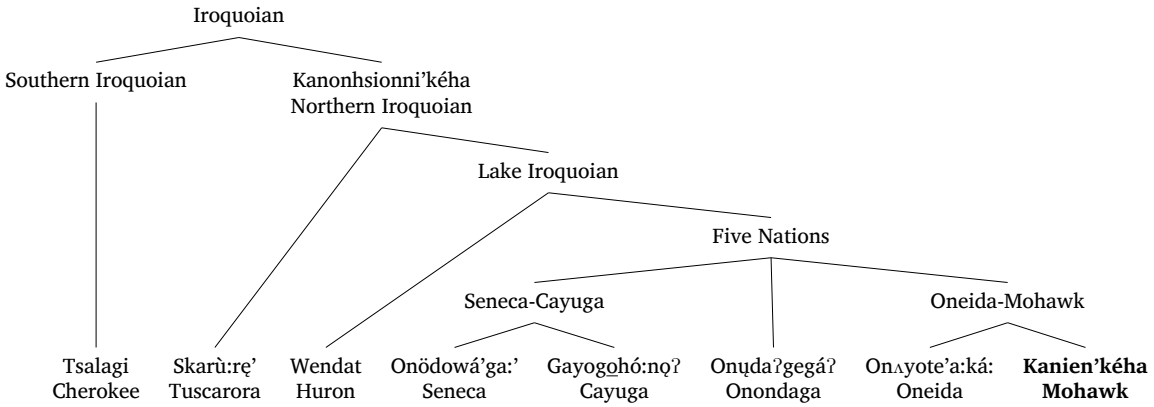
beings. Therefore, our language is essential to our well-being and survival."[16]

In this sense, the Kanien'kéha language is incredibly important to Kanien'kehá:ka people, as it is the central way of expressing gratitude toward the rest of the world. In the following section, I will introduce the Kanien'kéha language.

1.2.2 Kanien'kéha language

Kanien'kéha is a Kanonhsionni'kéha (Northern Iroquoian) language, part of the broader Iroquoian language family (Mithun, 2017). The Iroquoian language family is split into two branches: Southern and Northern, the former of which solely consists of the language Cherokee, and the latter of which consists of the remaining languages. The Iroquoian languages and their genetic relationships are schematized in (26). Endonyms are on top while exonyms are on the bottom.

(26) Iroquoian language family tree (adapted from Mithun (2017))[17,18,19]



See Michelson (1988); Mithun (1999); Julian (2010); Michelson (2016); Mithun (2017); Barrie and Uchihara (2019); Mithun and DeCaire (2024) for more detailed dicussions of the Iroquoian language family.

As shown in (26), Oneida is the closest language to Kanien'kéha. Kanien'kéha speakers can generally understand Oneida and Onondaga, but not Cayuga and Seneca (p.c. Wári McDonald).

Within the Kanien'kéha language, there are three principal dialects: Western, Central, and Eastern. The Western dialects are spoken in Ohswé:ken (Six Nations) and Kenhtè:ke (Tyendinaga), the Central dialect is spoken in Ahkwesáhsne, and the Eastern dialects are spoken in Kahnawà:ke, Kanehsatà:ke, and Wáhta (see

[16] Niawenhkó:wa to Wishe Mittelstaedt and Akwiratékha' Martin for their suggestions of what could go in this section. Niawenhkó:wa to Arihwí:saks Benedict for showing me this quote.

[17] I follow Lukaniec (2018) in assuming that Huron and Wendat, which are sometimes assumed to be distinct, are in fact the same language.

[18] I follow Mithun (2017) in not including the Iroquoian languages Nottoway, Laurentian, and Susquehannock due to the lack of sufficient language material to accurately categorize them in terms of sub-branches. See Mithun (1999); Mithun and DeCaire (2024), cited in Gatchalian (2025), for a longer discussion of these languages.

[19] See Julian (2010) for arguments against the Lake Iroquoian and Five Nations subgroupings.

the map of the communities in the previous section).[20,21] While these dialects are all mutually intelligible, there are many differences that distinguish them.[22] There are three main phonological differences that I will describe here. Firstly, the realization of the liquid differs depending on the dialect. In Ahkwesáhsne, the liquid is pronounced as [l] (closer to English <l>),[23] whereas in all other dialects it is pronounced as [ɻ] (closer to English [ɹ] (<r>) or the sound of English [ɾ] (<t>) in *water*) (Michelson, Michelson and Deer, 2024). An example is shown in (27).

(27) Dialectal differences in the liquid

a. Ahkwesáhsne (Central)

/l-ũkwe/ → [**l**ű:gwe] *rón:kwe* 'man'

b. Other dialects (Eastern and Western)

/ɻ-ũkwe/ → [ɻű:gwe] *rón:kwe* 'man'

The second sound-related difference between dialects has to do with the affricate. In the Eastern dialects, it is pronounced as alveolar [dz] (prevocalically) and written as <ts>, whereas in the Central and Western dialects it is pronounced as post-alveolar [ʤ] (prevocalically) and written as <tsi> (see Chapter 2 for more details on the voicing patterns in Kanien'kéha). An example is shown in (28).

(28) Dialectal differences in the affricate

a. Eastern dialects (Kahnawà:ke, Kanehsatà:ke, Wáhta)

/o-tsiʔts-aʔ/ → [odzì:dzaʔ] *otsì:tsa'* 'flower'

b. Central (Ahkwesáhsne) and Western (Ohswé:ken, Kenhtè:ke) dialects

/io-ʧiʔʧ-aʔ/ → [oʤì:ʤaʔ] *otsì:tsia'* 'flower'

The last sound-related difference between dialects discussed here has to do with the sound sequences tiV and kiV. These sequences are pronounced as shown in the table in (29).

[20]DeCaire (2023) categorizes the dialect in Kana'tsioharè:ke as Central and the dialect in Ganienkeh as Eastern.

[21]As noted by DeCaire (2023), many community members and speakers prefer to categorize their dialect based on their specific community. I have found this to be the case as well. Further many speakers express the importance of *family dialects*: that certain families speak in specific ways, and that in many cases it's hard to classify specific patterns as community-wide.

[22]See DeCaire (2023) for examples of non-phonological differences.

[23]While for some speakers in Ahkwesáhsne, the liquid is virtually identical to the English [l], for many, it has elements of a flap or another rhotic.

(29) Dialectal variation in tiV and kiV (adapted from Michelson, Michelson and Deer (2024))

	Western	Central	Eastern
/tiV/→	[ʧV]	[gjV]	[ʧV]
/**ti**ohtũ/ 'nine'→	[ʧóhdũ]	[**gj**óhdũ]	[ʧóhdũ]
/kiV/→	[gjV]	[gjV]	[ʧV]
/**ki**akʌ̃ʔs/ 'I go out' →	[**gj**á:gʌ̃ʔs]	[**gj**á:gʌ̃ʔs]	[ʧá:gʌ̃ʔs]

Other sound related differences will be described throughout this thesis, such as the differences in pronunciation of /nh/ and /rh/ sequences.

Across all the communities (and therefore, dialects), Kanien'kéha has become increasingly less spoken since the 1940s due to harsh colonial practices. While 'civilizing the savages' became official imperial policy in 1830, large scale effects on the vitality of Kanien'kéha did not occur until the official advent of residential schools in 1879 (Milloy, 1999). At these schools, children were prevented from speaking their native languages, resulting in either an inability or significant reduction in their ability to speak, or a deep-rooted sense of shame in their language (DeCaire, 2023). These schools ballooned in number in the 1920s (Milloy, 1999), resulting in the 1940s being the last period of collective intergenerational transmission of Kanien'kéha, which has steeply declined since (DeCaire, 2023). Contributing to the decline in vitality after the number of residential schools began to decrease in the 1950s (Milloy, 1999) was the spiritual successor to these schools, the child welfare system (Armitage, 1998), which, throughout the 60s–80s took Indigenous children away from their parents, severing their connections to the community and the language (i.e. the "60s Scoop") (Walkem, 2002). Although a minority of families have passed down Kanien'kéha since the 1940s, these systems have resulted in, as mentioned above, a sharp decline in intergenerational transmission and consequently, the number of L1 speakers (DeCaire, 2023). Even in the cases where Kanien'kéha had been retained within individuals, Kanien'kehá:ka people were hesitant to pass down the language for fear of inhibiting their children's ability to find jobs, as well as negatively impacting their children's lives due to racism directed towards people whose first language was not English (DeCaire, 2023).

Based on research done in 2021, DeCaire (2023) reports that there are 562 L1 (first language) speakers across the Kanien'kehá:ka communities, with the most in Ahkwesáhsne,[24] and none in either of the Western communities Ohswé:ken or Kenhtè:ke.[25] This means that around 1% of the population speaks Kanien'kéha as a first language (DeCaire, 2023). Additionally, these speakers are, for the most part, above the age of 60, meaning that each year the number decreases as members of the older generations pass away. Accordingly, DeCaire (2023) classifies the vitality of Kanien'kéha as 8 on the GIDS scale (where 8 is most

[24]DeCaire (2023) reports that there are 350 L1 speakers in Ahkwesáhsne. However, this report was an estimation. In an in-depth investigation of the number of L1 speakers in Ahkwesáhsne, Benedict (in prep) finds that there are 254 (as of 2026).

[25]The number of L1 speakers reported for Kahnawà:ke is 150, 60 for Kanehsatà:ke, and 2 for Wáhta (DeCaire, 2023).

unhealthy) (Fishman, 1991), “severely endangered” to “critically endangered” on the UNESCO scale (United Nations Educational, Scientific and Cultural Organization (UNESCO) Ad Hoc Expert Group on Endangered Languages, 2003), and 8a to 8b on the EGIDS scale (“moribund”–“nearly extinct”) (Lewis and Simons, 2010), but clarifies that these metrics should be taken with a grain of salt because they do not take into account revitalization efforts nor prevalence of L2 speakers. All in all, these metrics illustrate the sensitive state that Kanien’kéha is in.

Responding to the sharp decline in the number of Kanien’kéha speakers, since the late 1970s, there have been efforts in the various communities to revitalize Kanien’kéha, and increase the number of L2 speakers in order to reinvigorate intergenerational transmission of the language (Stacey, 2016; DeCaire, 2023; Brant, 2023). These include several community cultural centres, languages nests, and child and adult immersion programs. Consequently, there is a growing number of proficient L2 speakers of Kanien’kéha, increasing the likelihood of revitalized intergenerational transmission. I refer the reader to Stacey (2016); Gomashie (2019); DeCaire (2023); Benedict (in prep) for more details.

1.3 Methodology

In this section, I will outline how and from who the language material in this dissertation was collected, and how it will be presented.

1.3.1 Ahkwesáhsne dialect

This dissertation is relevant to all dialects of Kanien’kéha, as they are all mutually intelligible with each other and, for the purposes of the stress system, all behave the same. That is, the location of stress is the same in the vast majority of words across all dialects, as is the distribution of length and tone. There are also many differences in sounds, morphology, as well as meaning, some of which are described in the preceding section. For this reason, it is necessary to be clear that this dissertation uses language material specifically from the Ahkwesáhsne dialect (Ahkwesahsnéha).[26]

The Ahkwesáhsne dialect is spoken on the Ahkwesáhsne reserve, described in the preceding section. Despite the fact that there are more L1 speakers in Ahkwesáhsne than on any other reserve, there has been relatively little attention paid to this dialect, with the majority of the research being done on the Eastern dialects (specifically Kahnawà:ke) (e.g. Beatty, 1972; Feurer, 1976; Hopkins, 1988; Michelson, 1988). As far as I know, the only works to focus on the Ahkwesáhsne dialect are Bonvillain (1973); Boles (2024); Flaim (2025); McDonald (2026).

[26]Some speakers say that there are also dialects within Ahkwesáhsne itself. These include (but are not limited to) the Snye dialect, spoken in Snye, the island dialect, spoken on Cornwall island, and the Saint Regis dialect.

1.3.2 Elicitation and speakers

While working on the Ahkwesáhsne dialect, I had the pleasure of working with the first language speakers Mary Onwá:ri Tekahawáhkwen McDonald, Kahsennanó:ron Lazore, Wahiaké:ron Gilbert, Anie's Maureen Benedict, Hilda King, and Lyle Lazore.[27] Additionally, I consulted with highly proficient L2 speakers from different communities Akwiratékha' Martin, Wishe Mittelstaedt, Arihwí:saks Colin Benedict, Taiawentón:ti Sunday, Tsowén:te Cross, and Ro'nikhonhkátste Norton.

All examples in this thesis were double-checked. If an example was provided by a speaker, it was checked either with another speaker or a written source that contained the example. If an example came from a written source (e.g. Beatty, 1972; Bonvillain, 1973; Michelson, 1973; Feurer, 1976; Hopkins, 1988; Michelson, 1988; DeCaire, 2023; Martin, 2023; Michelson, Michelson and Deer, 2024; McDonald, 2026) it was checked with at least one L1 speaker. In the few cases where words were reported in written sources but they could not be corroborated by speakers that I have worked with, I have added a footnote clarifying that this is the case. All crucial examples (i.e. examples that would make or break a pattern) were checked with at least two L1 speakers.

The majority of elicitation sessions involved either a translation task, a reading task, or a repetition task. The translation task involved me providing an English word or short phrase, and the speaker providing the Kanien'kéha translation. Whenever possible, I employed this method so that neither the written form of the word nor my pronunciation of the word would influence the speaker's production.[28] The reading task involved written words or short phrases being presented to the speakers and them reading them aloud. The repetition task involved me saying the target words or short phrases, and speakers repeating said words/short phrases. In cases where longer phrases or more naturalistic productions were to be elicited (see examples in section 5.2), I used a more complex translation task, which was always done with more than one speaker. In this task, I provided speakers with a context. Then, I provided them with maximally two lines of dialogue, instructing them to treat these lines like a script within the larger context previously provided. This would then form the base for a longer dialogue with naturalistic speech.

Elicitation sessions were conducted in Ahkwesáhsne, at McGill, or on Zoom. When in person, they were recorded using a Zoom H2essential Handy Recorder. When online, sessions were recorded using the

[27] Wahiaké:ron Gilbert is a speaker of the Kahnawà:ke and Kanehsatà:ke dialects.

[28] The standardization of the Kanien'kéha orthography (Lazore, 1993) has levelled many dialectal and individual differences so as to have a more consistent writing system. However, this means that it is easy for speakers to feel like their pronunciations are "wrong" because the orthography reflects something else. For this reason, the reading task can result in unnatural productions. Additionally, many speakers do not read Kanien'kéha, so this task is not feasible for them.

I avoided saying the words in Kanien'kéha whenever possible because, as a non-speaker of Kanien'kéha, my speech could influence theirs. For example, speakers might hear that a particular aspect of my pronunciation of a given word is wrong, so when they produce the word, they might over-enunciate this aspect.

cellphones of the speakers.[29]

1.3.3 Presentation of language material

Language material is presented in the following format (unless inapplicable to the specific examples being provided).

(30) /underlying form/ → [surface form] *orthography* 'English definition'

In the rest of this section, I will outline the transcription choices I make in presenting the examples.

Forms enclosed in // are the underlying representation of the words in question, including the morpheme breaks. That is, they are the stored representations. Morpheme glosses are not included here in order to reduce clutter. The only analytical choice I make in reference to the underlying representations that is outside the scope of this thesis has to do with the morphological joiner (which will be described in section 2.3). Specifically, I assume that the morphological joiner is in the underlying representation, as I assume it to be a piece of the morphology (contrasting with the analyses in Michelson, 1988; Piggott, 1995).

Forms enclosed in [] are the surface form of the tokens in question (i.e. how the form is pronounced). It is necessary to clarify a few choices I make in reference to the surface form transcriptions. Firstly, in many cases I transcribe [s] as long ([s:]). This length is not contrastive, and it only occurs under specific phonological conditions, which will be described in detail in section 3.3. It will play a role in my analysis of the syllable structure.

Secondly, the choice to transcribe [h] in many cases is analytical. /kh/, /th/, and /sh/ sequences surface similarly to the English sounds [k^h] [t^h] and [s]. However, I transcribe [h] in the surface form because these sequences behave phonologically like two segments rather than one. This is also the case when [h] is flanked by consonants (e.g. /kht/). Despite the fact that /ChC/ sequences surface as almost identical to the corresponding /CC/ sequence (e.g. /kht/ and /kt/), these sequences behave differently phonologically, and for this reason, the [h] is transcribed in the surface form in the former case. This will be described in more detail in Chapter 3.

Thirdly, I adopt the convention in the previous Kanien'kéha literature and in the orthographic system (to be described shortly) that stress is marked with an acute or grave accent. The acute accent marks a high tone, while the grave accent marks a falling tone. This will be discussed in more detail in Chapters 3, 4, and 5.

[29] Speakers were also recorded with the Zoom teleconferencing application, but the quality was significantly lower.

Fourthly, as described previously, I will distinguish between the two epenthetic [e]s in the surface form. The epenthetic [e̲] that invisible to stress assignment is underlined whereas the epenthetic [e͞] that is visible to it is boxed.

Finally, final glottal stops that are morphologically present are invariably transcribed in surface forms. This is despite the observation made by many learners, teachers, speakers, and scholars that the glottal stop is often not pronounced in this position. I choose to transcribe the final glottal stop because it is not always clear what the conditions are when the final glottal stop is dropped, nor if it is consistent across speakers or even for a single speaker (Michelson, 1988; Martin and Michelson, 2025).

The orthographic form of each example will be in italics following the surface form. I follow the conventions of the *Mohawk language standardization project* (Lazore, 1993). According to these conventions, stress is marked with acute and grave accents (as briefly described above), the nasal vowels /ʌ̃/ and /ũ/ are transcribed as <en> and <on> respectively, the glottal stop is trancribed as <'>, and the palatal glide [j] is written as <i>.[30] Other details of the orthographic system, such as correspondences between sounds and graphemes, will be described in the section on the segmental inventory.

Since the orthographic system is based on the Kahnawà:ke dialect, orthographic transcriptions will sometimes differ from the surface transcriptions I provide.[31] For example, as mentioned above, the liquid in the Kahnawà:ke dialect is closer to English <r> whereas the liquid in the Ahkwesáhsne dialect is closer to English <l>, but since the orthography is based on the Kahnawà:ke dialect, the orthographic transcription is <r>.

There are two exceptions to the focus on the Kahnawà:ke dialect. The first exception has to do with the tiV and kiV sequences. Recall from (29) that, in Kahnawà:ke both of these sequences are pronounced as [ʤV], so they are written as <tia>, but in Ahkwesáhsne, they are both pronounced as [gjV], so they are written as <kiV>. See the examples in (31) and (32).

[30] The Western dialects write the palatal glide as <y> instead. See Mithun (1979) and Michelson (to appear) for a description of the development of the orthography, and why <i> is used in most of the dialects.

[31] That the orthographic system is based on the Kahnawà:ke dialect is also reflected in the Michelson, Michelson and Deer (2024) dictionary.

(31) Ahkwesáhsne dialect orthography

/waʔt-iakeni-hthal-ʌ̃ʔ/ → [waʔkjagenihthá:lʌ̃ʔ] *wa'**kia**kenihthá:ren'* 'we did converse'

(32) Kahnawà:ke dialect orthography

/waʔt-iakeni-hthaɽ-ʌ̃ʔ/ → [waʔʤagenihthá:ɽʌ̃ʔ] *wa'**tia**kenihthá:ren'* 'we did converse'

The second exception has to do with the affricate. Recall that the Eastern dialects pronounce the affricate as [dz] but the Central and Western dialects pronounce the affricate as [ʤ]. This is also reflected in the orthographies of the different dialects: In the Eastern dialects it is written as <ts>, in the Central dialects as <tsi>, and the Western dialects as <tsy>. This is shown in the following examples.

(33) Eastern dialects

/io-tsiʔts-aʔ/ → [odzì:dzaʔ] *otsì:**ts**a'* 'flower'

(34) Central dialect

/io-ʧiʔʧ-aʔ/ → [oʤì:ʤaʔ] *otsì:**tsi**a'* 'flower'

(35) Western dialects

/io-ʧiʔʧ-aʔ/ → [oʤì:ʤaʔ] *otsì:**tsy**a'* 'flower'

Since this thesis focuses on the Ahkwesáhsne dialect, I will adopt the Ahwesáhsne/Central dialect orthographic conventions.

1.4 Roadmap

In this section, I will provide a brief overview of the rest of the dissertation, going chapter by chapter. For any reader who is not interested in linguistic theory, but interested in the elements of this thesis designed for Kanien'kéha learners and teachers, I direct them to Chapter 5 (described just below).

In Chapter 2, I will introduce the necessary background information for the two chapters on theoretical phonology (3 and 4). This will include the segmental inventory, which will be followed up with a discussion of some phonological features I assume the be present in Kanien'kéha segments. Then, I will describe the prosodic domains within which the patterns under focus in this thesis take place, while providing some background on Kanien'kéha morphosyntax.

In Chapter 3, I will provide an analysis of the syllable structure of Kanien'kéha. Specifically, I will analyze Kanien'kéha as building maximally CVX syllables, where X is the second half of a long vowel or a laryngeal. Consequently, consonants that cannot fit into this constrained syllable shape must be syllabified in another way. I will propose that in order to syllabify these stranded consonants, Kanien'kéha builds

nonmoraic syllables. These nonmoraic syllables can take the form of a single syllabic consonant, a CC onset-nucleus sequence, or a C[e] sequence (where [e] is the invisible epenthetic vowel). This analysis will account for a number of things. Firstly, it will account for the phonotactic patterns in Kanien'kéha, such as the commonality of OO sequences and dispreference for clusters involving a sonorant consonant: RO, OR, RR. Secondly, this analysis will account for the invisibility and distribution of the invisible epenthetic [e]. Thirdly, it will account for the distribution of the visible epenthetic [ⓔ], which I will argue is in response to what I call the *Adjacency Condition*. The Adjacency Condition is a constraint on the distribution of nonmoraic syllables, prohibiting them from being adjacent. Thus, moraic epenthesis (i.e. visible epenthesis) will militate against violations of this constraint. The syllable structure analysis in this section will also account for the behaviour of the laryngeals and the glides.

Incorporating the insights of the previous chapter on syllable structure, I will propose a foot-based analysis of the stress patterns in Chapter 4. I will argue that, in order to account for the stress patterns in Kanien'kéha within the context of the syllable structure discussed in Chapter 3, a novel type of foot is necessary. Specifically, I will argue that Kanien'kéha builds *moraic-syllable trochees*, left-headed feet that contain minimally and maximally two weighted syllables. A weighted syllable is defined here as a syllable containing at least one mora. Defining moraic-syllable trochees as such ensures that the nonmoraic syllables described above will not improve nor degrade the well-formedness of the foot, resulting in their ostensible invisibility to foot construction, and therefore stress placement. In this chapter I will also provide analyses of the Tonic Lengthening process, word-minimality effects, and tonal patterns. This chapter will conclude the theoretical phonology components in this thesis.

In Chapter 5, I will address the challenges posed by the stress and epenthesis system for Kanien'kéha learners. I will start by addressing the inconsistency in stress placement due to the invisible epenthetic [e]. I will provide pedagogically-oriented descriptions of these patterns and the [e] in question with the aim of explicating the stress rules that L1 speakers subconsciously know for learners. After discussing the stress placement patterns, I will discuss the pitch associated with each type of stressed syllable. I will describe these pitch patterns using graphics and plain-language prose designed to clarify for learners the exact pronunciations of the various pitch patterns of the stressed syllables within words and sentences. Finally, I will provide an introduction to the computer program *Praat* (Boersma and Weenink, 2024), and how it can be used to adjust one's pitch patterns when learning a new language, with the aim of improving one's accent.

Chapter 2 Kanien'kéha phonology background

In this chapter, I will lay the groundwork for the detailed distributional descriptions and analyses provided in Chapter 3 and Chapter 4. I will do so by first introducing the segments in the Kanien'kéha inventory and their basic distributions. Then, I will discuss some phonological features in certain segments that will be relevant for the analyses of syllable structure and stress. Finally, I will outline the domain and morphological context within which the patterns under focus in the rest of the thesis exist.

2.1 Segmental inventory

2.1.1 Consonantal inventory

There are 11 consonants in Kanien'kéha. These consonants vary slightly depending on the dialect. I will focus on the consonants in the Ahkwesáhsne dialect. The consonants in this dialect are presented in the consonant chart in (1). Orthographic symbols are shown in angle brackets.

(1) Consonant chart[1]

	(Post-)Alveolar	Palatal	Dorsal	Laryngeal
Plosive	t <t>		k <k>	ʔ <'>
Complex			kw <kw>	
Affricate	ʧ <tsi>			
Fricative	s <s>			h <h>
Nasal	n <n>			
Liquid	l <r>			
Glide		j <i>	w <w>	

Notably, there are no labial consonants (barring /w/ and /kw/),[2,3].

The consonants can be grouped into three classes based on their phonological behaviour: obstruents, sonorants, and laryngeals.

There are four obstruents in Kanien'kéha: /t/, /k/, /ʧ/, and /s/.[4] All of the obstruents display similar

[1] See Postal (1968), Hopkins (1988), and Michelson (1988) for a justification of why /kw/ is considered a single segment.

[2] There are some labial consonants that have come in through loanwords, like /m/. See Bonvillain (1978); Renard (2023*b*); Martin (2025) for more details. In some dialects, /wh/ sequences are pronounced as [f]. This seems to be a development from a voiceless bilabial fricative [ɸ].

[3] Some learners have mentioned that when watching the mouth of fluent speakers of Kanien'kéha, their lips barely move at all. This is due to the lack of labial consonants. Additionally, the rounded vocoids /o/, /ũ/, and /w/ are only 'weakly rounded' (Michelson, 1988).

[4] The left half of the complex segment /kw/ behaves like an obstruent. Since the right half does not, I do not include it in the discussion of the obstruents. That being said, since the left half of the segment behaves like an obstruent, I will include notes throughout this section describing the behaviour of /kw/.

behaviour in reference to voicing;[5] they are only voiced when preceding vocoids. In the case of the stops and the affricate, /t/, /k/, and /ʧ/, they are always voiced when immediately preceding vocoids, and voiceless elsewhere.[6] This is shown in the following examples.

(2) Voiced stops and affricate[7]

a.	/ka-niatal-atatieʔ/	→	[**g**anja**d**ala**d**á**g**jeʔ]	*kanien'taratákie'*	'there's a river flowing through there'
b.	/ka-shest-akʔon/	→	[**g**ashes**d**á**g**ũʔ]	*kashestákon'*	'it is tasty syrup'
c.	/lao-ʧiʔʧ-aʔ/	→	[laoʤìːʤaʔ]	*raotsì:tsia'*	'his flower'

(3) Voiceless stops and affricate

a.	/iahaʔ-s-hlek/	→	[jahà:shle**k**$^{\mathbf{h}}$]	*iahà:shrek*	'Push it!'
b.	/at-kahl-a-nha-ʔ/	→	[a**t**$^{\mathbf{h}}$gahláhnaʔ]	*atkaráhnha'*	'glasses'
c.	/ʧh-iʔtlũ/	→	[ʧhíʔde̲lũ]	*tshí'teron*	'Put him down!' [8]

/s/ undergoes the same prevocalic voicing process as the stops and the affricate. However, it is more limited in terms of where it surfaces as voiced. /s/ is only voiced before vocoids intervocalically as well as word-initially.[9]

(4) Voiced /s/

a.	/te-k-wis-athe-ʔt-haʔ/	→	[degewi**z**athè:thaʔ]	*tekewisathè:tha'*	'I make the glass shiny'
b.	/sa-hũw-a-kũ/	→	[**z**ahű́:wagũ]	*sahón:wakon*	'in your boat'

(5) Voiceless /s/

a.	/te-k-iest-a-niũ-s/	→	[degje**s:**dánjũs:]	*tekiestánions*	'I am mixing them all together'
b.	/io-ʔt-aksɐ̃-s/	→	[joʔdák**s:**ɐ̃s:]	*io'táksens*	'you and I have a disagreement', 'you and I have shit between us'

[5] Since the obstruent half of /kw/ is always followed by a vocoid half, the complex segment always surfaces as [gw]. In word-final position, /kw/ surfaces as [k̬w̬].

(i) /te-s-an-iʔʧũhkw-a-h**kw**/ → [dezaniʔʤű́hgwahkw̬] *tesani'tsiónhkwahkw* 'Jump!'

[6] Voiced stops have short lag VOT while voiceless stops have long lag VOT, and are aspirated. Bonvillain (1973) argues that the voiced affricate is underlying.

[7] The voiced allophone of the affricate [ʤ] sounds identical to the two segment sequence [ʤj]. We can tell the difference between the two based on their phonological behaviour. While [ʤj] behaves like two segments, [ʤ] behaves like one. See Appendix A for more details. Since the necessary phonological diagnostics are not always possible to check, it is not clear in many cases if the given string is [ʤ] or [ʤj]. For this reason, I do not use many examples of /ʧ/ throughout this thesis.

[8] The example here involves the affricate being underlyingly followed by /h/. Due to the distribution of the affricate within morphemes, this is the only consonant that the affricate is able to precede. This sequence is written as <tshi> in the orthography. I assume that the lack of affricate-C sequences is a historical accident; The affricate likely originally derived from the place of articulation of the following vowel. This derivation could have taken place 'through' /h/ because /h/ does not have a place of articulation.

[9] /s/ also surfaces as voiced in the environment /ʔsV/.

Note that when /s/ surfaces as voiceless in (5), it is phonetically long. This is the case whenever /s/ surfaces as voiceless, except in VhsV sequences. See section 3.3 for a deeper discussion of this pattern.

These obstruent voicing facts call for a featural analysis. Such an analysis will be presented in section 2.2, using the feature [Sonorant Voice] ([SV]).

In terms of distribution, the obstruents are quite free. They can occur word-initially, word-finally, and immediately preceding or following any another obstruent.[10] OO clusters are shown in the following examples.

(6) Obstruent-Obstruent clusters are unrestricted

a. /k-saheʔt-a-iʌ̃tho-wa-ko-as/ → [**ks:**aheʔdajʌ̃thwágwas:] *ksahe'taienthwákwas*
'I am harvesting beans'

b. /t-ka-ʔwaʔl-a/ → [**t^{h}g**aʔwà:la] *tka'wà:ra* 'meat pie'

c. /k-kawe-s/ → [**k^{h}g**á:wes:] *kká:wes* 'I paddle'

d. /wa-k-at-takwalihsi-ũ/ → [waga**t^{h}d**agwalíhʃjũ] *wa'kattakwarîhsion* 'I straightened up'

In (6), we can see that OO clusters are unrestricted in terms of place of articulation and sequencing (i.e. if AB is a licit OO cluster, so is BA). Further we can see that, because of the obstruent voicing facts described above, many OO clusters surface with the first member voiceless and the second member voiced. This profile of OO clusters suggests that both a coda-onset and a complex onset analysis might not be correct. I will return to this in Chapter 3.

Unlike the obstruents, the sonorant consonants do not exhibit a similar freedom of distribution. There are four sonorant consonants in Kanien'kéha: /n/, /l/, /w/, and /j/. While sonorant consonants regularly occur word-initially, they rarely occur word-finally. Further, the sonorant consonants can never immediately precede an obstruent, and, other than /j/, can never immediately follow an obstruent. When RO or OR sequences are created by the morphology, they are broken up with the invisible epenthetic [e̲]. This is also the case with RR sequences. This is shown in the following examples.

[10]Since only the first half of /kw/ behaves like an obstruent, it can follow any obstruent. The second half is more like a sonorant, so it cannot immediately precede other consonants. The affricate /ʧ/ is also slightly more restricted as it is not morphologically possible to create a word where /ʧ/ is word-final. The only morphemes that end in the affricate are noun roots, which generally cannot be word-final.

(7) Clusters with sonorant consonants and epenthesis

a.	/te-**k-l**ik-s/	→	[dége̲liks:]	*tékeriks*	‘I put two things together’
b.	/ie-k-iaʔt-i**nk**ʌ̃h-s/	→	[jegjaʔdíne̲gʌ̃hs:]	*ietia’tínekenhs*	‘I let it out (an animal)’
c.	/io-**wl**-aʔ/	→	[ówe̲laʔ]	*ówera’*	‘wind’

We can compare the relatively free distribution of the obstruents with the more limited distribution of the sonorant consonants in the following table, where the columns “word-initial” and “word-final” are referring to the possibility of segments occurring in such positions as singletons.

(8) Distribution of obstruents versus sonorants

	Word-initial	Word-final	_O	O_
Obstruents	yes	yes	yes	yes
Sonorants	yes	limited	limited	limited

This difference is striking, especially considering the cross-linguistic trend for OR to form complex onset clusters and RO to form coda-onset clusters.

The last class of consonants in Kanien’kéha is the class of laryngeals: /ʔ/ and /h/. Not only do the laryngeals not pattern with the obstruents and sonorants, but in some cases, they do not pattern with each other either. The laryngeals pattern together word-initially and in laryngeal-C sequences. Neither laryngeal can occur word-initially,[11] and unlike obstruents and sonorant consonants, can occur immediately preceding almost any obstruent or sonorant. Some examples of laryngeal-C sequences are given in (9).

(9) Laryngeal-C sequences

a. Laryngeal-R sequences

i.	/s-ks-a-**hl**-ũniũ/	→	[z͡ēks:ahlű̠njũ]	*seksahrónnion*	‘Set the table!’
ii.	/k-ahʧaʔ**n**-okũ/	→	[gahʤaʔnó:gũ]	*kahtsia’nó:kon*	‘under my hand’

b. Laryngeal-O sequences

i.	/ka-’wha**hs**-a-raʔkʌ̃/	→	[gaʔfahsaɾ̃:agʌ̃]	*ka’whahsarà:ken*	‘white skirt’
ii.	/at-iaʔ**t**-a-nha-ʔ/	→	[agjaʔdáhnaʔ]	*akia’táhnha’*	‘belt’

On the other hand, the laryngeals do not pattern together word-finally or in C-laryngeal sequences. While /ʔ/ can (and regularly does) occur word-finally (e.g. (7c) and)(9b-ii)), /h/ cannot.[12] In terms of C-laryngeal sequences, /h/ can occur immediately following almost any obstruent or sonorant consonant, but all Cʔ sequences are broken up with epenthesis. These patterns are shown in (10) and (11).

[11] /h/ can occur word-initially in some particles.
[12] /h/ is able to occur word-finally in some particles.

(10) Ch sequences

a. /k-ʔne**k-h**aʔ/ → [ge̲ʔnékhaʔ] *ke'nékha'* 'I'm pleading'

b. /io-tskwaʔ**rh**e-ʔ/ → [ots:gwà:l̥heʔ] *otskwà:rhe'* 'frog'

(11) Cʔ sequences and epenthesis

a. /waʔ-kn-a**k-**ʔ/ → [wà:ke̲nage̲ʔ] *wà:kenake'* 'them two women ate it'

b. /k-ʔniakʌ̃-s/ → [ge̲ʔnjá:gʌ̃ʔs:] *ke'niá:ken's* 'I escape'

These patterns suggest that the laryngeals should not be analyzed in the same way as the obstruents and sonorant consonants in terms of syllable structure. Additionally, they should not be analyzed as identical to each other.

We can expand the table in (8) to include the laryngeals in (12). A row is included for each laryngeal because they pattern differently.

(12) Distribution of obstruents, sonorants, and laryngeals

	Word-initial	Word-final	_O	O_	_R	R_
Obstruents	yes	yes	yes	yes	limited	limited
Sonorants	yes	limited	limited	limited	limited	limited
/h/	no	no	yes	yes	yes	yes
/ʔ/	no	yes	yes	no	yes	no

These distributions will be discussed in depth and analyzed in Chapter 3. In the following section, I will introduce the Kanien'kéha vowel inventory.

2.1.2 Vowel inventory

There are six vowels in Kanien'kéha, four oral and two nasal. The vowels in Kanien'kéha are shown in (13). I will go into less detail with the description of the vowels as vowel quality is less relevant to the stress system and syllable structure in the language. Orthographic symbols for each vowel are written in angle brackets.

(13) Vowel inventory[13]

	Front	Central	Back
High	i <i>		ũ <on>
Mid	e <e>	ʌ̃<en>	o <o>
Low		a <a>	

All underlying vowels can occur in any position in the word. Additionally, they all behave the same with respect to the metrical processes; they are counted by the stress placement system, they are lengthened under stress (Tonic Lengthening), and they are counted when evaluating the word-minimality constraint. Some examples of Tonic Lengthening are shown in (14).

(14) Tonic Lengthening

a.	/wak-itaʔ-s/	→	[wagí:daʔs:]	*wakí:ta's*	'I'm sleeping'
b.	/io-hnek-a-no-s/	→	[ohné:ganos:]	*ohné:kanos*	'water'
c.	/ʌ̃-hl-ʌ̃dũni-ʔ/	→	[ʌ̃hlʌ̃dű:niʔ]	*enhrentón:ni'*	'he'll be lonesome'

The only cases of certain vowels having different distributions than other vowels are when vowels are in hiatus, or certain vowel-glide sequences. Vowels in hiatus are permitted in Kanien'kéha when the first vowel is /a/ and the second is /ũ/, /o/, or /e/. See Michelson (1983); Hopkins (1987); Michelson (1988) for more details.[14] In terms of glide-vowel sequences, *[ji], *[wo], and *[wũ] are prohibited, while all others are permitted (although see Martin (2023) for exceptions).

We finally turn to the vowel-glide alternations in Kanien'kéha, as this will play a role in the analyses of syllable structure and stress in Chapter 3. The palatal glide [j] alternates with the high front vowel [i], while the labio-velar glide [w] alternates with the mid back vowel [o]. In the latter case, [w] only alternates with [o] (and vice versa) when immediately preceded by /k/. Some vowel-glide alternations are shown in the following examples. The glide alternants are shown in (15) and (17) while the vowel alternants are shown in (16) and (18).

[13]The pronunciation of /a/ varies from a low central position to a low back position. /a/ is also often difficult to distinguish from /ʌ̃/ which is usually pronounced lower and farther back than the indicated position. Detailed acoustic analyses are needed to clarify exact placements of the whole inventory.

[14]Other sources that describe vowels in hiatus in Kanien'kéha are Beatty (1972); Postal (2016).

(15) [j] examples

a. /k-at-ʔnikũhl-o**li-a**-ʔt-haʔ/ → [gade̲ʔnigũhloljà:thaʔ] *kate'nikonhrorià:tha'*
'the things I used to make fun with'

b. /lo-aniʔte**ni-ũ**/ → [loniʔdénjũ] *roni'ténion* 'he has farted'

(16) [i] examples

a. /k-at-ʔnikũhl-o**li-s**/ → [gade̲ʔnigũhló:lis:] *kate'nikonhró:ris* 'I have fun'

b. /waʔ-la-aniʔte**ni-**ʔ/ → [wahaniʔdé:niʔ] *wahani'té:ni'* 'he farted'

(17) [w] examples

a. /k-atsho**ko**-as/ → [gats:hógwas:] *katshókwas* 'I smoke'

b. /k-lũ**ko**-as/ → [gelű̲gwas:] *kerónkwas* 'I scrape it'

(18) [o] examples

a. /ɐ̃-k-atsho**ko**-ʔ/ → [ɐ̃gats:hó:goʔ] *enkatshó:ko* *I will smoke'

b. /ɐ̃-k-lũ**ko**-ʔ/ → [ɐge̲lű̲:goʔ] *enkerón:ko'* 'I will scrape it'

I will argue in section 3.7 that some instances of surface glides are underlyingly glides while others are underlyingly vowels. All of the instances where glides alternate with vowels will be analyzed as underlyingly vowels (see also section 2.2.2).

To summarize the discussion of the segmental inventory, consonants can be divided into three classes: obstruents, sonorant consonants, and laryngeals. Obstruents are quite free in distribution, while sonorant consonants are not. The laryngeals do not pattern like the obstruents nor the sonorant consonants, neither do they pattern with each other. In terms of the vowel inventory, the vowels are all distributed similarly regardless of quality. The main exception to this involves the glide-vowel alternations, where [i] alternates with [j] and [o] alternates with [w]. In the following section, I will introduce some features that I assume to be present in the segments described in the current section.

2.2 Features

Having described some of the basic segmental patterns in the previous section, I will now discuss some features that will account for these patterns. Since this thesis focuses on syllable structure and stress, I will only discuss features that are relevant to these analyses. I will introduce three monovalent features — [sonorant voice] (Rice, 1993), [vocalic], and high and low tones. The features discussed in this section will play a crucial role in the analyses in Chapters 3 and 4.

2.2.1 Sonorant voice

As described in the previous section, the obstruents undergo a voicing process when they are prevocalic. I will argue in this section that this is the work of the feature [sonorant voice] (Rice and Avery, 1989; Piggott, 1992; Rice, 1992, 1993; Piggott and van der Hulst, 1997). Specifically, I will propose that [SV] is underlyingly present in all vowels and sonorant consonants in Kanien'kéha. Before justifying the assumption that [SV] is active in Kanien'kéha, I will introduce the feature.

Immediately after SPE (Chomsky and Halle, 1968), phonologists typically used the binary feature [voice] to represent voicing in obstruents. Voiceless obstruents have the feature [-voice] while voiced obstruents have the feature [+voice]. Sonorant consonants, on the other hand, were assumed to have the feature [sonorant], and be underspecified for [voice]. The above-cited sources argue that, instead, in some languages there are distinct voicing features in obstruents and sonorants; [+voice] in voiced obstruents and [SV] in sonorants, dispensing with the feature [sonorant]. In this system, they argue, [SV] can either be present in just sonorants, or in both sonorants and voiced obstruents (so-called "sonorant obstruents"). They argue that this better accounts for the existence of (1) patterns where voiced obstruents do not pattern with sonorant consonants such as in Japanese Rendaku (in which case obstruents have [voice] and sonorants [SV]) and (2) patterns where obstruents do pattern with sonorant consonants, such as in Dahl's law in Kikuyu (in which case both obstruents and sonorant consonants have [SV]) (Rice, 1993).[15] I follow these authors in assuming that [SV] is an active feature in the phonology of certain languages.[16] An additional assumption I make about [SV] is that, when pronounced by itself under a nucleus, it is pronounced as a vowel.[17] This is because the feature [SV] is simply a voicing feature. I will elaborate on this decision in section 3.2.

I argue that [SV] is active in Kanien'kéha specifically to account for the obstruent voicing facts. As briefly discussed in section 2.1, there is no underlying voicing contrast in Kanien'kéha obstruents; they are voiced prevocalically, and voiceless elsewhere.[18]

[15] This featural distinction between [voice] and [SV] is also meant to capture the phonetic differences between these two types of voicing (Halle and Stevens, 1971; Harris, 2009). In sonorants, the voicing is spontaneous.

[16] I do not assume the articulated [SV] structure proposed in Rice (1993), simply the feature.

[17] Goad and Brannen (2003) note that while Rice (1993) assumes that [SV] by itself is pronounced as a nasal, she only assumes this to be the case when in a consonant position (e.g. onset). Rice makes no claims about how [SV] is pronounced in a nucleus.

[18] This is a common pattern in Salish languages as well (e.g. Newman, 1947; Flemming, Ladefoged and Thomason, 2008; Brown, 2008).

(19) Obstruents are voiced prevocalically

a.	/**k**a-shes**t**-a**k**ʔon/	→	[gashesdágũʔ]	*kashestákon'*	'it is tasty syrup'
b.	/**te**-**k**-wi**s**-athe-ʔt-haʔ/	→	[degewizathè:thaʔ]	*tekewisathè:tha'*	'I make the glass shiny'

I assume this process to involve the spreading of [SV] from the immediately adjacent vowel to the obstruent, voicing it. This is shown in (20).

(20) [SV] voicing obstruents[19]

/ka-nat-aʔ/ → [ganá:daʔ] *kaná:ta'* 'town'

k a n a t a ʔ g a n a d a ʔ
| | | → ↘ | ↘
SV SV SV SV SV SV

That is, I assume that obstruents underlyingly lack a specification for voicing, but when prevocalic, the voicing feature of the vowel, [SV], spreads to it resulting in voicing. When in non-prevocalic position, obstruents are voiceless, as I assume this is the default surface form. This analysis straightforwardly accounts for the obstruent voicing facts. I assume [SV] to be the relevant feature in this process as I will show independent evidence for the activity of [SV], specifically with respect to syllabification, in Chapter 3. In this way, using the feature [SV] is a more economic choice than [voice].

In conclusion, I assume that the feature [SV] is present in sonorant consonants and vowels in Kanien'kéha and that this feature is responsible for the prevocalic voicing process in obstruents. This is because of the simplicity of this analysis.

2.2.2 Vocalic

While [SV] is present in all sonorants, I assume that [vocalic] ([voc]) is present in all underlying vowels in Kanien'kéha. This is the feature that distinguishes between vowels and consonants.

(21) Vowels and consonants and [vocalic]

/ka-nat-aʔ/ → [ganá:daʔ] *kaná:ta'* 'town'

g a n a d a ʔ
| | | |
voc voc voc

Specifically, [voc] will play a role in distinguishing between the vowels and their glide counterparts (as discussed in section 2.1): [i] and [o] have [vocalic] while [j] and [w] do not. This is shown in the following

[19] I do not include [SV] on sonorant consonants in this example for the sake of clarity. There would also be [SV] on [n] and [ʔ]. Justification for /ʔ/ being a sonorant will be provided in section 3.6.

examples, where the /i/ in the root -ahi- surfaces as [i] and with vocalic in (22a) but as [j] and without vocalic in (22b). The exact process by which [voc] is deleted will be described in section 3.7.

(22) Glides and [voc]

a. [i] and [voc]

/ka-ah**i**/	→	[gáh**i**]	*káhi*	'fruit', 'berry'

g a h **i**
| |
voc voc

b. [j] and no [voc]

/s-ah**i**-a-ko/	→	[zà:**j**ago]	*sà:iako*	'Go pick fruit!', 'Go pick berries!'

z a **j** a g o
| | |
voc voc voc

This distinction between the vowels and non-vowels will play a role in accounting for the behaviour of the glides.

2.2.3 Tone

The last features I focus on account for the tones in Kanien'kéha. Recall that Kanien'kéha stressed syllables always start with a high pitch. I assume this to be due to a High tone docking to the stressed syllable. Specifically, it docks to the mora associated to the stressed syllable. This is shown in (23).

(23) High tone on stressed syllable[20]

/io-hwist-aʔ/	→	[ohwís:daʔ]	*ohwísta'*	'metal'

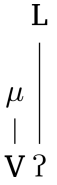
H
|
μ μ μ
| | ⟍
o h w í s d a ʔ

Additionally, recall that when stressed vowels are underlyingly followed by a laryngeal, they are pronounced with a high pitch followed by a steep fall. I assume, following Michelson (1988), that this is a product of an underlying low tone on laryngeals that, combined with the high tone associated to stressed syllables, results in a falling tone. (24) shows a derivation of how a representation of an underlying CVʔ sequence surfacing as CV̀: under stress.

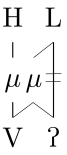
[20] I will argue in section 3.6 that the glottal stop syllabifies under the same mora as the preceding vowel.

(24) Falling tone derivation

a. Underlying CVʔ



b. CV̀:



In (24a), the vowel has a mora, and the glottal stop has a low tone. There are then a few steps that occur before the sequence surfaces. Firstly, when the vowel is stressed, a high tone becomes associated with it. Secondly, the vowel lengthens in order to host the low tone from the glottal stop as well (this process will be motivated and explained in more detail in section 4.4). Once the vowel is lengthened, the low tone delinks from the glottal stop, and relinks to the second mora. Finally, the glottal stop links to the second mora, in order to be syllabified. The resulting structure is pronounced as CV̀:, with the glottal stop not being pronounced (for perceptual and articulatory constraints - see section 3.6 for more details).

In the following section, I will introduce the domain in which the patterns discussed so far (and that will be discussed) occur. This section will also provide the relevant morphological background.

2.3 Domains and phonology

Kanien'kéha is traditionally considered a 'polysynthetic' language due to its complex morphology (Baker, 1996), resulting in single Kanien'kéha words often encompassing the meaning of full English sentences. In this thesis, the Kanien'kéha word is the domain under focus.[21] In the rest of this section, I will describe what this domain entails.

Kanien'kéha has three parts of speech: nouns, verbs, particles (Michelson, 2023; Coon, to appear). The words under focus in this thesis are nouns and verbs. I will not address particles in this thesis because they do not follow the stress rules of verbs and nouns. For example, while nouns and verbs must contain at least two syllables, this is not necessarily the case for particles.

Nouns and verbs pattern together in terms of the stress patterns and syllable structure to be discussed in this thesis. For example, all verbs and nouns canonically have penultimate stress.[22] Nouns generally consist

[21] I will assume in Chapter 4.2 that this domain constitutes a Prosodic Word, but the label is not crucial to the analysis.

[22] Words that do not follow this pattern (because of epenthesis) will be discussed at length in this thesis. Exceptions to the stress rules are generally loans: [dagó:s:] 'cat' from Dutch *de poes* 'the pussy cat'.

of a noun root, a pronominal prefix, and a noun suffix (although they are not limited to these morphemes). An example is shown in (25), in which I use the orthography for the sake of illustration.

(25) *kanónhsa'* (Michelson, Michelson and Deer, 2024)
ka-nonhs-a'
NA-house-NSF
'house'[23]

Kanien'kéha, like other Iroquoian languages, however, is remarkably verb-centric, meaning that "almost any word (or stem) can take verbal inflections, almost any word can function as a verb, verbs are the most frequent, and verbs have the most morphology" (Michelson, 2023). The morphological template of Kanien'kéha verbs is shown in (26), with square brackets marking the verb stem.

(26) Verb morphology template (adapted from Mithun (2017))[24]

a. Verb template[25]

pre-pronominal prefix – pronominal prefix – (semi-)reflexive – [noun stem – verb root – derivational suffixes] – aspect

Verbs minimally consist of a verb stem (which itself minimally consists of a verb root), a pronominal prefix, and an aspect suffix. An example of a minimal verb is shown in (27).

(27) *wakí:ta's* (Gatchalian, 2025)
wak-ita'-s
1sgP-sleep-HAB
'I'm sleeping'[26]

See Coon (to appear) for more details on the pronominal prefixes.

Given the template in (26), however, verbs can be a lot more morphologically complex. An example of this is shown in (28).

(28) *wa'tkarahsì:kia'ke'* (Michelson, 1988)
wa'-t-k-ar-ahsi't-ia'k-'
FACT-DU-1A-SRF-foot-cut-PUNC
'I broke my foot'[27]

Even though words (especially verbs) can be morphologically quite complex, the entire word is the domain under focus in this thesis. That is, I will analyze all patterns within the word that are relevant to

[23]NA is the gloss for neuter agent, while NSF is the gloss for 'Noun Suffix'.

[24]The definition of the verb stem has varied in the Iroquoian literature. See Gatchalian (2025, p. 11) for more details. I define the stem following Gatchalian (2025), but the definition is not of consequence for this thesis.

[25]'Noun stem' either refers to a noun root (e.g. *-nonhs-* in (25)), or a verb that has been nominalized in order to be incorporated.

[26]1sgP is the first person singular patient prefix. HAB is the habitual suffix.

[27]FACT is the factual prefix. DU is the duplicative prefix. 1A is the first person singular agent prefix. SRF is the semi-reflexive prefix. PUNC is the punctual suffix.

stress or syllable structure.[28] There is one main exception: the morphological joiner, which takes the form [a] (Michelson, 1988). The joiner only surfaces between incorporated noun roots and following verb roots, and/or verb roots and following derivational suffixes. Further, it only surfaces when the leftmost morpheme in the two-morpheme sequence ends in a consonant, and the rightmost morpheme in the sequence begins with a consonant.[29] Some examples are shown in (29).

(29) Morphological joiner

a. /s-ka-[na**t-a-t**i]/ → [s:ganá:dadi] *skaná:tati*
'the other side of the village' [30]

b. /naʔ-ka-[hiũ**h-a-t**i]/ → [naʔgahjű́hadi] *na'kahiónhati*
'the other side of the creek'

c. /waʔ-t-k-hiatũhse**l-a-j**ʌ̃ʔ/ → [waʔdə̃khjadũhsalá:jʌ̃ʔ] *wa'tekhiatonhserá:ien'*
'I played cards'

Due to this distribution, the joiner is often considered to be an epenthetic vowel, that breaks up consonant clusters in a specific morphological domain (i.e. the verbal stem) (e.g. Michelson, 1988; Piggott, 1995; Rowicka, 1999). However, it is not clear what phonological role the joiner would be playing as it 'breaks up' all CC clusters, despite many of them being completely licit elsewhere in the language (including within morphemes that occur stem-internally). For example, obstruent-obstruent and laryngeal-C clusters are intervened by the joiner at morpheme boundaries within the stem (see (29)), yet these clusters are largely unrestricted elsewhere in Kanien'kéha words. This is shown in (30) in which, not only are OO, GC, (G = laryngeal), and Cj clusters occurring word-internally, but stem-internally (where the joiner occurs).

(30) Stem-internal clusters

a. /waʔ-k-[a**tt**atakw-a-ht]-ʔ/ → [waʔgat^{h}dadágwahdə̲ʔ] *wa'kattatákwahte'*
'I exploded it'

b. /ka-[nje**ht**-kehlũ]/ → [ganjehdagè:lũ] *kaniehtakè:ron*
'there is snow on the ground here and there'

c. /te-s-[awʌ̃**ri**e]/ → [dezawʌ́́lje] *tesawénrie* 'Stir!'

In this way, it seems that the joiner is not present in order to repair marked structure, as would be expected for an epenthetic vowel (such as epenthetic [e]), but rather it is a morpheme, thus warranting an

[28] There are some clitics that do not follow the phonotactic patterns of the rest of the language. Among others, these include the plural enclitic /-shũʔa/ *-shon'a* and the ordinal enclitic /-hatũ/ *-haton*. I assume these clitics to be in a different phonological domain and thus not subject to the same phonotactic constraints.

[29] There are some puzzling examples involving the palatal glide [j]. However, these patterns are not consistent. That is C-j is sometimes broken up with the joiner and sometimes not.

[30] Michelson, Michelson and Deer (2024) reports that this form means 'across the road'.

in depth analysis of the morphosyntax. Consequently, I will not include a discussion of the joiner in my analysis of the phonological relationship between stress and epenthesis in Kanien'k'eha.

This is not to say that the joiner behaves like any other vowel in Kanien'kéha. One of the reasons why it is discussed alongside epenthetic [e] in the Kanien'kéha literature is because it itself displays complex interactions with stress. For this reason, a phonological analysis is necessary to account for this vowel. I will leave this to future work. For the patterns involving the joiner, I refer the reader to Michelson (1988).

For more information on the morphosyntactic and semantic systems in Kanien'kéha, see citations (and analysis) in Gatchalian (2025), specifically on page 6.

In the following chapter, I will discuss and present an analysis of the syllable structure in the domains discussed in this section: verbs and nouns.

Appendix A: Some details on the segmental inventory

In this appendix, I will describe some details of the inventory that were not covered in section 2.1. These include palatalization of /s/, devoicing of sonorants, and discussions of /ʧ/. These details are in an appendix because they do not pertain directly to the analyses presented in Chapters 3 and 4, but are important phonetic details that could be relevant in another analysis.

Palatalization of /s/

As described briefly in section 1.2.2, the stop palatalization facts differ depending on the dialect. They are repeated in the table in (31).

(31) Dialectal differences and palatalization (adapted from Michelson, Michelson and Deer (2024))

	Western	Central (Ahwesáhsne)	Eastern
/tiV/→	[ʤV]	[gjV]	[ʤV]
/**ti**ohtũ/ 'nine'→	[ʤóhdũ]	[**gj**óhdũ]	[ʤóhdũ]
/kiV/→	[gjV]	[gyV]	[ʤV]
/**ki**akʌ̃ʔs/ 'I go out' →	[**gj**á:gʌ̃ʔs]	[**gj**á:gʌ̃ʔs]	[ʤá:gʌ̃ʔs]

The phonological behaviour of these sequences is consistent across the dialects despite the surface forms being different.

/s/ also undergoes palatalization that is subject to dialectal variation. However, the dialectal variation is different than that of the stops. In all dialects, when /s/ is followed by [jV] and immediately preceded by [h], it surfaces as the post-alveolar [ʃ].

(32) /siV/ palatalization

a. /akwa-hsia-ʔ/→[agwáhʃjaʔ] *akwáhsia'* 'my handle'

b. /wa-k-at-takwalihsi-ũ/→[wagat^{h}dagwalíhʃjũ] *wa'kattakwarí̓hsion* 'I straightened up', 'I'm a straight person'

In Ahkwesáhsne specifically, /s/ is also palatalized when immediately preceded by /h/ and followed by the high front vowel /i/. Some examples are shown in (33).[31]

(33) /hsi/ palatalization

a. /io-hsin-aʔ/→[ohʃíːnaʔ] *ohsí̓:na'* 'leg'

b. /ahsil-ʔ/→[áhʃile̲ʔ] *áhsire'* 'blanket'

Finally, word-initial /s/ surfaces as [ʤ] (or as [dz] in the Eastern dialects) when followed by a high front vocoid.[32]

(34) /#si/ palatalization

a. /s-iena/→[ʤjéːna] *tsié:na* 'Hold it!'

b. /s-ihlũ/→[ʤìːlũ] *tsì:ron* 'Say it!'

Devoicing of sonorants

Sonorant devoicing takes places in a few different contexts. First, when /n/ is simultaneously preceded by a glottal stop and followed by the right edge of the word or /h/, the /n/ surfaces as voiceless.[33,34]

[31] This does not occur, however, when the /s/ is the final consonant in a noun root, such as in the following word that includes the noun root /-nũhs-/ 'house'.

(i) /ka-nũhs-iio/→[ganũh**s**íːjo] *kanonhsí̓:io* 'it is a good house'

Niá:wen to Wishe Mittelstaedt for figuring this out with me.

[32] It is unclear to me how /s/ surfaces when in Vsi position, as creating this sequence morphologically is difficult. The one exception I know of is in the following word, where some speakers pronounced palatalized /s/ as [ʃ], and others pronounced it as [ʒ].

(i) /waʔ-te-wak-at-wis-iaʔk-hseʔ/→[wadewagadewíːʃaʔkhseʔ] [wadewagadewíːʒaʔkhseʔ] *wa'katewatewísia'khse* 'the ice broke on me'

[33]The only consonants that can immediately follow [n] are [h] and [j] (although, as argued in section 3.7, [j] is underlyingly vocalic).

[34]I am aware of this being the case in Ahkwesáhsne and Kahnawà:ke, but I am not sure the other communities.

(35) Voiceless /n/

a. /s-nũhweʔn/→[zenṵ̊:weʔ**n̥**] *senòn:wen'n* 'Like it!'

b. /io-ʔnhetska/→[joʔ**n̥**hét̥s:ga] *io'nhétska* 'it is soft'

Similarly, /l/ surfaces as voiceless when preceding /h/ or word-final. This occurs specifically in the Ahkwesáhsne dialect.[35,36]

(36) Voiceless /l/

a. /lh/

/k-hlálho-s/→[khlál̥hos:] *khráhrhos* 'I pull it ashore'

b. /l#/

/eʔlhal/→[è:l̥hal̥] *è:rhar* 'dog'

In all dialects (as far as I am aware), the liquid is voiceless in final h-liquid sequences. Some examples are shown in (37).

(37) Voiceless liquid: /hl#/

a. /s-ʌ̃nakahl/→[zʌ̃ná:gahl̥] *sennáʼ:kahr!* 'Whistle!'

b. /s-ũhkahl/→[zṹhgahl̥] *sónhkahr!* 'Snore!'

/w/ is devoiced in similar environments as the liquid. It is devoiced when it is word-final (while simultaneously being immediately preceded by a vowel) or immediately preceding /h/. In these contexts it surfaces as [f].[37] Some examples are shown in (38).

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[35] In the Eastern dialects, /nh/ and /rh/ sequences surface as [hnh] and [hrh] with the sonorant consonant devoiced.

(i) hnh
/waʔ-k-nhotũ-ʔ/→[waʔgēhn̥hó:dũʔ] *waʼkehnhóʼton'* 'I closed it'

(ii) hrh
/k-otarhok-s/→[godáhr̥hoks:] *kotáhrhoks* 'I hook it on'

This does not happen in the Ahkwesáhsne dialect. In the Ahkwesáhsne dialect, /nh/ and /lh/ sequences sometimes surface as [nh] and [l̥h], sometimes as [hn] and [hl], and sometimes as [h] and [h].

(iii) /nh/
/ra-atʌ̃-nhaʔ-s/→[ladʌ́hnaʔs]~[ladʌ́nhaʔs]~[ladʌ́haʔs] *raténhnhaʼs* 'he hires someone'

(iv) /lh/
/k-hlálho-s/→[khlál̥hos:]~[khláhlos:]~[khláhos:] *khráhrhos* 'I pull it ashore'

Documenting the Ahkwesáhsne dialect in the 1970s, Bonvillain (1973) reported that Rh sequences were pronounced as Rh by the older speakers, while hR was the more common variant amongst the younger speakers.

It is not clear what the dialectal variant is for the Western dialects, but Akwiratékha' Martin told me (p.c.) that these sequences surface as [nh] and [rh] in these dialects.

[36] There is one speaker from Ahkwesáhsne who does not do this. Instead, these liquids are pronounced as the rhotic [ɻ̊].

[37] It is unclear if this is across dialects and across speakers.

(38) Voiceless /w/

a. /wh/

i. /io-wholht-ʔ/→[ohfo̥lhde̲ʔ] *óhwhorhte'* 'burr'

b. /w#/

i. /s-an-iʔt-oke**w**/→[zaniʔdó:gef] *sani'tó:kew* 'Go wipe yourself!'

See section 3.4 for other aspects of this pattern.

Lastly, while not specifically sonorant devoicing, /l/ also undergoes a debuccalization process. Specifically, /l/ only surfaces as [l] word-initially, and within the stem (this is also the case in dialects that have a rhotic instead of /l/). If /l/ is non-initial and outside the stem, it lenites to [h]. In the following examples, the stem is enclosed in curly brackets.

(39) /l/ surfaces as [l]

a. /la-{nũhweʔ}-s/→[**l**anṹ:weʔs] *ranòn:we's* 'he likes it'

b. /wak-{halatat}-ũ/→[wakha**l**adá:dũ] *wakharatá:ton* 'I have raised it up'

(40) /l/ surfaces as [h]

a. /iah te-la-{nũhweʔ}-s/→[jah de**h**anṹ:weʔs] *iah tehanòn:we's* 'he doesn't like it'

In the examples in (39), the liquid is either word-initial, or in the stem resulting in it surfacing as [l]. In the example in (40) on the other hand, the /l/ is neither in the stem nor word-initial, resulting in it surfacing as [h]. Renard (2023*a*) argues that this is a positional faithfulness effect, where it is preserved in strong stem-internal and word-initial position, but weakened elsewhere.

Distinguishing between /ʧ/ and /ʧj/

Single segment /ʧ/ should not be confused with the two segment sequence /ʧj/, which sound the same ([ʧ]). We can tell that these are different because [ʧ] behaves like a single segment while [ʧj] behaves like two. We can see this being the case specifically with Tonic Lengthening, and the metrically visible epenthetic vowel, which are both processes that are sensitive to 'segment count'. I will go through the Tonic Lengthening facts first. Recall that Tonic Lengthening lengthens stressed vowels when followed by a single consonant (e.g. (41)). While the two segment [ʧj] blocks Tonic Lengthening (e.g. (42)), the single segment [ʧ] does not (e.g. (43)).

(41) Tonic Lengthening

a.	/k-atati-s/	→	[gadá:dis:]	*katá:tis*	‘I talk’
b.	/io-ʔt-aksʌ̃-s/	→	[joʔdáks:ʌ̃s:][38]	*io’táksens*	‘you and I have a disagreement’, ‘you and I have shit between us’

(42) Tonic Lengthening and two segment [ʤj]

a.	/waʔ-k-laʧiũ-ʔ/	→	[waʔgeláʤjũʔ]	*wa’kerátsion’*	‘I did tear it’

(43) Tonic Lengthening and single segment [ʤ]

a.	/ka-hwaʧil-ʔ/	→	[gahwá:ʤile̲ʔ]	*kahwá:tsire’*	‘family’

Two segment [ʤj] also seems to behave differently from one segment [ʤ] in reference to epenthesis. Epenthetic [e͡] breaks up sequences of three consonants (e.g. (44)). When two segment [ʤj] is preceded by a consonant underlyingly, it is broken up by epenthesis. This is shown in the example in (45). Finally, if the single segment [ʤ] is preceded by a consonant, there is no epenthesis (i.e. this sequence is treated like a two segment sequence). This is shown in (46).

(44)	/waʔ**t-k-t**eni-ʔ/	→	[waʔde͡kʰdé:niʔ]	*wa’tekté:ni’*	‘I changed it’
(45)	/waʔ-la**k-ʧj**ʌ̃ʔt-ʔ/	→	[wahagé͡ʤjʌ̃ʔte̲ʔ]	*wahakétsien’te’*	‘he treated me’
(46)	/wa**k-**ʧiʔio-haʔ/[39]	→	[wakʰʤiʔjó:haʔ]	*waktsi’ió:ha’*	‘I’m feable’

Chapter 3 Syllable structure

The patterns under focus in the theoretical components of this thesis — the metrical processes and their interactions with epenthesis — are inextricably tied to syllable structure. For example, the metrical processes all make crucial reference to syllable structure: the stress system places stress on the penultimate syllable, Tonic Lengthening lengthens stressed vowels in open syllables, and the minimal word is two syllables. Additionally, epenthesis most commonly occurs cross-linguistically to repair marked syllable structure (Hall, 2011). For these reasons, combined with the absence of any comprehensive syllable structure analyses of Kanien'kéha in the literature, a syllable structure analysis is a necessary piece of any analysis of these patterns. Such an analysis, however, is challenged by a number of factors. Consider the following patterns.

Typically, languages that permit CC clusters tend to have OR (forming a complex onset) or RO (forming a coda-onset) clusters, while heavily constraining OO clusters (recall that R = sonorant consonant, O = oral obstruent) (Hooper, 1976; Clements, 1990). For example, in English, there are OR (e.g. **pl**ate) and RO (e.g. a**mb**er) clusters, and although there are OO clusters, they are restricted in terms of sequencing (e.g. cha**pt**er but not *cha**tp**er). Curiously, Kanien'kéha exhibits the opposite pattern: OR/RO clusters are restricted while OO clusters are completely unrestricted. This is shown in the table in (1), which presents the possible combinations of obstruents and sonorant consonants. The Y axis involves C1 while the X axis involves C2.

(1) CC clusters[1,2,3]

	/j/	/w/	/l/	/n/	/s/	/t/	/k/
/l/	lj						
/n/	nj						
/s/	sj					st	sk
/t/	(tj)				ts	tt	tk
/k/	(kj)	kw			ks	kt	kk

As shown in (1), obstruent clusters are unrestricted in terms of place of articulation and sequencing. Some examples are shown in (2).

[1] As described in Chapter 1, the pronunciation of /kj/ and /tj/ depends on the dialect. In Ahkwesáhsne, these neutralize to [gj], but in Kahnawà:ke, they neutralize to [ʤ].

[2] The glides cannot be the first member of a CC cluster.

[3] I do not include the affricate /ʧ/ nor the complex segment /kw/ in this table. For /ʧ/, this is because it is extremely morphologically limited. That is, while Cʧ sequences are possible to create, and do exist, building a word where a consonant follows /ʧ/ is almost impossible simply for morphological reasons. For /kw/, this is because the left side of the consonant behaves like an obstruent while the right side behaves like a sonorant, making its distribution slightly more complex.

(2) OO clusters

a. /wa-k-a**t-t**akwalihsi-ũ/→[wagat^{h}dagwalíhʃjũ] *wa'kattakwaríhsion* 'I straightened up'

b. /k-a**tk**aʔw-as/→[gat^{h}gà:was:] *katkà:was* 'I let go of it'[4]

c. /la-**ks**a-ʔa/→[laks:à:ʔa] *raksà:'a* 'little child'

On the other hand, CC clusters involving a sonorant consonant are restricted, with RO clusters being completely absent from the language. When underlying OR/RO clusters are created by the morphology, they are broken up by invisible epenthetic [e̲] (with the exception of Cj and kw — see section 3.7). This is shown in (3).

(3) OR/RO clusters and epenthesis

a. /te-**k-l**ik-s/ → [dége̲liks:] *tékeriks* 'I put two things together'

b. /iahũ-**k-n**aʔkal-ũti-ʔ/→[jahũge̲naʔgalű:diʔ] *iahonkena'karón:ti'* 'I threw the dice'

c. /ʌ̃-t-k-wʌ̃n-i**nk**ʌ̃ʔ-nʔ/→[ʌ̃t^{h}ge̲wʌ̃níne̲gʌ̃ʔne̲ʔ] *entkewennínekeʼne'* 'I speak up, out'

This pattern is puzzling. If Kanien'kéha had complex onsets, why would OO clusters be preferable to rising sonority OR clusters? Similarly, if Kanien'kéha had a wide variety of coda-onset clusters, why would OO clusters be preferred over RO clusters? It is not immediately clear what syllable structure constraints are at play in determining which clusters undergo epenthesis and which do not.

To add to the puzzle, it is specifically the invisible epenthetic [e̲] that breaks up these clusters, resulting in, for example, antepenultimate stress in (3a) rather than the canonical penultimate stress. This contrasts with the metrically visible epenthetic [ē] that breaks up underlying CCC clusters (Cē CC). Some examples of metrically visible epenthesis are shown in (4). In these examples, the stress is on the penult (i.e. not shifted) despite one of the final two syllables containing an epenthetic vowel.

(4) Metrically visible epenthesis

a. /s-k-ah**kt-s**/→[s:gáhgēts] *skáhkets* 'I got back'[5]

b. /**k-ks**-o-s/→[gé̄ks:os:] *kéksos* 'I put the dish in water'

c. /wa**k-nj**ak-s/ → [wagénjaks] *wakéniaks* 'I get married'

While the metrical invisibility of epenthetic [e̲] has been extensively studied (e.g. Postal, 1968; Michelson, 1988, 1989; Alderete, 1995; Piggott, 1995; Rowicka, 1999; Rawlins, 2006; Houghton, 2013; Elfner, 2016; Garvin et al., 2019; Adler and Zymet, 2021), the phonotactics have been largely left out. For example,

[4]One speaker that I work with sometimes pronounces an /h/ before /tk/.

[5]Laryngeals preceding CCC clusters are invisible to the process. For this data point this means that /kts/ is the CCC cluster. See section 3.6 for more details.

Alderete (1995) argues that there is a constraint that militates against the footing of epenthetic vowels, but does not connect this constraint to the peculiarity of the location in which [e̲] surfaces. Some others have assumed that metrically invisible [e̲] only breaks up OR clusters, and thus conclude that it militates against rising sonority clusters (e.g. Rawlins, 2006). The only author (as far as I am aware) that takes into account the fact that metrically invisible [e̲] targets most clusters involving a sonorant consonant is Rowicka (1998, 1999, 2001). Rowicka uses Strict CV (Lowenstamm, 1996) (an offshoot of Government Phonology (Kaye, Lowenstamm and Vergnaud, 1990)) wherein all consonants are followed by a nucleus, empty or filled. She argues that metrically invisible [e̲] should be analyzed as an audible empty nucleus, and that empty nuclei become audible when adjacent to a sonorant consonant.[6] However, Rowicka's analysis suggests that the fact that metrically invisible epenthesis breaks up OR/RO clusters but not OO clusters is an accident. I will argue that this placement of metrically invisible epenthesis is not random, and in fact mirrors languages where consonants are gesturally far apart. In these languages OO clusters are phonotactically free, and OR/RO clusters are broken up by an excrescent vowel (e.g. Tashlhiyt Berber (Dell and Elmedlaoui, 1985, 2002), Oowekyala (Howe, 2000), Khmer (Butler, 2014)). The behaviours of the epenthetic vowels will fall out of the analysis once phonotactics are taken seriously.

The formal analysis can be outlined as follows. I will argue, in a Moraic Theory analysis, that the phonotactics of OO and OR/RO clusters, as well as the variable metrical visibility of epenthetic [e] follow from a syllable structure analysis in which the syllable size is constrained, and almost any consonant can be syllabic (the exception being /ʔ).[7] More specifically, I will argue that Kanien'kéha builds maximally CVX syllables (where X is a laryngeal/glottal (G) or the second half of a long vowel) and if a given C cannot syllabify into a syllable of this shape, a syllable node must be projected from it (or an adjacent consonant), creating a syllabic consonant. In the case of a cluster with a sonorant consonant, I will argue that epenthetic [e̲] should be analyzed as phonologized excrescence, and that this can be derived with the same machinery used to build syllabic obstruents. Since laryngeals are the only segments able to syllabify tautosyllabically with the preceding vowel, they will pattern differently.

I will argue that consonants can only get weight in the coda (Weight-by-Position (Hayes, 1989)), and that, consequently, all syllabic consonants are nonmoraic.[8] Since these syllables are nonmoraic, they are invisible to the metrical processes, which will be properly introduced in section 3.1. I will also propose a constraint, the Adjacency Condition (formally defined in section 3.5), on the distribution of nonmoraic syl-

[6] Rowicka accomplishes this with the lateral operation Interonset Government, which normally occurs between consonants spanning an empty nucleus. The governor is an obstruent, while the governee is a sonorant consonant (in most cases). She argues that in Kanien'kéha, sonorant consonants cannot be governed in Interonset Government and consequently, the intervening empty nucleus must be pronounced.

[7] As discussed in section 3.7, I analyze some instances of [j] and [w] as underlyingly vocalic. These can be syllabic (i.e. vowels). The glides that are underlyingly /j/ and /w/ will not be able to be syllabic.

[8] I do not assume syllabic consonants in other languages to be nonmoraic.

lables. This constraint will prohibit nonmoraic syllables from occurring consecutively. I will show that the distribution of the metrically visible epenthetic [e͙] falls out once we assume this constraint. Specifically, I will suggest that the metrically visible epenthetic vowel is inserted in order to prevent violations of the Adjacency Condition.

The rest of this chapter precedes as follows. In the following section, I introduce the metrical processes hinted at in Chapter 2. In section 3.2, I present my theoretical assumptions, detailing the phonological machinery that I assume to analyze the data. After describing my theoretical assumptions, I will show how these assumptions account for the data. In section 3.3, I will discuss OO clusters, arguing that in such clusters a nonmoraic syllable is always built to house one of the obstruents. I will argue that nonmoraic syllables are also built in order to syllabify OR/RO sequences in section 3.4. In these cases, the nucleus will be filled by a metrically invisible vowel. After discussing the different types of nonmoraic syllables, I will introduce the Adjacency Condition in section 3.5. I will argue that this constraint will account for the metrically visible epenthetic vowel. I will then discuss the laryngeals in section 3.6. I will argue that the laryngeals are able to syllabify tautosyllabically with the preceding vowel. Wrapping up the analysis, I will discuss the glides and why they sometimes do not pattern with the other sonorant consonants in section 3.7. Finally, I will argue that metrically invisible epenthesis should be analyzed as phonological in section 3.8.

3.1 Metrical processes

In this section, I will describe the metrical processes that will be used as diagnostics for the syllabification of various clusters, and the visibility of epenthetic vowels: stress placement, Tonic Lengthening, and the word-minimality constraint.

As mentioned above, canonical stress in Kanien'kéha is on the penult. This is shown in (5).

(5) Penultimate stress

a. /ak-hnaʔt-a-htsher-**a**-ʔke/→[akhnaʔdahts:helà:ge] *akhna'tahtsherà:ke* 'On my purse'

b. /kwa-hr**o**ri-s/→[gwahló:lis:] *kwahró:ris* 'I tell you (pl)'

c. /ʌ̃-k-kw**a**tho-ʔ/→[ʌ̃k^{h}gwáthoʔ] *enkkwátho'* 'I will drop by'

When the stressed vowel is in an open syllable, it undergoes Tonic Lengthening, as shown in (6). Tonic Lengthening is blocked before every CC cluster, as shown in (7).[9]

[9]There is another type of lengthening, Laryngeal Lengthening, which can occur before consonant clusters. This is discussed in depth in section 3.6.

(6) Tonic Lengthening

a. /k-hi**a**tũ-s/→[khjá:dũs:] *khiá:tons* ‘I write’

b. /k-ʧikheʔt-a-hn**i**nũ-s/→[kʰʤikheʔdahní:nũs:] *ktsikhe’tahní:nons* ‘I’m buying candy’

c. /te-tia-atʌ̃lo-ʔ/→[degjadʌ́:loʔ] *tetiatén:ro’* ‘the two females match’

(7) Tonic Lengthening blocked before CC clusters

a. /sa-ʔnotst-**o**skũ/→[zaʔnots:dós:gũ] *sa’notstóskon* ‘you are completely naked’

b. /s-ahi-**a**-kha/→[zahjákha] *sahiákha* ‘Go pick berries, fruit!’

c. /t**e**-k-iaʔk-s/→[dégjaʔks:] *tékia’ks* ‘I break it in two’

This could suggest that CC clusters are coda-onset clusters, but I will show that this analysis is untenable. Note that Tonic Lengthening is also blocked before CC clusters that, upon first glance, appear to be either complex onsets or single segments, such as Ch and Cj sequences.

The last metrical process that will be referred to throughout this chapter involves the insertion of [i], which militates against violations of word-minimality. The minimal word in Kanien’kéha is two syllables (I will argue later on that it is two metrically visible syllables). When the morphology creates a sequence with only one syllable, prothetic [i] is inserted. This is shown in (8).

(8) Prothetic [i]

a. /k-ek-s/→[**í:**geks:] *í:keks* ‘I eat’

b. /s-owh/→[ˈi:zof] ***í:sowh*** ‘you put it in the water’

c. /k-ko-as/→[**í**kʰgwas:] *íkkwas* ‘I am picking it’

Note that since stress is on the penult, and any word without a penult will insert [i] in order to form a penult, prothetic [i] is always stressed. In this way, prothetic [i], unlike epenthetic [e] is always metrically visible.

3.2 Theoretical assumptions

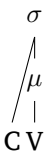
3.2.1 Building syllables

In this section, I will describe how I assume Moraic Theory, within which syllables will be built serially using a right-to-left syllabification algorithm. Additionally, I will justify my usage of nonmoraic syllables, arguing that the absence/presence of a mora is an ideal way to capture metrical (in)visibility.

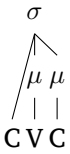
As stated above, I assume syllables to be built within Moraic Theory (Hyman, 1985; Hayes, 1989).[10] I assume that all underlying vowels have intrinsic moras, while consonants can only be assigned a mora in the coda (i.e. Weight-by-Position (WBP)) (Hayes, 1989). Sample CV and CVC syllables are shown in (9).

(9) Moraic Theory syllables

a. CV syllable



b. CVC syllable



Moraic structures will be built serially, in two parses. In the first parse, core syllables will be built ((C)V). That is, all underlying vowels project a syllable node, and if there is a preceding segment that can syllabify in the onset, it will. In the second parse, all remaining segments will be syllabified. A sample derivation of a CVCCV string is shown in (10) (in which the CC string forms a coda-onset).

(10) Syllabifying CVCCV in two parses

a. Core syllables



b. Syllabifying remaining segments



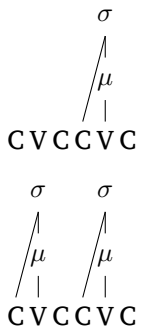
I assume that segments are parsed into syllables parametrically from right-to-left (Itô, 1988). This will account for the placement of the metrically visible epenthetic vowel (among other patterns). In the first

[10] Another option is to analyze Kanien'kéha syllables using Onset-Rhyme theory. While this would be possible, there are two main advantages to Moraic Theory in accounting for the patterns in Kanien'kéha. Firstly, Moraic Theory provides a straightforward way of accounting for metrical visibility (moraic units are visible, nonmoraic units are not), while Onset-Rhyme theory does not. One might be able to say that nuclei that are filled are metrically visible while nuclei that are empty are invisible. However, this leads to the second advantage of Moraic Theory in accounting for the patterns in Kanien'kéha. Moraic Theory allows for the representation of a filled nucleus that is also nonmoraic (and thus invisible), accounting for C<u>e</u> whereas this is not possible (or the very least, less feasible) in Onset-Rhyme theory, in which it would be challenging to capture a syllable with a filled nucleus that is also metrically invisible. If the nucleus of a syllable is filled, in what way could it be metrically invisible? For these reasons, Moraic Theory better fits the Kanien'kéha data.

parse, a CV sequence cannot be syllabified until all CV units to its right are syllabified. In the second parse, a consonant cannot be syllabified if there are any consonants to its right that have not yet been syllabified. The derivation in (11) illustrates this in a CVCCVC sequence (where the second and fourth consonants can syllabify into the coda).

(11) Syllabifying CVCCVC serially

(11) Parse 1: Core syllables



(12) Parse 2: Syllabifying remaining segments



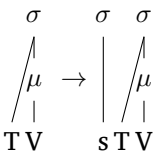
To account for the unexpected phonotactics (some of which were described at the outset of this chapter), I assume that segments generally remain featurally unchanged from input to output (i.e. are faithful), forcing the syllabification system to accommodate them by projecting additional syllable nodes. When a given segment cannot be syllabified into an existing CVX syllable, I assume that the segment is syllabified according to a sonority-driven syllabification algorithm, similar to what is proposed for Tashlhiyt Berber (Dell and Elmedlaoui, 1985, 2002). More specifically, a syllable node is projected from the most sonorous nearby element (to be defined shortly). Stay-tuned for an illustration of how this works. I assume the sonority hierarchy in (13).

(13) Sonority hierarchy

Vowels > Sonorant consonants > h > s > Stops, /ʧ/, /kw/[11,12]

The sonority-driven syllabication algorithm works as follows: as described above, core CV syllables are built in the first parse. In the second parse, segments that have not already been syllabified syllabify into existing syllables. If a given segment needs to be syllabified but cannot syllabify into an existing syllable, the surrounding elements are "scanned" to determine the best candidate to project an additional syllable node. Scanning applies serially, scanning the most sonorous elements first: the unsyllabified segment first looks for the most sonorous element (i.e. vowels) in the adjacent segments from right to left. If there is an available vowel that can project a syllable node, it does so. Since the scanning proceeds from right to left, if there are two adjacent vowels, the rightmost one projects a syllable node. If there are no vowels to project an additional syllable node, the algorithm proceeds to look for the second most sonorous element (i.e. sonorant consonants). This process proceeds until a syllable node is projected, housing the unsyllabified segment. Let us consider an example string sTV, where T is a stop and thus has lower sonority than the preceding /s/ (as specified in (13)). In this example, TV has already been syllabified as a CV syllable, so it is /s/'s 'turn'. This is shown in (14).

(14) Sonority-driven syllabification: sTV



In (14), /s/ cannot syllabify into the existing syllable as this would result in a complex onset which, as mentioned above, I argue are not licit in Kanien'kéha. In order to syllabify /s/, another syllable node must be projected. /s/ scans its options: /s/ and T. /s/ has the highest sonority, so it projects a syllable node.

Note that I use the word 'element' as a cover term for both segments and features. This is because I am assuming that a single feature is able to a project a syllable node. Specifically, I will argue that the feature [Sonorant Voice] ([SV]) (Rice, 1993) is able to project a syllable node from a sonorant consonant, yielding a vowel. Recall that I argued in section 2.2 that [SV] is the voicing feature in all sonorant segments in Kanien'kéha in order to capture the prevocalic voicing process in which obstruents surface as voiced when immediately preceding vowels. Since vowels are the most sonorous of the sonorants, when [SV] appears without manner features, it is pronounced as a vowel.

[11] I treat /ʔ/ as a sonorant consonant. This will be justified in section 3.6.

[12] See Parker (2002) and the references therein for a discussion on why /h/ might have higher sonority than /s/.

There are two other aspects of syllable structure that I assume are governed by sonority: onset-nucleus relationships, and coda-onset relationships. Since a prototypical syllable is CV, there is a rise in sonority from the onset to nucleus. Even though any consonant can be syllabic in Kanien'kéha, I assume that the Sonority Sequencing Principle still holds (e.g. rising sonority /ts/ is a licit onset-nucleus sequence, whereas falling sonority /st/ is not, as per (13)). I also assume that coda-onset sequences must fall in sonority (i.e. the Syllable Contact Law (in the spirit of Hooper, 1976; Murray and Vennemann, 1983)). These assumptions are presented in (15) and (16).

(15) Onset-Nucleus rise: Onset-nucleus sequences rise in sonority.

(16) Syllable Contact Law: Coda-onset sequences fall in sonority.

Lastly, as outlined in section 2.2, I assume that all vowels have the feature [voc], and that this is what distinguishes vowels from their glide counterparts ([i]~[j] and [o]~[w]).

My analysis of syllable structure and epenthesis will fall out of these assumptions (in combination with the assumption that syllables can be nonmoraic — to be spelled out in the following section).

After syllabification, metrical processes (e.g. Tonic Lengthening) will occur. For this reason, these processes will not be included in the representations in this chapter. The metrical processes will be analyzed in depth in Chapter 4.

3.2.2 Nonmoraic syllables

As shown in the previous section, I assume that syllable nodes can be projected from consonants. The question now is whether these syllabic consonants are moraic or not. I assume that they are not. This is because I assume that consonants can only be assigned weight when in the coda. That is, since consonants do not have an underlying mora (as opposed to vowels), and they only get weight in the coda (as opposed to in the nucleus), when consonants become syllabic, they form nonmoraic syllables. Some of the nonmoraic syllables I assume are in (17).

(17) Weightless syllables



I follow other authors like Hyman (1985), Crosswhite (1999), and Shih (2018) in arguing that representing a syllable as weightless is necessary to account for a number of different patterns (cf. Hayes, 1989). Since the mora is an abstract unit used to account for a given segment's relevance to a variety of metrical

processes (e.g. stress, tone, lengthening), the assertion that a syllable can be weightless carries clear predictions. That is, a weightless syllable will be *invisible* to these metrical processes. For example, a weightless syllable will be invisible to a stress placement process that is sensitive to moras (although the exact process by which this happens will be elaborated in Chapter 4).

Although the majority of the papers asserting that syllables can be weightless are referring to syllables with schwa (Hyman, 1985; Kager, 1989; Crosswhite, 1999; Féry, 2003; Shih, 2018)[13] some others have argued that nonmoraic representations should be used for syllables that resemble syllables that I will propose are nonmoraic in Kanien'kéha. For example, to account for their invisibility to reduplication, Shaw (1993) proposes that C syllables in Kammu are nonmoraic. Nonmoraicity has been used in the Kanien'kéha literature as well; Piggott (1995) and Mellander (2002) proposed that metrically invisible Ce̲ syllables are nonmoraic, which is a position I will also adopt. The analysis in Michelson (1989) is consistent with this as well.

I will also show that the ability to create nonmoraic syllables is an additional advantage of Moraic Theory for analyzing Kanien'kéha. This is because the mora expresses both weight and position. This means that segments may have moras, or lack them, resulting in metrical visibility or invisibility, respectively. However, see Rowicka (1998, 1999, 2001) and Vancaeyzeele (2022) for how this might work in Government Phonology (Kaye, Lowenstamm and Vergnaud, 1990; Scheer, 2004).

3.3 Obstruent clusters

In this section I will show how the above described theoretical assumptions and analytical architecture can account for the various ways in which OO clusters pattern. I will argue that in OO clusters, one of the obstruents always becomes syllabic, undergoing augmentation (to be described shortly) as a result. When an obstruent becomes syllabic, it creates a nonmoraic syllable. I will show how this analysis accounts for the free phonotactics in OO clusters as well as show how this analysis correctly predicts how these clusters behave in reference to metrical processes. I will start by describing OO clusters in more detail, showing why more conventional analyses will not work, then provide my analysis.

3.3.1 Obstruent clusters: the data

In this section, I will describe OO clusters in more detail, focusing on phonotactics and metrical processes. Throughout this section, I will evaluate the possible conventional analyses of these clusters, with an emphasis on ruling out the coda-onset analysis. All of the phonotactic patterns that I describe apply to word-

[13] Kager (1989) is cited in van Oostendorp (1995).

medial and word-initial OO clusters, but not word-final clusters (which are much more restricted). I will leave word-final OO clusters to section 3.5.

To my knowledge, no one in the literature argues that Kanien'kéha OO clusters are complex onsets, instead arguing that they are coda-onset clusters. This is because all OO clusters block Tonic Lengthening on the preceding stressed vowel, ruling out a complex onset analysis. This is shown in (18).

(18) OO clusters block Tonic Lengthening

a. /loti-nũhwa**kt**-a-ni/→[lodinũhwákʰdani] *rotinonhwáktani* 'they are sick'

b. /waʔ-k-attok-ʔ/→[waʔgátˀtogeʔ] *wa'káttoke'* 'I noticed it'

c. /sa-ʔnotst-o**sk**ũ/→[zaʔnots:dós:gũ] *sa'notstóskon* 'you are completely naked'[14]

The pattern in (18) has led the majority of the literature (although originally suggested by Hyman (1977)) to assume that OO clusters form coda-onset clusters, and that the coda is providing weight, nullifying the need for lengthening.[15,16] However, this assumption incorrectly predicts that no type of lengthening ever occur before an OO sequence, which is not the case. As shown in (19), a different type of lengthening, Laryngeal Lengthening can occur before OO clusters. This happens specifically when the OO cluster is preceded underlyingly by a laryngeal.[17] Although this could be attributed to Compensatory Lengthening, Compensatory Lengthening should be blocked in precisely this context if the following C is in coda.

(19) Laryngeal Lengthening before OO clusters

a. /waʔ-k-ate-ien-oʔ**kt**-ʌ̃ʔ/→[waʔgadejenò:kʰdʌ̃ʔ] *wa'kateienò:kten'* 'I ran out of oil or gas'

b. /k-at-ʔ**sk**o-s/→[gadɛ̀:s:gos:] *katè:skos* 'I get into water'

c. /waʔ-**k-k**o-ʔ/ → [wà:kʰgoʔ] *wà:kko'* 'I picked it'

In assuming that OO clusters block Tonic Lengthening because the first O is in coda, we are making two additional assumptions. First, we are assuming that the stressed vowel is lengthening to make the stressed syllable heavy, and second that the coda is accomplishing the same goal (i.e. it contributes weight). That

[14]When /s/ is in an OO sequence, it surfaces as long. I will discuss this more shortly.

[15]The other argument that most authors use is that OR clusters are broken up by epenthesis to militate against rising sonority coda-onset clusters (e.g. Rawlins). However, these authors are under the incorrect assumption that RO clusters are not broken up by epenthesis. This means that they can argue that since OO clusters block lengthening, and rising sonority clusters are illicit (due to the Syllable Contact Law), OO clusters must be coda-onset.

[16]These authors also do not attempt to address asymmetries at the word-edges. That is, word-initial OO clusters are extremely common while word-final OO clusters are not. While this is not necessarily insurmountable, it is not entirely clear what the coda-onset analysis predicts for the word-edges, given that word-final CC clusters can be coda-onset (Kaye, 1990*b*), as well as word-initial CC clusters (Goad, 2012).

[17]I follow Michelson (1988), in calling this Laryngeal Lengthening. Regardless of whether Laryngeal Lengthening and Tonic Lengthening are the same process, they should be blocked by a coda, as a long vowel + a coda would result in a trimoraic syllable. If Kanien'kéha allowed trimoraic syllables, we would expect Tonic Lengthening to always occur before OO clusters. I will discuss this process in more depth in section (3.6).

Laryngeal Lengthening can occur before OO clusters, then suggests that there could be some other reason why Tonic Lengthening is being blocked before OO clusters.

The coda-onset analysis also makes a series of incorrect predictions as to the phonotactics of OO clusters.

First of all, the coda-onset analysis of OO clusters incorrectly predicts that RO clusters should be licit. This is because falling sonority is the preferred sonority profile of coda-onset clusters cross-linguistically (Hooper, 1976; Murray and Vennemann, 1983; Clements, 1990; Rice, 1992). In this way, we would predict that any language that has OO coda-onset clusters, also has RO coda-onset clusters. For example, in English, OO clusters are fine (e.g. *actor*), but so are RO clusters (e.g. *alpine*). As described above, RO clusters in Kanien'kéha are broken up with the metrically invisible epenthetic vowel. This is shown in (20).

(20) RO clusters and epenthesis[18,19]

a. /io-ʧi**nkw**al/→[oʤíne̲gwaḷ̥] *otsínekwar* 'yellow, orange'[20]

b. /ie-k-iaʔt-i**nk**ʌ̃h-s/ → [jegjaʔdíne̲gʌ̃hs:] *ietia'tínekenhs* 'I let it out (an animal)'

c. /ʌ̃-t-k-wʌ̃n-i**nk**ʌ̃ʔ-nʔ/→[ʌ̃t^{h}ge̲wʌ̃níne̲gʌ̃ʔne̲ʔ] *entkewennínekenʼne'* 'I speak up, out'

These data show that, purely based on the existence of OO clusters and the absence of RO clusters, a coda-onset analysis of OO clusters is on less sturdy ground. In order to maintain the coda-onset analysis, we would have to say that, contrary to what is common cross-linguistically, OO forms a better coda-onset than RO in Kanien'kéha. Due to the fact that the vast majority of authors who have written about Kanien'kéha assume that OO clusters (along with all other CC clusters) form coda-onsets (e.g. Michelson, 1988; Piggott, 1995; Hagstrom, 1997; Rawlins, 2006), I will continue to evaluate this analysis, illustrating the undesirable assumptions one would have to make in order to analyze OO clusters as coda-onset.

Based on the fact that RO clusters are broken up in Kanien'kéha, one could make the typologically unusual claim that coda-onset clusters in Kanien'kéha must have flat sonority. However, this assertion would make two incorrect predictions as to the profile of Kanien'kéha CC clusters. Firstly, this might suggest that flat-sonority RR clusters should be licit when this is not the case; RR clusters are broken up with epenthesis. This is shown in (21).

[18]Michelson (1988) mentions that /rk/ is a licit sequence, however, she was referring to [è:rhar khok], which is across a word-boundary. Michelson has clarified that this is an error (p.c.).

[19]In the majority of cases, RO clusters are militated against via allomorphy. The remaining RO clusters that are militated against via epenthesis all have the profile /nk/.

[20]This form is pronounced as [odzì:ne̲gwaɽ] in Kahnawà:ke. We can still tell that [e̲] is epenthetic because it is skipped by the stress placement system.

(21) RR clusters are broken up with epenthesis

a. /io-ia**nl**e-ʔ/→[jojáne̲leʔ] *ioiánere'* 'it is good'

b. /io-**wl**-aʔ/→[ówe̲laʔ] *ówera'* 'wind', 'air'

c. /wak-akia**nl**ũ-ʔs/→[wagagjáne̲lũʔs] *wakatiáneron's* 'I get scared'

Secondly, the assertion that coda-onset clusters must have flat sonority would also make the wrong prediction as to Cj and kw sequences.[21] This is because Cj and kw sequences, like OO sequences, block Tonic Lengthening on the preceding vowel (ruling out a complex onset analysis). If OO clusters should be analyzed as coda-onset due to the Tonic Lengthening facts, then Cj and kw sequences should be analyzed in the same way. This is shown in (22).

(22) Cj sequences block Tonic Lengthening[22]

a. /te-**k-i**aʔk-s/→[dégjaʔks:] *tékia'ks* 'I break it in two'

b. /tʌ̃k-nũ**ni**-a-hkw-ʔ/→[dʌ̃ge̲nű́njahgwe̲ʔ] *tenkenónniahkwe'* 'I will dance'

c. /k-ka**li**aʔk-s/→[k^{h}gáljaʔks:] *kkária'ks* 'I pay'

(23) kw sequences

a. /ie-l-a-**ko**-as-kwʔ/→[jelágwas:gweʔ] *ierákwaskwe'* 'she used to choose'

b. /io-ne**ko**-aʔ/→[onégwaʔ] *onékwa'* 'pea, pill'

c. /k-iʌ̃t-a-**ko**-as/→[gjʌ̃dágwas] *kientákwas* 'I collect wood'

If coda-onset clusters were restricted to having flat sonority, then we would not expect Cj sequences to be behaving like they are coda-onset sequences by blocking Tonic Lengthening.

In order to account for the observations that Cj and OO clusters block Tonic Lengthening, and RO and RR sequences are illicit, one could make the claim that Kanien'kéha allows only rising and flat sonority coda-onset clusters (where RR clusters are ruled out for a different reason). However, this would incorrectly predict that OR clusters are licit coda-onset clusters, when in reality most OR clusters are broken up by epenthesis. This is shown in (24).

[21]Note that /kw/ sequences should not be confused with the single segment /kw/. See section 3.7 for a longer discussion of Cj and kw sequences.

[22]As described in section 1.2, in Ahkwesáhsne Cj sequences there is a dorsalization process whereas in Kahnwà:ke Cj sequences there is a palatalization process. This results in /t/ surfacing as [g], and /s/ surfacing as [ʃ]. I assume that the sonorant consonants also undergo a place change but it is much more subtle and difficult to hear. This is because a post-alveolar /n/ or /l/ will sound very similar to an alveolar one before [j].

(24) OR is broken up by epenthesis

a. /te-**k-l**ik-s/ → [dége̲liks:] *tékeriks* ‘I put two things together’

b. /iahũ-**k-n**aʔkal-ũti-ʔ/→[jahũge̲naʔgalű̃:diʔ] *iahonkena’karón:ti’* ‘I threw the dice’

c. /**tn**-ehl-ʔ/→[íde̲nehle̲ʔ] *ítenehre’* ‘you and I want’

In order to maintain the coda-onset analysis of OO clusters, one would have to say that sonority is completely irrelevant to coda-onset clusters in Kanien’kéha, and that there are other pressures that shape the profile of coda-onset clusters. I will now explore a number of pressures that tend to shape coda-onset clusters cross-linguistically, showing that these also do not play a role in determining the profile of OO clusters in Kanien’kéha.

One factor that may be at play in determining the profile of coda-onset sequences in Kanien’kéha is the restriction on place. Cross-linguistically, coda-onset sequences tend to match in place, with the coda ‘submitting’ to the place of the onset (Itô, 1988; Steriade, 1994; Beckman, 1998; Rubach, 2008; Henke, Kaisse and Wright, 2012). This is especially the case in flat-sonority coda-onset clusters (i.e. geminates) (Prince, 1984; Goldsmith, 1990). In Kanien’kéha, OO clusters are unrestricted in place, as shown in (25) (also see the table in (1)).

(25) OO clusters unrestricted in place

a. /**t-k**a-ʔwaʔl-a/ → [tʰgaʔwà:la] *tka’wà:ra* ‘meat pie’

b. /a**k-**ʧenh-aʔ/→[akʰʤʌ́haʔ] *aktsiénha’* ‘my fire’

c. /waʔ-k-a**t-t**akwalihsi-ũ/→[waʔgatʰdagwalíhʃjũ] *wa’kattakwarí*hsion ‘I straightened up’

While it is possible for OO clusters to match in place (see (25c)), they do not need to. This shows that the conventional place constraints on coda-onset clusters cross-linguistically are also not present in Kanien’kéha. The data in (25c) also challenges the possible complex onset analysis of OO clusters. This is because complex onsets tend to not have the same place of articulation cross-linguistically (Harris, 1994; Goldsmith, 2011), but the OO cluster in (25c) does so without a problem. In fact, these consonants do not just share a place of articulation, they are identical. The only exception to the pattern that identical obstruents can follow each other, is /ss/ clusters, which surface as [ts]. This is shown in (26).

(26) /ss/ sequences

a. /**s-s**tath-a-ʔt-haʔ/→[ts:dathà:thaʔ] *tstathà:tha'* 'you're drying it'

b. /**s-s**aheʔt-ak-s/→[ts:ahè:daks:] *tsahè:taks* 'you eat beans'

Given the patterns we have seen so far, a proponent of the coda-onset analysis of OO clusters would have to argue that sonority and place of articulation are irrelevant to the well-formedness of coda-onset clusters in Kanien'kéha. However, it will get increasingly difficult to argue for the coda-onset analysis once we consider additional factors that shape coda-onset clusters cross-linguistically.

Another factor that tends to shape coda-onset clusters cross-linguistically is a constraint on sequencing (Kaye et al. 1990). That is, if AB is a licit coda-onset cluster in a given language, then BA is not. For example, in English, [lp] and [kt] are licit coda onsets (e.g. *tra[kt]or* and *a[lp]ine*) but not [pl] or [tk] (word-medial [pl] is analyzed as a complex onset) (Rice, 1992; Harris, 1994). In Kanien'kéha, there are no sequencing constraints in OO clusters. This is shown in (27).

(27) OO clusters and sequencing

a. /tk/∼/kt/

i. /loti-nũhwa**kt**-a-ni/→[lodinũhwákʰdani] *rotinonhwáktani* 'They are sick'

ii. /k-a**tk**aʔw-as/→[gatʰgà:was:] *katkà:was* 'I let go of it'

b. /sk/∼/ks/

i. /**k-s**aheʔt-a-iʌ̃tho-wa-ko-as/→[ks:aheʔdajʌ̃thwágwas:] *ksahe'taienthwákwas* 'I am harvesting beans'

ii. /**s-k**al/→[ís:gal̥] *ískar* 'Peel off the bark!'

The data in (27) also further challenges the complex-onset analysis, as sequencing constraints are also expected in complex onsets (e.g. *kl* is a licit complex onset in English, but not *lk*).

There also tend to be constraints on voicing in coda-onset clusters cross-linguistically. That is, coda-onset clusters tend to match in voicing (especially in OO clusters) (Rubach and Booij, 1990; Lombardi, 1991; Padgett, 1991; Chitoran, 1998; Lombardi, 1999; Rubach, 2008). Although Kanien'kéha does not have a voicing contrast in obstruents, obstruents can become voiced when preceding vowels, and aspirated when preceding obstruents. This means that OOV sequences surface with the obstruents disagreeing in voicing: the first obstruent is voiceless aspirated because it is followed by an obstruent, and the second obstruent is voiced unaspirated because it is followed by a vowel.[23] This is shown in the above examples as well as in (28).

[23]See the discussion on [SV] and voicing in Chapter 2.

(28) OO clusters and voicing

a. /**k-t**akeliʔta-s/→[k^{h}dagelì:das:] *ktakerì:tas* 'I am frying'

b. /ʌ̃-**t-k**-wʌ̃n-inkʌ̃ʔ-nʔ/→[ʌ̃t^{h}gewʌ̃níne̲gʌ̃ʔneʔ] *entkewennínekeʼne'* 'I speak up, out'

This voicing mismatch in many OO clusters further challenges the coda-onset analysis.

It is also striking that Kanien'kéha OO clusters are often gesturally distant, such as in the examples in (28). That is, in TT sequences the first stop is aspirated.[24] When /s/ is involved, the gestural space between the obstruents is filled by /s/. That is, regardless of the position of /s/ in an OO cluster it lengthens to fill the intervening space.[25] This is shown in (29).

(29) Gestural distance and sO/Os sequences

a. /aseʔ**s-**ʧʲ i/→[azéʔs:ʤi] *aséʼstsi* 'it is new'

b. /la-**ks**a-ʔa/→[laks:à:ʔa] *raksà:ʼa* 'little child'

c. /te-k-ie**st**-a-niũ-s/ → [degjes:dánjũs:] *tekiestánions* 'I am mixing them all together'

Gestural distance between consonants is also atypical of coda-onset clusters cross-linguistically.[26] Gestural distance is also atypical of complex onsets cross-linguistically, which tend to overlap in place (e.g. /l/ becomes devoiced following /p/ in English because of gestural overlap: *p[l̥]ace*) (Browman and Goldstein, 1986; Shaw, 2010).

At this point, if we were to hold onto the coda-onset analysis, we would have to make the undesirable claim that Kanien'kéha coda-onset clusters do not resemble in almost any way coda-onset clusters cross-linguistically: they are free in terms of sonority, place, sequencing, and are gesturally distant.[27] Additionally, it would still be unclear why OR/RO clusters are worse coda-onset clusters than OO clusters. In this way, the coda-onset analysis has very little explanatory power.

Rather than making typologically odd claims about what it means to be a coda-onset or complex onset cluster in order to account for Kanien'kéha OO clusters, it is preferable to assume these sequences to be

[24] As noted by Bonvillain (1973), Ahkwesáhsne speakers do not always release the stops when the TT cluster is homorganic. The resulting sequence can sound like a geminate. This is even the case in some /tht/ sequences: /io-at-hte̲lũ/→[jótʰhde̲lũ] *iótheteron* 'it is dangerous'. Other languages reportedly do this as well when there are adjacent homorganic stops that would otherwise have a release (e.g. in Finnish (Hall, 2003) and Tashlhiyt Berber (Dell and Elmedlaoui, 2002)). Whereas Bonvillain states this as an absolute in Kanien'kéha, I have found much more variation in my work with fluent speakers.

[25] This is not discussed in any of the previous literature on Kanien'kéha although Karin Michelson has noted to me that /s/ also seems to be very long in Oneida. A deeper phonetic analysis should be done in the future to clarify this claim. Appendix C includes some anecdotal spectrograms comparing English and Kanien'kéha /s/s, as well as TT sequences separated by aspiration.

[26] The reason codas tend to match in place with the following onset is that they are generally gesturally close, making it difficult to perceive a change in place of articulation from coda to onset (Steriade, 1994; Henke, Kaisse and Wright, 2012).

[27] This lack of restrictions might lead the reader to suggest extrasyllabicity (à la Bagemihl, 1991). However, it is unclear to me how this would work. While an extrasyllabicity analysis correctly predicts that there would be no phonotactic relationship in OO clusters (as the two consonants would not be visible to each other), it incorrectly predicts that OR/RO clusters should also be licit. One could say that while extrasyllabicity predicts the lack of phonotactic constraints relevant to syllable structure, there are additional phonotactic constraints that hold regardless of syllable structural relationship (à la Broselow, 1982). However, this analysis would not predict anything.

bogus clusters (in the sense of Harris (1994)) that require a different analysis.

To conclude this section, I have shown that more conventional analyses of OO clusters in Kanien'kéha (e.g. coda-onset, complex onset) are undesirable as they incorrectly predict the shape and behaviour of these clusters. OO clusters are phonotactically unrestricted, and gesturally distant, making them unlikely candidates for coda-onset clusters or complex onsets. Neither of these analyses account for why Tonic Lengthening is blocked by OO clusters, but Laryngeal Lengthening is not. Finally, neither analysis can account for why OO clusters are preferred over OR/RO clusters.

In the following section, I will argue that in OO clusters, one of the consonants is always syllabic and that this correctly predicts the phonotactics, as well as the observation that they are not broken up by epenthesis whereas the cross-linguistically less marked OR/RO clusters are.

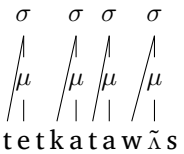
3.3.2 Obstruent clusters: the analysis

In this section, I will show how the theoretical assumptions laid out in section 3.2 can account for OO clusters (i.e. within a framework where all syllables are maximally CVX, where X = V or G). In order to account for the phonotactics of OO clusters, I will argue that in these clusters one of the obstruents is syllabic, and that which obstruent is syllabic depends on relative sonority (see the sonority hierarchy in (13)). I will show in sections 3.4 and 3.5 how this analysis accounts for how OO clusters interact with epenthesis.

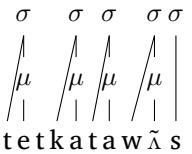
I will start by discussing flat sonority TT clusters. Since there are no complex onsets in Kanien'kéha, and the coda is limited to the laryngeals, TT clusters are faced with a syllabification crisis: how will this sequence be syllabified? I argue that the leftmost consonant projects a syllable node, resulting in aspiration. This is predicted by the sonority-driven algorithm, as shown in (30).

(30) Syllabifying OO sequences
/iah te-**t-k**-at-awʌ̃-s/→[jah detʰgadá:wʌ̃s:] *Iah tetkatá:wens* 'I don't swim there'

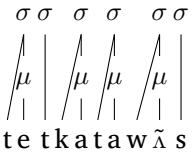
a. CV units built



b. /s/ cannot syllabify in the coda, so it must project a syllable node.



c. /t/ cannot form a complex onset, nor be in the coda, so it must project a syllable node.



In (30a) the core CV syllables are built. After the first parse, syllabification starts again at the right edge to syllabify the unsyllabified segments. In (30b), the /s/ syllabifies as its own segment because the coda can only host laryngeals (as specified in the section on theoretical assumptions). I will return to this in section 3.5. In (30c), /t/ needs to be syllabified. /t/ cannot attach to the following onset because there are no complex onsets, and it cannot attach to the preceding syllable as a coda because codas are limited to laryngeals. Another syllable node must be projected to house /t/. The two available options to project a syllable node are /t/ and /k/. The rightmost element is /k/, but projecting a syllable node from /k/ would not help in syllabifying /t/ because a /tk/ onset-nucleus sequence would form an illicit flat sonority onset-nucleus sequence. The only option then is for /t/ to project its own syllable node.[28]

Recall that a stop in the first slot of a TT sequence is aspirated. I argue that this is a result of the stop being syllabic. That is, when a consonant becomes syllabic, it undergoes augmentation.[29] In the case of syllabic stops, they become aspirated. In the case of syllabic /s/, the /s/ lengthens. I propose that whenever an obstruent is predicted to be syllabic by my analysis, it undergoes this sort of augmentation. Further, I propose that this should be analyzed as a phonologized version of the transitions that occur in languages such as Khmer (Thomas, 1992; Pittayaporn, 2015), Tashlhiyt Berber (Dell and Elmedlaoui, 1985, 2002), and Piro (Matteson and Pike, 1958) (see a more in depth explanation of phonologization in section 3.4).[30,31] I will argue in section 3.4 that metrically invisible epenthesis can be understood as a phonologized transition as well (albeit derived slightly differently from the phonologized transition in OO clusters). Note that the parallels between these languages and Kanien'kéha do not stop at transitions. Just like Kanien'kéha, the above-mentioned languages also tend to have free phonotactics between obstruents.

Falling sonority OO clusters are syllabified in the exact same way as flat sonority OO clusters. This is shown in (31) in which the OO cluster falls in sonority from /s/ to the following /t/.

[28]A possible theoretical option is to have the segment projecting the syllable node project its own onset as well. As described by Goad (2002), this could account for the aspiration on the first T and the length on /s/. However, this representation would be impossible to express in moraic theory if the nucleus is weightless. Additionally, I will show subsequently that the lengthening of /s/ occurs when there already is an onset preceding syllabic /s/ (in Cs syllables). This means that the augmentation happens independently, and there is no need to posit onset projection from the same segment.

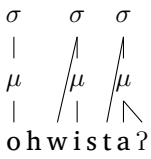
[29]I do not make any assumptions about how this might work featurally, or if there are features involved at all. I leave this to future research.

[30]Matteson and Pike (1958) argues that aspiration in Piro is devoiced schwa.

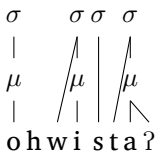
[31]This analysis also accounts for why this aspiration sometimes does not occur between homorganic TT sequences in Ahkwesáhsne: no transition was necessary between segments that have the same place of articulation. That being said, if phonetic transition was the entire purpose of the aspiration, then there would be no instances in which aspiration occurs between homorganic stops. This is not the case. Homorganic TT sequences are sometimes produced with aspiration in Ahkwesáhsne, and all of the time in Kahnawà:ke. This suggests that this is not just a byproduct of syllable structure, but a phonologized component of it.

(31) Syllabifying sT sequences
/io-hwi**st**-aʔ/→[ohwís:daʔ] *ohwísta'* 'money', 'bell', 'metal'

a. Core syllables built



b. /s/ projects syllable node



In (31a), core syllabification has occurred and the second parse has begun, syllabifying /ʔ/ (the syllabification of /ʔ/ will be described in section 3.6). The next segment to be syllabified in the second parse is /s/. /s/ cannot attach to the syllable to its right because complex onsets are not permitted in the language. /s/ is also prevented from syllabifying into the coda of the preceding syllable because the coda is limited to the laryngeals. /s/ must instead project its own syllable node in (31b). This analysis correctly predicts that /s/ lengthens as a result of augmentation, mirroring the behaviour of /s/ in gesturally distant CC clusters cross-linguistically (e.g. in Nuxalk (Hoard, 1978)).[32,33]

Word-final singleton obstruents can be dealt with in the same way as the first member of flat and falling sonority OO clusters. They cannot be syllabified into the preceding syllable as the coda, and there is no following syllable in which to syllabify, so it must project a syllable node. This correctly predicts that word-final obstruents also undergo augmentation (i.e. stop aspiration, and /s/ length). This is shown with word-final /s/, in (30).

In both flat and falling sonority OO clusters, a syllable consisting of an obstruent is built. Since the syllable node is projected from a consonant, and consonants can only get weight in the coda, the O syllable is nonmoraic. This results in the O syllable being metrically invisible (i.e. not counted by stress, nor word-minimality). These syllables behave exactly like Ce̲/Re̲ syllables, which I will discuss in section 3.4. Metrically invisible O syllables are shown in (32).

[32]An alternative analysis is that /s/ is normally long but shortens when word-initial, intervocalic, and in h_s position. However, this analysis is less parsimonious. Additionally, I don't see why this would be the case, especially considering that the short /s/s are in (what appears to be) onset position.

[33]/s/ also seems to be able to be phonetically lengthened. We can see this word-finally and in h_V position. Word-finally, /s/ is much longer than even the instances of long /s/. I attributed this to final lengthening, which is a phonetic process (Barnes, 2006). Additionally, whereas the /s/ in VhsV sequences is normally short, it sometimes eclipses the preceding /h/ creating a long /s/ and ostensibly deleting the /h/. This is not a regular process, and as far as I can tell, is unpredictable based on the phonology. I assume that this is a phonetic process.

(32) O is metrically invisible

a. /t-aũ**s-tw**-atat-kɤ̃-ʔ/→[da.ũ.z̲e̲.de̲.wa.dá.**t^{h}**.gɤ̃ʔ] *taonsetewatátken'* 'we (you all and I) should meet again'

b. /k-oh-s/→[í:.goh.**s:**] *í:kohs* 'I put it into water'

In (32a), stress is on the penultimate vowel, ignoring the O syllable. This can help us understand the stress system: stress only counts moraic syllables as it is placed on the penultimate moraic syllable.[34] I will discuss this in more depth in Chapter 4. In (32b), the underlying segments form the two syllables [goh] and [s:]. Despite this, the prothetic [i] is inserted to ensure that the minimal word is two *moraic syllables*.

The nonmoraicity of O syllables is also how I will account for why Tonic Lengthening is blocked before OO clusters. I argue that Tonic Lengthening on the stressed vowel is blocked when the following syllable is nonmoraic (as it is also blocked before Ce̲/Re̲ syllables). Specifically (and I will argue for this in more detail in Chapter 4), I propose that Tonic Lengthening occurs as a response to a constraint — Head-Prominence (adapted from Mellander (2002)) — that says that the stressed syllable must be heavier than the immediately following syllable.[35] When the immediately following syllable is nonmoraic, there is no need for Tonic Lengthening to occur as the moraic stressed syllable is already heavier then nonmoraic following syllable. Thus, this constraint predicts where and when Tonic Lengthening should occur. Additionally, whereas the coda-onset analysis of OO clusters would predict that lengthening should never occur before OO clusters regardless of the reason for the lengthening (as the coda would always block lengthening), the Head-Prominence constraint and current syllabification analysis allows for there to be lengthening before such clusters, as long as the lengthening is driven by a different constraint. I will argue that this is the case for Laryngeal Lengthening in section 3.6. Examples of Laryngeal Lengthening occurring preceding nonmoraic syllables is shown in (33).

(33) Laryngeal Lengthening before C syllable

a. /waʔ-k-ate-ien-oʔkt-ɤ̃ʔ/→[waʔ.ga.de.je.n**ò:**.k^{h}.dɤ̃ʔ] *wa'kateienò:kten'* 'I ran out of oil or gas'

b. /k-at-ʔskoh-s/→[ga.d**è:**.s:.goh.s:] *katè:skos* 'I get into water'

More evidence for this relationship between nonmoraic syllables and Tonic Lengthening will be provided in sections 3.4 and 3.6. I will elaborate on why this relationship between nonmoraic syllables and Tonic Lengthening exists the way it does in Chapter 4.

[34] Stress cannot simply count moras, as this would wrongly predict where stress falls. This will be discussed in Chapter 4.

[35] This constraint is simplified for the purposes of this chapter. Laryngeal Lengthening will be the response to a different constraint. See Chapter 4 for more details.

Note also that the analysis presented thus far accounts for why there are free phonotactics in OO clusters: the system prioritizes faithfulness to the input for consonants, resulting in OO clusters being syllabified in such a way that there are no expected phonotactic restrictions between the obstruents.[36]

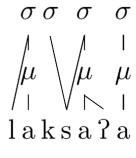
Whereas flat and falling sonority OO clusters (i.e. TT, sT) are forced to syllabify heterosyllabically, rising sonority OO clusters (Ts) are able to syllabify as an onset-nucleus sequence. This is because they satisfy the constraint in (15) on the sonority profile of onset-nucleus sequences.[37] This is shown in (34).

(34) Syllabifying VTsV
/la-**ks**a-ʔa/→[laks:à:ʔa] *raksà:'a* 'little child'

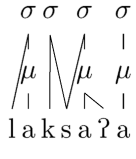
a. Core syllables built



b. /s/ is the most sonorous element element so it projects a syllable node



c. /k/ is lower sonority than /s/, so it becomes the onset of the /s/ syllable



In (34a), core CV syllables and all segments to the right of the /k/ have already been syllabified. I will argue for the syllabification of /ʔ/ in section 3.6. /k/ cannot attach to the following syllable because there are no complex onsets, and it cannot attach to the preceding syllable because /k/ cannot go into the coda. This means that another syllable node must be projected. /k/ scans the available elements to see which is the most sonorous. The available elements are /k/ and /s/.[38] Since /s/ is more sonorous than /k/, it projects the syllable node. This occurs in (34b). /s/ undergoes lengthening as a result of becoming syllabic. /k/ attaches as the onset of the /s/ syllable in (34c).[39] This creates a nonmoraic Cs syllable. Since Oh sequences

[36]The faithfulness to the input could have to do with the 'polysynthetic' nature of the languages (Michelson, 2016). Since each piece of the word is so critical to comprehension (morphemes can often be one or two segments), it is important not to change them, when possible.

[37]From Proto-Northern Iroquoian to Proto-Oneida-Mohawk *ns→*ts/_t,k,k^{w} (Julian, 2010). This could be the work of the onset-nucleus rise constraint.

[38]The vowel to the left of /k/ is not available because it has already projected a syllable node. This means that the [SV] within /a/ is prevented from projecting a syllable node as well.

[39]Since /s/ is linked to both the syllable node that it projects, and the following onset, we might expect that this /s/ is longer than other syllabic /s/. This is impressionistically true to me, but without proper phonetic tests, it is difficult to be sure. Whereas the difference between normal /s/ and long /s/ is clear, the difference between long /s/ and longer /s/ is harder to see. Phonetic tests should be done to evaluate this.

also have rising sonority, they will also syllabify tautosyllabically but I will postpone a discussion of the exact specifications of the syllabification of these sequences to section 3.6 because it requires an analysis of the laryngeals. This syllabification of Ch and Cs sequences wil correctly predict their behaviour in CsC and ChC sequences, as discussed in section 3.5.

Since Cs syllables are nonmoraic, they display the same behaviour as O syllables with respect to metrical processes: they are invisible to stress, invisible to word-minimality, block Tonic Lengthening on the preceding stressed syllable, but allow Laryngeal Lengthening when underlyingly preceded by a laryngeal. The relationship between Cs syllables and metrical processes is shown in (35). Again, Oh syllables behave the same way, but I will show this in section 3.6.

(35) Cs is metrically invisible[40]

a. Cs is invisible to stress

i. /ts-halat**-s**/→[ts.ha.lá:.da.ts:] *tsharáːtats* 'you lift it for him'

b. Cs is invisible to word-minimality

i. /k-sũ-s/→[í.ks.ũs:]*íksons* 'I hate it'

c. Cs blocks Tonic Lengthening

i. /waʔ-k-jũkeni-iʔt-a**ks**-a-ʔn-ʔ/→[waʔgjũgeniʔdáks:aʔne̲ʔ] *wa'kionkeni'táksa'ne'* 'we got into a disagreement'

d. Cs allows Laryngeal Lengthening

i. /io-hoʔ**ks**l-aʔ/→[oh**òː**ks:e̲laʔ] *ohòːksera'* 'slippery elm'

In (35a), stress is placed on the penultimate moraic syllable, ignoring the final [ks] syllable. In (35b), the underlying segments form the syllables [ks:], [sũ] and [s:]. However, word-minimality only counts the [sũ] syllable, and inserts prothetic [i] in order to make the word two moraic syllables. In (35c), the underlying sequence /ts/ blocks Tonic Lengthening on the preceding stressed syllable, as is expected if /ts/ forms a nonmoraic syllable. Finally, in (35d), Laryngeal Lengthening occurs before the Cs sequence showing that it cannot be a coda-onset sequence. These patterns show how the nonmoraic syllable analysis correctly predicts that Cs syllables pattern with O syllables with respect to metrical processes.

I argue that the constraint that enforces a rise in sonority from onset to nucleus is also what determines the shape of /ss/ sequences. Recall that the one exception to the free phonotactics between obstruents is /ss/, which surfaces as [ts].

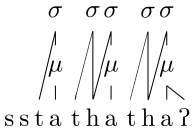
[40]Examples of /ts/ interacting with Tonic Lengthening are difficult to find because it is not clear in most cases if a given [ts] sequence is /tsh or /ts/. In the orthography, these are both written as <tsh> to distinguish from the Kahnawà:ke affricate [dz], which is written as <ts>.

(36) /**s-s**tatha?t-ha?/→[ts:dathà:tha?] *tstathà:tha'* 'you're drying it'

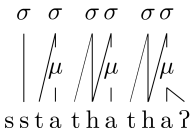
I argue that this follows from the constraint on onset-nucleus sonority combined with the right to left syllabification system. This is shown in (37).

(37) Syllabifying /ss/
/**s-s**tatha?t-ha?/→[ts:dathà:tha?] *tstathà:tha'* 'you're drying it'

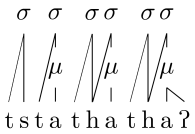
a. Structure built until /ss/



b. Rightmost /s/ projects syllable node



c. /s/([t]) atttaches as the onset



In (37b), the rightmost /s/ in /ss/ is syllabified because there is right to left syllabification. If the leftmost /s/ were to attach as the onset, this would result in flat sonority from onset to nucleus. Instead, the leftmost /s/ surfaces as [t] in order to syllabify as a well-formed onset of /s/ in (37c),[41] forming a nonmoraic syllable [ts:]. The leftmost /s/ cannot form its own nonmoraic syllable due to a constraint that I will introduce and discuss in section 3.5 — the Adjacency Condition — which militates against adjacent nonmoraic syllables.

I argue that the reason why /s/ changes to [t] in /ss/ sequences, but in all other cases the consonants are faithfully realized is because the minimal change from /s/ to [t] is less costly than projecting a syllable node. Due to the right to left syllabification algorithm, it is never expected to violate faithfulness in the other OO clusters.[42]

In summary, I have argued that the segments in OO clusters are faithful to their correspondents in the input, resulting in the building of nonmoraic syllables (i.e. O and Cs) to syllabify all segments. This has accounted for the free phonotactics in OO clusters. I have also shown how the nonmoraic syllable analysis links together these clusters in how they interact with metrical processes. This will link the behaviour of OO clusters with clusters involving sonorant consonants in the next section. The analysis that all of the

[41] This can be formalized as a switch from [+cont] to [-cont].

[42] In an underlying TTV sequence, the TV would be syllabified first. Changing either T to /s/ at this point would not help the syllabification process. Regardless of whether the consonants are T or /s/, an additional syllable node will need to be projected to house the leftmost T.

nonmoraic syllables pattern together will account for the distribution of the metrically visible epenthetic vowel, as will be discussed in section 3.5.

3.4 Clusters with sonorant consonants

In this section, I will illustrate how the current analysis of Kanien'kéha syllable structure correctly predicts that OR/RO clusters are broken up by epenthesis, and that the epenthetic vowel is metrically invisible. Specifically, I will argue that, just like with OO clusters, an additional syllable node needs to be projected to fully syllabify the OR/RO cluster. Rather than projecting from one of the consonants, a syllable node will be projected from the sonorant feature on the sonorant consonant ([SV]), resulting in epenthetic [e̲]. This analysis will represent phonologized excrescence. Since the syllable node will be projected from a feature within a consonant, the Ce̲ syllable will contain no mora, resulting in metrical invisibility. I will begin by describing OR/RO clusters in more detail, showing why the epenthetic [e̲] that breaks up these clusters cannot be understood as a standard epenthetic vowel. I will follow this up with my analysis of these clusters.

3.4.1 OR/RO/RR clusters: the data

In this section, I will show that OR/RO clusters are indiscriminantly broken up by metrically invisible [e̲], and that the analysis cannot simply be that epenthetic [e̲] breaks up sequences that would be illicit coda-onset clusters or complex onsets.

As briefly described above, the majority of OR/RO clusters are broken up by metrically invisible [e̲]. This occurs both word-initially and word-medially.[43] Some examples are shown in (38).

(38) OR/RO/RR and epenthesis

a. OR is broken up by epenthesis

i. /te-**k-l**ik-s/ → [dége̲liks:] *tékeriks* 'I put two things together'

ii. /iahũ-**k-n**aʔkal-ũti-ʔ/→[jahũge̲naʔgalű̃: diʔ] *iahonkena'karón:ti'* 'I threw the dice'

iii. /**tn**-ehl-ʔ/→[íde̲nehle̲ʔ] *ítenehre'* 'you and I want'

b. RO clusters and epenthesis

i. /ie-k-iaʔt-i**nk**ʌ̃h-s/ → [jegjaʔdíne̲gʌ̃hs:] *ietia'tínekenhs* 'I let it out (an animal)'

ii. /io-ʧi**nkw**al/→[oʤíne̲gwal̥] *otsínekwar* 'yellow, orange'

[43]Word-final weightless [e̲] breaking up a OR/RO cluster (where R does not equal /ʔ/) does not occur, not because these clusters are licit at the right edge, but because the language seems to militate against these clusters in a different way. Specifically, these contexts are never created morphologically. We will see in section 3.6, however, that Cʔ sequences pattern with OR sequences in undergoing epenthesis, and this can occur word-finally.

iii. /ɤ̃-t-k-wɤ̃n-i**nk**ɤ̃ʔ-nʔ/→[ɤ̃tʰgewɤ̃níneɡɤ̃ʔneʔ] *entkewennínekenʼne'* 'I speak up, out'

c. RR is broken up by epenthesis

i. /io-**wj**-aʔ/→[ówejaʔ] *óweia'* 'shawl', 'wing'[44]

ii. /io-**wl**-aʔ/→[ówelaʔ] *ówera'* 'wind, air'

iii. /wak-akia**nl**ũ-ʔs/→[wagagjánelũʔs] *wakatiáneronʼs* 'I get scared'

As shown in the above examples, any CC cluster containing a non-laryngeal and /n/, /l/, or /w/ is broken up with epenthetic [e].[45]

The epenthetic [e] that breaks up OR/RO clusters is metrically invisible in that it is not counted for stress (e.g. (38a-i)) and is ignored for the purposes of word-minimality (e.g. (38a-iii)). Note, also, that Tonic Lengthening is blocked when the stressed vowel is followed by a Ce syllable (e.g. (38c-i)). I will show in section 3.6 that the same epenthetic vowel breaks up Cʔ sequences.

Some of the examples in (38) (e.g. (38b-iii)) involve morpheme-internal epenthesis. Nonetheless, we can tell that these [e]s are epenthetic in the absence of evidence from alternations because they are metrically invisible and occur next to a sonorant consonant (metrically invisible epenthetic vowels never occur between obstruents).[46]

The main question that arises from these data is, why are OR/RO sequences being broken up by epenthesis? I will first investigate the most common analysis of metrically invisible epenthesis, that it breaks up clusters that would be illicit coda-onset clusters.

Most analyses in the Kanien'kéha literature only take into account OR clusters,[47] arguing that they are broken up to militate against rising sonority coda-onset clusters (e.g. Alderete, 1995; Hagstrom, 1997; Rawlins, 2006; Elfner, 2016). These authors take this position because the language generally conspires to avoid RO clusters in a different way: morphologically. While OR sequences are commonly created by the morphology and broken up with epenthesis, RO are only ever underlying when morpheme-internal. It is extremely difficult to create a morphological structure where an RO cluster is created across a morpheme boundary (i.e. concatenating a morpheme that has a final sonorant consonant to the left of a consonant-initial morpheme). This difficulty arises because of three obstacles. Firstly, morpheme-final sonorant

[44]This noun means 'shawl' in Ahkwesáhsne, and 'wing' in Kahnawà:ke.

[45]Cj/jC sequences behave differently. Cj sequences are not broken up by epenthesis, and /jC/ sequences surface as [C]. This will be discussed in section 3.7.

[46] Some examples of morpheme-internal OR epenthesis are the following.

(i) Morpheme internal OR epenthesis

a. /la-list-o**sl**a-s/→[lalis:dózelas:] *raristóseras* 'welder'

b. /w-a**kl**a-s/→[wágelas:] *wákeras* 'it smells'

c. /io-**sn**ɤ̃naʔt-aʔ/→[ozenɤ̃nà:daʔ] *osenennà:taʼ* 'muscle'

[47]Rowicka (1999) is the lone exception, to my knowledge.

consonants are much more rare than morpheme-final obstruents (also resulting in word-final sonorant consonants being exceptionally rare).[48] Secondly, when there are cases of morpheme-final sonorant consonants, finding a consonant-initial morpheme to suffix to it can be very challenging. Thirdly, in the unlikely event where there is a morpheme that ends with a sonorant consonant and there is another consonant-initial morpheme that can attach to the right edge of the sonorant consonant-final morpheme, allomorphy starts playing a role (i.e. allomorphs with final sonorant consonants do not appear before consonant initial morphemes). This third factor seems to be the most prevalent in militating against RO/RR clusters.[49]

Although RO clusters are predominantly avoided morphologically, the data in (38b) shows that RO sequences are in some cases also repaired with the metrically invisible epenthetic [e̲]. The fact that RO clusters are militated against with the epenthetic [e̲] (as well as morphologically) shows that it cannot be the case that OR sequences are broken up because of bad syllable contact. If metrically invisible epenthesis were occurring to militate against rising sonority coda-onset clusters, we would expect that RO and RR clusters would be licit. Since RO sequences are not permitted, it seems unlikely that metrically invisible epenthesis is only serving to create well-formed coda-onset clusters.

Lastly, it is unclear how the syllable contact analysis would account for left-edge clusters, which have a similar profile to word-medial consonant clusters. If word-medial CC sequences are coda-onset clusters, and OR sequences are broken up because they would form illicit coda-onset clusters, then what is the analysis for clusters of the same profile at the left edges of words?

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[48] Bonvillain (1973) reports that both word-final /l/ and /n/ in ʔn# clusters surface as voiceless in the Ahkwesáhsne dialect of Kanien'kéha. This is corroborated by my fieldwork.

(i) Word-final sonorant consonant clusters
  a. /t-hs-taʔ-n/→[dés:taʔn̥] *testa'n* 'Stand up!'
  b. /s-nũhweʔn/→[ze̲nṹ:weʔn̥] *senòn:we'n* 'Like it!'

See Appendix A for more details.

[49] Some examples of the extensive allmorphy are shown in (i). Allomorphs are separated by a tilde.

(i) Morpheme-final allomorphy
  a. 'she, they>them M' allomorphy
  [lũwan-] *ronwan-*~[lũwadi-] *ronwati-*
  b. 'Semi-reflexive' allomorphy
  [-at-] *-at-* ~[-adã̀-] *-aten-* ~[-an-] *-an-* ~[-ani-] *ani-* ~[-al-] *-ar-* ~[-a-] *-a-*

In (ia), the allomorphs for the transitive pronoun 'she, they>them M' are shown (the agent is 'she, they' and the patient is 3rd plural masculine). There is a morpheme-final sonorant consonant in [lũwan-] *ronwan-*, but this allomorph never occurs before consonants, thereby avoiding RO clusters. In (ib), it is the same story: although there are allomorphs that end in a sonorant consonant (e.g. [-an-] *-an-*), they never occur before a consonant.

(39) Left edge clusters

a. /**k-t**akeliʔta-s/→[k^{h}dagelì:das:] *ktakerì:tas* 'I am frying'

b. /**k-st**ath-a-ʔt-haʔ/→[ks:dathà:thaʔ] *kstathà:tha'* 'I make it dry'

The opposite account, that metrically invisible epenthesis breaks up sequences that would be illicit complex onsets suffers from a similar issue. While this would account for why falling sonority RO clusters, are broken up with epenthesis, it would predict that OR clusters, which are common complex onsets cross-linguistically, would surface intact. As shown in (38a-i), OR clusters are broken up by epenthesis. Further, this analysis would suggest that Cj sequences are complex onsets when, as shown in (22), this cannot be the case because Cj sequences block Tonic Lengthening.

I have thus far shown that metrically invisible epenthesis does not seem to be aimed at forming rising sonority complex onset clusters or falling sonority coda-onset clusters. This is surprising because, as discussed in Hall (2011), epenthesis generally targets marked structure in order to create unmarked structure. In Kanien'kéha, OR/RO clusters are broken up by epenthesis, but not for any clear cross-linguistically common reason (i.e. well-formed complex onsets or coda-onset clusters).

An alternative analysis, taken by Rowicka (1999), is that metrically invisible epenthesis is breaking up clusters that are marked in Kanien'kéha specifically, but not cross-linguistically. She argues that all clusters with sonorant consonants are marked in Kanien'kéha and that they are consequently broken up with epenthesis. There are two main issues with this proposal. Firstly, it is undesirable to make a language specific markedness constraint, as it predicts that there are no restrictions on the shapes of possible syllables. Secondly, it is simply not the case that whenever a sonorant consonant is adjacent to another (non-laryngeal) C, it is broken up. Whereas VsR sequences are always broken up with metrically invisible epenthesis, CsR sequences are not.[50] This is shown in (40) and (41).

(40) sR and epenthesis

a. /k-hwa**sl**ũ-s/→[khwázelũs:] *khwáserons* 'I take the bark off'

b. /**s-w**-at-iel-ɤ̃-s/→[sewagjé:lɤ̃s:] *sewatié:rens* 'sometimes'[51]

c. /**s-l**iht/→[ízeliht^{h}] *íseriht* 'Cook!'

(41) CsR and epenthesis

a. /te-i-ojʔa**k-s-n**e/→[dejojaʔáks:ne] *teioia'áksne* 'It flashes', 'movie theatre'

b. /ie-k-a**tsn**ɤ̃ht-haʔ/→[jegats:nɤ́̃hthaʔ] *iekatsnénhtha'* 'I go downstairs'

[50]Clusters can also sound like they involve OR or RO clusters, but these are intervened by /h/. In these clusters, there is no overlap between the obstruents and the following sonorants (as there is /h/ between them), unlike in English OR clusters.

[51]The speakers that I have worked with pronounce the initial sibilant as [s]. Based on the phonology and morphology, we would have expected [z].

c. /te-io-**hsw**athe-ʔ/→[dejohs:wáheʔ] *teiohswáthe'* 'it is bright'

The data in (41) shows that it cannot be the case that there is a language specific markedness constraint militating against sonorant consonants being in clusters. Metrically invisible epenthesis must be sensitive to syllable stucture rather than indiscriminately breaking up clusters involving a sonorant consonant (Itô, 1989, cf. Broselow, 1982).[52]

In the next section, I will argue that metrically invisible epenthetic [e̲] that breaks up OR/RO clusters should be analyzed as phonologized excrescence, and that this will account for why OR/RO clusters are targeted but OO clusters are left alone.

3.4.2 OR/RO/RR clusters: the analysis

As I have shown in this section, metrically invisible [e̲] occurs in unexpected places if it were a standard epenthetic vowel. That is, metrically invisible [e̲] breaks up cross-linguistically unmarked OR/RO clusters to the exclusion of cross-linguistically marked OO clusters. While this does not seem like typical behaviour of epenthesis cross-linguistically, this does seem similar to vowel excrescence. I will argue in this section, that metrically invisible [e̲] should be analyzed as phonologized excrescence, rather than standard vowel insertion. That is, I will argue that metrically invisible epenthesis does not involve insertion of any new material.

An excrescent element is often described as a 'transition' between two segments (Levin, 1987; Hall, 2003, 2006). That is, when there are two segments that are gesturally timed in a particular way, an intermediate element will also be produced. This is the case, for example, in English *prin[t]ce* where the closure associated with the nasal opens to articulate [s], producing an intermediary [t] in the process (Feldscher and Durvasula, 2017). These intermediate elements are most often described as phonetic and not part of the phonology (Levin, 1987).

In languages where the gestures in CC clusters are far from each other (i.e. gestural underlap, in the sense of Karlin (2022)), excrescence often takes the form of aspiration when intervening between voiceless consonants, or a mini schwa-like vowel when one of the consonants involved is voiced (Hall, 2006).[53] For example, this is the case in Tashlhiyt Berber (Dell and Elmedlaoui, 1985, 2002), Sierra Popoluca (Elson, 1947; Gafos, 2002), many South-East Asian languages (Thomas, 1992; Butler, 2014; Pittayaporn, 2015), and many Salish and west coast languages (e.g. Bagemihl, 1991; Czaykowska-Higgins and Willett, 1997; Howe, 2000). In this type of language, OO clusters are often phonotactically free, just like in Kanien'kéha

[52]This is cited in Hall (2011).

[53]When a fricative is involved, often the fricative bleeds into the nucleus (Flemming, Ladefoged and Thomason, 2008). This could be how syllabic /s/ was derived historically.

(perhaps because of the gestural distance). Due to the phonotactic freedom and gestural profile, these types of languages are often analyzed as having syllabic or extrasyllabic consonants (similar to Kanien'kéha).[54] Some languages with this type of gestural profile that have been argued to have syllabic consonants are Tashlhiyt Berber (Dell and Elmedlaoui, 1985, 2002), Oowekyala (Howe, 2000), Montana Salish (Egesdal, 1993),[55] Jahai (Butler, 2014), and Turung (Pittayaporn, 2015), while languages that have been argued to have extrasyllabic consonants with this type of gestural profile are Nuxalk[56] (Bagemihl, 1991), and Nxaʔamxcín (Czaykowska-Higgins and Willett, 1997). A possible interpretation of the correlation between gestural distance in OR/RO clusters and vowel excrescence is that the transition is filling the space where a nucleus would otherwise be.

Interestingly, whereas excrescent schwa occurs between CC clusters when one of the segments is voiced in languages like Tashlhiyt Berber, in other languages like Finnish, Nuxalk, and other Salish languages, the transitional vocoid only occurs between two consonants when a sonorant consonant is involved. Notably, these languages, like Kanien'kéha, do not contain a voicing contrast in obstruents (Karlin, 2022; Hoard, 1978; Galloway, 1990; Bagemihl, 1991; Bates and Carlson, 1992; Urbanczyk, 1996; Czaykowska-Higgins and Willett, 1997; Flemming, Ladefoged and Thomason, 2008).[57] In this sense, it is almost like the voicing of the voiced segment is bleeding into the intervening space. This is interesting because we might expect sonorant consonants to become syllabic in these contexts (à la Zec (1995, 2007)).

Since this transitional vocoid is phonetic, it is invisible to much of the phonology. For example, in many South East Asian languages that have tone, no tone contrast can be hosted on the excrescent vowels (Bennett, 1995; Green, 1995; Butler, 2014; Burgdorf, 2020; Brahma, 2021).

We can see the similarities between Kanien'kéha and the above mentioned languages (e.g. Mon Khmer, Salish, Tashlhiyt Berber) in the table in (42), in which the above languages are grouped under 'excrescence languages'. English is included as a point of reference.

[54]See also Davidson and Stone (2003) in which it is shown that gestures are far apart for speakers of a new language, with clusters they are not used to. This results in these speakers keeping the gestures apart.

[55]This source is cited in Flemming et al. 2008.

[56]Hoard (1978) argues that many consonants in Nuxalk are syllabic.

[57]The transitional vocoid also often occurs between Cʔ sequences. This will be addressed in section 3.6.

(42)

	Kanien'kéha	Excrescence languages	English
OO phonotactics	Free	Free	Restricted
CC temporal profile	Gesturally distant	Gesturally distant	Gesturally close
Sonorant clusters	Invisible epenthesis	Excrescence	Permitted

As shown in (42), phonotactics in Kanien'kéha are very similar to those in 'excrescence languages'. The main difference here is that where clusters involving a sonorant consonant are broken up by invisible epenthesis in Kanien'kéha, they are broken up with an excrescent vowel in 'excrescence languages'. This suggests that invisible epenthesis in Kanien'kéha is in some way related to excrescence in excrescence languages. Further evidence for this is that there has been much debate over whether excrescent vowels are phonological or not in certain languages. For example, while Shaw (1993) argues that non-underlying schwa is phonological in Temiar, Yap (2009) argues that it is phonetic.[58] This suggests that the formal implementation of these transitional elements is not always so straightforward. Perhaps the reason for this is that excrescent elements may become phonologized as epenthetic over time, resulting in various languages like Finnish having vowels that are in between excrescence and epenthesis, displaying behaviour of both epenthetic and excrescent vowels (Hall, 2006; Karlin, 2022). Connecting this possibility to invisible epenthesis in Kanien'kéha, I argue that in Kanien'kéha, metrically invisible epenthesis was historically excrescence breaking up syllabic consonants when a sonorant consonant was involved.[59,60] Over time, this was reanalyzed by new generations as a phonological element, being represented in the phonology and thus visible to much of the phonology (like in reference to prevocalic voicing), but retaining its metrical invisibility.[61,62,63] I assume that being phonologized means being in the phonological representation (as opposed to being a phonetic byproduct). I will represent this phonologization process as the projection of the syllable node from the [SV] feature of the sonorant consonant.[64] See section 3.8 for a discussion on

[58]Willett and Czaykowska-Higgins (1995) argue that in Nxaʔamxcín, there is a distinction between excrescent and epenthetic schwa.

[59]Akwiratékha' Martin pointed out to me that in one morpheme in particular, the nominalizer /-hsl-, -tshl-/→[hs̲el, tsh̲el], the epenthetic [e̲] often does not get pronounced. Wishe Mittelstaedt also pointed out that one speaker in particular often doesn't pronounce the invisible epenthetic [e̲] in the words *téken̲i*, *iahsen̲e'kónhrek*, and *wetenenhniseraiéri'te'*. He further notes that this is also often the case with the pronouns *ten̲i-* and *sen̲i-* This makes sense if we take this to be a remnant of the excrescent nature of epenthetic [e̲]; it has retained some excrescent elements in a few examples. Karin Michelson notes that this reduced pronunciation might be a more recent development. Tehahswathè:tha' Jacob Doreen (p.c.) also notes that in the related language Onondaga, where clusters involving sonorant consonants are not broken up, OR and RO clusters are pronounced with an excrescent vowel between them. This could have been the historical state Kanien'kéha was in pre-epenthesis.

[60]Karin Michelson (p.c.) notes that if invisible epenthetic [e̲] was historically excrescence, it would have been a very long time ago. This is because, in all sources historical sources, including writing by speakers themselves going back to first contact, the invisible epenthetic [e̲]s are written with no mention of a difference in quality.

[61]This is suggested to be possible in Hall (2006).

[62]Interestingly, in a comparative study of Iroquoian languages, Julian (2010) argues that this is where metrically invisible epenthesis came from in Kanien'kéha. However, Karin Michelson notes that he does not actually evidence for this claim. I also do not have historical evidence, just phonological and synchronic.

[63]A question that might come up is why is syllabic [SV] surfacing as specifically with the quality [e]. Firstly, this is not an uncommon quality of epenthetic vowel, such as in Modern Hebrew and Basque (De Lacy, 2006; Hualde and De Urbina, 2011; Faust, 2024). Secondly, I suggest that the excrescent element was pulled forward because of the overwhelmingly coronal consonant inventory.

[64]This analysis could be relevant to languages like Upper Chehalis (Kinkade, 1963; Rowicka, 2001) and Temiar (Shaw, 1993) as

why metrically invisible epenthesis must be analyzed as phonological, and not as excrescence.

In what follows, I will spell out how my analysis models this phonologized excrescence. I will argue that since OR/RO clusters cannot be syllabified as complex onsets (as there are no complex onsets) nor as coda-onset clusters (as the coda is restricted to laryngeals), an additional syllable node must be projected to fully syllabify both segments. Since the projection of a syllable node is determined by the sonority-driven algorithm, the most sonorous segment will project the syllable node to fully syllabify OR/RO clusters. The sonority hierarchy I assume is repeated in (43).

(43) Sonority hierarchy

Vowels > Sonorant consonants > h > s > Stops, Affricates

In OR/RO clusters, although there is no available vowel to project a syllable node, there is the feature [SV], on the sonorant consonant. Recall that [SV], which is present in vowels and sonorant consonants, surfaces as a vowel when pronounced by itself. In this way, [SV] is the most sonorous element available on the sonorant consonant. Syllabic [SV] will surface as the metrically invisible epenthetic vowel [e̲]. Finally, I will argue that this process should be understood as phonologized excrescence rather than standard epenthesis, as, unlike vowel epenthesis, excrescence frequently breaks up OR/RO clusters to the exclusion of OO clusters cross-linguistically.

I will start by discussing cases in which metrically invisible epenthesis breaks up OR clusters. This is shown in (44).

(44) OR epenthesis derivation
/te-**k-l**ik-s/→[dége̲liks:] *tékeriks* 'I put them next to each other'

a. Core syllables and the final syllable



b. [SV] projects a syllable node



these languages exhibit metrically invisible epenthesis only breaking up voiced segments. In the case of Upper Chehalis, there is no obstruent voicing contrast so this is only with sonorant consonants. On the other hand, this analysis would not work for a language like Selayarese because epenthesis is not sensitive to the voicing features of the surrounding consonants, despite being metrically invisible (Broselow, 1999).

c. Onset attaches to [SV] syllable



In (44a), the CV units and all structure to the right of the unsyllabified /k/ have been syllabified. In (44b) /k/ needs to be syllabified. /k/ cannot syllabify into the coda of the preceding syllable because codas are restricted to laryngeals, and it cannot syllabify into the following onset because there are no complex onsets. Instead, /k/ must look for the most sonorous element to project a syllable node. The options are /k/ itself, /l/ (resulting in a syllabic sonorant consonant),[65] or the [SV] feature (i.e. the sonorant feature) linked to the sonorant consonant. I assume that solitary [SV] is a vowel, so it is the most sonorous, projecting the syllable node in (44b). See Goad and Brannen (2003) for a similar analysis of the speech of an English speaking child. Since [SV] is a feature on a consonant that projects a syllable node, there is no mora associated with this nucleus, resulting in a nonmoraic syllable. In (44c), /k/ attaches to the syllable node projected by [SV]. This syllable is pronounced as [ge] with [SV] surfacing as the weightless vowel.[66]

I argue that the reason why syllabic [SV] sounds like a fully-fledged vowel, indistinguishable from underlying /e/, is because [SV], just like an obstruent, undergoes augmentation as a phonologized transition. I will return to this at the end of the current section. Note that since obstruents do not bear [SV], the current analysis correctly predicts that there can never be metrically invisible epenthesis breaking up OO. I will address why Cj and kw sequences differ from other clusters involving sonorant consonants in section 3.7.

Under the proposed analysis, RR sequences are dealt with in the exact same way as OR because the right-to-left syllabification system projects a syllable node from the [SV] in the rightmost R. Then, the leftmost R attaches as the onset to this syllable. For example, in an /nl/ sequence, the [SV] from the /l/ would project the syllable node to house /n/.

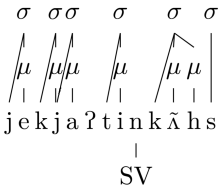
A similar syllabification process occurs for RO sequences. In this case the syllable node is projected from the first member of the CC sequence because the most sonorous element is the [SV] on the R. This is shown in (45).

[65] I do not take a stance on the features on sonorant consonants. That being said, I assume that they have a place of articulation and a manner feature (e.g. [nasal]). When [SV] is pronounced with these other features, it is consonantal.

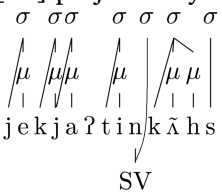
[66] I assume that the prevocalic voicing process involving [SV] described in section 2.2 also occurs when the nucleus is just syllabic [SV].

(45) RO epenthesis derivation
/ie-k-ia?t-i**nk**ʌ̃h-s/ → [jegja?díne̲gʌ̃hs:] *ietia'tínekenhs* 'I let it out (an animal)'

a. Core syllables and the final syllable



b. [SV] projects a syllable node



c. Onset attaches to [SV] syllable



In (45a), all CV syllables have been built in the first parse and the second parse has syllabified all remaining consonants to the right of /n/. /n/ cannot syllabify into an existing syllable, so another syllable node must be projected. The options for what could project a syllable node are /n/, [SV], or the following onset /k/. The most sonorous element is [SV] as it is pronounced as a vowel when by itself, so it is the most optimal candidate to project a syllable node (resulting in a nonmoraic syllable). This is despite the fact that /k/ is the rightmost segment. This is because of the serial nature of the scanning process, where the system looked for [SV] before obstruents because it has higher sonority. In (45b), [SV] projects a syllable node. In (45c), /n/ becomes the onset. This forms the syllable [ne̲] where [e̲] acquires its syllabic [SV] feature from the /n/.[67]

Analyzing the [e̲] that breaks up OR/RO clusters as syllabic [SV] correctly predicts that Ce̲ syllables pattern with the O and Cs syllables in reference to metrical processes. As mentioned at the beginning of this chapter, Ce̲ syllables are invisible to stress, like O and Cs syllables. This is shown in (46).

[67] This analysis also correctly predicts that word-final sonorant consonants should be rare. This is because a word-final sonorant consonant cannot syllabify into the coda of the preceding syllable. However, it also predicts that word-final sonorant consonants should trigger weightless epenthesis, when this is not the case. Future research should investigate this.

(i) Word-final sonorant consonants
   a. /s-at-neko-ahnehkwan/→[zade̲negwahnéhgwan] *satenekwahnéhkwan* 'Take the pill!'
   b. /lo-ianer/→[lojá:ne̲l̥] *roiá:ner* 'he is a chief'

There are a handful of words outside those in (i) with word-final sonorant consonants.
Perhaps a relevant component to a potential analysis of word-final sonorants is that in many cases, they are devoiced (see Appendix A).

(46) Ce̲/Re̲ syllables and stress

a. /te-**k-l**ik-s/ → [dége̲liks:] *tékeriks* ‘I put two things together’

b. /io-ʧi**nkw**al/→[oʤíne̲gwal̥] *otsínekwar* ‘yellow, orange’

c. /io-**wj**-aʔ/→[ówe̲jaʔ] *óweia’* ‘wing’

Whereas stress is normally on the penultimate syllable, Ce̲ syllables are skipped. For example, in (46c), stress is on the antepenult because one of the final two syllables, [we̲] is nonmoraic.

The nonmoraicity of Ce̲/Re̲ syllables also correctly predicts that these syllables are invisible to word-minimality, like O and Cs syllables. This is shown in (47).

(47) Ce̲/Re̲ and word-minimality[68]

a. /s-liht/→[**íze̲**liht^{h}] *íseriht* ‘Cook!’

b. /s-l-ɤ̃/→[**íze̲**lɤ̃] *íseren* ‘Put it in!’

c. /tn-ehl-ʔ/→[**íde̲**nehle̲ʔ] *ítenehre’* ‘you and I want’

In the forms in (47), prothetic [i] is inserted to make the word contain two weighted syllables, despite there being two other vowels. For example, in (47a) there are two syllables with vowels before prothesis: [ze̲] and [lih]. However, since only one of these syllables is moraic, prothetic [i] must be inserted. This contrasts with the metrically visible epenthetic vowel which is visible to word-minimality computations. This will be discussed in section 3.5.

Finally, analyzing Ce̲ syllables as equivalent to O and Cs syllables in the eyes of metrical processes correctly predicts that they interact with vowel lengthening in the same way. Recall that I am arguing that Tonic Lengthening (driven by Head-Prominence) is normally blocked before nonmoraic syllables, but that other types of lengthening can still occur in this position. This is also the case with Ce̲ syllables. Specifically, when underlyingly preceded by the vowel that will be stressed, Ce̲/Re̲ syllables block Tonic Lengthening on the preceding stressed vowel (48). When surface Ce̲/Re̲ sequences are underlyingly preceded by a laryngeal, Laryngeal Lengthening is not blocked (49). This process will be discussed in more depth in section 3.6.

[68]Finding small words with weightless epenthesis breaking up RO is very difficult. The only examples I could find are with underlying Rʔ. For this reason, there are no examples provided where Re̲ is shown to be invisible to word-minimality.

(48) Ce̲/Re̲ blocks Tonic Lengthening

a. /io-**wl**-aʔ/→[ówe̲laʔ] *ówera'* 'wind, air'

b. /w-a**kl**a-s/→[wáge̲las:] *wákeras* 'it smells'

c. /ie-k-iaʔt-i**nk**ʌ̃h-s/ → [jegjaʔdíne̲gʌ̃hs:] *ietia'tínekenhs* 'I let it out (an animal)'

(49) GCe̲/GRe̲ does not block Laryngeal Lengthening

a. /waʔ-**k-l**-ʌ̃ʔ/→[wà:ge̲lʌ̃ʔ] *wà:keren'* 'I put it in', 'I filled it up'

b. /waʔ-**kn**-ak-ʔ/→[wà:ge̲nage̲ʔ] *wà:kenake'* 'them two women ate it'

c. /ka-ʔ**sl**e/ → [gà:ze̲le] *kà:sere* 'car'

In these examples, we can see that Ce̲ syllables interact with vowel lengthening in the exact same way as O and Cs syllables. The nonmoraic syllable analysis captures this parallel. Both Tonic and Laryngeal Lengthening and their relationships with syllable weight will be spelled out in more detail in Chapter 4.

As an interim summary, I have argued that metrically invisible epenthesis should be analyzed as [SV] that has become syllabic (rather than the insertion of any material), to model phonologized excrescence. Syllabic [SV] heads a nonmoraic syllable because it is a feature from a sonorant consonant, and consonants only get weight in the coda. This analysis has derived the metrical invisibility of Ce̲ as well as the fact that it only breaks up clusters with sonorant consonants while never breaking up ostensibly more marked CC sequences like OO.

Note also that thus far I have analyzed Kanien'kéha as having syllabic obstruents, but not syllabic sonorant consonants, which goes against the implicational universal spelled out by Zec (1995, 2007) that if a language has syllabic obstruents then it also has syllabic sonorant consonants. I will show in section 3.6 that sonorant consonants can also be syllabic under specific conditions.

I will now discuss some concerns that the reader might have with a feature projecting a syllable node.

How is it that a single feature can project a syllable node? The reader might be concerned that whereas most syllable nodes are projected from groups of features, metrically invisible epenthesis involves the projection of a syllable node from a single feature. However, it is not clear how a constraint on the minimum number of features would work. Is it that a given element x is only eligible to project a syllable node if it contains two or more features? It seems to me that as long as a feature (or group of features) is pronouncable in a given language (as well as obeys the rules of syllabification), then it should be eligible to be syllabic. Additionally, many analyses in the phonological literature involve featurally impoverished nuclei. For example, phonologists often assume that featurally impoverished vowels are in the nucleus (e.g. schwa). Another example is in Government Phonology where the nucleus is often left completely empty.

Thus, phonologists often assume that the nucleus can be impoverished. The only difference between these analyses and my analysis is that my analysis derives how the feature came to be syllabic within Moraic Theory, rather than assuming some other method creating an impoverished nucleus. For example, within frameworks like Government Phonology, the nucleus already exists, so the impoverished element simply sits there.

If the feature [SV] can be syllabic, could another feature by itself be syllabic? I argue that while my analysis predicts that [SV] can be syllabic in other languages, it does not make any predictions as to whether other features can become syllabic. Even in the case of [SV], the current analysis predicts that [SV] can become syllabic under very specific conditions: when (1) the morphology creates many complex clusters that cannot fit into the constrained syllable size of the language, resulting in the need for additional syllable nodes, and (2) the process by which additional syllable nodes are projected is sonority-driven. I suggest that this is an advantage of this analysis; whereas other analyses that place constraints on the metrical visibility of epenthetic vowels predict that metrically invisible epenthetic vowels should be common cross-linguistically, my analysis correctly predicts that metrically invisible epenthesis should only arise as a conspiracy of factors, and thus should be rare.[69]

How can a feature that is already part of an adjacent segment project a syllable node? We often assume that features can be shared in, for example, coda-onset place assimilation (Itô, 1988). In this way, a feature within a given geometry can act independently by spreading to another position or, in this case by projecting a syllable node.

In this section, I have argued that metrically invisible epenthesis is really just syllabic [SV] and that this is why only OR/RO clusters are broken up by epenthetic [e̲], but not OO clusters, despite being subject to the same constraints. I have shown how this can be derived in the sonority driven syllabification system, and how this analysis correctly predicts that Ce̲, O, and Cs syllables pattern together with respect to metrical processes. Finally, I have argued that metrically invisible epenthesis should be understood as phonologized excrescence.

In the following section, I will introduce a constraint on the distribution of nonmoraic syllables, and show that this accounts for metrically visible epenthesis.

[69]Hall (2011) says that epenthetic vowels are commonly metrically invisible, citing Kanien'kéha as an example, as well as Selayerese and Lebanese Arabic. However, in other work (e.g. Hall, 2003, 2006), Hall argues that many of the cases of apparent vowel epenthesis can be analyzed as gestural overlap and, consequently as phonetic. She even questions whether weightless epenthesis in Kanien'kéha is phonological. My findings match Hall's that there are many cases of metrically invisible epenthesis. However, unlike metrically invisible epenthesis in Kanien'kéha, the vast majority of these can either be unambiguously argued to be phonetic (e.g. Dakota (Hale and Eagle, 1980; Miner, 1993; Hall, 2003)) or have evidence to suggest that they are phonetic (e.g. Temiar (Shaw, 1993; Yap, 2009)). There is a reason why Kanien'kéha is repeatedly referenced as the example with metrically invisible vowels, and that is because it is one of the only cases where metrically invisible epenthesis is unambiguously phonological. I will show this to be the case in section 3.8.

3.5 The Adjacency Condition

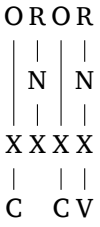
In this section, I will introduce a constraint on the distribution of the nonmoraic syllables hitherto described, the Adjacency Condition. The Adjacency Condition will govern the behaviour of metrically visible epenthesis. This constraint is formally defined in (50).

(50) Adjacency Condition: Adjacent nonmoraic syllables are prohibited.

Before showing how this constraint can account for metrically visible epenthesis in Kanien'kéha, I will situate this constraint in the literature, showing that a constraint like this is necessary to capture the cross-linguistic prohibition on adjacent 'weak' syllables. A weak syllable, in this context, refers to a syllable that is defective in some way (e.g. restricted vowel quality, metrical invisibility, limited size). In this sense, the Adjacency Condition is in some ways a variant of a *Lapse constraint, militating against adjacent unstressed syllables in iterative footing languages.

One piece of evidence for the Adjacency Condition comes from the Empty Category Principle (ECP) in Government Phonology, of which the Adjacency Condition is in some ways a formal variant (Kaye, Lowenstamm and Vergnaud, 1985, 1990; Charette, 1991). The ECP governs the distribution of weak syllables in Government Phonology: syllables with empty nuclei. A syllable with an empty nucleus is shown in (51).

(51) Empty nucleus in GP (C∅CV)



Government phonologists argue for the presence of an empty nucleus intervening between a CC cluster if the CC cluster is not constrained by phonotactics, and there are V-∅ alternations between the CC cluster. The ECP says that a syllable with an empty nucleus must be adjacent to a syllable with an overt nucleus.[70] This effectively ensures that syllables with empty nuclei are not adjacent to each other. Empty nuclei have been used to account for vowel alternations and free phonotactics in a number of different languages, including Moroccan Arabic (Kaye, Lowenstamm and Vergnaud, 1990), English (Harris, 1994; Newell, 2021), Slavic (Scheer, 2004), and Italian (Faust, Lampitelli and Ulfsbjorninn, 2018). Rowicka (1998, 1999, 2001) also uses this to account for many of the patterns that I account for in this section (where metrically visible epenthesis occurs).[71]

[70] This is accomplished with an operation called Proper Government.

[71] While my analysis is very similar to Rowicka's in certain ways, it crucially differs in other ways. Specifically, the right-to-left

Whereas the ECP generally deals with adjacent syllables of one specific type (those with empty nuclei), there are a number of other languages that exhibit the effects of the Adjacency Condition with other types of weak syllables. One example is in Passamaquoddy. In Passamaquoddy, syllables with schwa are generally metrically invisible, suggesting a nonmoraic syllable analysis (LeSourd, 1993).[72] Also like Kanien'kéha Ce̲ syllables, metrically invisible Cə syllables in Passamaquoddy cannot be adjacent to each other. When this occurs, one of the Cə syllables becomes metrically visible.[73] This can be accounted for with the Adjacency Condition.

In French, there is a similar constraint active, governing the distribution of Cə syllables. Cə syllables have played an important role in the ever-mysterious stress system in French, because they resist being stressed (Durand, 1976). Interestingly, Cə syllables exhibit the same adjacency pattern as Passamaquoddy Cə and Kanien'kéha Ce̲ syllables. When two Cə syllables are adjacent inside a lexical word, the first surfaces as Cɛ, making it eligible to be stressed (Selkirk, 1978; Andreassen and Eychenne, 2013).

One of the most talked about weak syllables in the literature is the minor syllable, which occurs in many South-East Asian languages. These syllables typically restrict what vowels can sit in the nucleus, with the vowel often being limited to schwa (Butler, 2014). Additionally, these syllables exhibit metrical invisibility as, for example, many of them cannot host tone or be stressed (Butler, 2014). Interestingly, in the vast majority of languages, minor syllables never occur adjacent to other minor syllables (Diffloth and Zide, 1992; Bennett, 1995; Burgdorf, 2020; Brahma, 2021).[74,75] Languages tend to enforce this constraint by restricting minor syllables to occurring in 'sesquisyllables' — two syllable words where the first syllable is a minor syllable and the second is major (Brunelle and Pittayaporn, 2012).

One last example that can be accounted for with the Adjacency Condition is Japanese vowel devoicing. Vowel devoicing in Japanese occurs in between voiceless obstruents. Devoiced syllables tend to avoid being accented, making them eligible for a nonmoraic syllable analysis. Additionally, devoiced vowels

syllabification algorithm that I have outlined in this chapter correctly predicts that the metrically visible epenthetic vowel will be inserted between the first two consonants in a CCC sequence (C[e]CC). Rowicka's Strict CV approach, however, incorrectly predicts that the it will be inserted between the second two consonants (*CC[e]C) (although she assumes the opposite to be the case). In Strict CV, the ECP is enforced with *Proper Government*; all empty nuclei must be Properly Governed by a filled nucleus in an adjacent syllable. In standard Strict CV (and Government Phonology), empty nuclei are specifically governed by the immediately following filled nucleus (Scheer, 2004). The consensus in the literature is that this results in illicit sequences such as C∅C∅CV surfacing as CV̲C∅CV, with the first empty nucleus being filled because there's no immediately following filled nucleus to govern it. In Rowicka's analysis, however, Proper Government goes in the other direction (empty nuclei are properly governed by the immediately preceding filled nucleus). In a string CVC∅C∅CV (such as underlying CCC sequences in Kanien'kéha) then, Rowicka's analysis would predict that it is the rightmost of the two empty nuclei that is filled: CVC∅CV̲CV. This is because the leftmost V would govern the following empty nucleus, but then nothing would be able to govern the second empty nucleus, so it would have to be filled. In Kanien'kéha, however, this is the incorrect placement of the metrically visible epenthetic vowel.

[72]Unlike Kanien'kéha [e̲], metrically invisible [ə] is underlying in Passamaquoddy.

[73]Cə syllables also become metrically visible when preceded by a consonant cluster. Under the current analysis, as a preliminary idea, this might suggest that Passamaquoddy consonant clusters should be analyzed similarly to Kanien'kéha.

[74]Burmese is one notable exception (Shih, 2018). Matisoff (2003) also notes some other exceptions, but says that most of these are results of 'reprefixation' (i.e. under specific morphological conditions).

[75]In Temiar, CC sequences are broken up by schwa, which is metrically invisible (Yap, 2009). However, CCC sequences are broken up by [e] (Itô, 1989). This suggests that there is a need for a real vowel in this position. Under the current analysis, this would be because of a violation of the Adjacency Condition. This is supported by the observation that CCCC sequences surface as CəCeCC.

tend to not occur in adjacent syllables; when a given string provides the environment for devoiced vowels in consecutive syllables, only one of the vowels will be devoiced (Tsuchida, 2001; Fujimoto, 2015).[76] This suggests that there is some constraint active that militates against having two adjacent syllables with a devoiced vowel.

All of these examples, suggest that there is some constraint active cross-linguistically against having two adjacent weak syllables. Within the current analysis, a weak syllable is a nonmoraic one.

In what follows, I will show how the Adjacency Condition accounts for the distribution of metrically visible epenthesis, as well as of the nonmoraic syllables in Kanien'kéha. Specifically, I will argue that metrically visible epenthesis is inserted in order to avoid a violation of the Adjacency Condition. I will discuss how the Adjacency Condition interacts with the previously proposed nonmoraic syllables: O, Cs/Ch, and C<u>e</u>. Finally, I will show how this analysis accounts for some asymmetries at the word-edges.

3.5.1 O syllables and the Adjacency Condition

The Adjacency Condition makes a clear prediction as to the distribution of O syllables. Since they are nonmoraic, there cannot be two of them next to each other. This will straightforwardly account for why most CCC sequences are broken up with metrically visible epenthesis, as shown in (52).

(52) OOO clusters and epenthesis

a. /s-k-ah**kt-s**/→[s:gáhgə̱ts:] *skáhkets* 'I got back'

b. /waʔ**t-k-t**eni-ʔ/ → [waʔdə̱kʰdé:niʔ] *wa'tekté:ni'* 'I changed it'

c. /**k-ks**-o-s/→[gé̱ks:os:] *kéksos* 'I put the dish in water'

In these clusters, the first two obstruents have nowhere to syllabify, necessitating the projection of two additional syllable nodes (when they have flat or falling sonority). While the rightmost of the first two obstruents (O**O**O) can project a syllable node, the leftmost (**O**OO) cannot. This is because, if the first of the two obstruents also projects a syllable node, this would result in a violation of the Adjacency Condition. This is shown in (53).

[76]The point here is not that vowel devoicing always constitutes a degenerate syllable or always behaves in this way as vowel devoicing may happen in adjacent syllables in Quebec French (Guzzo, Goad and Garcia, 2025), Keresen (Mithun, 1999), and other dialects of Japanese, for example. The point is that they sometimes can behave like the other degenerate syllables discussed.

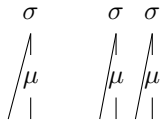
(53) Adjacency condition and CCC
/waʔ**t-k-t**eni-ʔ/→[waʔdə̄kʰdé:niʔ] *[waʔtʰkʰdé:niʔ] *wa'tekté:ni'* 'I changed it'



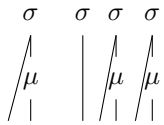
To avoid the structure in (53), a mora + [SV] compound must be inserted.[77] The derivation of CCC sequences is shown in (54).

(54) CCC syllabification
/waʔ**t-k-t**eni-ʔ/ → [waʔdə̄kʰdé:niʔ] *wa'tekté:ni'* 'I changed it'

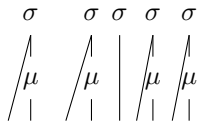
a. Core syllables



b. /k/ projects its own syllable



c. A mora + [SV] is inserted and projects a syllable node. /t/ attaches to the onset of this syllable



In (54a), all CV syllables have been built. In (54b) the second parse has begun and /k/ needs to be syllabified. It cannot form a complex onset with the following syllable because there are no complex onsets. So /k/ projects its own syllable node, forming a nonmoraic syllable. In (54c), /t/ needs to be syllabified. /t/ cannot attach to the /k/ syllable because this would result in an illicit flat sonority onset-nucleus sequence. /t/ cannot project its own syllable node because, as shown previously, this would result in a violation of the Adjacency Condition. In order to be syllabified, a mora + [SV] complex is inserted, which projects a syllable node to which /t/ can attach and become the onset. Since the syllabification is right to left, the mora is not expected to be inserted between the second two consonants.[78]

[77] [SV] is also inserted in order to pronounce the mora. This is because, as will be mentioned in section 3.6, I suggest that some moras are not pronounced.

[78] Parallel examples where underlying CCC sequences surface as CVCC are in Nxaʔamxcín (Willett and Czaykowska-Higgins, 1995), Yokuts (Guekguezian and Jesney, 2021), and Temiar (Shaw, 1993). In Temiar, CC sequences are broken up with [ə], and CCC is broken up with [e]. This mirrors Kanien'kéha, where a segment that appears more like excrescence (in the case of Temiar, without an articulatory target) breaks up CC whereas a true epenthetic vowel breaks up CCC sequences.

3.5.2 Cs/Ch syllables and the Adjacency Condition

The current analysis correctly predicts that CsCV and ChCV sequences should not undergo epenthesis (unlike the other CCC sequences).[79,80,81,82] This is because, under the current analysis, Ch and Cs can form a single nonmoraic syllable due to their rising sonority (Cs.CV, Ch.CV), unlike other CC sequences which cannot be syllabified tautosyllabically. Some examples of CsC and ChC sequences are shown in (55) and (56).

(55) CsC sequences

a. /**k-st**ath-a-ʔt-haʔ/→[ks:dathà:thaʔ] *kstathà:tha'* 'I make it dry'

b. /ka-ʧiʔnũht-a**k-s-k**owa/→[gaʤiʔnũhdaks:gó:wa] *katsi'nonhtakskó:wa* 'gorilla', 'big monkey'

c. /ie-**tst**-a-lho-hst-aʔ/→[jets:dahlóhs:daʔ] *ietstahróhsta'* 'shingles'

(56) ChC sequences

a. /ɤ̃-**k-ht**ehl-o-ʔ/→[ɤ̃khdè:loʔ] *enkhtè:ro'* 'I will put the root in water', 'I will boil the root'

b. /s-khe-ihnũ**k-hs**-eʔ/→[z͡ekhehnű́khseʔ] *sekhehnonkhse'* 'I come for her'

c. /wa-l-a**t-hkw**iʔt-ʔ/→[waháthgwiʔdeʔ] *waháthkwi'te'* 'he moved over'

Since Cs and Ch only form a single nonmoraic syllable there is no violation of the Adjacency Condition. A representation syllabifying a ChC sequence (CsC sequences are syllabified in the same way) is shown in (57).[83]

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[79] There are a few exceptions to the pattern where CsC is exempt. One example is the following Csh sequence, but I will also show some CsR examples later.

(i) /waʔ-**k-sh**est-ũ:ni-ʔ/→[waʔgeshes:dű́:niʔ] *wa'keshestón:ni'* 'I made syrup'

[80] The current analysis also predicts that there there are no adjacent Cs syllables. As far as I am aware, it is simply not possible to create a CsCs sequence morphologically. There are some cases that appear to be like CsCs sequences, but this is because they contain a single segment /ʧ/.

(i) /k-ʧikheʔt-a-hninũ-s/→[k^{h}ʤikheʔdahní:nũs:] *ktsikhe'tahní:nons* 'I'm buying candy'

[81] The current analysis predicts that there are no adjacent Ch syllables (i.e. ChCh). As with CsCs, ChCh sequences do not seem possible to create morphologically. The only exception to this is /th/ sequences, which seem to behave like a single segment when following a consonant.

(i) Cth, CCth, Csth

a. /k-a-ʔ-nikũhl-oʔkt-haʔ/→[gaʔnigũhlò:kthaʔ] *ka'nikonhrò:ktha'* 'I become hopeless'

b. /k-hthar-haʔ/→[kht^{h}ahlaʔ] *khtháhrha'* 'I talk'

c. /ie-naʔko-aʔek-st-ha/→[jenaʔgwaʔeks:tha] *iena'kwa'ékstha* 'drumstick'

In (a), there is an instance of underlying CCh, which surfaces as CCh with no epenthesis (whereas other CCh sequences are broken up with epenthesis). In (b), Chth surfaces despite no other ChCh sequences being licit. In (c), Csth surfaces without epenthesis despite CsCh being illicit. In all of these sequences, [th] seems to be behaving like one segment, otherwise moraic epenthesis would have been warranted. I do not propose a full analysis of this, but I assume that this can be accounted for if /th/ are coalescing into one segment to occupy one slot in these sequences.

[82] In the rule based analysis in Michelson (1988) where hCC and ChC sequences do not undergo epenthesis, we would expect that ChCh would also be licit. This would also be expected from the analysis in Rowicka (1999). However, this is not the case.

[83] ChC sequences sound identical to their CC counterpart. For example, /kt/ sounds identical to /kht/. In ChR sequences, there is no overlap between the C and the R.

(57) ChC and Adjacency Condition
/ɤ̃-**k-ht**ehl-o-ʔ/→[ɤ̃khdè:loʔ] *enkhtè:ro'* 'I will put the root in water', 'I will boil the root'



The syllabification in (57) is in contrast to most other CCC sequences in which the first two members often have to syllabify heterosyllabically, resulting in metrically visible epenthesis.

Notably, CsC and ChC sequences display the same phonotactic profile: the first consonant must be an obstruent[84] (or just a stop in CsC sequences),[85] while the last consonant is completely unrestricted. This means that the last consonant can be a sonorant consonant. This is shown in (58) and (59).

(58) CsR sequences

a. /ie-k-a**tsn**ɤ̃ht-haʔ/→[jegats:nɤ̃́hthaʔ] *iekatsnénhtha'* 'I go downstairs'

b. /te-i-ojʔa**k-s-n**e/→[dejoja̲ʔáks:ne] *teioia'áksne* 'It flashes', 'movie theatre'

c. /waʔ-**k-hsw**-a-ʔt-a-ni/→[waks:wà:dani] *wakhswà:tani* 'I get annoyed'

(59) ChR sequences

a. /**k-hi**adũ-s/→[khjá:dũs:] *khiá:tons* 'I write'

b. /**k-hw**aslũ-s/→[khwáze̲lũs:] *khwáserons* 'I take the bark off'

c. /waʔ**t-hl**a-hkw-ʔ/→[wà:thlahgwe̲ʔ] *wà:thrahkwe'* 'he picked it up'

This profile of CsC/ChC sequences is expected if s/h is in the nucleus: there is a necessary rise from onset to nucleus, so the preceding consonant must have lower sonority, whereas there is no sonority relationship between the nuclear s/h and the following consonant.

The analysis of CsC/ChC sequences also explains why, unlike VsRV sequences, epenthesis does not break up CsR sequences.[86] If a weightless epenthetic vowel broke up sR in CsR, then /s/ would attach to its

[84] As far as I am aware the only exceptions to the restriction on the consonant preceding the /h/ include some cases of /nhl/, and a single instance of /lhk/.

(i) /nhl/, /rhk/
a. /ka-nhl-aʔ/→[ganhlaʔ] *káhnhra'* 'virus, disease'
b. /ʧo-athor-hkowa/→[ʤotho̬lhgó:wa] *Tsiothohrhkó:wa* 'January'

In Kanehsatà:ke, the word for 'burr' contains a /lht/ sequence, but this is not used in Ahkwesáhsne (or in Kahnawà:ke).

(ii) Kanehsatà:ke: /io-whorht-ʔ/→[óhforhde̲ʔ] *óhwhorhte'* 'burr'

(iii) Ahkwesáhsne: /io-lhoht-ʔ/→[óhlohde̲ʔ] *óhrhohte'* 'burr'

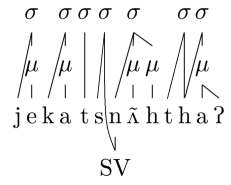
[85] There are many instances of hsC, but I argue in Appendix B that these /h/s behave like stops. There are also a couple instances of /ʔsw/ sequences. When pronouncing these forms, speakers sometimes insert an excrescent vowel between the ʔ and the following /s/, suggesting that this sequence is illicit for them (e.g. [wadelaʔ[a]swí:jo] *watera'swí:io* 'It is good luck'). In sum, ʔsw sequences seem to be exceptions. This could also be explained by appealing to /h/~/ʔ/ variation. I will say more on this in the section on laryngeals.

[86] There are some CsR sequences that are broken up with epenthesis in both places: C[e̲]se̲R. I could only find two such examples.

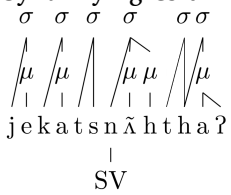
onset, as well as project a syllable node to which C can attach as the onset, resulting in adjacent nonmoraic syllables: Cs.se.R. This is shown in (60a), which contrasts with the representation in (60b) which does not violate the Adjacency Condition.

(60) Syllabifying CsR
/ie-k-a**tsn**ʌ̃ht-haʔ/→[jegats:nʌ́hthaʔ] *iekatsnénhtha'* 'I go downstairs'

a. CseR violates the Adjacency Condition
*



b. Syllabifying CsR



If the sR in CsR sequences were to be treated like sR in VsR, there would be a violation of the Adjacency Condition, as shown in (60a).[87] Instead, /s/ must project a syllable node to create the syllable /ts/, as shown in (60b).

3.5.3 Ce/Re syllables and the Adjacency Condition

The Adjacency Condition also accounts for the distribution of Ce syllables. When there are two Ce/Re syllables in a row, the first of them becomes weighted. This is shown in (61).

(i) /waʔ-k-slahw-ʔ/→[waʔgé̱ze̱lahweʔ] *wa'késerahwe'* 'I added liquid to something'

(ii) /wak-snʌ̃naʔt-a-nūhwak-s/→[wagē̱ze̱neʔdanǜ̀:waks:] *wakesenenna'tanòn:waks* 'my muscles are sore'

I could also find one example, shown previously, where CsR surfaces as CseR.

(iii) /io-hoʔ**ks**l-aʔ/→[ohò:kse̱laʔ] *ohò:ksera'* 'slippery elm'

[87] In this way, there is a sort of lookahead mechanism where /s/ or /h/ knows that this would be the result, so it projects a syllable node to prevent this. The lookahead would be limited to seeing the preceding C and that it would form a licit onset rather than having to syllabify by itself. Another way of seeing this is that any derivation where [SV] projects in CsR sequences would crash because it would violate the Adjacency Condition. Adler and Zymet (2021) argue that lookahead is a necessary mechanism in phonology.

An alternative way of dealing with this is saying that Cs and Ch are core syllables and they are built with the rest of the CV syllables. This means that epenthesis is never an option. A potential concern with this suggestion is that this violates the sonority-driven syllabification system. This is because we would expect that, if Cs and Ch are core syllables in a sonority-driven syllabification system, OR (or C[SV]) would also be. However, this suggestion would already account for much of the sonority effects in syllabification, with the sonority-driven syllabification system itself. The only piece that would still have to be accounted for is the [SV] being projected from sonorant consonants.

(61) Two adjacent Ce̲ syllables

a. /**s-wl**-ak-s/→[zé̲we̲laks:] *séweraks* ‘you eat wind’

b. /i-ɤ̃-**k-w-**ʔ/→[iɤ́̃:ke̲we̲ʔ] *ién:kewe’* ‘I will arrive over there’

c. /s-a**t-wj**ɤ̃st/→[zadé̲we̲jɤ̃s:t^{h}] *satéweienhst* ‘Study!’

The data in (61) shows that metrically invisible epenthesis cannot occur in adjacent syllables. When the environment for this is created by the morphology, metrically invisible epenthesis occurs in between the second two consonants, and metrically visible epenthesis occurs between the first two (Ce̲CeC). We can see this, for example, in (61a) in which the underlying consonant sequence is /swl/. This sequence surfaces with two epenthetic [e]s, [ze̲wel]. We know that the first of the two epenthetic [e]s is metrically visible because stress is on the antepenult (meaning that one of the epenthetic vowels must be weighted), and there is no length on the stressed vowel, meaning that the following syllable must be nonmoraic.

This pattern is specifically relevant to when two Ce̲ syllables are adjacent to each other, as words can have two Ce̲ syllables if they are not adjacent. This is shown in (62).

(62) Nonadjacent weightless syllables

a. /io-**nl**aht-ʔ/ → [óne̲lahde̲ʔ] *ónerahte’* ‘leaf’

b. /ʌ-**k-l**-a-h**kw-**ʔ/→[ɤ́̃ge̲lahgwe̲ʔ] *énkerahkwe’* ‘I will use it as a container’

c. /waʔ-t-k-ata**t-n**a**k-**ʔ/→[waʔgaʔdádenage̲ʔ] *wa’tkatátenake’* ‘I scratched myself’

The data in (62) shows that the metrical visibility alternations in (61) are about adjacency (as opposed to quantity of metrically invisible vowels in a given word), as these data contain words with two Ce̲ syllables in a word, but both are metrically invisible as they are non-adjacent.

As with CCC sequences, I assume that the metrically visible epenthesis in Ce̲Ce̲ sequences can be modeled as the insertion of a mora + [SV] compound.[88] This is shown in (63). As a shorthand, I use RRR to refer to the sequences that would result in two adjacent syllables with metrically invisible [e̲], but don’t because of the Adjacency Condition.

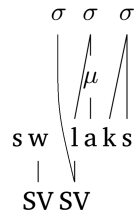
[88] I also assume [voc] is inserted with the mora + [SV]. However, for the sake of preventing clutter, I do not include [voc] in the pictures.

(63) RRR syllabified [89]
/**s-wl**-ak-s/→[zéwe̲laks:] *séweraks* 'you eat wind'

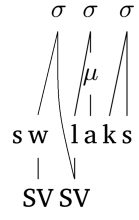
a. Core syllables and final nonmoraic syllable



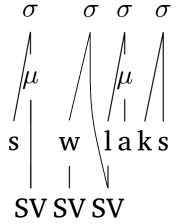
b. First [SV] projects a syllable node



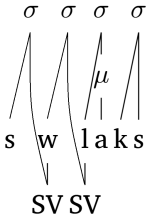
c. Attach onset



d. Insert a mora and attach onset



e. *Adjacent nonmoraic syllables



In (63a), CV units, and the final nonmoraic syllable are built. In (63b) and (63c) the final weightless syllable is built with [SV] from /l/ projecting the syllable node and the /w/ attaching as the onset.[90] Then, the initial /s/ must be syllabified. If /s/ (or the [SV] on /w/) were to project a syllable node, this would result

[89] I only represent [SV] on the sonorant consonants here so as to not have too much clutter, but there should also be [SV] on each vowel.

[90] Another theoretically plausible option is that just a mora is inserted here, and [SV] from the adjacent sonorant consonant spreads to the mora.

in an illicit structure like that in (63e), which violates the Adjacency Condition. The system instead must insert a mora + [SV] complex to which /s/ attaches as the onset in (63d).

3.5.4 Word edges and the Adjacency Condition

The Adjacency Condition also accounts for the disparity between the freedom of word-initial clusters in comparison to that of word-final clusters.

As described previously, word-initial consonant clusters have exactly the same profile as word-medial consonant clusters (barring GC sequences, which will be discussed in section 3.6). Some left edge clusters are shown in (64).

(64) Left-edge clusters

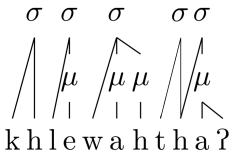
a. /**k-t**akeliʔta-s/→[k^{h}dagelì:das:] *ktakerì:tas* 'I am frying'

b. /**k-hl**ewaht-haʔ/→[khlewáhthaʔ] *khrewáhtha'* 'I punish her/it'

c. /**k-st**ath-a-ʔt-haʔ/→[ks:dathà:thaʔ] *kstathà:tha'* 'I make it dry'

As shown in (64), OO, ChC, and CsC sequences are all permitted word-initially. These clusters display the same phonotactic restrictions as word-medial clusters: the first consonant must have lower sonority than h/s, and the last consonant is unrestricted. These cases can be handled in the exact same way as the word-medial consonant clusters previously discussed. When consonant clusters are word-initial, they are followed by a vowel, so the final consonant of the cluster can syllabify into the following syllable, allowing a preceding nonmoraic syllable. This is shown in (65) with a word-initial ChC sequence.

(65) Syllabifying left edge clusters
/**k-hr**ewaht-haʔ/→[khlewáhthaʔ] *khrewáhtha'* 'I punish her/it'



In (65), /kh/ is able to form a nonmoraic syllable because the following syllable is moraic.

Consonants at the right edge, however, are much more restricted. While any obstruent can be word-final, word-final clusters are, for the most part, limited to GC (which I will save for section 3.6) and Cs sequences. Some right edge clusters are shown in (66).

(66) Right-edge clusters

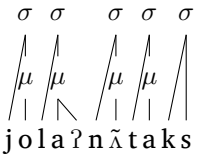
a. /s-li**ht**/→[íze̲liht^{h}] *íseriht* ‘Cook!’

b. /s-ʔnhaht-iaʔ**k**/→[z◌̍ʔn̥háhgjaʔk^{h}] *se’nháhtia’k* ‘Cut the branch!’

c. /io-laʔnʌta**k-s**/→[jolaʔnʌ́ː daksː] *iora’nén:taks* ‘it is sticky’

This pattern follows from the constraints placed by the Adjacency Condition: word-final singleton obstruents create a single nonmoraic syllable, while clusters at the right edge are limited to those that only require the projection of one syllable node. In this way, right edge clusters are limited to the same CC clusters as those that can occur as the first two members of surface CCC sequences (I will discuss GCC sequences in section 3.6). Cs is a licit sequence word-finally, as well as preconsonantally in CsC sequences.[91,92] An example with a word-final Cs sequence is shown in (67).

(67) Syllabifying word-final Cs sequences
/io-laʔnʌ̃ta**k-s**/→[jolaʔnʌ́ː daksː] *iora’nén:taks* ‘it is sticky’



Since the word-final CC cluster has rising sonority, it can be syllabified as an onset-nucleus sequence, making it form only one nonmoraic syllable.

While Cs and GC sequences are regularly created by the morphology, no other CC sequence is. This means that, just like RO sequences, we do not see underlying CC# clusters being militated against by the phonology. The only example of this I could find is in (68).

[91] I would expect that since both /s/ and /h/ behave like a vowel and are treated very similarly, final Ch sequences should also be licit. However, I have not found any forms (or verb roots) that end in [Ch]. This could be because final Ch would sound identical to final C (because the final C would be syllabic, garnering aspiration), so they neutralized to C.

There is one verb root reported in the dictionary as the following. The verb root is presented as -ahiakh- in the dictionary (Michelson, Michelson and Deer, 2024).

(i) /s-ahiakh/→[zahjákha] *sahiákha* ‘Go pick berries, fruit!’

This presentation of the form suggests that a weighted epenthetic [a] is inserted to make sure that Ch is not word-final. However, the [a] seems to be underlying. The incorporated noun root in this form is -ahi- ‘berry’. The following [a] is the joiner. The following verb root seems to be /-kh-/, however there is no such verb root. There is one verb root that is /-kha-/ ‘to attach’. This must be the verb root. This explains why the above form has [a]. Thank you to Max Blackburn for helping me figure this out.

[92] Kanien’kéha seems to prefer /s/ as a syllabic consonant to all other syllabic consonants. This vowel-like behaviour can be seen in the aspect suffixes (habitual, punctual, and stative). Each of these suffixes has a number of different allomorphs depending on the identity of the base-final segment. If the base-final segment is a consonant (other than /ʔ/), the aspect suffixes are vowel-initial or /s/ initial. The few aspect suffix allomorphs that are consonant initial never appear after a consonant-final base. This is not entirely surprising considering how /s/ patterns cross-linguistically. The flexibility of /s/ cross-linguistically has long been noted (Goad, 2011; Vaux and Wolfe, 2009). It has an unmarked coronal place of articulation, is present in almost every language, and often does not behave like an obstruent. For example, Blackfoot has been argued to have /s/ in the nucleus with varying moraic representations (Goad and Shimada, 2014; Polgárdi, 2025). Nuclear /s/ also exists in some Miyako dialects where the fricative vowel sometimes surfaces as [s] or [z] (Pellard and Hayashi, 2019).

(68) Final TT sequences broken up

/sa-s-ah**kt**/→[zazáhg̱ə̱t^{h}] *sasáhket* 'Go back!'

In (68), metrically visible epenthesis breaks up the final CC sequence (/kt/). The fact that it is specifically metrically visible epenthesis breaking up this word-final CC cluster shows that we are dealing with a violation of the Adjacency Condition. If epenthesis did not occur, it would result in a violation of the Adjacency Condition (*[za.záh.k^{h}.t^{h}]).[93]

There are a few exceptions to this rule that most CC clusters are dispreferred at the right edge. Specifically, there are a few examples of /kt/ and /(h)st/ clusters at the right edge.[94] Some examples are shown in (69).

(69) kt#, hst#

a. /t-io-htũhne**kt**/→[gjodű̱hnek^{h}t^{h}] *kiotónhnekt* 'startling'

b. /s-at-wjʌ̃**hst**/→[zaḏé̱wɛ̱jʌ̃hs:t^{h}] *satéweienhst* 'Study!'

c. /s-wiskwʌ̃htalʔe**hst**/→[zɛ̱wis:gwʌ̃hdálɛ̱ʔehs:t^{h}] *sewiskwenhtáre'ehst* 'Slip on ice!'

These clusters violate the Adjacency Condition and are thus a problem for the current analysis. It is interesting that the CC clusters that go against expectations involve /t/ in the second position, when this is also the case in many Germanic languages (e.g. *text* [kst#]) (Rice, 1992). However, I leave this to future research.

3.5.5 A problem for every stress-epenthesis analysis

There is one underlying sequence that relatively consistently violates the Adjacency Condition. These are COR sequences, some examples of which are shown in (70).

[93] This is similar to the analysis of Mandarin speaker's acquisition of final CC clusters in English. For these learners, final C^{h}C^{h} sequences are licit if there are intervened by a prosodic boundary. However, if there is no prosodic boundary then this is illicit because it would consitute adjacent empty nuclei and be banned by the ECP (see above) (Goad and White, 2008).

[94] There are a few stray examples of other CC sequences at the right edge. However, I could only find one example of each of these sequences (as opposed to final /kt/ and /st/ sequences of which there are a handful of examples each).

(i) Rare final clusters: sk, tst, kt, st

a. /ta-s-ohe**tst**/→[dazóhets:t^{h}] *tasóhetst* 'Pass it this way!'

There are also some counterexamples in particles and numbers (e.g. /wi**sk**/→[wísk^{h}] *wísk* 'five'), but since these are not the focus of this thesis, they are not relevant.

(70) COeR examples

a. /waʔ**t-k-l**-ɤ̃ʔ/→[wà:t^{h}ge̲lɤ̃ʔ] *wà:tkeren'* 'I'm splicing something at the same level'

b. /iaʔt-k-at-staw-awʔe**st-**ʔ/→[jaʔt^{h}gats:dawáwe̲ʔes:de̲ʔ] *ia'tkatstawáwe'este'* 'I went into the bush'[95]

c. /waʔ**t-k-n**ak-ʔ/→[wà:t^{h}ge̲nage̲ʔ] *wà:tkenake'* 'I scratched it'

In many COR sequences, there is metrically invisible epenthesis breaking up the OR cluster, but no epenthesis breaking up the CO cluster (metrically visible or invisible). This means that these forms involve two adjacent nonmoraic syllables: C.Oe̲. This would result in a representation like in (71).

(71) Representation of COR
/waʔ**t-k-l**-ɤ̃ʔ/→[wà:t^{h}ge̲lɤ̃ʔ] *wà:tkeren'* 'I'm splicing something at the same level'



Due to the large number of surface COe̲R sequences, it is not the case that these are simply exceptions.

COR sequences are also a problem for essentially every other analysis of Kanien'kéha stress and epenthesis. For example, COe̲R sequences would constitute two adjacent syllables with empty nuclei in Rowicka (1999). In rule ordering analyses, metrically visible epenthesis would occur first, so this analysis would predict epenthesis in both slots (COR→C$\underline{\text{e}}$OR→C$\underline{\text{e}}$Oe̲R) (Michelson, 1988; Elfner, 2016; Lamont, 2024). I do not know of any analysis that can handle these data.

Interestingly, there are some cases where, ostensibly /COR/ sequences surface as [C$\underline{\text{e}}$Oe̲R] (i.e. the expected pattern). These are shown in (72).

(72) COR expected pattern

a. /t-ũta-la-ah**kt-**ʔ/→[dũdaháhg$\underline{\text{e}}$de̲ʔ] *tontaháhkete'* 'he came back'

b. /**k-t-**ʔ/→[í:g$\underline{\text{e}}$de̲ʔ] *í:kete'* 'I am standing'

c. /t-aũ**s-tw**-atat-kɤ̃-ʔ/→[daũz$\underline{\text{e}}$de̲wadát^{h}gɤ̃ʔ] *taonsetewatátken'* 'we (you all and I) should meet again'

However, as notes by Max Blackburn (p.c.), each of these examples could plausibly involve underlying /e/ rather than metrically visible epenthetic [$\underline{\text{e}}$].[96,97]

[95] Michelson, Michelson and Deer (2024) transcribes this word with a /tsk/ rather than /tst/ sequence, and an /h/ immediately preceding the last /s/, but this is not how the word has been pronounced by speakers I have worked with.

[96] In the case of (72b), the verb root could be /-et-/ as opposed to /-t-/. In the case of (72c), the prefix /aũs-/ could be /aũse-/. The example in (72a) is less straightforward, but one could suggest (perhaps undesirably) that there is root allomorphy: /-ahkt-/~/-ahket-/. Thank you to Max for showing me these possibilities.

[97] It is also interesting that whereas COR (for the most part) does not undergo metrically visible epenthesis, ORR always does. This

In this section, I have formally introduced a constraint, the Adjacency Condition, which prohibits non-moraic syllables from occurring consecutively. I showed how this constraint can account for all instances of metrically visible epenthesis and how it provides further evidence for the syllabification system described above. In the next section I will show how the Adjacency Condition provides more evidence for the syllabification of the laryngeals.

3.6 Laryngeals

I have assumed up until this point that the laryngeals are the only segments that are able to syllabify tautosyllabically with the preceding vowel in V_C sequences. I will argue for this assumption in this section which will, in turn, provide further support for the above analysis of contoids. I will show that since the laryngeals can syllabify in the preceding syllable, they behave differently than obstruents and sonorant consonants when pre-consonantal. I will start by describing how the laryngeals behave, demonstrating that they must be treated differently than the obstruents and sonorant consonants. Then I will provide an analysis in which I will propose that /ʔ/ always syllabifies into the nucleus with the preceding vowel, while /h/ can syllabify in the nucleus or the coda (or the onset, under specific conditions).

3.6.1 Laryngeals: the data

In this section, I will describe how the laryngeals are distributed, how they interact with other consonants, and how they interact with metrical processes. Along the way, I will address earlier analyses of the laryngeals, showing that they cannot capture all of the data.

First of all, whereas other consonants can straightforwardly be analyzed as being able to syllabify in the onset, this is not the case with the laryngeals. While all other consonants can occur word-initially, neither laryngeal can.[98,99] If the laryngeals could syllabify into the onset, we would expect them to be able to be word-initial.

Further, if the laryngeals were able to syllabify into the onset, we would expect them to pattern with the obstruents and sonorant consonants intervocalically (which I have analyzed previously as being in the onset). Whereas the stressed vowel preceding an obstruent or sonorant consonant undergoes Tonic

suggests that maybe the [SV] is playing a role in 'helping' the insertion process. That is, if the system has [SV] available (in ORR), then it only has to insert a mora, making it less costly than when mora + [SV] must be inserted (in COR)

[98] Bonneau (1988) claims that there is word-initial /ʔ/ in most vowel-initial words. However, I have not seen this reported by any other source, and I have not found this to be the case in my fieldwork. Although /ʔ/ may be inserted word-initially, there is no indication that these are phonological.

[99] There are a few particles that begin with /h/. Here are a few examples.

(i) Word-initial /h/ in particles
   a. /hɑ̃ː/→[hɑ́ː] *hén:* 'yes'
   b. /hanioʔ/→[hánjoʔ] *hanio'* 'Come on!'

Lengthening, this is not the case for the laryngeals. When intervocalic /h/ is preceded by the stressed vowel, no lengthening occurs.[100] This is shown in (73).

(73) Intervocalic /h/

a. /ka-a**h**i/→[gáhi] *káhi* 'berry', 'fruit'

b. /ka-ne**h**ũ/→[ganéhũ] *kanéhon* 'skin', 'hide'

c. /k-ate**h**ʌ̃-s/→[gadéhʌ̃s:] *katéhens* 'I'm embarrassed'

The fact that intervocalic /h/ blocks Tonic Lengthening (unlike intervocalic non-laryngeals) suggests that /h/ does not syllabify into the onset in this position.

On the other hand, when intervocalic /ʔ/ is preceded by the stressed vowel, lengthening occurs as with intervocalic obstruents and sonorant consonants. However, in the case of intervocalic glottal stop, Laryngeal Lengthening, rather than Tonic Lengthening (i.e. involving a falling tone) occurs. Unlike in previously described instances of Laryngeal Lengthening, the laryngeal is not deleted. This is shown in (74).

(74) Intervocalic /ʔ/

a. /ũkweh-shuʔa/→[ũgwehshǔ:ʔa] *Onkwehshòn:'a* 'people'

b. /wa-k-itaʔ-ũ/→[wagidà:ʔũ] *wakità:'on* 'I slept'

c. /aʔal-ʔ/→[à:ʔale̲ʔ] *à:'are'* 'curtain', 'veil'

Although the data in (74) do not rule out an onset analysis, they pose a challenge for this analysis. This is because if /ʔ/ were syllabified into the onset intervocalically, we would not expect it to influence the tone on the preceding stressed vowel.

Further support for the idea that the laryngeals must be analyzed differently than other consonants comes from CCC sequences (CC sequences involving laryngeals will be described subsequently as they are more complex). Whereas CCC sequences with other consonants in initial position are broken up with the metrically visible epenthetic vowel (e.g. (52a) /s-k-ah**kt-s**/→[s:gáhg̲e̲ts] *skáhkets* 'I got back'), GCC sequences are not. This is shown in (75) and (76).

[100]There are a few exceptions to intervocalic /h/ blocking Tonic Lengthening. These are discussed in Appendix B.

(75) ʔCC

a. /waʔ**-t-k**-ahsihal-a-ko-ʔ/→[waʔtʰgahʃihalá:goʔ] *wa'tkahsihará:ko'* 'I unblock it'

b. /te-k-iaʔ**k-s**/→[dégjaʔks:] *tékia'ks* 'I break it in two'

c. /waʔ**-k-t**akeliʔtahw-ʔ/→[waʔkʰdagelí:dahwe̲ʔ] *wa'ktakerì:ta'we'* 'I did fry it'

(76) hCC[101]

a. /ohnaʔkɤ̃-**hkh**a/→[ohnaʔgɤ́̃hkha] *ohna'kénhkha* 'the last time'

b. /kiaʔt-ita**hkh**e-ʔ/→[gjaʔdidáhkheʔ] *kia'titáhkhe'* 'I am in something moving'

c. /s-wa-k-a**hkt**-ũ/→[ze̲wagáhkʰdũ] *sewakáhkton* 'I have gone back'

Contoids in the first position of a CCC sequence require the moraic epenthesis in order to (1) be syllabified and (2) avoid violating the Adjacency Condition. Laryngeals in said position do not need either of these things, suggesting that another syllable node does not need to be projected to house laryngeals in this position.

Additional support for this analysis comes from the phonotactics of GC sequences. Whereas obstruents and sonorant consonants cannot precede sonorant consonants (e.g. (38a-i) /te-**k-l**ik-s/→[dége̲liks:] *tékeriks* 'I put two things together'),[102] the laryngeals can precede any consonant (other than another laryngeal).[103] This flexibility is shown in (77) and (78).

(77) /h/ can precede O and R

a. /io-**hn**ial-ʔkowa/→[ohnjale̲ʔkó:wa] *ohniare'kó:wa* 'serpent'

b. /a-k-ka**hl**atho-ʔ/→[akʰgahlátoʔ] *akkahrhátho'* 'I ought to turn it over'

c. /io-nla**ht**-ʔ/ → [óne̲lahde̲ʔ] *ónerahte'* 'leaf'

(78) /ʔ/ can precede O and R

a. /waʔ**-k**-anũhtũniũ-hw-ʔ/→[waʔganũdɯ̃́njũhwe̲ʔ] *wa'kanonhtónnionhwe'* 'I did think', 'I thought of it'

b. /sa-ʔ**n**otst-oskũ/→[zaʔnots:dós:gũ] *sa'notstóskon* 'you are completely naked'[104]

c. /lo-hskɤ̃ʔ**l**akehte-ʔ/→[lohs:gɤ̃ʔlagéhdeʔ] *rohsken'rakéhte'* 'male', 'warrior'[105]

Recall that OR and RR sequences are broken up by the metrically invisible epenthetic vowel because an additional syllable node is needed to fully syllabify the OR/RR sequence. That GR sequences are not broken

[101] These sequences are much more difficult to create morphologically because morphemes tend not to end in /h/.
[102] The one exception to this is /s/ in CsR sequences. See the examples in (58).
[103] ʔj is also prohibited (Michelson, 1988).
[104] In my fieldwork, I have found that the root for 'naked' might be *-'netst-*.
[105] In Ahkwesáhsne, this word means 'male'. In Kahnawà:ke, this means 'warrior'.

up by the metrically invisible epenthetic vowel then provides further support for the idea that the laryngeals syllabify differently than the sonorant consonants and obstruents.

Yet another piece of evidence that the laryngeals should not be treated like the obstruents or sonorant consonants comes from sequencing (i.e. relative ordering). Whereas most underlying OO and OR/RO sequences behave the same no matter the sequencing (other than Ts-sT), CC clusters involving a laryngeal do not. That is, GC sequences behave differently than CG sequences. More specifically, whereas CG sequences pattern like other CC sequences, GC sequences pattern unlike any other CC sequence in the language.

I will first discuss sequencing in reference to Ch and hC clusters. Ch and hC sequences behave differently from each other in reference to vowel length and metrically visible epenthesis.

Before discussing these asymmetries, a note is necessary on the relative sequencing of R and /h/ in Rh sequences. Rh sequences are slightly more complex than Oh sequences due to dialectal and interspeaker variation. Since this thesis focuses on the Ahkwesáhsne dialect, the examples I use will include the Ahkwesáhsne pattern.[106] Rh sequences in Ahkwesáhsne may surface as Rh or hR. Regardless of the dialect, the only Rh sequences are [lh][107] and [nh].[108] Some examples of Rh sequences are shown in (79). /rh/ and /nh/ sequences are written as <hrh> and <hnh> in the orthography.

(79) Rh~hR in Ahkwesáhsne

a. /wak-ia?t-a-**nh**a?/→[agja?dáhna?] ~[agja?dánha?] *atia'tahnha'* 'belt'

b. /ie-tst-a-**lh**o-hst-a?/→[jets:dahlóhs:da?] ~[jets:dalhóhs:da?] *ietstahróhsta'* 'shingles'

Bonvillain (1973) notes in her fieldwork that older speakers pronounce these sequences as Rh while younger speakers tend to pronounce them as hR. The majority of the speakers that I have worked with pronounce these sequences as hR.[109] Importantly, regardless of whether /Rh/ surface as [Rh] or [hR], these sequences pattern with the Ch sequences (in patterns that will be described shortly). This means that the [hR] sequences that are underlyingly /Rh/ will pattern differently than [hR] sequences that are underlyingly /hR/ (which will be discussed shortly). Since /Rh/ sequences pattern with the other Ch sequences regardless of the surface form, I will suggest that Rh sequences should still be syllabified as Rh, even when surfacing as [hR]. For this reason, I will discuss Rh sequences with the other Ch sequences.

[106] In Kahnawà:ke, Rh sequences are pronounced as hRh (Mithun, 1979). This is how they are also transcribed in Michelson (1988) and Michelson, Michelson and Deer (2024).

(i) Rh becomes hRh in Kahnawà:ke

a. /k-**nh**a?-s/→[géhnha?s:] *kéhnha's* 'I hire it', 'I order it'

b. /wa?-k-ka**rh**atho-?/→[wa?k^{h}gahrhátho?] *wa'kkahrhátho'* 'I did turn it over'

Karin Michelson calls the /h/ preceding the sonorant consonant 'fake /h/' because it does not undergo the same phonological processes as normal /h/.

[107] This is [rh] in the dialects that use the rhotic liquid.

[108] There are some instances of /wh/ (pronounced as [f]), but these are few and far between.

[109] When /lh/ sequences are pronounced in that order, the /l/ surfaces as voiceless [l̥].

Returning to the asymmetries between Ch and hC sequences, no matter the quality of the C (unless it is another laryngeal), when an underlying Ch sequence is immediately preceded by a stressed vowel, the vowel does not undergo any type of lengthening. This is also the case for hO sequences. However, when underlying hR sequences are immediately preceded by a stressed vowel Laryngeal Lengthening occurs. That is, /h/ deletes, and the vowel lengthens and takes on a falling tone (as with ʔC sequences). This is shown in (80) and (81).

(80) Ch sequences and length

a. Oh[110] sequences and lengthening

i. /s-ahi-a-**kh**a/→[zahjákha] *sahiákha* 'Go pick berries, fruit!'

ii. /a-k-kahla**th**o-ʔ/→[ak^{h}gahláthoʔ] *akkahrhátho'* 'I ought to turn it over'[111]

b. Rh sequences and length

i. /at-kahl-a-**nh**a-ʔ/→[at^{h}gahláhnaʔ] *atkahráhnha'* 'glasses'

ii. /k-ʌ̃to**l-h**aʔ/→[gʌ̃dóhlaʔ] *kentórha'* 'I am lazy'

(81) hC sequences and length

a. hO sequences and length

i. /a-k-ta**hk**o-ʔ/ → [ak^{h}dáhgoʔ] *aktáhko'* 'I ought to take it out'

ii. /i-aʔ-hii-aʃe**ht**a-ʔ/→[jahijaʛéhdaʔ] *iahiiatsiéhta'* 'I shot it at him'

b. hR sequences and length

i. /io-**hn**ial-ʔ/→[ò:njale̲ʔ] 'snake'

ii. /io-ka**hl**-aʔ/ → [ogà:laʔ] *okà:ra'* 'eye'

These data show that Ch and hC sequences cannot be syllabified in the same way, as the lengthening patterns would then be the same in both. Further, these data show that hO sequences require a different analysis than hR sequences.

These data also provide evidence against many analyses of /h/ in VhC sequences in the literature. For example, these data challenge the analysis that /h/ always syllabifies into the coda in VhC sequences (e.g. Michelson, 1988; Alderete, 1995; Piggott, 1995; Rawlins, 2006), as well as the analysis that /h/ forms a heavy diphthong with the preceding vowel (Bonneau, 1988). Since lengthening occurs before hR sequences,

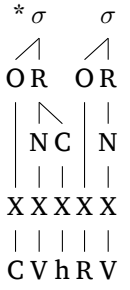
[110]When the O in a Oh sequence is a stop, it sounds like an aspirated stop. When the preceding C is /s/, it sounds like a long /s/ followed by some aspiration. This is reported by Hopkins (1988) as well. Sometimes no aspiration is present. I assume this to be a phonetic effect due to the high perceptibility of /s/ compared to that of /h/. I will continue to transribe these sequences as [sh] for analytical transparency.

[111]Michelson, Michelson and Deer (2024) have /h/ before the /th/ in this root, but it is not pronounced this way by the speakers I have been working with, and it is not written this way in Martin (2023).

the coda and heavy diphthong analyses should be ruled out as they would predict that lengthening (of any type) would be blocked before all hC sequences. This is because the coda and heavy diphthong analysis both involve /h/ contributing weight, which would block lengthening. This is shown in (82). I use Onset-Rhyme theory here because there is no distinction between the representation of the second half of a heavy diphthong and a coda in Moraic Theory.

(82) hC and Tonic Lengthening

a. Coda-onset



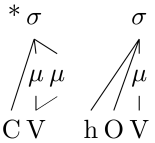
b. Heavy diphthong



As with lengthening before ʔC sequences, lengthening before hR sequences should not be analyzed as compensatory lengthening because, in some cases the /h/ is still pronounced despite following the lengthened vowel.

These data also challenge the analysis where /h/ forms a complex onset with the following consonant (Hagstrom, 1997). While the coda and heavy diphthong analyses cannot account for hR sequences, the complex onset analysis cannot handle hR or hO sequences. If hC formed a complex onset, why would hO block Tonic Lengthening, and why would /h/ delete in hR sequences? This incorrect prediction is shown in (83) in which there is a long stressed vowel illicitly immediately an hO sequence.

(83) Complex onset hC



Metrically visible epenthesis further supports the analysis that Ch and hC sequences should be syllabified

differently. Whereas hCC sequences are not broken up by the metrically visible epenthetic vowel (see (76)), CCh sequences are. This is shown in (84).

(84) CCh sequences and epenthesis

a. /te-**k-kh**a-s/ → [deg[é]khas:] *tekékhas* 'I attach two things together'

b. /**s-kh**e-ihnũk-hs-eʔ/→[z[e]khehnű́khseʔ] *sekhehnonkhse'* 'I come for her'

c. /**k-l-h**aʔ/→[g[é]hlaʔ] *kéhrha'* 'I fill it in'

d. /waʔ-k-ata**t-l-h**ahs-ʔ/→[waʔgadad[é]hlahse̲ʔ] *wa'katatéhrhahse'* 'I served myself'

Interestingly Ch sequences also do not trigger metrically visible epenthesis in ChC sequences (as briefly described above), shown in (85).

(85) ChC

a. /ɤ̃-**k-ht**ehl-o-ʔ/→[ɤ̃khdè:loʔ] *enkhtè:ro'* 'I will put the root in water', 'I will boil the root'[112]

b. /wa-l-a**t-hkw**iʔt-ʔ/→[waháthgwiʔde̲ʔ] *waháthkwi'te'* 'he moved over'

c. /**k-hi**adũ-s/→[khjá:dũs:] *khiá:tons* 'I write'

In this way, CC sequences involving /h/ display sequencing constraints in that hC sequences behave differently than Ch sequences. Whereas Ch sequences behave more like OO/OR/RO sequences in reference to metrical processes, hC sequences behave differently. I will argue that this is because, unlike other consonants, /h/ (as well as /ʔ/) is able to syllabify with the preceding vowel.

CC sequences containing /ʔ/ also display sequencing constraints suggesting that ʔC and Cʔ sequences should be syllabified differently. ʔC sequences behave differently than Cʔ sequences in three different ways: metrically invisible epenthesis, Tonic/Laryngeal Lengthening, and metrically visible epenthesis. Whereas /ʔ/ can precede almost any consonant, all Cʔ sequences are broken up by the metrically invisible vowel (like OR sequences). The metrically invisible vowel surfaces as [e̲] when /ʔ/ is word-final or followed by a consonant (like with CR clusters), but if /ʔ/ is followed by a vowel, the epenthetic vowel takes the quality of the vowel following /ʔ/. This vowel copying process is traditionally called Vowel Twin (Postal, 1969). This is shown in (86) and (87).

[112]To my ear, OhO sequences sound identical to OO sequences. This should be tested more. The /h/ should still be there phonologically because it is still present in ChR sequences, which would have involved metrically invisible epenthesis if the /h/ was not present.

(86) C?# and epenthesis[113]

a. /sa-hska**l-**ʔ/→[záhs:galḛʔ] *sáhskare'* 'your boyfriend', 'your girlfriend'

b. /waʔt-k-t-a-ʔ**n-**ʔ/→[waʔdɛ́kʰdaʔnḛʔ] *wa'tékta'ne'* 'I stood up'

c. /waʔ-k-atat-iʌ-hah**s-**ʔ/→[waʔgadagjʌ́ː:hahsḛʔ] *wa'katatién:hahse'* 'I saved it'

(87) Vowel twin examples[114]

a. /wak-nũhs-i**s**ʔ-ũ-hakie/→[wagḛnũhʃizṵʔũhágje] *wakenonhsison'onhátie* 'I finish the house a little bit at a time'

b. /iaʔt-k-at-staw-a**w**ʔest-ʔ/→[jaʔtʰgats:dawáwḛʔes:dḛʔ] *ia'tkatskawáwe'este'* 'I went into the bush'

c. /te-i-o**j**ʔ ak-s-ne/→[dejojaʔáks:ne] *teioia'áksne* 'It flashes', 'movie theatre'

The second way that Cʔ sequences behave differently from ʔC sequences has to do with Tonic/Laryngeal Lengthening. Whereas stressed vowels preceding underlying Cʔ sequences (which surface as Cḛʔ) are short like those preceding OO/OR/RO clusters, stressed vowels immediately preceding ʔC sequences are lengthened via Laryngeal Lengthening: /ʔ/ is deleted, and the stressed vowel takes on a falling tone. These lengthening patterns are shown in (88) and (89).

(88) ʔC sequences and length

a. /io-ahʧ**a**ʔn-aʔ/→[ohʤàː:naʔ] *ohtsià:na'* 'hand'[115]

b. /wak-i**a**ʔk-ũ/→[wagjàː:gũ] *wakià:kon* 'I cut it off'

c. /s-sah**e**ʔt-ak-s/→[ts:ahèː:daks:] *tsahè:taks* 'you eat beans'

(89) Cʔ sequences and length

a. /waʔt-k-ne**r**ʔak-ʔ/→[waʔtʰgḛnélaʔgḛʔ] *wa'tkenéraʔke'* 'I mistook it'

b. /ʌ̃-k-o**j**ʔak-ʔ/→[ʌ̃gójaʔgḛʔ] *enkóia'ke'* 'I'll aim for it'[116]

c. /k-**l**ʔok-s/→[gɛ́loʔks:] *kéro'ks* 'I chop with an axe'

If Cʔ and ʔC sequences were syllabified the same way, we would not expect this difference in behaviour in reference to lengthening.

[113]Interestingly, /ʔ/ is sometimes not pronounced despite providing the environment for epenthesis. This is reported by Michelson (1988) as well.

[114]In a rule ordering analysis, Postal (1969) argued that these Cʔ sequences are underlyingly coda-onset, and that vowel copying occurs after all of the relevant metrical processes. However, this analysis implies that incorrect syllable structure is built first, only be to be undone, which is problematic. While I do not assume this analysis, I do follow Postal (1969) in assuming that these sequences are underlyingly Cʔ. See Postal (1969) for in depth arguments supporting this statement.

[115]This form means 'palm of your hand' or 'handful' in Kahnawà:ke.

[116]This form appears to violate the Adjacency Condition. I will argue in the analysis that this is not the case as the mora from the orginal vowel is still present despite not being pronounced.

These data also show that a coda analysis of /ʔ/ in ʔC sequences is undesirable: if /ʔ/ were in the coda, we would expect it to block lengthening. Compensatory lengthening is also off the table because /ʔ/ is sometimes pronounced despite being preceded by a long vowel (I will discuss this in more depth in section 3.6.2).

Finally, metrically visible epenthesis provides further support for the argument that Cʔ and ʔC sequences should be treated differently. As shown in (75) (repeated here as (90)), ʔCC sequences are not broken up by the metrically visible vowel.

(90) ʔCC

a. /waʔ-**t-k**-ahsihal-a-ko-ʔ/→[waʔt^{h}gahʃihalá:goʔ] *wa'tkahsiharáːko'* 'I unblock it'

b. /te-k-iaʔ**k-s**/→[dégjaʔks:] *tékia'ks* 'I break it in two'

c. /waʔ-**k-t**akeliʔtahw-ʔ/→[waʔk^{h}dagelí:dahwe̲ʔ] *wa'ktakerìːtahwe'* 'I did fry it'

In contrast, CCʔ sequences are (other than some COʔ sequences, discussed in section 3.5). This is shown in (91).

(91) CCʔ and metrically visible epenthesis[117]

a. /t-a-w-ale**sl-**ʔ/→[dũlé:z◌̄le̲ʔ] *tonré:sere'* 'It boiled', 'flowed over'

b. /**k-t**ʔa-s/→[k◌́ta̲ʔs:] *kéta's* 'I put it in'

c. /**k-l**ʔok-s/→[g◌́lo̲ʔks:] *kéro'ks* 'I chop with an axe'

These differences show that, unlike OO/OR/RO clusters, CC clusters with /ʔ/ display sequencing constraints. This suggests that /ʔ/ must be treated differently from the other consonants.

To summarize this section, I have shown that (1) the laryngeals in GC sequences cannot be analyzed like other consonants in the first position of CC sequences, and (2) they cannot be straightforwardly analyzed as codas, or onsets.

In the next section, I will argue that these patterns can be accounted for if /ʔ/ must always syllabify in the nucleus, while /h/ can syllabify into the nucleus or the coda.

3.6.2 Laryngeals: the analysis

In this section, I will argue that the laryngeals are phonologically placeless and that this prevents them from syllabifying in the onset, but allows them to syllabify in the nucleus and the coda. I will argue, further, that the laryngeals must be analyzed differently in terms of syllable structure, with /h/ being able to syllabify

[117] In forms like (91b and (91c), where Vowel Twin occurs, the original vowel has deleted, and only the copy remains on the surface.

in the coda or the nucleus (or under special circumstances, the onset), and /ʔ/ needing to syllabify in the nucleus.[118] I will first discuss /h/, then ʔ.

3.6.2.1 Syllabifying /h/

I will argue here that, in addition to /ʔ/, /h/ is the only segment able to syllabify tautosyllabically with the preceding vowel. Depending on the environment, /h/ can syllabify in the coda or the nucleus. I will also argue that, under specific conditions, /h/ can syllabify into the onset.

I will start by discussing hC sequences, showing how the current analysis that /h/ can syllabify in the previous syllable can account for how these sequences interact with the phonotactics, epenthesis, as well as with metrical processes.

Recall that intervocalic hC sequences are never broken up with epenthesis, even when the C is a sonorant consonant (unlike all other OR sequences, barring ʔR). This is shown in the above examples in (77) (e.g. (77a): /io-**hn**ial-ʔkowa/→[ohnialɛ̲ʔkó:wa] *ohniare'kó:wa* 'serpent'). The fact that hR sequences are not broken up by epenthesis is expected if /h/ can syllabify with the preceding vowel. Recall that, under the current analysis OR sequences are broken up by metrically invisible epenthesis in order to syllabify the C. So if /h/ already has a position in the syllable in which to syllabify (the exact position will be shown shortly), there is no need for epenthesis.

This analysis also correctly predicts that hC cannot occur word-initially, as shown in (92). This contradicts Hagstrom (1997) who argues that hC is a complex onset.

(92) #hC is illicit

a. /**hl**-ehiahr-a-ʔ-s/ → [lehjà:laʔs:] *rehià:ra's* 'he remembers'

b. /**hl**-ehsak-s/→[léhsaks:] *réhsaks* 'he is looking for it'

c. /**hs**-ahi-a-kha/→[zahjákha] *sahiákha* 'Go pick berries', 'Go pick fruit!'

The data in (92) show that /h/ cannot be analyzed as part of a complex onset and that it is more likely that /h/ is in the preceding syllable in VhC sequences.

The analysis of /h/ syllabifying in the preceding syllable in VhC sequences also correctly predicts its behaviour as the first member of CCC sequences. Recall that CCC sequences are broken up by metrically visible epenthesis to militate against violations of the Adjacency Condition, but that hCC sequences do not undergo epenthesis. This is shown in (93).

[118] See Dyck (1997) for a similar analysis of laryngeals in Cayuga.

(93) hCC sequences and epenthesis[119]

a. /kiaʔt-ita**hkh**eʔ/→[gjaʔdidáhkheʔ] *kia'titáhkhe'* 'I am in something moving'

b. /ohnaʔkɐ̃-**hkh**a/→[ohnaʔgɐ́hkha] *ohna'kénhkha* 'the last time'

c. /s-lo-a**hkt**-ũ/→[shók^{h}dũ] *shóhkton* 'he went back'

If the above analysis of metrically visible epenthesis is correct, then hCC must not be violating the Adjacency Condition. This falls out of the analysis that /h/ syllabifies with the preceding vowel; whereas other CCC sequences require the projection of two additional syllable nodes (resulting in the potential to violate the Adjacency Condition), hCC sequences only require the projection of one, to syllabify the second consonant (h**CC**), as /h/ can syllabify with the vowel in the preceding syllable. This provides evidence that /h/ is not syllabifying as its own syllabic consonant (like other consonants in CC sequences).

So if /h/ is able to syllabify tautosyllabically with the preceding vowel in VhC sequences, where is it syllabifying exactly?

With VhO sequences, the answer is straightforward. Since hO sequences block Tonic Lengthening on the preceding stressed vowel (shown in (94)), the best candidate for /h/ is the coda.

(94) hO and Tonic Lengthening

a. /a-k-ta**hk**o-ʔ/ → [ak^{h}dáhgoʔ] *aktáhko'* 'I ought to take it out'

b. /waʔt-iaki-ala**ht**at-ʔ/→[waʔgjagjaláhdade̲ʔ] *wa'kiakiaráhtate'* 'we two are running'

c. /waʔ-k-a**hs**eht-ʔ/→[waʔgáhsehde̲ʔ] *wa'káhsehte'* 'I hid it'

If /h/ is in the coda in VhO sequences, the patterns in (94) follow: /h/ gets WBP and so it provides weight to the syllable. Since it provides weight, Tonic Lengthening does not need to occur.[120] A representation of a VhO sequence is shown in (95).

[119]It is very hard to create this sequence morphologically. This is because hsC sequences would not show anything, as these behave like other CsC sequences in not undergoing epenthesis. hsC sequences are be discussed in more detail in Appendix B. hkC sequences are difficult to create because one could either find morpheme-final hk- (which does not exist — this will be discussed at the end of this section), or morpheme final Vh with morpheme-initial kC (which is difficult to create). The last option is htC. The problem is that finding morpheme-initial tC to suffix to morpheme-final /h/ is nearly impossible. Additionally, while there is morpheme-final ht-, there are no suffixes to add to it that are consonant initial (other than /h/, but /th/ often behaves like one segment, so this is not helpful).

[120]The implicit assumption here is that both Tonic and Laryngeal Lengthening occurs to make the stressed syllable heavy. I will discuss this in more depth in Chapter 4.

(95) VhO representation



Coda /h/ can be derived in a straightforward manner in the current right to left syllabification system. During the second parse, /h/ must be syllabified. /h/ cannot syllabify into the syllable to its right as this would form a complex onset, but it can syllabify into the syllable to its left. /h/ syllabifies into the coda because it is followed by an obstruent (the significance of the obstruent will be discussed shortly), blocking Tonic Lengthening on the preceding stressed vowel. Since in this context /h/ can syllabify into an already existing syllable, another syllable node does not need to be projected.

Restricting codas to /h/, and not sonorant consonants is not surprising given the profile of codas cross-linguistically (Clements, 1990; Beckman, 1998; Boroff, 2007; Gordon, 2016). For example, in Japanese (Itô, 1988) and Selayarese (Mithun and Basri, 1986) the coda is limited to placeless segments. However, the only placeless segments in Kanien'kéha are /ʔ/ (to be discussed subsequently), and /h/, preventing all other segments from being in the coda.

It is also interesting that despite the analysis that /h/ can syllabify in the coda, there are no cases of word-final /h/ (other than some instances in particles) (Michelson, 1988).[121] Under the current analysis, this means that Kanien'kéha has a syllabification system like Chamicuro or Italian where codas are permitted, but not word-finally (Flack, 2009; Krämer, 2009). Word-final consonants are all syllabic (or /ʔ/, which will be addressed shortly).

The case of VhR sequences are slightly more complicated. When these sequences are preceded by a stressed vowel, Laryngeal Lengthening occurs.[122] That is, the stressed vowel lengthens and gets a falling tone, and the /h/ deletes. This is shown in (96). This process also occurs with VʔC sequences.

[121] In some cases, it seems that there are phonetic word-final /h/s, but nothing phonological.

[122] Laryngeal Lengthening technically only refers to the lengthening process, and not the deletion (as Michelson (1988) breaks this process up into two rules), but I will use it to refer to the process as a whole. I also assume that Laryngeal Lengthening is distinct from Tonic Lengthening, as will be argued in Chapter 4.

(96) hR and Laryngeal Lengthening

a. /**o-h**nial-ʔ/→[ò:njale̲ʔ] ‘snake’

b. /io-k**ah**l-aʔ/ → [ogà:laʔ] *okà:ra’* ‘eye’

c. /te-k-k**ah**nel-ʔ/→[dek^{h}gà:nele̲ʔ] *tekkà:nere’* ‘I look at it’

Before analyzing hR clusters, I would like to quickly address a potential alternative analysis of Laryngeal Lengthening: that it should be analyzed as compensatory lengthening (Rawlins, 2006). Rawlins assumes that Laryngeal Lengthening is a compensatory lengthening process: when /h/ follows the stressed vowel and precedes a sonorant, it deletes and the vowel lengthens as compensation. However, Rawlins does not address why this might be the case. It is unclear to me why /h/ would delete before a sonorant consonant in the stressed syllable, but not before an obstruent. Additionally, the laryngeal is not always deleted as speakers in Kanehsatà:ke often pronounced the /h/ as well, making the compensatory lengthening story untenable.[123] For these reasons, I do not assume Laryngeal Lengthening to be compensatory lengthening.

As described above, /h/ in hR sequences cannot be analyzed as a coda nor as the second half of a heavy diphthong as the presence of a mora on the /h/ would block lengthening (cf. Bonneau, 1988).[124] Additionally, analyzing hR as a complex onset (as proposed by Hagstrom (1997)) is undesirable because (1) this would result in the analysis that hR is the only complex onset in Kanien’kéha, (2) it is unclear why /h/ would delete in (96) if it were part of the following complex onset, (3) it is also unclear why the stressed vowel that underlyingly precedes hR sequences would be pronounced with a falling tone if the /h/ is in the following onset, and (4) this would wrongly predict that hR sequences can occur word-initially, when this is not the case (as shown in (92)).

It also cannot simply be the case that hR is an illicit sequence in Kanien’kéha as hR routinely appears outside of the stressed syllable, as shown in (77). The possible amendment to the *hR analysis where hR is only illicit in unstressed syllables is also undesirable, because this goes against typological trends of preservation of contrast and markedness cross-linguistically. In a given language, the stressed syllable tends to preserve more contrast (i.e. allow more marked structure) than unstressed syllables (Beckman, 1997, 1998). In this way, it would be surprising if hR was able to occur in an unstressed syllable, but not in a stressed syllable in Kanien’kéha.

I propose, instead, that /h/ in VhR sequences forms a light diphthong with the preceding vowel. A representation of this is shown in (97).

[123]Niá:wen to Akwiratékha’ Martin for pointing this out to me.

[124]Bonneau (1988) uses word-final GC sequences to argue for a heavy diphthong analysis. This will be discussed subsequently.

(97) VhR representation



Since /h/ forms a light diphthong with the preceding vowel in VhR sequences, it does not contribute weight, so lengthening still needs to occur (I will describe how this results in the deletion of /h/ shortly).[125] This can be derived using the right to left syllabification algorithm in the same as way as with VhO sequences, described above.

I argue that /h/ is able to syllabify in the nucleus with the preceding vowel for a few reasons. Firstly, as we saw in section 3.5, /h/ can syllabify in the nucleus on its own in ChC sequences (see the justification presented therein). Secondly, VC nuclei have been proposed for Kanien'kéha laryngeals for independent reasons (Bonneau, 1988; Hagstrom, 1997),[126] in another Lake Iroquoian language, Cayuga (Dyck, 1997), and in a number of other languages (e.g. VR nuclei in Kru languages (Kaye, 1985)). Lastly, /h/ often takes on the place of articulation of an adjacent vowel, making it essentially a voiceless vowel.

The representation in (98) shows Laryngeal Lengthening preceding VhR. Note that I assume Laryngeal Lengthening to be the addition of a mora (this will be expounded on in Chapter 4).

(98) Laryngeal Lengthening preceding VhR



As can be seen in (98), although the /h/ is not pronounced phonetically, it is present phonologically. I argue that this is what derives the falling tone. As described in section 2.2, I follow Michelson (1988) in assuming that the laryngeals have an underlying low tone, and that the laryngeal sharing the second mora with the vowel is what results in a low tone on the second half of the stressed vowel.[127] This results in a falling tone from the first mora (which has a high Tone) to the second mora. I will describe exactly how this works in Chapter 4. Unlike Michelson, I do not assume that the laryngeal deletes. Rather, I argue that the /h/ is phonologically present, but is both too cumbersome to articulate and too difficult to perceive when simultaneously following a low tone and preceding a consonant. In terms of articulation, low tone is often pronounced as creak. This means that the speaker would have to produce creak for the low tone followed

[125] I will argue in section 4.4 that Lengthening before laryngeals occurs in order to host the mora underlyingly present in the laryngeal consonant. While both Laryngeal and Tonic Lengthening result in a bimoraic stressed syllable, these will be motivated by different constraints.

[126] The arguments proposed by Bonneau (1988) and Hagstrom (1997) are not relevant to the current thesis as they make different assumptions about syllable structure.

[127] In Chapter 4, I will propose that tone is delinked outside of the stressed syllable, in order to account for the Pitch Accent system.

by stiff vocal folds for the /h/. I assume that this difficulty results in speakers often not pronouncing the /h/. Note that producing creak/Low tone followed by /h/ is not impossible. This correctly predicts that /h/ is sometimes pronounced by some speakers in Kanehsatà:ke, implying that /h/ is still present in the phonological representation.[128] I argue that when /h/ *is* pronounced, it is still difficult to perceive (à la License by Cue (Steriade, 1994)). In Kanien'kéha, /h/ can normally be heard as the fading out of the preceding vowel in VhC sequences or as aspiration in ChV sequences. This means that one of the main cues to /h/ in Kanien'kéha is its effect on the adjacent vowel (which explains why ChC sequences sound the same as the corresponding CC sequences). So when /h/ is preceded by creak/Low tone, and followed by a consonant, it is very difficult to perceive. The difficulty to articulate and perceive /h/ when following low tone and preceding a consonant conspire to make it seem like /h/ has phonologically deleted. Evidence for the analysis that /h/ does not phonologically delete in Laryngeal Lengthening contexts comes from Rh sequences. Recall that underlying Rh sequences may be pronounced as [hR] or [Rh] but that, for the most part, they are pronounced as [hR] by speakers in Ahkwesáhsne. Interestingly, if Laryngeal Lengthening (triggered by an underlying /ʔ/) occurs before this sequence, it is generally pronounced as Rh. This follows from the analysis that /h/ is difficult to pronounce between a low tone and a consonant. To avoid doing so, Rh sequences are pronounced as [Rh] when following a falling tone in order to be able to pronounce the /h/ as well as have it be perceived. I will provide a longer discussion of underlying Rh sequences shortly, describing why they, but not underlying hR sequences are able to metathesize. More evidence that the laryngeal remains in the representation and is not deleted will come from /ʔ/, which will receive a similar analysis.

While it may seem odd that /h/ syllabifies in two different positions depending on the following consonant, I argue that this follows from the Syllable Contact Law (Murray and Vennemann, 1983). Recall that I proposed in section 3.2 that /h/ has higher sonority than the rest of the obstruents, but lower sonority than the sonorant consonants. This means that in VhO sequences, hO forms a licit falling sonority coda-onset sequence. Note that since /hs/ sequences block Tonic Lengthening, this provides evidence that /h/ has higher sonority than /s/. On the other hand, in VhR sequences, hR would form an illicit rising sonority coda-onset, so /h/ must syllabify into the nucleus instead.

I argue that, by default, /h/ wants to be in the coda but is forced to syllabify into the nucleus when followed by a sonorant. The 'default coda' analysis for /h/ is borne out in the cases of intervocalic /h/. When /h/ is intervocalic, it behaves like it is in the coda as it blocks Tonic Lengthening. This is shown in (99).

[128]Michelson takes data like this as evidence that Laryngeal Lengthening should be a separate rule from Laryngeal Deletion.

(99) Intervocalic /h/ blocking lengthening

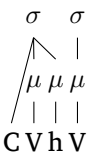
a. /ka-a**h**i/→[gáhi] *[gá:hi] *káhi* ‘berry’, ‘fruit’

b. /ka-ne**h**ũ/→[ganéhũ] *[gané:hũ] *kanéhon* ‘skin’, ‘hide’

c. /wa-law-ʌ**h**ahs-ʔ/→[wahawʌ̃́hahsẹ̲ʔ] *[wahawʌ̃́:hahsẹ̲ʔ] *wahawénhahse’* ‘He called him names’, ‘he put him down’

Michelson (1988) suggests that intervocalic /h/ could be a geminate, however, /h/ does not occur word-initially, suggesting that /h/ avoids the onset.[129] It would be unsatisfactory if it were the case that /h/ cannot be word-initial, but can be the onset half of a geminate.[130] For this reason, I assume the coda analysis of intervocalic /h/, as shown in (100).

(100) Intervocalic coda /h/



The second way that the default coda analysis for /h/ is borne out is in hOO sequences, which block Tonic Lengthening on the preceding stressed vowel. This is shown (93), repeated here as (101).

(101) hOO blocks Tonic Lengthening

/s-lo-a**hkt**-ũ/→[shóhk^{h}dũ] *shóhkton* ‘he went back’

Despite the analysis that the first obstruent in hOO sequences is syllabic (meaning there is no coda-onset relationship), the /h/ behaves like it’s in the coda, blocking Tonic Lengthening. This is shown in (102). The syllabification of the initial [sh] sequence will be explained shortly.

(102) /h/ is in the coda in hOO

/s-lo-a**hkt**-ũ/→[shóhk^{h}dũ] *shóhkton* ‘he went back’



[129]It is interesting that, despite the analysis that /h/ can project a syllable node, it still cannot occur word-initially. Why can it not project a syllable node word-initially (either as a singleton or in hC)? I suggest that this is because of a conspiracy of factors. First /h/ is already a weak nucleus as it is a consonant. Weakening it further, /h/ is difficult to hear making it undesirable to project a syllable nucleus (it will do so if forced). Second, syllables like to have onsets. This means that a syllable consisting of a weak nucleus /h/ without an onset is dispreferred. Lastly, word-initial syllables tend to be more perceptually salient. Thus, it makes sense that an onsetless syllable with a weak nucleus would not want to be word-initial. This can be modeled straightforwardly in OT.

[130]This is also an argument against intervocalic /h/ being represented like word-medial TT sequences, with one as a syllabic consonant, and the other as the onset of the following syllable.

The representation in (102) also shows how hCC sequences avoid violating the Adjacency Condition. The final syllable /tũ/ is moraic, the penult is nonmoraic /k/, and the antepenult is moraic /hoh/; there are no consecutive nonmoraic syllables.

The default-coda analysis of /h/ also predicts that if /h/ were followed by a syllabic sonorant consonant, /h/ would syllabify in the coda and thus Tonic Lengthening would be blocked. However, the only context, under my analysis, where a syllabic sonorant consonant can arise is in Rh sequences (to be discussed subsequently). As far as I am aware, it is impossible to find a morphological context in which /h/ can precede an Rh sequence, making this prediction untestable.[131,132]

While /h/, by default, syllabifies in the coda, I argue that there is one context in which it can syllabify in the onset: in ChV sequences. I argue that /h/ is normally barred from syllabifying in the onset. This analysis is supported by the observation that intervocalic /h/ blocks Tonic Lengthening (in (99)) combined with the fact that /h/ never occurs word-initially (other than in a few particles). I attribute the avoidance of the onset to the placelessness of /h/. This will also account for why /ʔ/ cannot occur in the onset (as will be discussed subsequently). In fact, this is a common analysis for laryngeals cross-linguistically. For example, the placeless laryngeals avoid the onset in Macushi and Chamicuro (Rose, 1996; Parker, 2001; Boroff, 2007).

Since /h/ cannot syllabify into the onset by itself, features will spread from the preceding consonant to allow the /h/ to be a well-formed onset. This analysis will account for why Ch sequences often sound like a single segment as well as for why Rh sequences can be pronounced in different ways in different dialects and by different speakers. The rest of the syllabification of the Ch sequences will follow in accordance with the sonority driven syllabification algorithm.

I will start by first discussing the feature sharing. As mentioned above, /h/ will get features from the preceding consonant in order to syllabify as a well-formed onset. This correctly predicts that Oh sequences do not sound like Oh sequences, but rather like single segments. In /sh/ sequences, the /h/ often is completely omitted, surfacing as voicelessness on /s/ that would otherwise be voiced intervocalically.[133,134] In

[131] There are two forms in Michelson, Michelson and Deer (2024) that are reported to have underlying hRh, and result in Downstress.

(i) /io-tskwahlhe/→[ots:gwà:l̥he] *otskwà:rhe* 'frog'

(ii) /io-nelahlh-a?/→[onelà:l̥ha?] *onerà:rha'* 'shoulder blade'

However, after speaking with one of the authors of the dictionary, Karin Michelson, we agreed that there does not seem to be any evidence that there is an underlying hRh sequence in either of these forms, and that they could be ʔRh instead. Karin Michelson said that Gunther Michelson reported the forms as optionally containing V́hRh or V̀Rh. This could be taken as evidence for the current analysis as this would suggest that hRh blocks Tonic Lengthening, but ʔRh does not.

[132] In Kahnawà:ke, underlying Rh sequences are pronounced as hRh, and this sequence blocks Tonic Lengthening. However, I will argue subsequently that no matter how Rh sequences are pronounced (and no matter the dialect), they are still Rh phonologically.

[133] Sometimes some aspiration can be heard, as reported by Hopkins (1988). I have also heard some cases of this as well.

[134] Often, /s/ surfaces as long here. I assume this is because /s/ and /h/ are gesturally overlapping, and in the overlapping space, only /s/ can be heard.

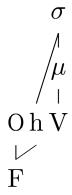
Th sequences, the /h/ surfaces as aspiration on the stop.

Since I have argued that /h/ cannot be in the onset due to its placelessness, a possible analysis is that the place of articulation of the C spreads to the following /h/. However, this does not account for Rh sequences. Recall that in Ahkwesáhsne, Rh can surface as Rh or hR, behaving the same in reference to vowel lengthening and metrically visible epenthesis regardless of the sequencing.[135] In Kahnawà:ke, underlying Rh sequences are pronounced as hRh, with the sonorant consonant devoiced; hRh sequences in Kahnawa'kéha behave the same as Rh/hR sequences in Ahkwesahsnéha. This suggests that these sequences are phonologically ordered the same, but pronounced differently, as is also the case for Spanish metathesis (Gilbert, 2022).[136] Since Rh sequences can be pronounced in the above ways, it does not seem like the features being shared are limited to place. I remain agnostic as to the exact features being spread, but tentatively propose that the features spreading are minimally the place of articulation from both obstruents and sonorant consonants, and [SV] from sonorant consonants. This will account for Oh sequences straightforwardly as the /h/ is no longer really an /h/ if it has a place of articulation. In terms of Rh sequences, I propose that the spreading of [SV] to the /h/ creates a conflict as /h/ is inherently voiceless (represented with the feature [Spread Glottis]). In order to pronounce this Rh sequence, speakers have different strategies. Some might maintain the order of Rh, with the voicelessness appearing after.[137] Some might pronounce the voicelessness first, with Rh surfacing as hR. Finally, some might devoice the sonorant consonant in order to pronounce the whole sequence, like in hRh sequences in Kahnawà:ke. In all ChV sequences, the features of the C allow /h/ to syllabify in the onset (even if it is pronounced before the sonorant consonant).

The sonority driven syllabification algorithm can derive the rest of the syllabification of ChV sequences. I will start with OhV sequences. These are built as in (103).

(103) OhV syllabification

a. Syllabifying /h/

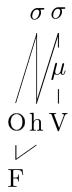


[135]The ostensible metathesis of R and /h/ could suggest an analysis where /h/ is a floating feature not anchored to a position. However, this would not account for all of the other cases where /h/ behaves like it occupies a slot (e.g. hR vs hO).

[136]This contributes to the growing amount of literature arguing that metathesis is not a possible phonological operation (Gilbert, 2022; Mooney, 2022).

[137]Julian (2010) argues that /*nh/ became /hn/ in the related language Cherokee as well.

b. Syllabifying O



In (103a), the /h/ has syllabified into the onset of the following syllable, with the help of the features from the preceding obstruent. Then, the O needs to be syllabified. O cannot syllabify into an existing syllable without resulting in an illicit coda or complex onset, so another syllable node must be projected. The system looks around for the most sonorous element to project a syllable node. The most sonorous element is /h/, so /h/ projects a syllable node, and O attaches as the onset. This creates a nonmoraic syllable.

RhV sequences are dealt with in a very similar way. The /h/ attaches as the onset of the following syllable, with the support of the features from the preceding sonorant consonant. Then, the sonorant consonant must be syllabified. I argue that the sonorant consonant becomes syllabic. This is shown in (104).

(104) RhV syllabification



As described above, /h/ syllabifies into the onset with the help of the features from the sonorant consonant. When the sonorant consonant needs to be syllabified, an additional syllable node must be projected as R cannot go into the preceding coda nor form a complex onset. The system looks around for the most sonorous element to project a syllable node. [SV] on the R is the most sonorous element. However, if [SV] projected a syllable node, it would have to surface in between two featurally linked segments (Rh). I propose that this is not licit as it would disrupt the feature sharing between R and /h/. Instead, the next most sonorous element must project a syllable node: the sonorant consonant itself. This creates a nonmoraic syllable. I argue that, although syllabic obstruents are much more widespread than syllabic sonorant consonants in Kanien'kéha, this follows from Zec's work on the sonority of syllabic consonants. Zec (1995, 2007) argues that more sonorous segments make better nuclei. I argue the same thing. The reason why there are less syllabic sonorant consonants under my analysis is that whenever there is an opportunity for a sonorant consonant to become syllabic, there is a more sonorous element available to project a syllable node, [SV]. In this way, the current analysis is in line with Zec's work: Kanien'kéha prefers more sonorous nuclei. Note

that this analysis only works if Rh is featurally linked before the sonorant consonant needs to be syllabified (e.g. in a right to left syllabification algorithm). If the R was to be syllabified first, then there would be no feature sharing between the R and /h/, and so [SV] would be able to project a syllable node.

The syllabification of ChV sequences involving a nonmoraic syllable (see the above structures in (103) and (104)) correctly predicts that these syllables are invisible to stress as well as to word-minimality. This is shown in (105) and (106).

(105) Oh/R and stress

a. /s-ahi-a-**kh**a/→[zahjákha] *sahiákha* 'Go pick berries', 'Go pick fruit!'

b. /at-kahl-a-**nh**a-ʔ/→[at^{h}gahláhnaʔ] *atkahráhnha'* 'glasses'

(106) Oh and word-minimality[138]

a. /**k-h**aw-ʔ/→[íkhawe̲ʔ] *íkhawe'* 'I am holding it'

Syllabifying Oh and R as nonmoraic syllables also correctly predicts that these syllables interact with lengthening in the same way as the other nonmoraic syllables. That is, they normally block Tonic Lengthening on the preceding stressed syllable, but when they are underlyingly preceded by a laryngeal, Laryngeal Lengthening can occur. This is shown in (107) and (108).

(107) Oh/R syllables blocks Tonic Lengthening

a. /te-io-hswa**th**e-ʔ/→[dejohs:wátheʔ] *teiohswáthe'* 'it is bright'

b. /k-ɤ̃to**l-h**aʔ/→[gɤ̃dóhlaʔ] *kentórha'* 'I am lazy'

(108) GOh/GRh allows Laryngeal Lengthening

a. /wak-ʔ**kh**al-ʔ/→[wag$\boxed{\text{è:}}$khale̲ʔ] *wakè:khare'* 'I have on a slip'

b. /ka-ʔ**nh**eks/→[gà:nheks:] *kà:nheks* 'silk', 'satin', 'rawhide'

That lengthening can occur before R syllables also rules out the possibility that R in these sequences is in the coda.[139]

[138] I can't find any examples of a word with only one underlying metrically visible vowel, as well as an Rh sequence.

[139] Up until this point, it might have been possible that R was in the coda in Rh and word-final position. This is for a couple reasons. Firstly, R patterns with /h/ being rare (or non-existent in the case of /h/) word-finally. This would also account for some alternations of /l/ in word-final and pre-/h/ position. Firstly, in Ahkwesáhsne, /l/ is devoiced when pronounced before /h/ or word-finally.

(i) Voiceless /l/

a. /elhal/→[è:l̥hal̥] *è:rhar* 'dog'

b. /k-hlálho-s/→[khlál̥hos:] *khráhrhos* 'I pull it ashore'

As the coda tends to weaken consonants, it could make sense that the liquid is becoming a weaker consonant (maybe undergoing diachronic debuccalization). This could suggest that [l] is on the coda here when before /h/ and word-finally.

Additionally, some interesting evidence comes from one speaker in particular. This speaker pronounces the liquid as [l] in almost all positions, but pre-/h/ and word-finally, this speaker pronounces the liquid as [r]. The data in (ii) are from this speaker.

Finally, the nonmoraic syllable analysis also correctly predicts that COh and ORh sequences trigger metrically visible epenthesis to militate against the violation of the Adjacency Condition. This is shown in (109).

(109) COh[140] and ORh and epenthesis

a. /te-**k-kh**a-s/ → [deg[é]khas:] *tekékhas* 'I attach two things together'

b. /**s-kh**e-ihnũk-hs-eʔ/→[z[e]khehnű́khseʔ] *sekhehnonkhse'* 'I come for her'[141]

c. /**k-l-h**aʔ/→[g[é]hlaʔ] *kéhrha'* 'I fill it in'

d. /waʔ-k-ata**t-l-h**ahs-ʔ/→[waʔgadad[é]hlahse̲ʔ] *wa'katatéhrhahse'* 'I served myself'

Under the current analysis, metrically visible epenthesis follows from the above syllabification of ChV sequences. Since R/Oh has syllabified as a nonmoraic syllable, the next segment to be syllabified, the preceding C, cannot project its own syllable node without violating the Adjacency Condition, so a mora + [SV] compound must be inserted.[142]

To summarize this section, I have provided more evidence as to the validity of the metrically visible and invisible epenthetic vowels by showing that a segment that can syllabify in any slot avoids epenthesis, because an additional syllable node is rarely needed to house it. I argued that /h/, by default, syllabifies into the coda, but that it can be forced into the nucleus because of the Syllable Contact Law, or into the onset with the help of the features from the preceding consonant.

3.6.2.2 Syllabifying /ʔ/

In this section, I will argue that, like /h/, /ʔ/ is able to syllabify tautosyllabically with the preceding vowel. While /h/ is able to syllabify in the coda or the nucleus (or in some contexts, the onset), I will argue that /ʔ/ is forced to syllabify in the nucleus with the preceding vowel, in the spirit of Bonneau (1988)[143] and

(ii) /l/→[r] word-finally and before h

a. /lo-ianer/→[lojá:ner] *roiá:ner* 'chief'

b. /elhal/→[érhar] *è:rhar* 'dog'

c. /k-hlálho-s/→[khlárhos:] *khráhrhos* 'I pull it ashore'

Note that this speaker also does not pronounce falling tone and length on the stressed vowel.

Since [r] is more sonorous than [l], these data would seem to suggest that the sonorant consonant is becoming more sonorous to be in the coda. However, this does not work with the lengthening data, nor with the metrically visible epenthesis data to be presented subsequently.

[140]The COh sequences in question are limited to Ckh. Although there are some cases of epenthesis breaking up Cth and Csh sequences, this is by far the exception. As described previously, CsC sequences do not generally undergo epenthesis. Additionally, /th/ often behaves like a single segment, so it does not violate the Adjacency Condition.

[141]Since stress falls to the right of epenthetic [e], we cannot see whether the epenthetic vowel is metrically visible.

[142]In the case of ORh, the [SV] also cannot project a syllable node for two reasons: (1) the R it is part of has already projected a syllable node, and (2) [SV] is linked to R and /h/, so it is incapacitated and cannot project.

[143]Bonneau (1988) argues that both laryngeals are in the nucleus to account for why all OR sequences are broken up by epenthesis, but GR are not. Note that this argument is necessarily predicated on the assumption that all other CC clusters are coda-onset clusters, and so distinguishing the laryngeals by saying that they can be in the nucleus allows them to be free from epenthesis. He argues

Hagstrom (1997).[144,145] I assume that /ʔ/ must always share a parent node with a preceding vowel. This means that /ʔ/ will attach to whatever node is immediately dominating the preceding vowel, which in most cases is a mora. /ʔ/ sharing a mora with the preceding vowel is shown in (110).

(110) /ʔ/ in nucleus



Also unlike /h/, I will argue that /ʔ/ is a sonorant (like in Zina Zotoko (Odden, 2007)) and thus bears the feature [SV]. This will account for why, if there is no vowel underlyingly preceding /ʔ/, metrically invisible epenthesis occurs; metrically invisible epenthesis is just syllabic [SV]. In what follows, I will show how the nucleus and sonorant analyses of /ʔ/ account for the extant patterns.

I will start by showing that the nucleus analysis of /ʔ/ correctly predicts that an additional syllable node will not be projected in ʔC or ʔCC sequences (resulting in epenthesis), which is the case for the non-laryngeals.

Since /ʔ/ can syllabify in the nucleus, it can precede any consonant, even sonorant consonants.[146,147] This is because, whereas other CR sequences require the projection of an additional syllable node in order to be fully syllabified, ʔC sequences do not; C syllabifies into the onset of the following syllable, and /ʔ/ syllabifies into the nucleus of the preceding syllable.

This nucleus analysis of /ʔ/ also straightforwardly accounts for why ʔCC sequences are not broken up by epenthesis (unlike other CCC sequences). Some examples are shown in (111).

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that Vʔ forms a light diphthong whereas Vh forms a heavy diphthong. However, the pattern that Bonneau bases this off of (GR# sequences) is not correct.

[144]Hagstrom (1997) suggests that /ʔ/ must share a mora with the preceding vowel in order to account for why [e̲] can be weightless in the 'closed syllable' Ce̲ʔ. This is because Hagstrom assumes that the difference between the metrically invisible and metrically visible epenthetic vowels is that the invisible one is inserted into an open syllable, whereas the visible one is inserted into a closed syllable. Although Hagstrom analyzes /ʔ/ in almost the exact same way as I do, we come at it from very different angles. Hagstrom suggests this to account for his analysis, but does not expand on how this accounts for anything else.

[145]This analysis is also suggested for Totonaco in Pike and Pike (1947).

[146]hʔ and ʔh sequences are also prohibited. This is for two reasons. Firstly, neither segment can be in the onset due to their placelessness. Secondly, as I will show subsequently, /ʔ/ cannot follow a consonant.

[147]/ʔj/ sequences are the only other GC sequence that are not permitted (although there is at least one morpheme internal case). I assume that this has to do with the dorsalization/palatalization process where the C in Cj sequences (even in /hj/) always undergoes dorsalization/palatalization.

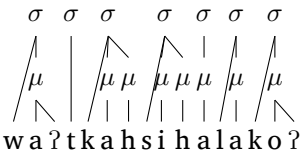
(111) ʔCC and epenthesis

a. /waʔ-**k-s**aheʔt-a-iʌ̃thw-a-ko-ʔ/→[waʔks:aheʔdajʌ̃thwá:goʔ] *wa'ksahe'taienthwá:ko'* 'I did harvest beans'[148]

b. /waʔ-**k-t**akeliʔtahw-ʔ/→[waʔk^{h}dagelì:dahwe̲ʔ] *wa'ktakerì:tawe'* 'I did fry it'

CCC sequences are normally broken up by metrically visible epenthesis so as to avoid violating the Adjacency Condition: the first two consonants require the projection of two additional syllable nodes, risking the building of two adjacent nonmoraic syllables. However, in ʔCC sequences, only the C following /ʔ/ needs an additional syllable node to be projected, as /ʔ/ can syllabify in the nucleus of the preceding syllable.[149] This is shown in (112).

(112) ʔCC and Adjacency Condition
/waʔ**t-k**-ahsihal-a-ko-ʔ/→[waʔt^{h}gahʃihalá:goʔ] *wa'tkahsiharà:ko'* 'I unblock it'



In (112), there is a /ʔtk/ sequence. The /k/ syllabifies into the onset of the following moraic syllable. The /t/ must be syllabified but cannot form a complex onset nor be in the coda, so it projects a syllable node.[150] Syllabic /t/ forms a nonmoraic syllable. This would be a problem if the preceding consonant were a non-laryngeal, as it would not be able to syllabify anywhere, necessitating the insertion of a mora to avoid violating the Adjacency Condition. However, since /ʔ/ can syllabify with the preceding vowel, it does so, avoiding a violation of the Adjacency Condition.

The nucleus analysis of /ʔ/ also correctly predicts that VʔC sequences behave exactly like VhR sequences when preceded by the stressed vowel: the vowel lengthens and gets a falling tone, and /ʔ/ deletes.[151] Recall that this process is called Laryngeal Lengthening. This is shown in (113).

[148]In Kahnawà:ke, this word is *wa'ksahe'taienthó:ko'*. Akwiratékha' Martin suggests that the [thw] sequence in the Ahkwesahsnéha pronunciation could be from Oneida influence.

[149]An alternative analysis, where /ʔC/ forms an onset nucleus sequence (like Cs or Ch) is undesirable because this would predict that /ʔ/ is a licit onset consonant. However, ʔC nor /ʔ/ on its own is able to occur word-initially. Further, I will argue subsequently that /ʔ/ does not syllabify in the onset intervocalically. This avoidance of the onset suggests that ʔCC sequences should not be analyzed like CsC/ChC sequences in reference to metrically visible epenthesis. Lastly, it would be odd if /ʔ/ could be in the onset when the nucleus is a consonant (including when that consonant is a stop, which would mean that /ʔ/ has even lower sonority than a stop, somehow), but not in any other case.

[150]/ʔ/ (nor the [SV] on it that I will introduce shortly) cannot project a syllable node because there would still be nowhere for the C to syllabify as only the coda position is open.

[151]There are some roots that are exceptions to this. These are documented in Michelson (1988) and Michelson, Michelson and Deer (2024) (amongst other sources).

(113) /ʔ/ and Laryngeal Lengthening

a. /io-ahʧ**a**ʔn-aʔ/→[ohʧà:naʔ] *ohtsià:na'* 'hand'

b. /wak-i**a**ʔk-ũ/→[wagjà:gũ] *wakià:kon* 'I cut it off'

c. /ia-**o**ʔte/→[jaò:de] *iaò:te* 'it is windy'

Just as with Laryngeal Lengthening prompted by hR clusters, Laryngeal Lengthening before an underlying ʔC sequence can occur before consonant clusters. This is shown in (114).

(114) Laryngeal Lengthening before clusters

a. /k-a-ʔ-nikũhl-oʔ**kt-h**aʔ/→[gaʔnigũhlò:k^{h}thaʔ] *ka'nikonhrò:ktha'* 'I become hopeless'

b. /k-ũ-kaliaʔ**k-hs**e/→[gũgaljà:khse] *konkarià:khse* 'I have paid you'

c. /waʔ**t-k**-nak-ʔ/→[wà:t^{h}ge̲nage̲ʔ] *wà:tkenake'* 'I scratched it'

The observation that /ʔ/ patterns exactly like /h/ when /h/ seems to be in the nucleus provides strong evidence that the same nucleus analysis is necessary for /ʔ/. The parallel behaviour of /h/ in hR sequences and /ʔ/ in ʔC sequences also challenges the weightless coda analysis, suggested by Piggott (1995).[152] If it were the case that /ʔ/ in ʔC sequences was a weightless coda, then, in order to capture the symmetry between hR and ʔC sequences, we would be forced to make the claim that /h/ has weight preceding an obstruent but not before a sonorant consonant.

Since ʔC sequences are represented the same as hR sequences, then Laryngeal Lengthening happens in the exact same way in both cases. This is shown in (115).

(115) Laryngeal Lengthening and ʔC



In (115), the vowel has lengthened (i.e. become bimoraic), and /ʔ/ has attached to the second mora. As with /h/, I assume /ʔ/ to have an underlying low tone (following Michelson (1988)). This will result in a falling tone from the head mora to the dependent mora which houses /ʔ/. This will be discussed in more detail in Chapter 4.[153]

Note that, as with /h/, /ʔ/ remains phonologically present in the representation in (115) despite not being pronounced. I argue that this is for the same reason as for /h/. That is, it is difficult to pronounce and

[152]This is a common analysis — see Lindskoog and Brend (1962) for Cayapa and Safir (1979) for Capanahua (cited in Dabkowski (2024)).

[153]To derive the pitch accent system, I assume a high tone to associate to the head mora of a stressed syllable. See Chapter 4 for more details.

perceive /ʔ/ when preceded by a low toned vowel and followed by a consonant (L-ʔ-C). This is because the low tone and the consonant following /ʔ/ conspire to smother all of the cues of /ʔ/ (à la Steriade (1994)). The two main cues to /ʔ/ are the creak on the preceding vowel,[154] and the burst. The creak is masked by the low tone because the low tone is also often pronounced as creak. The /ʔ/ burst is covered by the following consonant (as is the case for closure bursts cross-linguistically (Henke, Kaisse and Wright, 2012)). This makes it difficult to pronounce and perceive /ʔ/. However it does not make it impossible. This correctly predicts that an underlying /ʔ/ is sometimes pronounced by some speakers following a falling tone (Michelson, 1988).

More evidence that /ʔ/ is present phonologically is that when /ʔ/ is intervocalic, Laryngeal Lengthening still occurs on the preceding stressed vowel, but /ʔ/ is pronounced.[155] This is shown in (116).

(116) Intervocalic ʔ

a. /ũkweh-shuʔa/→[ũgwehshṹːʔa] *Onkwehshòn:'a* 'people'

b. /wa-k-itaʔ-ũ/→[wagidàːʔũ] *wakità:'on* 'I slept'

c. /k-htʃi-ʔa/→[kʰʤìːʔa] *khtsì:'a* 'I am her older brother'

In the data in (116), /ʔ/ is behaving like it is still in the nucleus by contributing a low tone. In these cases, despite sharing a mora with the vowel, /ʔ/ is pronounced (unlike in ʔC contexts). This makes perfect sense under the analysis that /ʔ/ is still present phonologically (despite not being pronounced): there is no following consonant, so the burst can be pronounced/perceived.

The data in (116) also provide evidence that, whereas /h/ has a preference to syllabify into the coda, /ʔ/ must always syllabify in the nucleus.[156] That is, even in intervocalic position (where most consonants would syllabify into the onset), /ʔ/ behaves like it is still in the nucleus, contributing tone.

I have thus far shown that the nuclear /ʔ/ analysis correctly predicts how /ʔ/ behaves when it is underlyingly preceded by a vowel. I will now show what happens when it is not preceded by a vowel.

Firstly, as far as I am aware there are no morphemes that have initial /ʔ/ and are also able to be word-initial. Consequently, there are no cases of word-initial /ʔ/. This pattern is predicted by the current analysis.

This analysis also correctly predicts that all underlying Cʔ sequences are broken up with epenthesis. This is shown in (117).

[154]The creak on the vowel preceding /ʔ/ provides support for the analysis that /ʔ/ syllabifies into the nucleus, as it implies a close relationship with the preceding vowel.

[155]Intervocalic /ʔ/ blocks both Tonic and Laryngeal Lengthening on the preceding stressed vowel for some speakers in Ahkwesáhsne.

[156]It is not uncommon cross-linguistically for intervocalic /ʔ/ to syllabify outside of the onset. For example, it syllabifies in the coda in Palu'e and Balantak (Boroff, 2007).

(117) Cʔ and epenthesis

a. /la**k-**ʔni/→[lágeʔni] *ráke'ni* 'father (voc)'[157]

b. /iaʔt-k-at-staw-a**w**ʔes**t-**ʔ/→[jaʔt^{h}gats:dawáweʔes:deʔ] *ia'tkatstawáwe'este'* 'I went into the bush'[158]

c. /w-ahsko-ũ**t-**ʔ/→[wáhs:gũdeʔ] *wáhskonte'* 'lean to, bridge'

d. /tn-eh**l-**ʔ/→[ídenehleʔ] *ítenehre'* 'you and I want'

Notice that the epenthetic [e] that breaks up Cʔ sequences is metrically invisible. In (117b), stress is on the pre-antepenult because there are two nonmoraic Ceʔ syllables intervening between the penultimate moraic syllable and the right edge. Additionally, the stressed vowel is short because the following syllable is nonmoraic. In (117d), prothetic [i] is inserted because the syllable [leʔ] (in addition to [de]) is nonmoraic, leaving a single moraic syllable which does not meet the minimal word requirement of two moraic syllables. Also note that CʔC sequences (e.g. (117a)) are the only CCC sequences that are broken up by the metrically invisible vowel between the first two consonants (as opposed to the metrically visible vowel). Under the current analysis, this implies that CeʔC sequences do not violate the Adjacency Condition.

Assuming the previous analysis that metrically invisible epenthesis is the phonetic result of [SV] on a sonorant consonant projecting a syllable node, /ʔ/ must have [SV] as well. I argue that this is the correct analysis for three reasons. Firstly, /ʔ/ patterns with sonorant consonants in reference to excrescence in many different languages. That is, OR and Cʔ commonly trigger excrescence cross-linguistically. Flemming, Ladefoged and Thomason (2008) lists a number of languages where this is the case: Montana Salish, Kalispel (Vogt, 1940), Spokane (Bates and Carlson, 1992), Shuswap (Kuipers, 1974), the Thompson language (Thompson and Thompson, 1992), and Nxaʔamxcín (Willett and Czaykowska-Higgins, 1995).[159]

[157]Most speakers pronounce this form without the /ʔ/.

[158] In this form, Vowel Twin has occurred, so the epenthetic vowel has taken on the quality of the vowel following /ʔ/. I assume that this vowel is syllabic [SV] (as in the other cases of invisible epenthesis), and that the vowel features from the following vowel spread across /ʔ/ to syllabic [SV], resulting in a copy (i.e. translaryngeal harmony (Steriade, 1987), which is also assumed by Bonneau (1988) and Michelson (1988)). In some cases, the original vowel deletes (making a vowel intrusion analysis (Hall, 2003) untenable).

(i) /ɑ̃-k-oiʔak-ʔ/→[ɑ̃gójaʔgeʔ] *enkóia'ke'* 'I'll aim for it'

(ii) /k-lʔok-s/→[g$\boxed{\text{é}}$loʔks:] *kéro'ks* 'I chop with an axe'

(iii) /k-at-itʔa-s/→[gadídaʔs:] *katíta's* 'I get into something (e.g. a car)'

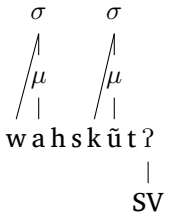
I suggest that in these cases, all of the vowel features have been transferred to the vowel copy, leaving the original syllable node + mora complex unpronounced (but still preserved in the structure). This is similar to catalexis (Kiparsky, 1991; Jacobs, 1993). This analysis accounts for a few things. First, it accounts for the fact that Tonic Lengthening is blocked on the preceding stressed syllable; Tonic Lengthening does not occur because the following syllable is nonmoraic. Second, this analysis accounts for why stress is on the penult in the latter two examples, despite the final vowel being nonmoraic; the underlying syllable + mora complex is still counted by the stress system. Thirdly, this analysis accounts for why the first of the above examples does not involve a violation of the Adjacency Condition; while it appears like there are two adjacent nonmoraic syllables on the surface, there is actually an unpronounced moraic syllable intervening. Fourthly, this analysis accounts for why prothesis does not occur in the second of the above examples; there are already two moraic syllables present ([g$\boxed{\text{é}}$] and the unpronounced mora + syllable complex), so mora insertion is not necessary. Lastly, this analysis accounts for why moraic epenthesis occurs in the first syllable of the second example; the following syllable is nonmoraic, so the /kl/ sequence cannot broken up by invisible [e], and must instead be broken up by moraic [$\boxed{\text{e}}$]. As this thesis is not on the featural content of Kanien'kéha segments, I do not pursue a full analysis of this. Future research should investigate how to reconcile this analysis with the [voc] analysis presented in section 4.3.2.

[159]Metrically invisible, but also phonological epenthesis also occurs in Upper Chehalis in OR and Cʔ clusters (Rowicka, 2001).

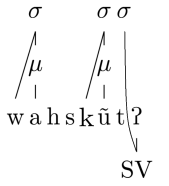
Since under the current analysis syllabic [SV] in Kanien'kéha is really phonologized excrescence, it makes sense that metrically invisible epenthesis would occur between Cʔ as well: Cʔ was historically broken up by excrescence in Kanien'kéha that is now phonologized. In terms of /ʔ/ containing the feature [SV], /ʔ/ often patterns with the sonorant consonants cross-linguistically. For example, Odden (2007) argues that /ʔ/ forms a natural class with the sonorant consonants in Zina Kotoko. /ʔ/ also patterns with the sonorant consonants in reference to vowel intrusion (Hall 2003). Lastly, /ʔ/ is phonetically like a sonorant consonant in many languages. Garellek (2013) shows that there is often not a complete glottal closure in /ʔ/ and that /ʔ/ in these cases is more like an approximant. Although a phonetic test is needed to show that this is the case in Kanien'kéha, the phonological behaviour of /ʔ/ provides support for this argument. For these reasons, I assume /ʔ/ to have the feature [SV], and that the epenthetic [e̲] that breaks up Cʔ sequences is syllabic [SV]. This is shown in (118).

(118) SV projected from /ʔ/
/w-ahsko-ũt**-**ʔ/→[wáhs:gũde̲ʔ] *wáhskonte'* 'lean to', 'bridge'

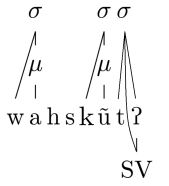
a. CV syllables



b. SV projects



c. Onset and /ʔ/ attaches



In (118a), all CV syllables have been built. In (118b) /ʔ/ needs to be syllabified. There is no vowel to syllabify with, so the most sonorous element available, [SV] projects a syllable node. In (118c), /ʔ/ and the preceding /t/ attach to this syllable, forming a weightless syllable.[160] Note that since I have assumed

[160]Notice that, in this position, /ʔ/ could be construed as a weightless coda. In this way, my analysis does not deviate too greatly from that of Piggott (1995). That being said, part of what defines a coda in Kanien'kéha under the current analysis is getting weight. This is relevant for the previous discussion on /h/. So although /ʔ/ looks like a coda, it is not completely behaving like one. Additionally, it is only in this position when preceded by a weightless vowel.

that /ʔ/ attaches to the same parent node as the preceding vowel, the representation in (118c) is licit: both /ʔ/ and the preceding vowel are dominated by the syllable node.[161]

The representation of Ce̲ʔ as a three-segment nonmoraic syllable also correctly predicts that CʔC sequences are only broken up with metrically invisible epenthesis. Whereas two syllable nodes would need to be projected to fully syllabify CCC sequences, necessitating the insertion of a mora to avoid violating the Adjacency Condition, only one additional syllable node needs to be projected in order to fully syllabify CʔC sequences (i.e. to house the Cʔ sequence).

In conclusion, I have argued that /ʔ/ must always syllabify in the nucleus with a preceding vowel, and that it has the feature [SV]. This has accounted for why ʔC sequences are never broken up with epenthesis, but for why Cʔ sequences always are, unlike Ch sequences which are not.

3.7 Cj and kw

While OR sequences are broken up with metrically invisible epenthesis (e.g. (38a-i): /te-**k-l**ik-s/→[dége̲liks:] *tékeriks* 'I put two things together'), there are two exceptions: Cj and kw. In this section, I will argue that these sequences are underlyingly CV (/Ci/ and /ko/), and therefore involve a mora. This will account for why these sequences do not undergo epenthesis.

I will start by describing how Cj and kw sequences pattern, reviewing traditional analyses throughout. I will then provide my analysis, showing how this can account for the extant patterns.

3.7.1 Cj and kw: the data

Before describing how the patterns involving Cj and kw, it is necessary to clarify which strings I am referring to (starting with Cj, then kw). The Cj sequences that will be discussed in this section involve any C (barring /ʔ/, /h/, and /w/)[162] followed by a surface palatal glide [j]. In these sequences, the C undergoes a change in place of articulation.[163,164] Cj sequence can arise within or across morpheme boundaries. Some examples of Cj sequences are shown in (119), with Cj transcribed as underlyingly /Ci/.

[161] Hagstrom (1997) takes the stronger position that /ʔ/ must share a mora with the preceding vowel. This analysis does not work if we assume that metrically invisible [e̲] is nonmoraic.

[162] [ʔj] and [wj] sequences do not exist on the surface. [hj] sequences do, but these always involve /h/ in the nucleus (on its own in Chj sequences and with the preceding vowel in Vhj sequences).

[163] The change in place of articulation is particularly noticeable on /s/ and /t/. /s/ surfaces as [ʃ] while /t/ surfaces as [ʧ]. The change from /t/ to [ʧ] is specific to Ahkwesáhsne. In Kahnawà:ke, /t/ and /k/ neutralize to [t]. The change in place of articulation is difficult to hear in the other segments, but is still present. In /l/, it is clear there is a place of articulation change, but it is not clear to where. Impressionistically, /l/ sounds like it is palatal. In /n/, it is difficult to hear a place change, but it could be palatal.

[164] In Cje sequences, the /j/ is barely audible, and sometimes absent.

(119) Cj sequences

a. /waʔ-**t-i**aki-atskaʔhũ-ʔ/→[waʔgjagjats:gáhũʔ] *wa'kiakiatskà:hon'* 'we ate'[165]

b. /k-ka**li**aʔk-s/→[k^{h}gáljaʔks:] *kkária'ks* 'I pay'

c. /tɤ̃k-nũ**ni**-a-hkw-ʔ/→[dɤ̃ge̲nű̲njahgwe̲ʔ] *tenkenónniahkwe'* 'I will dance'

On the other hand, the kw sequences that will be discussed in this section only occur morpheme-internally. /kw/ sequences that arise across a morpheme boundary are broken up with metrically invisible epenthesis like all other Cw sequences discussed in section 3.4 (I will return to these cases shortly as a point of comparison). The kw sequences in question should also not be confused with single segment /kw/.[166] The kw sequences relevant to this section will be transcribed as underlyingly /ko/. Some examples of the kw sequences in question are in (120).

(120) kw sequences

a. /ie-l-a-**ko**-as-kwʔ/→[jelágwas:gweʔ] *ierákwaskwe'* 'she used to choose'

b. /io-ne**ko**-aʔ/→[onégwaʔ] *onékwa'* 'pea', 'pill'

c. /k-iɤ̃t-a-**ko**-as/→[gjɤ̃dágwas:] *kientákwas* 'I collect wood'

I address Cj and kw sequences together in this section because they pattern together. Specifically, both Cj and kw (1) do not undergo metrically invisible epenthesis, (2) block Tonic Lengthening on the preceding stressed vowel, (3) do not trigger metrically visible epenthesis in CCj and Ckw sequences, and (4) display vowel-glide alternations ([i]~[j] and [o]~[w]). In the remainder of this subsection, I will illustrate these patterns.

First of all, unlike all other CR sequences, Cj and kw sequences are not broken up with metrically invisible epenthesis. This can be seen in the above examples in (119) and (120). As described just above, the kw sequences in question pattern unlike all other Cw sequences (including kw sequences that arise across a morpheme boundary), which are broken up by metrically invisible epenthesis, as shown in (121).

[165]This form is transcribed with length and falling tone in Michelson, Michelson and Deer (2024) and Martin (2023), but the speakers in Ahkwesáhne that I have been working with do not pronounce this form as such.

[166] In this thesis, single segment /kw/ is transcribed as underlyingly /kw/ and [gw] on the surface.

(i) Single segment kw

a. /l-ũ**kw**e → [lű́:gwe] *rón:kwe* 'man'

b. /io-**kw**il-ʔ/ → [ó:gwile̲ʔ] *ó:kwire'* 'sapling', 'tree'

Although single segment /kw/ is phonologically different than the kw sequence in question in this section (as /kw/ patterns like a single segment), they are phonetically identical, both surfacing as [gw]. These sequences both contrast on the surface with /khw/ sequences which sound like [k^{h}w].

(121) Cw and epenthesis

a. /**k-w**il-a-hsonh-s/→[g̲ewiláhsũhs:] *kewiráhsonhs* ‘I hate babies’

b. /l-ata**t-w**ʌ̃n-iio-hst-haʔ/→[ladade̲wʌ̃nijóhs:thaʔ] *ratatewenniióhstha’* ‘he takes advantage of everything’

c. /**s-w**-at-iel-ʌ̃-s/→[ze̲wagjé:lʌ̃s:] *sewatié:rens* ‘sometimes’

The observation that the Cj and kw sequences do not undergo epenthesis suggests that they should not be treated like the other CR sequences.

Both Cj and kw sequences also block Tonic Lengthening. This is shown in the examples in (122) and (123).

(122) Cj blocks Tonic Lengthening

a. /k-ka**li**aʔk-s/→[kʰgáljaʔks:] *kkária’ks* ‘I pay’

b. /tʌ̃k-nũ**ni**-a-hkw-ʔ/→[dʌ̃ge̲nű̀njahgwe̲ʔ] *tenkenónniahkwe’* ‘I will dance’

(123) kw blocks Tonic Lengthening

a. /io-ne**ko**-aʔ/→[onégwaʔ] *onékwa’* ‘pea’, ‘pill’

b. /k-iʌ̃t-a-**ko**-as/→[gjʌ̃dágwas:] *kientákwas* ‘I collect wood’

The observation that Cj and kw sequences block Tonic Lengthening on the preceding stressed vowel has resulted in the majority of the literature assuming that Cj and kw sequences are coda-onset clusters (e.g. Michelson, 1988; Piggott, 1995; Rawlins, 2006). I do not pursue this analysis for the same reasons for which I do not analyze OO clusters as coda-onset clusters (see section 3.3).

Also unlike the other consonants in Kanien’kéha which trigger metrically visible epenthesis when in the third position of an underlying CCC sequence (e.g. (52b) /waʔ**t-k-t**eni-ʔ/→[waʔdɛ̄kʰdé:niʔ] *wa’tekté:ni’* ‘I changed it’), the glides do not (CCj and Ckw). This is shown in (124) and (125).

(124) CCj and epenthesis

a. /waʔ**t-ki**-arahtat-ʔ/→[waʔtʰgjaláhdade̲ʔ] *wa’tkiaráhtate’* ‘we two (fem) are running’

(125) Ckw and epenthesis

a. /**k-ko**-as/→[íkʰgwas:] *íkkwas* ‘I am picking it’

b. /waʔ-la**k-ko**aht-ʔ/→[wahákʰgwahde̲ʔ] *wahákkwahte’* ‘he bumped me’

Finally, unlike all other consonants, the glides alternate with vowels. When the vocoid is followed by a consonant, it surfaces as a vowel, whereas when it is followed by a vowel, it surfaces as a glide. [j] alternates

with [i] whereas [w] alternates with [o].[167,168,169] This is shown in (126) and (127). The examples in (i) contain surface [i]/[o] because the vocoid is followed by a consonant whereas the examples in (ii) contain surface [j]/[w] because it is followed by a vowel.[170]

(126) [j]~[i]

a. /-oli-/ 'drive'

i. /k-at-ʔnikũhl-o**li-s**/→[gade̲ʔnigũhló:lis:] *kate'nikonhró:ris* 'I have fun'

ii. /k-at-ʔnikũhl-o**li-a**-ʔt-haʔ/→[gade̲ʔnigũhloljà:thaʔ] *kate'nikonhrorià:tha'* 'the things I used to make fun with'

b. /-aniʔteni-/ 'fart'

i. /waʔ-la-aniʔte**ni-**ʔ/→[wahaniʔdé:niʔ] *wahani'té:ni'* 'he farted'

ii. /lo-aniʔte**ni-ũ**/→[loniʔdénjũ] *roni'ténion* 'he has farted'

(127) [w]~[o]

a. /-atshoko-/ 'smoke'

i. /ɐ̃-k-atsho**ko**-ʔ/→[ɐ̃gats:hó:goʔ] *enkatshó:ko'* 'I will smoke'

ii. /k-atsho**ko**-as/→[gats:hógwas:] *katshókwas* 'I smoke'

b. /-lũko-/ 'scrape'

i. /ɐ̃-k-lũ**ko**-ʔ/→[ʌge̲lű:goʔ] *enkerón:ko'* 'I will scrape it'

ii. /k-lũ**ko**-as/→[gelűgwas:] *kerónkwas* 'I scrape it'

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[167]Michelson (1988) argues that Cj and kw are underlyingly /Cj/ and /kw/ based on evidence from the morphological joiner. However, it is not clear to me why the joiner behaves the way it does, and, as far as I am aware, a complete formal analysis of it taking into account its non-epenthetic nature (as outlined in section 2.3) has not been done. Until that point, I refrain from taking into account the patterns of the joiner. In the case of /kw/, Michelson's analysis incorrectly predicts that /kw/ that arises across a morpheme boundary should also not undergo epenthesis, which is not the case. Additionally, when describing these roots with alternating kw-ko, speakers pronounce it with /ko/. Older sources also transcribe kw sequences as underyingly /ko/, like in Postal (1968), and descriptive sources like Cory (n.d.) and Rousseau (1945).

[168]In most languages where [w] alternates with a vowel, it alternates with [u]. Since there is no [u] in Kanien'kéha, it alternates with [o].

[169]Pronominal prefixes that sometimes end in [go] do not alternate with kw. However, these are much more complicated because there are many more allomorphs involved, so it is unclear what the underlying form is.

[170] As far as I am aware, all Cj sequences that have variable following environments alternate with Ci, and vice versa. However, there are some roots whose behaviour is not so transparent. For example, the verb root /-teni-/ 'change' surfaces with a final [i] when followed by a glottal stop, suggesting that it is underlyingly /i/.

(i) /waʔt-k-teni-ʔ/ → [waʔd[ē]k^{h}dé:niʔ] *wa'tekté:ni'* 'I changed it'

However, the same root sometimes triggers epenthesis when followed by a consonant, suggesting it is underlyingly /j/.

(ii) /te-k-teni-ʔs/→[dek^{h}dénjeʔs:] *tekténie's* 'I change it'

Further, this root also can appear immediately before the joiner, which is usually only the case when the root underlyingly ends with a consonant (Michelson, 1988).

In the following section, I will argue that the glides are underlyingly vocalic, and that the patterns described in this section follow from this analysis.

3.7.2 Cj and kw: the analysis

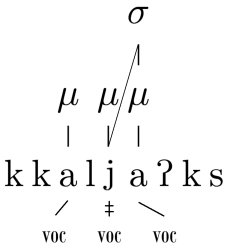
I will argue here that the Cj and kw sequences in question are underlyingly /Ci/ and /ko/, respectively, and that they will surface as Cj and kw when followed by a vowel (as in the examples in (126) and (127)).[171,172] This analysis straightforwardly accounts for why Cj and kw sequences are not broken up by metrically invisible epenthesis. Syllabifying Cj is shown in (128) (kw sequences are derived in the exact same way). Recall that all vowels underlyingly have the feature [vocalic]; this feature and the role it plays in the syllabification of Cj and kw sequences is also shown in the following trees, as it will be relevant later in this section.

(128) Syllabifying Cj
/k-ka**lia**ʔk-s/→[k^{h}galjaʔks:] *kkária'ks* 'I pay'

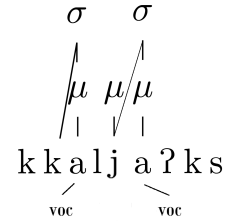
a. Underlying



b. Core syllables part 1: jV



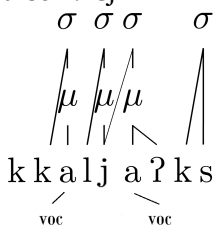
c. Core syllables part 2



[171]For completely different reasons, Blackburn (2024) argues for this position as well.

[172]In some morphemes [j] always surfaces as [j], and behaves like it is underlyingly so. I assume that epenthesis does not break up these Cj sequences because they are featurally linked due to the palatalization process described above.

d. Parse 2: Cj



In (128a), there are only underlying segments, with no syllabification having occurred yet. Each vowel is dominated by a mora, and has a [voc] feature. In (128b), the first parse of syllabification begins. The rightmost moraic vowel, /a/ projects a syllable node. The preceding /i/ becomes its onset, however because [voc] is only licensed in the nucleus, the [voc] on /i/ delinks. This results in the /i/ surfacing as [j].[173] The mora on the vocoid is preserved so that it might be able to be syllabified in the second parse.[174] The rest of the core CV syllables are parsed in (128c). In (128d), all segments to the right of /l/ have been syllabified in the second parse, and the /l/ needs to be syllabified, but there is no available structure to attach to, so another syllable node must be projected. The most sonorous elements are [j], which still contains the mora, or the [SV] under [j]. I propose that the mora + [SV] combination in the [j] is a better nucleus than just [SV], so [j] projects a syllable node, and the C immediately to its left attaches as the onset creating a CV Cj syllable. This derivation shows why metrically invisible epenthesis does not occur to break up Cj and kw sequences. This analysis falls out of assuming that these glides are underlyingly moraic.

Assuming the glides in the relevant Cj and kw sequences are moraic also accounts for why CCj and Ckw sequences are not broken up by metrically visible epenthesis: there is no violation of the Adjacency Condition.[175] The glide is moraic so it forms a moraic syllable with the immediately preceding C. The leftmost C (**C**Cj/**C**kw) is then able to be syllabified into a nonmoraic syllable. I show an example with a CCj sequence in (129), but Ckw can be analyzed in the exact same way.

[173] I assume that this is a special quality of /i/ and /o/ in Kanien'kéha that, like in other languages allows them to shed [voc] and syllabify in the onset. While this is more often the case with /i/ and /u/ cross-linguistically, since Kanien'kéha does not have oral /u/, /o/ takes its place. As argued in Chapter 2, I argue that /o/ is able to do this via place sharing with the preceding /k/. When the vowel is not /i/ or /o/, I assume that the vowel hiatus rules in Hopkins (1987) occur. This analysis also correctly predicts that the second vowel in a VV sequence should be preserved (because it is syllabified first).

[174] In the case of intervocalic and word-initial [j], there was also an underlying mora that was preserved when /i/ was syllabified into the onset, but the mora got delinked following the end of the second parse because it wasn't parsed into a syllable.

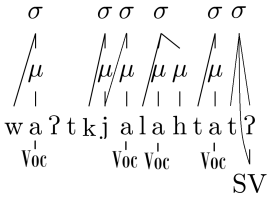
[175] In cases where [j] is underlyingly /j/, moraic epenthesis is triggered in CCj sequences. For example, this is the case with the verb root /-njak-/ *niak*.

(i) /wa**k-nj**ak-s/ → [wag[é]njaks] *wakéniaks* 'I get married'

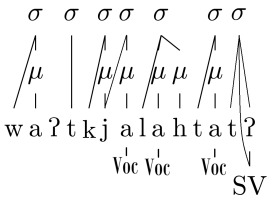
I assume that since this high front vocoid is underlyingly /j/, it does not contain a mora.

(129) CCj and Adjacency Condition[176]
/waʔ**t-ki**-arahtat-ʔ/→[waʔtʰgjaláhdade̲ʔ] *wa'tkiaráhtate'* 'we two are running'

a. Cj syllabified



b. Leftmost C syllabified



In (129a), partial syllabification has occurred, stopping after the Cj sequence. The Cj sequence, as per the explanation above, has been syllabified as a moraic syllable. The next segment to syllabify is the /t/ that is immediately to the left of the /k/ in the Cj sequence. /t/ cannot syllabify into an existing syllable, so another syllable node must be projected. Accordingly, in (129b), /t/ projects a syllable node creating a nonmoraic syllable. Since the following Cj syllable is moraic, /t/ projecting a syllable node does not result in a violation of the Adjacency Condition. In this way, whereas other CCC sequences involve two adjacent nonmoraic syllables, when Cj or kw is involved there is no violation of the Adjacency Condition because [j]/[w] is underlyingly moraic.

While I have analyzed Cj sequences as underlyingly CV, Cj sequences behave like they contain a nonmoraic syllable in reference to Tonic Lengthening and stress placement. That is, Cj and kw syllables block Tonic Lengthening on the preceding stressed syllable (as mentioned above), and are invisible to stress (like the other nonmoraic syllables). This is shown in (130) and (131).

(130) Cj, stress, and lengthening

a. /te-**k-i**aʔk-s/→[dégjaʔks:] *tékia'ks* 'I break it in two'

b. /tɅ̃k-nũ**ni**-a-hkw-ʔ/→[dɅ̃ge̲nű̲njahgwe̲ʔ] *tenkenónniahkwe'* 'I will dance'

(131) kw, stress, and lengthening

a. /ie-l-a-**ko**-as-kwʔ/→[jelágwas:gwe̲ʔ] *ierákwaskwe'* 'she used to choose'

b. /io-ne**ko**-aʔ/→[onégwaʔ] *onékwa'* 'pea', 'pill'

[176]The [SV] on the leftmost glottal stop is not shown for the purposes of space.

Cj and kw syllables also behave like nonmoraic syllables in reference to word-minimality. This is shown in (132) and (133), in which /i/ and /o/ do not contribute a mora, resulting in the necessary insertion of prothetic [i].

(132) Cj and word-minimality

/**k-i**ɪ̃-s/→[ígjɪ̃s:] *íkiens* 'I put it down'

(133) kw and word-minimality

/k-**ko**-as/→[ík^{h}gwas:] *íkkwas* 'I am picking it'

This leaves us with a puzzle. Cj and kw syllables behave like they are moraic in terms of the Adjacency Condition, but as nonmoraic in reference to Tonic Lengthening, stress, and word-minimality. In Chapter 4, I will show that the relevant metrical processes are only sensitive to *vocalic moras*, defined here as moras that contain the feature [voc] (in the spirit of Paramore (2025)). This will account for why CVh syllables behave like they are bimoraic for the purposes of syllable binarity, but do not impact foot shape nor stress placement. I will appeal to this argument for Cj and kw syllables as well. Although Cj and kw syllables are moraic, the mora does not dominate a segment with a [voc] feature (as [voc] was delinked in order to syllabify the vocoid in the onset), making it invisible to various metrical processes. This results in Cj and kw syllables being not counted for various metrical processes, but still behaving like they are moraic in terms of the Adjacency Condition.

In this section, I have argued that Cj and kw sequences should be analyzed as underlyingly CV sequences, and are thus moraic. This has accounted for why these sequences, unlike other OR sequences are not broken up by metrically invisible epenthesis, and for why they do not trigger metrically visible epenthesis. I also proposed that, although these syllables are moraic, this mora is not visible to metrical processes because it dominates an onset segment. This will be elaborated in Chapter 4.

3.8 Metrically invisible epenthesis is phonological

In this chapter, I have argued that [e̲] should be analyzed as phonologized excrescence as it is distributed and behaves, in many ways, like an excrescent vowel. That is, it breaks up unmarked OR/RO/RR clusters while leaving more marked OO clusters, and is metrically invisible.[177] Despite the parallels with excrescence, I have been assuming that metrically invisible [e̲] is phonological.[178] The question remains, why have I not

[177] Cə sequences (where ə is excrescent) also tend to block lengthening on the preceding stressed vowel, just like Ce̲ in Kanien'kéha.

[178] cf. Hall (2011) who suggests that metrically invisible epenthesis in Kanien'kéha could be excrescence. Although Garvin et al. (2019) do not use the term 'excrescence' for Kanien'kéha metrically invisible epenthesis, they represent it in Q theory (Shih and Inkelas, 2018) in the same way as the exrescent vowel in Panãra (a single q slot).

analyzed metrically invisible [e̲] as excrescence? In this section, I will argue that epenthetic [e̲] should be analyzed as phonological rather than phonetic.

Recall that in a number of languages with gestural underlap in CC clusters, there is a transitional vocoid that breaks up the CC clusters. For example, in Tashlhiyt Berber, CC clusters are often broken up with a schwa (Ridouane, 2008). This transitional vocoid is merely a phonetic byproduct of the temporal organization of the consonant gestures and thus patterns distinctly from normal epenthetic vowels (Gick and Wilson, 2006). Hall (2006) outlines a number of qualities that distinguish between excrescent and epenthetic vowels. They are presented in (134).

(134) Excrescence vs epenthesis (Karlin, 2022, - adapted from Hall (2006))

	Excrescent vowels	Epenthetic vowels
Environment	Between heterorganic consonants only	May or may not be between heterorganic consonants
Markedness	Not a repair	Repairs marked structures that are avoided elsewhere in the language
Quality I	Often schwa; influenced by neighboring consonants	Not necessarily schwa, may be a fixed vowel; not influenced by consonant
Quality II	If copy of nearby vowel, only across sonorants or gutturals	No restrictions on copying
Optionality	Optional; influenced by speech rate	Obligatory; presence not dependent on speech rate
Duration	Variable duration	Consistent duration

In terms of the environment, metrically invisible [e̲] in Kanien'kéha patterns with the epenthetic vowels. That is, it breaks up homorganic and heterorganic clusters alike.[179] Some examples of [e̲] breaking up homorganic clusters are in (135).

(135) Homorganic clusters

a. /lo-ht**l**ũ-ʔs/→[lóhde̲lũʔs:] *róhteron's* 'he gets scared'

b. /**k-w**il-a-hsonh-s/→[ge̲wiláhsũhs:] *kewiráhsonhs* 'I hate babies'

The second diagnostic in (134) has to do with markedness. Whereas excrescent vowels do not repair marked structure, epenthetic vowels do. As argued throughout this chapter, OR/RO sequences are just as marked as OO sequences (as potential coda-onset or complex onset clusters), yet metrically invisible epenthesis only breaks up OR/RO clusters. I have proposed that metrically invisible epenthesis is the same repair strategy as making an obstruent in an OO cluster syllabic — they are both avoiding marked coda-onset and complex onset clusters. In this way, metrically invisible epenthesis is a mechanism to repair marked structure (albeit not a conventional one).

[179] As mentioned above, in Ahkwesáhsne, homorganic TT sequences are sometimes pronounced without a release on the first T. This makes sense that some speakers would do this if metrically invisible [e̲] is phonologized excrescence: the excrescent vowel would only become epenthesis in heterorganic environments first, then spread to homorganic ones. Thus the pattern in Ahkwesáhsne can be simply understood as the epenthesis pattern having not completely extended yet.

The third diagnostic in (134) is that excrescent vowels tend to be influenced by adjacent consonants. To my ear, metrically invisible [e̲] is indistinguishable from underlying [e] and metrically visible [ē̲].[180] The only way of telling the difference between the three is by examining the phonology or the morphology. This means that metrically invisible [e̲] does not seem shorter nor more centralized than underlying or metrically visible [ē̲]. This is supported by all historical sources that document Kanien'kéha (including those written by speakers themselves), which always write the invisible [e̲], and never comment on its quality (Karin Michelson, p.c.).

The fourth diagnostic in (134) is not relevant for our purposes because metrically invisible [e̲] is not a copy. That being said, in underlying CʔV sequences the metrically invisible vowel that breaks up the Cʔ sequence takes the same quality as the vowel following /ʔ/. However, in these cases, the original vowel often deletes, making it unlikely that this is excrescence. This is shown in (136).

(136) Deletion of copied vowel

a. /ʌ̃-k-o**j**ʔ**a**k-ʔ/→[ʌ̃gójaʔgeʔ] *enkóia'ke'* 'I'll aim for it'

b. /k-**l**ʔ**o**k-s/→[gélo̲ʔks:] *kéro'ks* 'I chop with an axe'

c. /k-at-i**t**ʔ**a**-s/→[gadída̲ʔs:] *katíta's* 'I get into something (e.g. a car)'

The fifth diagnostic in (134) is that excrescent vowels tend to be optional whereas epenthetic vowels are not. From my work with speakers, I have found that metrically invisible [e̲] (which is always unstressed) is dropped about as much as any other unstressed [e].[181] The speech rate also does not seem to affect optionality. When pronounced slowly, [e̲] is still pronounced (showing that it is not just a transitional element) and when pronounced quickly, [e̲] is still pronounced, unlike excrescent vowels (Hall, 2006).[182]

The last diagnostic in (134) is that excrescent vowels tend to be variable in duration, whereas epenthetic vowels are not. Again, as far as I can tell metrically invisible [e̲] sounds like any other [e̲] in the language.

In this way, metrically invisible [e̲] patterns with the epenthetic vowels in every diagnostic provided by Hall (2006).

It is also indicative of the phonological nature of metrically invisible [e̲] that visible [ē̲] takes the same quality. This suggests that the quality was chosen by the phonology, otherwise one would have to argue that this is an accident.

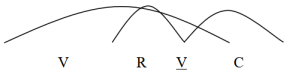
[180]While I am confident in this judgment (as is Karin Michelson (p.c.)), I have not done any fleshed out phonetic tests to show this. I encourage future researchers to do so.

[181]As mentioned above, there are a couple morphemes that are exceptions to this, including the nominalizer /-hsr-, -tshr-/→[hse̲r, tshe̲r], in which the epenthetic [e] often does not get pronounced in Kahnawà:ke (note that I have transcribed the nominalizer with /r/ because this is what is used in Kahnawà:ke). This makes sense if this was historically excrescence, as there would still be some instances that behave in some ways like excrescence.

[182]Syllables with [e̲] also seem to be psychologically real as speakers tend to syllabify Ce̲ syllables separately. However, this is not strong evidence because this could be the influence of English.

I would also like to show that metrically invisible [e] is not an intrusive vowel. Vowel intrusion is a phenomenon where a vowel that is adjacent to a consonant cluster (e.g. **V**CC) can be heard in the intervening space between the consonants (**VCV**C) (Hall, 2003, 2006). This occurs regardless of the markedness of the consonant cluster it breaks up. For example, VRO might be heard as VRVO. This is shown in (137).

(137) Vowel intrusion (from Hall 2003)



Vowel intrusion usually involves the vowel spreading over specifically a sonorant consonant and/or /ʔ/. The intrusive vowel usually takes the same quality as the 'original', but it is relatively variable. Since there is only one vowel gesture, it is treated as one phonologically (while it sounds like two): it does not introduce a new syllable, it is not relevant to stress, etc. Hall shows that this is the case in Scots Gaelic, Ho-cank, and Dakota (whose intrusive vowels had previously been analyzed as weightless phonological elements (Kennedy, 1994; Miner, 1993)). On the other hand, Hall specifies that the weightless epenthetic vowel in Upper Chehalis cannot be an example of vowel intrusion because the epenthetic vowel is phonetically stable and is not influenced by the formants of the nearby vowel, the weightless vowel can occur very far from any underlying vowel, and the vowel interacts with the phonology.

A vowel intrusion analysis of Kanien'kéha epenthesis would account for the fact that it appears to break up OR and RO clusters (treating /ʔ/ like a sonorant consonant), why it is metrically invisible, and why it is breaking up unmarked clusters. However, for the same reasons as for Upper Chehalis, I argue that the weightless [e] in Kanien'kéha cannot be considered a case of vowel intrusion. As with Upper Chehalis, the weightless epenthetic [e] in Kanien'kéha is phonetically stable, and never influenced by the quality of the vowel on the other side of the sonorant consonant. If metrically invisible epenthesis were vowel intrusion, the epenthetic vowel would just be a piece of the vowel gesture on the other side of the sonorant consonant, so we would expect the intrusive vowel to either have the same quality as said vowel, or be influenced by it in some way. Additionally, [e] in Kanien'kéha can occur far from a nearby vowel, and not have to occur across a sonorant consonant. This is shown in (138).

(138) Distance between [e̲] and other V

a. /wa-la-l-a-**hst-**ʔ/→[wahá:lahs:de̲ʔ] *wahá:raste'* 'he drew it'

b. /waʔ-e-hiatũ-hsel-a-nʌ̃ta**kt-**ʔ/→[waʔehjadũhselanʌ́:dak^{h}.de̲ʔ] *wa'ehiatonhseranén:takte'* 'she put up wallpaper'

c. /wa-wak-ahsiʔt-a-kalewa**ht-**ʔ/→[ũgwahʃiʔdagalé:wahde̲ʔ] *onkwahsi'takaré:wahte'* 'I hurt my foot'[183]

For example, in (138a) weightless epenthetic [e] appears between [s:d] and [ʔ]#. In this form, there is no vowel on the other side of /ʔ/ that could be intruding. The only other option is that the intrusive vowel is the [a] preceding [s:d] whose gesture spans [s:d] and fills the space between [d] and [ʔ]. If weightless [e] were vowel intrusion, the vowel would be extending its influence much farther than it normally does (across multiple consonants). Further, vowel intrusion is restricted to occurring across only certain segments, but this is not the case in Kanien'kéha, as shown above.

Finally, I would like to show that Kanien'kéha metrically invisible epenthesis is not like Scots Gaelic intrusive vowels, which are often indistinguishable from underlying vowels phonetically, yet still phonetic (Hall, 2003).[184] Whereas Scots Gaelic intrusive vowels are completely invisible to the phonology, metrically invisible epenthetic [e̲] in Kanien'kéha is not.

Recall that when metrically invisible [e̲] is in a syllable immediately preceding another syllable with metrically invisible [e], it becomes metrically visible. This is shown in (139).

(139) No adjacent Ce̲ syllables

a. /**s-wl**-ak-s/→[zé̲we̲laks:] *séweraks* 'you eat wind'

b. /i-ʌ̃-**k-w-**ʔ/→[iʌ́:kē̲we̲ʔ] *ién:kewe'* 'I will arrive over there'

c. /s-a**t-wj**ʌ̃st/→[zadé̲̄we̲jʌ̃s:t^{h}] *satéweienhst* 'Study!'

In (139b), for example, the /k-w/ sequence is normally broken up by metrically invisible epenthesis, shifting stress and blocking Tonic Lengthening on the preceding stressed syllable. However, instead of [e̲], [ē̲] is inserted when followed by the weightless syllable [le̲ʔ]. This allows stress to only shift to the antepenult, and permits Tonic Lengthening on the preceding stressed syllable. Weightless [e̲] and weighted [ē̲] in this context are indistinguishable, with the only way of telling them apart being the stress location, and the presence of Tonic Lengthening. If invisible [e̲] were phonetic, then we would not expect it to be sensitive to the weight of the following syllable.

[183] /wa-wak/→[ũkw] is the 'wawa' rule. When these prefixes are concatenated, they surface as [ũk] or [ũkw].

[184] However, Kanien'kéha metrically invisible [e̲] is phonetically consistent whereas the Scots Gaelic intrusive vowel is a copy vowel (Hall, 2003).

Metrically invisible [e̲] also seems phonological in Cʔ sequences. Often, when pronouncing Ce̲ʔ, /ʔ/ is not pronounced despite providing the environment for epenthesis. This can be handled straightforwardly if [e̲] is phonological: /ʔ/ is underlying so it provides the environment for epenthesis, but is deleted (although I remain agnostic as to how this would work specifically). If metrically invisible [e̲] is phonetic, it is not clear why it would be inserted in the first place if /ʔ/ deletes. That is, if metrically invisible [e̲] is merely a phonetic byproduct that results from the gestural distance between C and the following /ʔ/, then it simply would not be pronounced if /ʔ/ is not pronounced.

Due to the phonetic stability of invisible [e̲] in reference to visible [e̅] and underlying [e], as well as its interaction with the phonology, I assume that metrically invisible [e̲] is phonological, and consequently must be treated as such.

3.9 Conclusion

In this chapter I have argued for an analysis of syllable structure out of which the ostensibly backwards phonotactics as well as the evasive epenthesis patterns in Kanien'kéha fall. Rather than arguing that OO are licit sequences while OR/RO are not, I have argued that Kanien'kéha should be analyzed like languages with free phonotactics and gestural distance (e.g. Salish): that there is constrained syllable structure (in size and coda identity), and consequently all CC clusters are separated by gestural distance. I have argued that this gestural distance was historically filled by transitional vowel excrescence and aspiration, but that over time this is has been phonologized, resulting in metrically invisible epenthesis.

I argued that segments that cannot be syllabified into the constrained CVX (X = V or G) syllable structure are syllabified into nonmoraic syllables (Ce̲, Cs, or Ch), and that these syllables all behave the same in reference to metrical processes. I also showed that these syllables behave the same in reference to what I call the Adjacency Condition, which militates against consecutive nonmoraic syllables. This accounted for metrically visible epenthesis; when syllabifying a given underlying sequence would result in two nonmoraic syllables, metrically visible epenthesis occurs.

In the following chapter, I will propose analyses of the metrical processes discussed in this thesis, built on the syllable structure analysis argued for here.

Appendix B: ”Strong /h/”

I will now discuss what I call ‘strong /h/’. This is a type of /h/ in Kanien’kéha that I argue was historically derived from a stop (/*k/ or in some cases /*t/) and patterns as such. Whereas normal /h/ exhibits consistent phonological behaviour, this /h/ interacts with the phonology in unexpected ways. However, these patterns are expected if we understand strong /h/ as a different phonological entity, namely one historically derived from /*k/. I will start by showing some cases in which /h/ is patterning unexpectedly. This discussion is in the appendix to Chapter 3 rather than the main text because, while it is relevant to the discussion of syllable structure, it discusses an analysis of some of the less common behaviour of /h/ (contrasting with the more common behaviour discussed in section 3.6).

Recall that intervocalic /h/ blocks Tonic Lengthening on the preceding stressed vowel. Some instances of intervocalic /h/ however, allow Tonic Lengthening. This is shown in (140).

(140) Intervocalic /h/ allowing Tonic Lengthening

a. /a-t-kelothi**h**-aʔ/→[at^{h}gelothí:haʔ] *atkerothí:ha’* ‘comb’

b. /k-atkũ**h**ʌ̃-s/→[gat^{h}gʉ́:hʌ̃s:] *katkón:hens* ‘I put my head down’

c. /waʔ-k-atat-iʌ-**h**ahs-ʔ/→[waʔgadagjʌ́:hahse̲ʔ] *wa’katatién:hahse’* ‘I saved it’

Note that in these contexts, /h/ is behaving like any other intervocalic consonant as it seems to be syllabifying in the onset, allowing Tonic Lengthening on the preceding stressed vowel. If this [h] should be analyzed as /*k/ (meaning that it is /h/ but patterns like /k/), then this pattern follows.

In some other instances, /h/ behaves like it is less sonorous than previously specified. Recall that /h/ is the most sonorous of the obstruents, allowing it to syllabify into the coda when preceding an obstruent, as well as host /s/ in the onset of an sh syllable. If it were always the case that /h/ had higher sonority than /s/, then we would expect that hsC sequences (including hsR) would be illicit (or at least more rare), as hs would form a falling sonority onset-nucleus sequence. However, hsC sequences are common in Kanien’kéha. Some hsC sequences are shown in (141).

(141) hsC

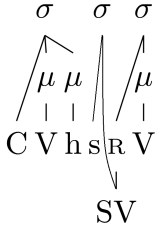
a. /lo-**hsk**ʌ̃ʔlakehte-ʔ/→[lohs:gʌ̃ʔlagéhdeʔ] *rohsken'rakéhte'* 'a warrior', 'a male'

b. /wa-la-l-a-**hst**-ʔ/→[wahá:lahs:de̲ʔ] *wahá:rahste'* 'He drew it'

c. /io-**hsw**ʌ̃ʔt-aʔ/→[ohs:wʌ̀̃:daʔ] *ohswèn:ta'* 'coal'

These hsC sequences must be syllabified as hs.C with the /hs/ forming an onset-nucleus sequence. This is because if /h/ were syllabifying in the coda of the preceding syllable, then this would make wrong predictions as to hsR sequences (e.g. (141c)). If /h/ were syllabifying into the preceding coda, then there would be no reason for /s/ to project a syllable node: [SV] could instead. This is shown in (142).

(142) hsR and coda-onset



If the /h/ in the examples in (141) were normal /h/, the syllabification would go as follows. R would syllabify into the onset of the following syllable in the first parse. In the second parse, /s/ would need to be syllabified. It would look around for the most sonorous element to project a syllable node. Since [SV] is the most sonorous available element, it would project a syllable node to which /s/ would attach as the onset. This results in metrically invisible epenthesis between /s/ and the following sonorant consonant. Finally, /h/ would become the coda of the preceding syllable. However, if /h/ were strong /h/ then this would not work because it would not be able to syllabify into the preceding coda. An additional syllable node would have to be projected to house /h/, resulting in two adjacent nonmoraic syllables, a violation of the Adjacency Condition (h.se̲). Instead, /s/ must project its own syllable node, to which /h/ can attach as the onset. This is exactly the same analysis as for TsC sequences. Since hsC and TsC sequences are patterning together, this suggests that /h/ should be analyzed like it has the sonority of a stop. This would allow it to syllabify into the onset of a syllable headed by /s/. This would make sense if these /h/s should be analyzed as /*k/ or /*t/ (depending on the context).[185] Further evidence for this is that hsC sequences only occur

[185] In many cases, another consonant can be concatenated to the left of the hsC sequences, creating an underlying ChsC sequence.

(i) /waʔ-k-hsw-a-ʔt-a-ni/→[waks:wà:dani] *wakhswà:tani* 'I get annoyed'

These sequences would constitute a violation of the Adjacency Condition if strong /h/ were present phonologically in the surface form as well: C.hs.CV. I assume that strong /h/ deletes in these sequences, resulting in the syllabification Cs.CV, satisfying the Adjacency Condition. I assume that deleting /h/ is less costly (as a quiet sound) than inserting a mora, or deleting a different segment to satisfy the Adjacency Condition. I do not spend more time on these forms because this analysis is not testable. ChsC sequences are pronounced as CsC sequences, but it is not clear whether this is because /h/ is being phonologically deleted, or because /h/ is just difficult to hear (like in Chs or shC sequences).

morpheme-internally.

Finally, in some cases, /h/ is behaving like it is has the place feature [dorsal] specifically. This can be seen in [w]~[o] alternations. Recall that [w] alternates with [o] following /k/. There are some cases, however, where this also happens following /h/.

(143) [gw]~[go]

a. /k-atsho**ko**-as/→[gats:hógwas] *katshókwas* 'I smoke'

b. /ɪ̃-k-atsh**ko**-ʔ/→[ɪ̃gats:hó:goʔ] *enkatshó:ko'* 'I will smoke'

(144) [hw]~[ho]

a. /teka-hlũ**ho**- ʔ/→[degà:lũhwe̲ʔ] *tekà:ronhwe'* 'it is put across', 'it is angled across'

b. /waʔt-k-hlo**ho**-ʔ/→[waʔdɛ̰khlóhoʔ] *wa'tekhróho'* 'I put something across', 'I put up a barrier'

In this pattern, /h/ is in the slot where /k/ normally is. As argued in Chapter 1, /o/ is able to surface as [w] before /k/ because the place of articulation of /k/ is spreading to /o/, allowing it to syllabify like a consonant (i.e. in the onset). For example, in (143a), morpheme-final /ko-/ surfaces as [kw] because the [dor] feature spreads to /o/, resulting in the /o/ surfacing as [w]. This almost exclusively occurs following /k/. The only exception is /h/. In this way, /h/ is behaving like /k/ in this context (i.e. like it has a [dor] feature).[186]

These patterns of strong /h/ exhibit behaviour not typical of /h/, as analyzed in the rest of this section. Strong /h/ behaves like it can be syllabified in the onset, like it has the sonority of a stop, and like it has a [dor] feature.[187] These can be accounted for if /h/ should be understood as /*k/. If strong /h/ is /*k/, it can be syllabified in the onset because it has a place of articulation. This also explains why it is distributed like a segment with the sonority of a stop. Finally, this explains why it seems to be behaving like a [dor] segment in conditioning [w]~[o] alternations.[188]

This would not be an unexpected pattern as lenition from /k/ to /h/ is quite common cross-linguistically (e.g. Spanish (Harris, 1967), Sebirwa (Chebanne, 2000), Riobamba (Orr and Longacre, 1968)). Further, as described by Shaw (1991) (cited in Orie and Bricker (2000), laryngeals that are identical on the surface often have different underlying representations. A very similar case is in Yucatec Mayan where there is a placeless /h/ and a 'strong' /h/ that behaves like it has the feature dorsal (Orie and Bricker, 2000). They

[186] /*k(w)/ in Proto-Ongan also became /h(w)/ in Jarawa (Blevins, 2007).

[187] In the hsC sequences, it is more likely historically /*t/ as Julian (2010) says that ts→hs/V_t,k,k^{w}.

[188] The limited diachronic evidence is that Julian (2010) has suggested that /*ts/ became [hs] in Kanien'kéha before /k/, /kw/, and /r/. So maybe strong /h/ could have been /*t/ or /*k/. This suggests that some of the cases of strong /h/ might have been historically /*t/. Julian (2010) also argues that there were several lenition processes in Cayuga and Seneca from /*t/ to /h/. He also argues that in Huron /*k/ became /h/.

argue that strong /h/ was historically (and in fact underlyingly) /x/.[189] It is important to note that while Orie and Bricker (2000) have extensive diachronic evidence for their analysis, I use mostly synchronic evidence across the Iroquoian languages.

Apart from the distributional evidence in Kanien'kéha, all of the evidence for the strong /h/ hypothesis comes from [k]~[h] alternations across the Iroquoian languages.

In Kanien'kéha, [k] alternates with [h] in a few forms. That is, different speakers pronounce it differently, or depending on the word, [k] or [h] might be pronounced. Some examples are shown in (145).

(145) [k]~[h] alternations in Kanien'kéha[190]

a. /ka-ʔnhe**(k/h)**s/→[gà:nheks:]~[gà:nhehs:] *kà:nheks~kà:nhehs* 'silk', 'satin', 'rawhide'

b. /-**h**weʔnũni-/~/-**k**weʔnũni-/ *-hwe'nonni-~-kwe'nonni-* 'to fold'

In (145a), [k] alternates with [h] preceding /s/. Note that this is the position of /h/ in hsC sequences. In (145b), [k] alternates with [h] preceding [w]. Note that this is the position that induces [kw]~[ko] alternations. In (145b), I provided the verb root, as from Michelson, Michelson and Deer (2024), it seems like the verb root may be pronounced differently depending on the word it is in.

Another example of [k]-[h] alternations in Kanien'kéha is in Feurer (1976),[191] who notes that when the indefinite pronouns receive focus (in question formation), /k/ lenites to [h], [ʔ], or is deleted.[192,193] In the example in (146), I provide an example where /k/ lenites to [h].

(146) Indefinite pronouns (Feurer, 1976)[194]

o**k**→oh 'what'

There are also synchronic [k]~[h] alternations in Onondaga. In Onondaga, /kk/ surfaces as [hk] (Woodbury, 2018).

[189]They argue that /x/ is marked and thus always surfaces as [h]. However, this would not work for Kanien'kéha because it seems to have the sonority of a stop.

[190](145a) and (145b) are from Michelson, Michelson and Deer (2024).

[191]Feurer (1976) documents Kanien'kéha in Kanehsatà:ke specifically.

[192]There also seem to be alternations between [h] and [ʔ] but I have not seen any consistent patterns for this. I invite researchers to figure out this pattern. There are also ʔ~h alternations in Cayuga (Michelson, Price and Lickers, 2011, :55). There are similar alternations in Wendat and Onondaga (Woodbury, 2018; Lukaniec, 2018).

[193]Thank you to Sophia Flaim for pointing this out to me.

[194]See Feurer (1976) for more elaborate discussions of the meanings of this morpheme.

(147) Onondaga /kk/-[hk] (Woodbury, 2018)

a. /a**k-g**ũʔshR-aʔ/→[ahgű̃ʔsæ:ʔ] ‘my pillow’

b. /hya th-aa-**k-g**weny-aʔ/→[hya tha:hgwé:nyaʔ] ‘I am not able to do it’

Wendat also exhibits [k]∼[h] alternations. In Wendat, the imperative suffix exhibits [k]∼[h] alternations (Lukaniec, 2018).[195,196]

(148) Wendat [k]∼[h] alternations (Lukaniec, 2018)

a. Imperative allomorphs: -∅, -h, -ah, -k, -hk, -enh

In Huron, Julian (2010) argues that /*k/ lenited to /h/ when preceding /*t/, /*ts/, /*s/, or /*ʃ/. Some examples are shown in (149).

(149) /*k/→/h/ in Huron (Julian, 2010)

a. /*kaˈna**k**taʔ/→/xaˈnahta/ *ganda’ta* ‘bed’

b. /*ˈwa**k**sẽ:h/→/ˈahʃẽ:h/ *Achen* ‘it is bad’[197]

More evidence for the strong /h/ hypothesis comes from the distribution of /hk/ sequences in Kanien’kéha, which I will argue are historically /*kk/. As noted by Bonneau (1988), /hk#/ sequences do not exist whereas /ʔk#/ sequences do in plenty.[198] This asymmetry reduces down to an asymmetry in the morphology. There are two ways of constructing Gk# sequences in Kanien’kéha. Firstly, there could be a morpheme with final /h/ or /ʔ/ concatenated with a word-final morpheme that is just /-k/. This environment does

[195]Thank you to Willie Myers for pointing this out.

[196]Kopris (2001) suggests different allomorphs for the imperative: -ʔ, and -h.

[197]The capitalization in the orthography is how it is represented in Julian (2010).

[198] Bonneau actually says that in general hC sequences are much more rare than ʔC sequences. He argues based on this assumption that Vʔ must form a light diphthong whereas Vh must form a heavy diphthong. However, this assumption is not completely correct. We can see this in the following table.

(i) HC# sequences

	t	k	s
ʔ	exists	very common	very common
h	exists	none	exists

As shown in (i), the asymmetry between hC# and ʔC# sequences is not even across obstruents (there are very few examples of word-final GR sequences). If Bonneau’s analysis was correct, we would expect ʔt# to be common, with there being few instances of ht#. This is not the case as these two sequences are about even as far as I have seen. Unlike with final Gt sequences, there is an asymmetry between final Gs sequences with ʔs# being abundant, while hs# is merely tolerated. In other words, hs# is common, but not as frequent as ʔs#. This pattern is not surprising; As described above, some /hs/ sequences surface merely as long /s/. Additionally, recall that word-final /s/ is always long because it is always syllabic and undergoes final lengthening. In this way, it would have been very easy for morpheme final /hs/ to turn into /s/ in many instances as they sound quite similar. Additionally, its important to note that Bonneau’s analysis predicts that hs# would be highly dispreferred as there are three positions in the rhyme. However, even though there are less hs# instances than ʔs#, there are still many instances of hs#. Here are a few.

(ii) hs#

a. /k-wil-a-hsonh-s/→[gewiláhsũhs:] *kewiráhsonhs* ‘I hate babies’

b. /k-oh-s/→[í:gohs:] *í:kohs* ‘I put it into water’

The real asymmetry is in Gk# sequences where ʔk# is common but hk# is unattested.

not exist. The only way to form Gk# is to have a morpheme-final Gk sequence. This exists in plenty for /ʔ/. See the following examples.

(150) ʔk#

a. /ʌska-ʔ**k**/→[ʌ́s:gaʔk^{h}] *énska'k* 'only one'

b. /s-ʔnhaht-iaʔ**k**/→[z̻e̻ʔn̥háhgjaʔk^{h}] *se'nháhtia'k* 'Cut the branch!'

Morpheme-final /hk/, however, does not exist. This seems to be the real asymmetry; morpheme-final /ʔk/ is common while morpheme-final /hk/ is unattested. This can be accounted for nicely by the strong /h/ hypothesis. I propose that many morpheme internal /hk/ sequences are historically derived from /*kk/, and that these sequences never occur morpheme-finally.[199]

Consider the fact that morpheme internal /kk/ does not exist. This is compounded by the fact that morpheme internal TT clusters in general are common.

(151) Morpheme-internal TT

a. /-aʔ**kt**ũ/ *-a'kton* 'bend'

b. /-atenaʔ**tk**al-/ *-atena'tkar-* 'spin'

c. /-a**tt**atakw-/ *-attatakw-* 'explode'

So why are there no morpheme internal /kk/ sequences? Recall that in Onondaga, there is a synchronic process where/kk/→[hk] (Woodbury, 2018). I suggest that this happened to the morpheme internal instances of kk in Kanien'kéha. If this is the case, then we would expect morpheme-internal /hk/ to pattern with morpheme internal TT. This seems to be the case. There are no morpheme final instances of /tt/, or /tk/. As above, this is because this would result in an Adjacency Condition violation word-finally.[200] This explains why morpheme-internal instances of /hk/ do not occur morpheme-finally: morpheme-final TT sequences are marked, and morpheme-internal /hk/ is distributed like a TT sequence (/kk/).[201,202]

[199]I want to stress that I do not have historical or cross-dialectal evidence for this claim, it merely is suggested by the phonology.

[200] Note that the exception to this is morpheme-final /kt/ sequences, which do exist. I have no account for this.

(i) Morpheme-final kt

a. /-oʔkt-/ *-o'kt-* 'finish'

b. /-atũtalikt-/ *-atontarikt-* 'laugh loudly or uncontrollably'

c. /-laʔnʌ̃takt-/ *-ra'nentakt-* 'stick something to'

However, these instances seem to be specific to /kt/. I take this, then, to be an exception.

[201]This only explains why morpheme final /hk/ is not common, but does not explain why morpheme-final /hk/ is completely absent as there could have been instances of /hk/ that were not derived from /*kk/, like with morpheme-final /ht/ or /hs/ sequences. Maybe this is because of a sort of chain shift. That is /kk*/ became /hk/, so /*hk/ turned into /h/ or /k/ to avoid ambiguity. Evidence for this suggestion is that the word for 'thank you' in Wendat *tiawenhk* has a final /hk/ sequence whereas in Kanien'kéha there is no final consonant [njá:wʌ̃].

[202]What about the features of strong /h/? Normal /h/ is placeless so it does not have a place feature. It is behaving like it has lower sonority than sonorant consonants, so I assume it to have the feature [+cont]. So what about strong /h/? I remain agnostic as to the

featural content of strong /h/ as a full investigation requires a more in depth featural analysis of Kanien'kéha, which is beyond the scope of this thesis. I will leave the reader with some of my thoughts on the matter. Strong /h/ must have a [dor] feature to account for its involvement in the [w]~[o] alternations. It also must have a feature that makes it have the same sonority as a stop, like [-cont]. The problem with this is that these two features would result in strong h being pronounced as [k]. This is clearly problematic and I leave this puzzle to future research.

Appendix C: Comparing the coda-onset analysis of CC clusters to the nonmoraic syllable analysis

Since the vast majority of the literature discussing Kanien'kéha stress and epenthesis assumes that medial CC clusters form coda-onset clusters (e.g. Michelson, 1988; Piggott, 1995; Rawlins, 2006; Elfner, 2016), this appendix compares the coda-onset analysis with the nonmoraic syllable analysis presented in Chapter 3 of this thesis, to illustrate why the latter is preferable. This is an important analytical difference because the two analyses result in vastly different analyses of the syllable structure in Kanien'kéha, and consequently, different analyses of epenthesis and stress in the language.

The coda-onset analysis championed in the literature holds that the first member of word-medial CC clusters is in the coda of one syllable, while the second member is the onset of the following syllable.

(152) /ka-nakt-aʔ/→[ga.ná**k^{h}.d**aʔ] *kanákta'* 'bed'

The principal reason why many sources propose that medial CC clusters are coda-onset is because they block Tonic Lengthening on the preceding stressed vowel. This is shown in the following examples.

(153) OO clusters block Tonic Lengthening

a. /loti-nũhwa**kt**-a-ni/→[lodinũhwák^{h}dani] *rotinonhwáktani* 'they are sick'

b. /k-ʔne**k-h**aʔ/→[ge̲ʔnékhaʔ] *ke'nékha'* 'I am begging', 'I am pleading'

c. /sa-ʔnotst-o**sk**ũ/→[zaʔnots:dós:gũ] *sa'notstóskon* 'you are completely naked'

However, the coda-onset analysis runs into challenges when we look at the left edges of words. At the left edge, we get CC clusters that have the exact same profile (and undergo the exact same phonotactically-driven processes) as word-medial CC clusters. Some examples of left edge clusters matching the profile of the word medial CC clusters in (153) are shown in (154).

(154) Left cluster profile

a. /**k-t**akeliʔta-s/→[k^{h}dagelì:das:] *ktakerì:tas* 'I am frying'

b. /**kh**e-nũhweʔ-s/→[khenṹ:weʔs:] *khenòn:we's* 'I like her'

c. /**s-k**-ahkt-s/→[sgáhg◙ts] *skáhkets* 'I got back'

One possible analysis of these left edge clusters (given the coda-onset analysis of medial CC clusters) is that they are complex onsets. That is, CC clusters prefer to be syllabified as coda-onsets (and do so word-medially), but at the left edge cannot do so, and consequently must syllabify as complex onsets. However,

this analysis would incorrectly predict that word-medial CCC clusters should be licit, as they should be able to be syllabified as VC.CCV with the first member of the CCC cluster in the coda of the preceding syllable, and the following two consonants forming a complex onset in the following syllable.

(155) /te-k-kha-s/→*[ték.khas] [deg̊ékhas:] *tekékhas* 'I attach things together'

A second possible analysis of left edge clusters given the coda-onset analysis of medial clusters involves extrasyllabicity (Michelson, 1988). Specifically, this analysis would involve any consonant to the left of the rightmost C (e.g. #**C**CV) being extrasyllabic. However, extrasyllabicity predicts that there should not be any phonotactic restrictions between the extrasyllabic segments and the following ones. Additionally, it is not clear what implications this analysis has for the phonotactics between extrasyllabic segments. In this way, this analysis fails to account for the fact that the left edge clusters have the same profile as word-medial clusters. If word-medial and word-initial clusters have the same phonotactic profile and are subject to the same constraints, they should be syllabified in the same way.

Finally, another option for left edge clusters is to say that, like medial CC clusters, left edge CC clusters are syllabified as coda-onset (à la Goad (2012)). In the following example, ∅ represents an empty nucleus.

(156) /**k-t**akeliʔta-s/→[∅kʰ.da.ge.lì:.das:] *ktakerì:tas* 'I am frying'

The issue here is that CC clusters in Kanien'kéha do not look in any way like coda-onset clusters. That is, they are not subject to any of the constraints that we would expect to hold of coda-onset clusters: voicing constraints, place constraints, sequencing constraints, and sonority constraints. See Chapter 3 for more details.

Another issue with the left-edge coda-onset analysis is that there are commonly CCC sequences in Kanien'kéha.

(157) Word-medial CCC

a. /ie-**tst**-a-lho-hst-haʔ/→[jets:dahlóhs:thaʔ] *ietstahrhóhstha'* 'shingles'

(158) Left edge CCC

a. /**s-st**ath-a-ʔt-haʔ/→[ts:dathà:thaʔ] *tstathà:tha'* 'you make it dry'

In these cases, we would have to say that these involve complex codas both at the left edge (e.g. ∅**ts:**.dat.hà:t.haʔ) and word-medially (e.g. jets:.dah.ló**hs:t**.haʔ). Complicating this analysis further, Laryngeal Lengthening can occur before such clusters. That is, in clusters that already contain two or three coda consonants (according to the current version of the coda-onset analysis), the preceding vowel can be long.

(159) a. /io-hwaʔ**tst**-aʔ/→[oh.wà:ts:.daʔ] *ohwà:tsta'* 'foam' (Michelson, Michelson and Deer, 2024)[203]

This would be very strange: a complex coda preceded by length, when CC clusters already block the existence of trimoraic syllables.

So if word-medial CC clusters are not coda-onset clusters, then what are they? Let's take a step back to re-examine the reasons supporting a coda-onset analysis in the first place: (1) CC clusters occur word-medially. This clearly does not necessitate a coda-onset analysis as medial CC clusters can be syllabified in many different ways (Harris, 1994). (2) Word-medial CC clusters block Tonic Lengthening on the preceding stressed vowel. While this can definitely be taken as support for the coda-onset analysis, there is also another reason why Tonic Lengthening could be blocked. Recall that Tonic Lengthening is blocked when immediately followed by a C[e] syllable (where [e] is the invisible epenthetic vowel). If we assume that C[e] is nonmoraic (to account for stress, word-minimality, etc.), then we can say that Tonic Lengthening is blocked when the following syllable is nonmoraic (in addition to when the stressed vowel is followed by a coda). Another possible analysis of CC clusters, then, involves them containing a nonmoraic syllable. See the following example, in which Tonic Lengthening is blocked because the stressed vowel is immediately followed by the nonmoraic syllable [k^h].

(160) /ka-nakt-aʔ/→[ga.ná.k^h.daʔ] *kanákta'* 'bed'

Given that the nonmoraic syllable analysis can account for the Tonic Lengthening facts (as well as the word-medial position of many CC clusters), we can directly compare it with the coda-onset analysis in the following table. This table shows what each analysis accounts for in Kanien'kéha phonology.

(161) Comparing coda-onset analysis and nonmoraic syllable analysis

	Coda-onset	Nonmoraic syllable
Accounts for	Tonic Lengthening	Tonic Lengthening
	word-medial position	word-medial position
		Left edge position
		Right edge position
		CC profile
		Invisible [e]
		Visible [ē]
		Behaviour of laryngeals

We can see from the above table that, not only does the nonmoraic syllable analysis account for everything that the coda-onset analysis accounts for, but much more. Let's go through each item one by one.

[203] I have not re-elicited this form.

First is Tonic Lengthening. As described above, we already need to say something special about why Ce̲ syllables block Tonic Lengthening on the preceding stressed vowel, so why can't this be the same special explanation for why consonant clusters block Tonic Lengthening? In this way, Tonic Lengthening is not a sufficient reason for a coda-onset analysis. The second pattern in the above table is that CC clusters occur word-medially. As mentioned above, this does not imply anything about syllabification; medial CC clusters can be complex onsets, involve nonmoraic syllables, contain empty nuclei, or involve other syllabifications. The next three items — left edge position, right edge position, and CC profile — can be categorized under phonotactics. While the nonmoraic syllable analysis accounts for the profile of nearly all the clusters in Kanien'kéha, the coda-onset analysis requires us to make stipulations such as "Kanien'kéha is just different". The next two items in the above table involve the epenthetic vowels. While the nonmoraic syllable analysis accounts for the exact placement of the two epenthetic [e]s, and their respective (in)visibility to the metrical processes (linking the visibility to the placement), ad hoc explanations would be necessary for the coda-onset analysis, such as an ordering difference (which implies that the insertion location and visibility of the epenthetic vowels are unrelated) (such as in Elfner, 2016), and appeals to ad hoc rules determining insertion location. Finally, while the coda-onset analysis incorrectly predicts that the laryngeals will behave exactly like their non-laryngeal counterparts, the nonmoraic syllable analysis holds that obstruents and sonorant consonants never syllabify in the rhyme, which allows for the laryngeals to syllabify there and consequently exhibit unique behaviour.

In summary, since the coda-onset analysis accounts for a small minority of syllable structure-related patterns in Kanien'kéha, I opt for the nonmoraic syllable analysis presented in Chapter 3, which accounts for all of the patterns in (161), while linking them together, demonstrating that they are not formally unrelated.

Chapter 4 Feet in Kanien'kéha

In the previous chapter, I detailed my analysis of Kanien'kéha syllable structure, arguing that in addition to standard moraic syllables, Kanien'kéha also builds nonmoraic syllables (Ce̲, C, Cs, Ch). While this analysis suggests that these syllables will behave differently in reference to the various metrical processes in Kanien'kéha (especially encouraging invisibility to these processes), the relationship between these syllables and the metrical processes was largely left out. This left some rather big questions regarding the exact nature of this relationship. In this chapter, I intend to address these questions, spelling out the nature of the metrical processes and their relationships with the nonmoraic syllables. Specifically, I will do so within a foot-based analysis. However, like a syllable structure analysis, a foot-based analysis for Kanien'kéha patterns is met by several challenges.

Cross-linguistically, feet strive to be binary (Prince, 1985, 1990; Hayes, 1995; Gordon, 2011; Bennett, 2012). A theory enforcing the binarity of feet accounts for the location of stress in many Kanien'kéha words, as there is canonical penultimate stress (Bonvillain, 1973; Chafe, 1977; Michelson, 1988). In these cases, a right-aligned syllabic trochee analysis, as pursued by Alderete (1995); Hagstrom (1997); Mellander (2002, 2003); Elfner (2016) and Lamont (2024) correctly predicts stress placement. This is shown in (1). Stress is marked with an acute or grave accent on the stressed vowel, depending on its tonal profile (to be discussed in section 4.4).

(1) Penultimate stress

a. /sa-tshena/→[za.ts.(hé:.na)] *satshé:na* 'your pet'[1]

b. /ka-nel-ũ/ → [ga.(né:.lũ)] *kané:ron* 'she (animal) is pregnant'

c. /t-ka-ʔwaʔl-a/ → [tʰ.gaʔ.(wà:.la)] *tka'wà:ra* 'meat pie'

Although this analysis in and of itself does not capture the Tonic Lengthening pattern, where the stressed vowel is lengthened in open syllables (all long vowels are derived under stress), it does capture the stress placement pattern straightforwardly.

However, in some cases stress falls on the antepenultimate or pre-antepenultimate syllable.

[1]This form ends in [ɐ̃] rather than [a] in Michelson, Michelson and Deer (2024). The speakers that I have worked with pronounce it with a final [a], so this is how I transcribe it.

(2) Nonmoraic syllables and stress

a. /ʌ̃-wak-itaʔw-ʔ/→[ʌ̃.wa.gí:.daʔ.**we̲**ʔ] *enwakí:ta'we'* 'I'll sleep'

b. /ʌ̃-k-l-ʌ̃ʔ/ → [ʌ́**ge̲l**ʌ̃ʔ] *énkeren'* 'I will put it in'

c. /io-kste-ʔ/→[jó.**ks:**.deʔ] *iókste'* 'it is heavy'

d. /io-nlaht-ʔ/ → [ó.**ne̲**.lah.**de̲**ʔ] *ónerahte'* 'leaf'

The shifting of stress might suggest that the foot size is oscillating, creating a trisyllabic foot in the case of (2b) ([(ʌ́.**ge̲**.lʌ̃ʔ)]) and a tetrasyllabic foot in the case of (2d) ([(ó.**ne̲**.lah.**de̲**ʔ)]).[2] This analysis, however, seemingly violates foot binarity. As argued in Chapter 3, the stress placement in forms such as those in (2) is a result of these forms containing *nonmoraic syllables* (to be re-introduced in section 4.1), transcribed in (2) in bold.[3] Nonmoraic syllables are skipped when placing stress (and behave uniquely in relation to other metrical processes such as Tonic Lengthening — this will be described and discussed in section 4.1). This means that stress in Kanien'kéha cannot only be sensitive to syllable count, and that it must be sensitive to moras. The more apt generalization is that stress is placed on the penultimate *moraic syllable*.

An alternative analysis where the footing system is only sensitive to moras (as opposed to syllables) is also unable to account for the placement of stress. Assuming a moraic trochee analysis as in Piggott (1995), Kanien'kéha would build H trochees in order to account for the Tonic Lengthening pattern where stressed vowels are lengthened in stressed syllables (to be described in depth in section 4.1). To derive the canonical penultimate stress in a moraic trochee system that builds H trochees, the final syllable has to be extrametrical. This is shown in (3).

(3) /ka-nel-ũ/ → [ga.(né:).lũ] *kané:ron* 'she (animal) is pregnant'

However, a moraic trochee analysis with final extrametricality would incorrectly predict that words that end in CVCVC**e̲** (where C**e̲** is a nonmoraic syllable) would have penultimate stress, as shown in (4) in which /ʔ/ is in the nucleus and thus does not contribute weight.

[2] I use the term 'stress shift' to refer to instances where the stress appears in a different location from what is expected, rather than to indicate that stress first falls on the penult, then moves further leftward.

[3] Piggott (1995) argues that syllables of the shape C**e̲** are nonmoraic as well.

(4) /ɑ̃-wak-itaʔw-ʔ/→*[ɑ̃.wa.gi.(dà:).<we̲ʔ>] [ɑ̃.wa.gí:.daʔ.we̲ʔ] *enwakí:ta'we'* 'I'll sleep'[4]

These data show that it is not enough for the footing system to simply refer to moras, as this results in stress falling too far to the right. In this way, Kanien'kéha stress cannot be sensitive to syllables *or* moras, as it must be sensitive to both.

In this chapter, I will argue for a novel type of trochee that only counts weighted syllables, and that stress is placed on the penultimate weighted syllable. That is, whereas a foot in languages like Hungarian consists of two syllables (regardless of weight), and a foot in languages like Cahuilla consists of two moras (regardless of syllable count) (Hayes, 1995),[5] I will argue that a foot in Kanien'kéha consists of two moraic syllables. In this sense, I follow the sources listed at the outset of this chapter in arguing for a strictly binary representation of feet, adding moraic syllables to the units that may be counted for foot formation.

This chapter is organized as follows. In section 4.1, I will re-introduce the metrical processes that will be discussed throughout this chapter: stress, minimal word effects, Tonic Lengthening, and tone. In the following section 4.2, I will present the core of my analysis of the foot structure in Kanien'kéha, arguing for a syllabic trochee analysis where only weighted syllables are counted. In section 4.3, I will incorporate the Tonic Lengthening facts into the syllabic trochee analysis. Finally, I will discuss the relationship between tone and length in section 4.4, arguing that length in the stressed vowel is not always a result of Tonic Lengthening.

4.1 Background

In this section, I will reiterate the central patterns being addressed in this section: the interactions between the metrical processes and the nonmoraic syllables. I will first describe the various metrical processes that will be analyzed in this chapter, then I will revisit the series of nonmoraic syllables argued for in Chapter 3, showing how they interact with the metrical processes.

4.1.1 Metrical Processes

In this section, I will describe the stress placement patterns, word-minimality effects, Tonic Lengthening process, and finally the tonal patterns (in reference to length) in Kanien'kéha. As described in section 2.3, the processes described here hold in nouns and verbs, but not in particles. I will provide analyses for all of these metrical processes over the course of this chapter.

[4] /ʔ/ is not pronounced when immediately following a stressed vowel. See sections 3.6 and 4.4 for more details.
[5] Languages that build HL trochees are commonly assumed to employ syllabic trochee systems.

4.1.1.1 Stress placement

Stress is canonically placed on the penultimate syllable in Kanien'kéha (Bonvillain, 1973; Chafe, 1977; Michelson, 1988). Stress is marked with either an acute accent (for high tone) or a grave accent (for falling tone) on the stressed vowel (tone will be discussed at the end of this section). Some examples are shown in (5).

(5) Penultimate stress

a. /ka-nel-ũ/ → [gané:lũ] *kané:ron* 'she (animal) is pregnant'

b. /ak-kahl-aʔ/ → [akʰgà:laʔ] *akkà:ra'* 'my glasses'

c. /io-wil-aʔ/ → [owí:laʔ] *owí:ra'* 'baby animal'

This pattern holds across almost all verbs and nouns.[6,7] Additionally, this pattern holds regardless of the morphology involved in the word. That is, stress placement is not sensitive to word-internal morphology, and can always be derived via the facts described in this section. This is shown in (6), in which stress falls on the penult regardless of the morphological makeup of the word and regardless of which morphemes stress will be 'jumping over'. In (6a), stress falls on the verb root /-atkahtho-/, in (6b) stress falls on a pre-pronominal prefix /waʔ-/ (which occurs to the left of the pronominal prefix /k-/ and verb root /-ko-/), and in (6c) stress falls on the pronominal prefix /la-/ to the left of the incorporated noun /-ks-/.

(6) Stress regardless of morphology

a. /waʔ-k-atkahtho-ʔ/→[waʔgatʰgáthoʔ] *wa'katkáhtho'* 'I looked at it'

b. /waʔ-k-ko-ʔ/→[wà:kʰgoʔ] *wà:kko'* 'I picked it'

c. /la-ks-o-s/→[láks:os:] *ráksos* 'he puts the dish in water'

4.1.1.2 Word-minimality

Throughout this chapter, I will provide support for my arguments as to the foot shape in Kanien'kéha with the word-minimality effects in the language, showing that the minimal word corresponds to the minimal foot (the word will never be smaller than the minimal foot as there can never be a footless lexical word). The minimal word in Kanien'kéha is two syllables. If the morphology creates a word that is under two syllables, prothetic [i] is inserted.

[6]There are a few exceptions to this pattern, which largely are loanwords: [dagó:s:] 'cat' from Dutch *de poes* 'the pussy cat' (Martin, 2025). There are a few exceptions in the native lexicon as well, such as the vocative [akʰʤiʔó] *aktsi'ó* 'my older sister'

[7] As noted by Michelson (1988) there may be idiosyncratic examples of secondary stress, but there does not seem to be any systematic secondary stress in Kanien'kéha. This means that there will be only one stressed syllable in all words, despite the potential for Kanien'kéha words to be quite long.

(i) /te-wak-alelɤ̃-hs-ũhnũ-hneʔ/→[dewagalelɤ̃hsũhnű́hneʔ] *tewakarerenhsonnónhne'* 'I went to the races.'

(7) Minimal word and prothetic [i]

a. /w-a/→[í:.wa] *[wá:] *í:wa* ‘it is inside it’

b. /k-e-ʔ/→[í:.geʔ] *[kè:] *í:ke’* ‘I am walking’

c. /hl-o/→[ì:.lo] *[ló:] *ì:ro* ‘he has arrived’[8]

In (7), the morphology creates sequences that would otherwise be syllabified as a single syllable. In order to avoid a monosyllabic word, prothetic [i] is inserted. Since stress falls on the penultimate syllable in Kanien’kéha, and [i] is inserted to create a second syllable at the left edge, prothetic [i] is always stressed. In section 4.1.2, I will show how the minimal word effects interact with nonmoraic syllables.

4.1.1.3 Tonic Lengthening

Vowels in stressed open syllables are lengthened in Kanien’kéha (Bonvillain, 1973; Chafe, 1977; Michelson, 1988). As described in Chapter 2, I follow Michelson (1988) in referring to this process as Tonic Lengthening.

(8) Tonic lengthening

a. /wak-halatat-ũ/→[wakhaladá:dũ] *wakharatá:ton* ‘I have raised it up’

b. /k-hiatũ-s/→[khjá:dũs:] *khiá:tons* ‘I write’

c. /io-nũt-aʔ/→[onṹ:daʔ] *onón:ta’* ‘hill’

As argued in Chapter 3, the only possible coda in Kanien’kéha is /h/, which gets Weight-by-Position. When the stressed vowel is followed by coda /h/, Tonic Lengthening does not occur. This is shown in (9).

(9) Followed by a coda

a. /j-aʔ-hii-atʃehta-ʔ/→[jahijaʤ**éh**daʔ] *iahiiatsiéhta’* ‘I shot it at him’

b. /a-k-tahko-ʔ/ → [ak^{h}d**áhg**oʔ] *aktáhko’* ‘I ought to take it out’

c. /wa-hsako-hseht-ʔ/→[wahsag**óhs**ehdeʔ] *wahshakóhsehte’* ‘he killed her’

I assume that Tonic Lengthening occurs to make the stressed syllable bimoraic, like in Icelandic (Kager, 1999), and that /h/ blocks lengthening because it gets Weight-by-Position (Hayes, 1989), nullifying the need for lengthening.

I will show in the following section that length does not always happen as a result of Tonic Lengthening. That is, there are other conditions under which lengthening occurs.

[8]The verb root for ‘arrive’ is written in the orthography as *-w-* in Michelson, Michelson and Deer (2024). Presumably this is because in Michelson (1988), Michelson argues that the glide is underlying in glide-vowel alternations. According to my analysis in Chapter 3, this is underlyingly /-o-/.

4.1.1.4 Tonal patterns

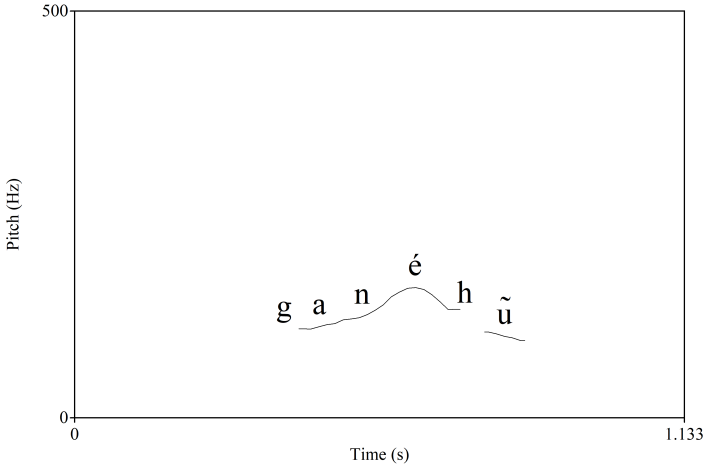
Here, I will describe the tonal patterns in Kanien'kéha, illustrating the relationship that tone has with stress and length.

Kanien'kéha has been described as a pitch accent language to capture the observation that the stressed syllable is primarily cued with pitch (either high (H) or falling tone (HL)), and that tonal contrasts never occur outside of the stressed syllable (Mithun, 1999; Michelson, 2016; Pentangelo, 2020). I will refrain from using the term 'pitch accent', ackowledging that it does not represent a clear typological category and has historically been used as a way to 'other' languages (Hyman, 2006, 2009). Following Hyman's suggestion to do 'property driven typology', instead of using the terms 'accent' or 'pitch accent', I use 'stress' when referring to a locus of prominence, and 'tone' when referring to the pitch associated with the prominent syllable.[9]

The stressed syllable always begins with a high tone (marked with an acute accent in the orthography and transcriptions) (Renard, 2023*b*). For example, we can see the high tone in the short stressed vowel in (10).[10]

(10) High tone

/ka-nehũ/→[ganéhũ] *kanéhon* 'skin, hide'



In (10), the pitch clearly rises to its zenith at the stressed vowel [e].[11]

When the stressed vowel is lengthened via the Tonic Lengthening process described in the preceding

[9]Hyman (2011) labels the related language Seneca as a Metrical Tone system, referring to the fact that the tone and stress systems are separate, but that the tone is imposed on stress.

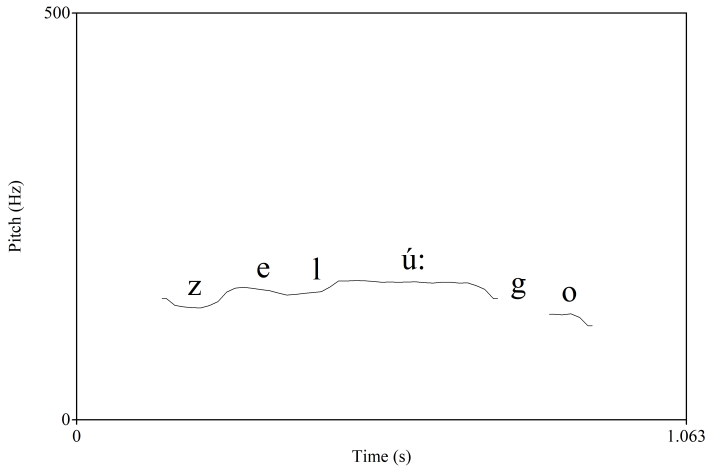
[10]Intervocalic /h/, unlike other intervocalic consonants, is syllabified into the coda (getting Weight-by-Position) and thus blocks lengthening. See section 3.6 for more details.

[11]A larger scale phonetic study is required to verify this. Although this has been reported in the literature, some earlier sources do not even mention the higher pitch. For example Beatty (1972) describes this as 'even pitch'.

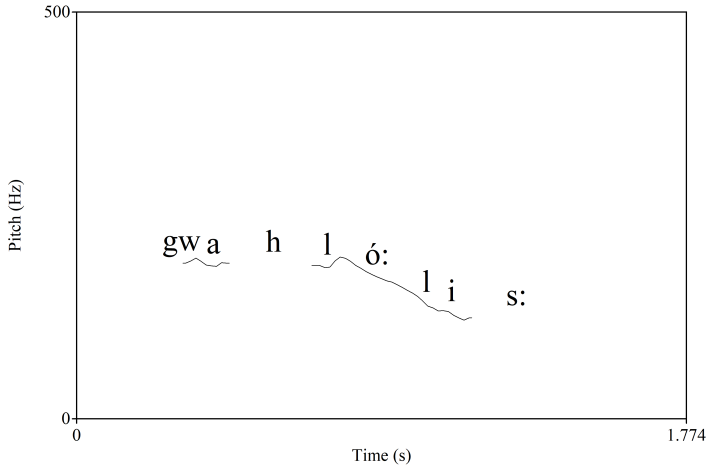
section, the rise in pitch is more shallow, but still present. The pitch may stay steady (11a) or fall slightly (11b) over the course of the stressed vowel. As far as I am aware, these are in free variation.

(11) Long stress

a. Steady: /s-rũko/→[ze̲lű:go] *serón:ko* 'Scrape!'



b. Slightly falling: /kwa-hloli-s/→[gwahló:lis:] *kwahró:ris* 'I tell you (pl)'



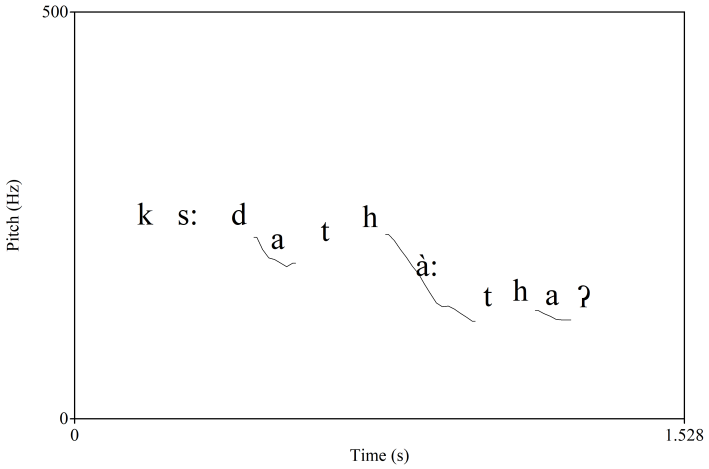
In (11a), the pitch rises on the stressed vowel [ű] and then falls after. In (11b), there is the characteristic rise at the start of the stressed vowel, but then the pitch drops over the course of the stressed syllable. Despite the declination commonly observed in a long stressed vowel, it still contrasts with the falling tone in the language.[12]

[12]Akwiratékha' Martin points out that there are seem to be some examples of constrastive Long Upstress and Short Upstress. These include, for example, [jũge̲ninjá:gũ] *ionkeniniá:kon* 'we are married' and [jũge̲ninjágũ] *ionkeniniákon* 'we have gotten married', and [lawɔ̃hé:jũ] *rawenhé:ion* 'he is dead' [lawɔ̃héjũ] *rawenhéion* 'he has died'. However, Karin Michelson (p.c.) notes that the words with Short Upstress here probably include an underlying glottal stop preceding the final vowel (e.g. /iũkni-niak-ʔũ/→[jũge̲ninjágũ̲ʔ]), but vowel twin has occurred to make the glottal surface word-finally, and prevent the stressed vowel from lengthening (see the discussion of vowel twin in section 3.6). This would explain the length differences in the above examples. In this sense, Short Upstress and Long Upstress are still not constrastive.

When a stressed vowel is underlyingly followed by a nuclear laryngeal (/ʔ/ or /h/ in VhR sequences),[13] the stressed vowel is lengthened and is pronounced with a falling tone (marked with a grave accent in the orthography and transcriptions) (Beatty, 1972; Bonvillain, 1973; Michelson, 1988). The lengthening here is called Laryngeal Lengthening (Michelson, 1988). Acoustically, the falling tone involves a rise in tone followed by a sharp fall. This is shown in the pitch contour in (12).

(12) Falling tone

/k-stath-a-ʔt-haʔ/→[ks:dathà:thaʔ] *kstathà:tha'* 'I make it dry'



The sharp fall in (12) contrasts with the slight fall in the long vowel with a high tone in (11b). This difference is obvious to speakers of the language, but can pose a challenge for learners.

The underlying nuclear laryngeal following the stressed vowel is normally not pronounced following the falling tone. I argued in section 3.6 that this is phonetic deletion rather than phonological deletion as the laryngeals are in some cases pronounced (e.g. by specific speakers, at specific speech rates, etc.). See section 3.6 for more details.

In the following section, I will show how the nonmoraic syllables argued for in Chapter 3 interact with the processes described in this section.

4.1.2 Nonmoraic syllables

In Chapter 3, I argued based on phonotactics, epenthesis, and the behaviours of the metrical processes that in addition to moraic syllables, Kanien'kéha builds nonmoraic syllables. Nonmoraic syllables take the shape C<u>e</u>, C, Oh, and Ts (<u>e</u> = metrically invisible epenthetic vowel, O = obstruent, T = stop). These syllables

[13] I argued in section 3.6 that /ʔ/ is always syllabified into the nucleus, so whenever the stressed vowel is followed by /ʔ/, it undergoes lengthening and gets a falling tone. /h/ in a Vh sequence is only in the nucleus when it is followed by a sonorant consonant. In this case, it behaves the same as /ʔ/ in causing length and falling tone on the stressed vowel.

interact with the previously described metrical processes in a different way than the moraic syllables.

Whereas moraic syllables are counted for stress placement, nonmoraic syllables are ignored. This means that the more apt generalization about Kanien'kéha stress placement is that stress is placed on the penultimate moraic syllable. Some examples of nonmoraic syllables being skipped are shown in (13). Stay tuned for a description of the relationship between nonmoraic syllables and Tonic Lengthening.

(13) Nonmoraic syllables and stress placement

a. /io-wl-aʔ/→[ó.**we̲**.laʔ] *ówera'* 'wind'

b. /io-hwist-aʔ/→[oh.wí.**s:**.daʔ] *ohwísta'* 'money', 'bell', 'metal'

c. /ka-khw-aʔ/→[gá.**kh**.waʔ] *kákhwa'* 'food, a meal'

d. /io-kste-ʔ/→[jó.**ks:**.deʔ] *iókste'* 'it is heavy'

Stress can even be shifted to the pre-antepenult if there are two nonmoraic syllables intervening between the penultimate moraic syllable and the right edge of the word.

(14) Multiple nonmoraic syllables and stress

a. /io-nlaht-ʔ/ → [ó.**ne̲**.lah.**de̲**ʔ] *ónerahte'* 'leaf'

b. /ʌ-k-l-a-hkw-ʔ/→[ʌ́.**ge̲**.lah.**gwe̲**ʔ] *énkerahkwe'* 'I will use it as a container'

c. /te-k-lik-s/ → [dé.**ge̲**.li.**ks:**] *tékeriks* 'I put two things together'

However, stress cannot fall further to the left than the pre-antepenult due to what I called in Chapter 3 the Adjacency Condition, which is defined in Chapter 3, repeated here in (15). As described in Chapter 3, the Adjacency Condition accounted for the distribution of a number of weak syllables across languages, such as the restriction on adjacent minor syllables in many South-East Asian languages (Butler, 2014).

(15) Adjacency Condition: Adjacent nonmoraic syllables are prohibited.

When there is a sequence that would otherwise result in a sequence of adjacent nonmoraic syllables, moraic epenthesis occurs to make the would-be leftmost syllable of the sequence moraic. This is shown in (16) — moraic epenthesis is marked with a boxed [e͞].

(16) C̲eC̲e→C[e̲]C̲e

a. /**s-wl**-ak-s/→[z[é].we̲.la.ks:] *[í.ze̲.we̲.la.ks:] *séweraks* ‘you eat wind’

b. /**s-wj**-ak-s/→[z[é].we̲.ja.ks:] *[í.ze̲.we̲.ja.ks:] *séweiaks* ‘you eat shawls’

c. /waʔ**t-k-t**eni-ʔ/→[waʔ.d[e̲].k^{h}.dé:.niʔ] *[waʔ.t^{h}.k^{h}.dé:.niʔ] *wa’tekté:ni’* ‘I changed it’

Let’s take (16a) as an example. Nonmoraic epenthetic [e̲] breaks up CC clusters that involve a sonorant consonant (see Chapter 3 for more details). In (16a), the underlying sequence provides two environments for metrically invisible epenthesis to occur: /sw/ and /wl/. If these sequences were not intersecting, they would have surfaced as [se̲w] and [we̲l] respectively. However, since they are adjacent, they surface as [s[e̲]we̲l], with the leftmost [e] being moraic. We can tell that the leftmost [e] is moraic because it is stressed (nonmoraic syllables cannot be stressed). We can tell that the rightmost [e] is nonmoraic because stress, which otherwise would have fallen on the penult, skips it. Additionally, there is no Tonic Lengthening on the stressed vowel, which is how stressed vowels surface when immediately preceding nonmoraic syllables (this will be discussed shortly).[14]

Since there cannot be adjacent nonmoraic syllables, it is not possible for stress to be further to the left than the pre-antepenultimate syllable.[15] This is shown in the table in (17) in which the stress possibilities are presented. In this table, Ce̲ represents a weightless syllable, CV: a heavy weighted syllable, CV a light weighted syllable, and C[e̲] an otherwise weightless syllable that surfaces as weighted.

(17) Possible stress and epenthesis patterns

CVCV́:CV	CV́:CVCe̲	CVCV́:C[e̲]Ce̲	CV́CeC[e̲]Ce̲	CéCeC[e̲]Ce̲
	CV́CeCV	CV́CeCVCe̲	CeCV́:C[e̲]Ce̲	
	CeCV́:CV		CéCeCVCe̲	

Even if all syllables in the word would otherwise be weightless, stress would maximally shift to the pre-antepenultimate syllable. This is because even count syllables from the right edge will become weighted. As far as I am aware, this type of word does not exist. However, there are cases where the final three vowels would otherwise be weightless, but do not surface as such. This is shown in (18).

[14] As discussed in section 3.8, invisible epenthetic [e̲], visible epenthetic [[e̲]], and underlying [e] are indistinguishable to my ear.

[15] Due to data in (70) in Chapter 3 showing that COR sequences sometimes result in an Adjacency Condition violation, stress may fall on the pre-pre-antepenultimate syllable. This is shown in the final [s:.de̲ʔ] sequence in the following word.

(i) /iaʔt-k-at-staw-awʔe**st-**ʔ/→[jaʔ.t^{h}.ga.ts:.da.wá.we̲ʔ.e.s:.de̲ʔ] *ia’tkatstawáwe’este’* ‘I went into the bush.’

In the majority of cases, however, stress never occurs to the left of the pre-antepenultimate syllable.

(18) CeCeCe→[CeCēCe]

/tn-t-ʔ/→[**í**denēdeʔ] *ítenete'* 'you and I are standing'

In this example, the final and antepenultimate syllables are weightless, but the penult is weighted because of its position in the string. Stress is on the syllable with prothetic [i].

Nonmoraic syllables are also ignored for the purposes of word-minimality. That is, the minimal word is two moraic syllables, and consequently the number of nonmoraic syllables is irrelevant (but subject to the Adjacency Condition). This is shown in (19).

(19) Prothetic [i]

a. /k-ek-s/→[í:.ge.ks:] *í:keks* 'I eat'

b. /s-l-ɤ̃/→[í.ze.lɤ̃] *íseren* 'Put it in!'

c. /tn-t-ʔ/→[**í**denēdeʔ] *ítenete'* 'you and I are standing'

For example, without prothetic [i] the segments in (19a) would form two syllables ([ge.ks:]). However, since the syllable [ks:] is not counted (it is nonmoraic), [i] needs to be inserted to form a second weighted syllable.

Finally, as briefly mentioned above, Tonic Lengthening is blocked if the immediately following syllable is nonmoraic. This is shown in (20), as well as in some examples in (19) for cases involving prothetic [i].

(20) Tonic Lengthening and nonmoraic syllables

a. /ak-laʔwist-a/→[a.ge.laʔ.wí.s:.da] *akera'wísta* 'my pancakes'

b. /io-kste-ʔ/→[jó.ks:.deʔ] *iókste'* 'it is heavy'

c. /te-k-lik-s/ → [dé.ge.li.ks:] *tékeriks* 'I put two things together'

The data in (20) shows that, even when the stressed vowel is in an open syllable (although see Hagstrom (1997) for an analysis where the C in a Ce syllable is in the preceding coda), lengthening is still blocked because the following syllable is nonmoraic.

Unlike Tonic Lengthening, Laryngeal Lengthening can occur on stressed vowels immediately preceding nonmoraic syllables. Recall that Laryngeal Lengthening occurs when the stressed vowel is followed by /ʔ/ or an hR sequence (R = sonorant consonant). When this occurs, the stressed vowel lengthens and takes on a falling tone, and the laryngeal deletes. Some examples of Laryngeal Lengthening occurring in stressed syllables immediately preceding nonmoraic syllables is shown in (21).

(21) Laryngeal lengthening before nonmoraic syllables

a. /waʔ-k-ate-ien-oʔ**kt**-ʌ̃ʔ/→[waʔgadejenò:kʰdʌ̃ʔ] ***wa'kateienò:kten'*** 'I ran out of oil or gas'

b. /io-h**ni**al-ʔ/→[ò:njaleʔ] 'snake'[16]

c. /waʔ-**k-l**-ʌ̃ʔ/→[wà:.ge̲.lʌ̃ʔ] ***wà:keren'*** 'I put it in', 'I filled it up'

In what follows, I will show how the patterns laid out in this section can be accounted for with a *moraic-syllable trochee* analysis, where only weighted syllables are counted. I assume that the syllabification that is described in Chapter 3 occurs before footing.

4.2 Feet

In this section, I will argue that Kanien'kéha builds trochees that only count weighted syllables. That is, feet in Kanien'kéha are left-headed and involve minimally and maximally two moraic syllables, thus expanding the typology of foot types (as shown in (22)). HL trochees are not included in this typology as I follow Mellander (2002, 2003) in assuming that HL trochees are a type of syllabic trochee. This will be addressed in the following section.

(22) Trochee typology (Hayes, 1985)

a. Syllabic trochee: $\sigma\sigma$

b. Moraic trochee: $\mu\mu$

c. **Moraic-syllable trochee**: $\sigma_{\mu}\sigma_{\mu}$

While the construction of moraic-syllable trochees departs slightly from that of the syllabic trochaic or moraic trochaic system in counting mother-daughter bundles ($\sigma + \mu$) as opposed to mothers or daughters (σ ***or*** μ), the building of the moraic-syllable trochee is similar to that of an iambic system that prefers LH feet. That is, the building of LH feet requires paying attention to both syllables and moras, just like moraic-syllable trochees.

I will start by showing that more conventional analyses are unable to account for the stress patterns in Kanien'kéha, and then show that a trochee system that only counts weighted syllables is necessary. This foot type that only counts weighted syllables will be able to shrink or grow in size (i.e. in total number of syllables) as long as it contains minimally and maximally two weighted syllables. Finally, I will show how

[16]There are very few cases of Laryngeal Lengthening being caused by /h/ occurring before consonant clusters. This is because /h/ only causes Laryngeal Lengthening when it is in the nucleus, and nuclear /h/ rarely occurs before consonant clusters. This is because /h/ in Vh sequences is only in the nucleus when the following segment is a sonorant consonant, and sonorant consonants are very limited in terms of what they can occur next to. The only examples of clusters that can follow nuclear /h/ are Rj sequences, which normally block lengthening. Rh sequences are another option, but there are no clear examples of underlying hRh sequences that are preceded on the surface by a stressed vowel.

the word-minimality effects are consistent with this foot analysis. I assume that Tonic Lengthening is not crucial to the foot type itself and is instead a response to a different constraint, so I will postpone discussing it to section 4.3.

4.2.1 Ruling out conventional feet

In this section, I will discuss conventional foot-based analyses of Kanien'kéha stress that others have proposed, to show that another type of foot, presented in section 4.2.2, is necessary. This is because, upon first glance Kanien'kéha may appear to be analyzable as a syllabic or moraic trochee language.[17] For example, stress is on the penult, which is expected if there is a right-aligned syllabic trochee, but there is also Tonic Lengthening which is consistent with a moraic trochee analysis coupled with extrametricality (Ikawa, 1995; Hayes, 1995). I will first discuss syllabic trochee analyses, and then moraic trochee analyses, showing that neither of these types of analyses can account for the Kanien'kéha facts. Finally, I will show that an HL trochee analysis also does not account for the Kanien'kéha stress system.

Before discussing possible foot analyses and why they do not account for the Kanien'kéha stress patterns, it is worth mentioning that Kanien'kéha stress patterns are also unanalyzable as being underlying. This is because, due to the 'polysynthetic' nature of Kanien'kéha, speakers are uttering words they have never uttered before very frequently. For each new word, stress must be computed. If stress were underlying, then there would be no way for the systematic patterns that we see in Kanien'kéha words to surface in new words.

4.2.1.1 Against Syllabic Trochees

I will start by discussing the disadvantages of a syllabic trochee analysis because the majority of the literature assumes Kanien'kéha to build syllabic trochees. As stated at the outset of this chapter, a syllabic trochee analysis, where the final two syllables (regardless of weight) are grouped into a foot, would straightforwardly account for the stress placement pattern in Kanien'kéha when not taking into consideration non-moraic syllables (and ignoring Tonic Lengthening). This has led various authors to pursue this analysis (Alderete, 1995; Hagstrom, 1997; Mellander, 2002). In this analysis, there would be a right aligned disyllabic trochee, as shown in (23).

[17] To my knowledge, there has been no iambic analysis of Kanien'kéha stress. See Ikawa (1995) and Rawlins (2006) for discussions of why this analysis is implausible.

(23) /ka-nel-ũ/ → [ga(né:lũ)] *kané:ron* ‘she (animal) is pregnant’

However, this analysis fails with any forms containing weightless syllables. This is because, despite their weightlessness, they are still syllables and would thus be counted.

(24) Syllabic trochees and incorrect predictions

a. /ʌ̃-k-l-ʌ̃ʔ/→*[ʌ̃(gél̲ʌ̃ʔ)] [ʌ́gel̲ʌ̃ʔ] *énkeren’* ‘I will put it in’

b. /waʔ-k-at-halatat-ʔ/→*[waʔgathala(dáde̲ʔ)] [waʔgathalá:dade̲ʔ] *wa’kathará:tate’* ‘I raised myself up’

The syllabic trochee approach would incorrectly predict the illicit stress placements in (24). In (24a), this analysis would target the weightless penult for stress. Further, it is not the case that stress shifts leftward in the forms in (24) merely to avoid stressing a nonmoraic syllable as, while this would correctly account for the form in (24a), it would not account for forms such as the one in (24b) in which the weightless syllable is in the dependent position of the foot in the incorrect parse. Adjusting the constraint that prevents nonmoraic syllables from being in the heads of feet to preventing nonmoraic syllables from being in any position of the foot would not account for (24a) which would require the footing [(ʌ́ge̲)lʌ̃ʔ] under the syllabic trochee analysis. An additional adjustment one could make to this analysis is to say that nonmoraic syllables prefer to not be in a foot, but can be forced to be foot-internal in forms such as [ʌ́gel̲ʌ̃ʔ] because there is no syllable to the left on which to place stress. However, even when there are forms where there is a moraic pre-antepenult, stress is still on the antepenult. This is shown in (25).

(25) /ka-nakle-ʔ/→*[gá:nage̲leʔ] [ganáge̲leʔ] *kanákere’* ‘there is plenty of it’

The antepenultimate stress in (25) is also not a result of there being a constraint militating against pre-antepenultimate stress as there are plenty of forms with pre-antepenultimate stress, some of which are shown in (26).[18]

[18]This pattern of stressing the fourth-to-last syllable contradicts the observation in Kager (2012) that stress windows are maximally three syllables from a word edge. However, this observation can be adjusted to be in line with the arguments of the current chapter by asserting that windows are maximally three *moraic syllables* (or in the case of Kanien’kéha specifically, two moraic syllables).

(26) Pre-antepenultimate stress

a. /io-nlaht-ʔ/ → [ó.ne̲.lah.de̲ʔ] *ónerahte'* 'leaf'

b. /ʌ̃-k-l-a-hkw-ʔ/→[Ʌ́.ge̲.lah.gwe̲ʔ] *énkerahkwe'* 'I will use it as a container'

c. /te-k-lik-s/ → [dé.ge̲.li.ks:] *tékeriks* 'I put two things together'

One final possibility for a syllabic trochee analysis I will address here involves nonmoraic syllables being unstressable, and when they are at the right edge of the word, extrametrical. This analysis correctly predicts stress placement in the words discussed so far (putting length aside), as shown in (27).

(27) Extrametricality and avoidance of stress

a. /ka-nel-ũ/ → [ga(né:lũ)] *kané:ron* 'she (animal) is pregnant'

b. /ʌ̃-k-l-ʌ̃ʔ/→[(Ʌ́ge̲)lʌ̃ʔ] *[ʌ̃(gé̲lʌ̃ʔ)] *énkeren'* 'I will put it in'

c. /io-kwil-ʔ/ → [(ó:gwi)le̲ʔ] *ó:kwire'* 'sapling', 'tree'

In (27a), in which there are no nonmoraic syllables, the final two syllables are footed, creating a syllabic trochee. In (27b), stress cannot fall on the weightless penult (as shown in the illicit form), so rather than the final two syllables being footed, the antepenult and the penult are (as head and dependent, respectively). In (27c), the final syllable is nonmoraic, so it is extrametrical and thus cannot be part of the foot. Consequently, the foot includes the antepenult (as the head) and the penult (as the dependent).

While this analysis works for the examples in (27), it does not work for words where there are two adjacenct nonmoraic syllables (i.e. when the Adjacency Condition is violated). These forms are discussed in section 3.5. Some examples are shown in (28).

(28) Adjacent nonmoraic syllables

a. /waʔ-k-hnek-ʌ̃tst-ʔ/→[waʔ.kh.né:.gʌ̃.**ts:.de̲**ʔ] *wa'khné:kentste'* 'I drained it'

b. /waʔ-ie-hiatũhsr-a-nʌ̃takt-ʔ/→[waʔ.eh.ja.dũh.se̲.la.nʌ́:.da.**k^{h}.de̲**ʔ] *wa'ehiatonhseranén:takte'* 'she put up wallpaper'

In these cases, the current analysis would predict stress to fall on the antepenult, when it actually falls on the pre-antepenultimate syllable. This is shown in (29).

(29) /waʔ-k-hnek-ɑ̃tst-ʔ/→*[waʔ.kh.ne.(gɑ́̃.ts:).<de̲ʔ>] [waʔ.kh.né:.gɑ̃.ts:.de̲ʔ] *wa'khné:kentste'* 'I drained it'

The predicted output in forms such as the one in (29) involves the final nonmoraic syllable being extrametrical, and consequently the foot containing the moraic antepenult (as the head) and the nonmoraic penult (as the dependent). However, stress should be on the pre-antepenult, thus making this analysis untenable.

In this way, a foot system that only makes reference to syllables is unable to capture the stress patterns in Kanien'kéha. These patterns show that the correct analysis needs to (1) allow foot-internal nonmoraic syllables while preventing them in foot-head position and (2) capture the leftward shift of stress as opposed to the adjustment of syllable weight to place stress nearer the right edge. At first glance, it would appear that moraic trochees meet these conditions, however I will show in the following section that a footing system that only makes reference to moras is also unable to account for the stress placement patterns in Kanien'kéha.

4.2.1.2 Against Moraic Trochees

Since nonmoraic syllables are skipped by the stress system while counting moraic syllables, a possible analysis involves moraic trochees. A moraic trochee analysis has been pursued in Piggott (1995); Rawlins (2006) and Adler and Zymet (2021). However, in order to account for the stress patterns, a moraic trochee analysis either needs to violate foot binarity, or is unable to account for forms with nonmoraic syllables. In this section, I will entertain two moraic trochee analyses to show why moraic trochees are not desirable. The first will account for the data, but will involve violating foot-binarity, while the second will not violate foot-binarity, but will be unable to account for the data.

Recall that moraic trochees are governed by the constraint Ft-Bin-μ, which says that moraic trochees must contain maximally and minimally two moras. Usually, this involves building LL or H feet. One potential analysis of Kanien'kéha, then, involves the building of an LL foot. In this analysis, the foot would be aligned with the right edge of the word in order to capture the penultimate stress pattern in words with no nonmoraic syllables (CV(CV́CV)). In order to account for the Tonic Lengthening pattern, we could not appeal to the binarity constraint because the foot is already binary. Therefore, we would need to say that the lengthening process occurs after the footing of the two L syllables, creating an HL foot. Tonic Lengthening in this analysis could be the result of a constraint such as Head-Prominence, which says that the foot head must be heavier than the foot dependent (I will appeal to such a constraint in my analysis). This is shown in (30).

(30) /ka-nat-aʔ/→ga(nádaʔ)→[ga(ná:daʔ)] *kaná:ta'* 'town'

Problematically, this analysis involves the binarity constraint holding at intermediate stages of the derivation, but not in the output, as on the surface it contains three moras (see the discussion in section 4.3 on why Tonic Lengthening must be taken to be a phonological process). This goes against a central insight in Prince and Smolensky (1993), that phonological constraints hold at the output, but not anywhere else. In this sense, an analysis where Kanien'kéha builds LL moraic trochees is undesirable.

A second option for a moraic trochee analysis involves feet consisting of a single H foot. Unlike the LL analysis, the H foot analysis directly addresses the Tonic Lengthening problem: after footing, the vowel is lengthened to achieve bimoraicity. In this analysis, the final syllable would need to be extrametrical in order to get the right-aligned H foot on the penult.

(31) H trochee on penult

/ka-nel-ũ/ → [ga(né:)<lũ>] *kané:ron* 'she (animal) is pregnant'

However, this system makes incorrect predictions with respect to forms in which the final syllable is nonmoraic. In these cases, the moraic trochee analysis would predict that stress would be on the penult, rather than the antepenult which is the attested pattern. We can compare the syllabic trochee predictions for the form in (32) to the moraic trochee predictions for the same in form in (24b).

(32) /waʔ-k-at-halatat-ʔ/→*[waʔgathala(dá:)<de̲ʔ>] [waʔgathalá:dade̲ʔ] *wa'kathará:tate'* 'I raised myself up'[19]

It is also not the case that stress is moving to the antepenult in order to be lengthened (as recall that stressed vowels are not lengthened when they are immediately followed by a nonmoraic syllable). If stress were shifting to the antepenult in order to be lengthened, then we would expect that stress would also shift in other cases in order to avoid immediately preceding nonmoraic syllables (i.e. in order to be lengthened). This is not the case, as shown above in (25) — /ka-nakle-ʔ/→[ganáge̲leʔ] *[gá:nage̲leʔ] *kanákere'* 'there is plenty of it'.

The moraic trochee analysis also struggles with forms where the penult is nonmoraic and stress is on the monomoraic antepenult.

[19]The syllabification of Oh sequences as not as straightforward as transcribed here. See Chapter 3 for a more detailed syllabification of Oh sequences.

(33) /ɪ̃-k-l-ɪ̃ʔ/ → [ʌ́ge̲lɪ̃ʔ] *énkeren'* 'I will put it in'

One could argue that stress placement on the antepenult here is because the ultima is extrametrical, and the penult is nonmoraic and thus cannot be stressed. However, the lack of Tonic Lengthening on the stressed vowel would mean that either L moraic trochees are well-formed in Kanien-kéha [(ʌ́)ge̲lɪ̃ʔ], for which we have no further evidence, or that the final syllable is in the foot (as part of a discontinuous [(ʌ́)$_{i}$ge̲(lɪ̃ʔ)$_{i}$] or trisyllabic [(ʌ́ge̲lɪ̃ʔ)] foot) which violates the constraint enforcing the extrametricality of the final syllable. Combined with the issues for forms with a final nonmoraic syllable, we can see that a moraic trochee analysis is not tenable for Kanien'kéha stress. I provide more evidence against the moraic trochee analysis in section 4.2.3.

Thus, I do not pursue a moraic trochee analysis as referring only to moras in the foot building process either results in a violation of foot-binarity, or does not account for the stress placement patterns in Kanien'kéha. The foot type in Kanien'kéha needs to always place stress on the penultimate weighted syllable. In the following section, I will show that an HL trochee analysis, which makes reference to both syllables and moras, is also unable to account for the stress placement facts in Kanien'kéha.

4.2.1.3 Against HL Trochees

At face value, an analysis where Kanien'kéha builds HL trochees seems desirable, as this would account for the Tonic Lengthening pattern as well as the pattern where stress is always on the penultimate weighted syllable. However, I will show that this analysis cannot account for cases in which the final syllable is nonmoraic.

Before addressing the analysis, it is necessary to define HL trochees, as they are not as straightforward as moraic or syllabic trochees which simply contain two of a certain prosodic unit. If we were to address HL trochees as a base type of trochee (like moraic or syllabic trochees), then we would expect that HL trochees would be as common as moraic or syllabic trochees, but this is not the case. Instead, I follow Mellander (2002, 2003) in assuming that HL trochees can be broken down into a binarity constraint and a constraint that ensures that the head is heavier than the dependent. Specifically, Mellander argues that HL trochees are only possible in syllabic trochee systems, and that what distinguishes standard syllabic trochee systems from HL optimizing systems is that there is another constraint — Head-Prominence — in HL optimizing systems which says that the head must be heavier than the dependent. Head-Prominence is what will motivate Tonic Lengthening. While I will adopt Mellander's approach to Tonic Lengthening in section 4.3, his syllabic trochee analysis cannot account for the data. This is most apparent in forms that end in the shape HL∅. The prediction of Mellander's analysis for forms of the shape HL∅ is that stress will

be on the penult.

(34) /waʔ-k-at-halatat-ʔ/→*[waʔgathala(dádeʔ)] [waʔgathalá:dadeʔ] *wa'kathará:tate'* 'I raised myself up'

Mellander's HL trochee analysis would predict the footing in (34). This footing would satisfy the syllabic trochee binarity constraint as there are two syllables, as well as satisfy the Head-Prominence constraint because the monomoraic head [da] is heavier than the nonmoraic dependent [deʔ]. However, this footing incorrectly predicts the stress placement; where Mellander's analysis predicts that stress should be on the penult, stress in the actual form is on the antepenult.

For these reasons, an HL trochee analysis cannot account for the stress patterns in Kanien'kéha. In the following section, I will show that a new type of trochee, moraic-syllable trochees, can capture the stress facts in Kanien'kéha.

4.2.2 Moraic-syllable trochees

Since the conventional foot analyses discussed previously cannot account for the stress patterns in Kanien'kéha, a different analysis is necessary. Following the observation in Michelson (1988) that stress is always on the penultimate weighted (in Michelson's terms, visible) syllable,[20] I argue that Kanien'kéha builds syllabic trochees but that only moraic syllables are counted. I call these feet moraic-syllable trochees, adding to the typology of types of trochees. Moraic-syllable trochees are left-headed feet that are constrained by the binarity constraint in (35).

(35) Ft-Bin-$\sigma_\mu\sigma_\mu$: The foot contains minimally and maximally two weighted syllables. A weighted syllable is defined as a syllable that dominates at least one mora.[21]

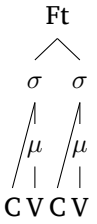
Note that this constraint maintains that Kanien'kéha builds binary feet, the difference being that both syllables and moras are counted rather than just syllables *or* moras.

In the representation in (36), I show an example of a moraic-syllable trochee. Tonic Lengthening is not included in this representation as it will be discussed in section 4.3.

[20] Michelson (1988) does not assume Moraic Theory.

[21] In Optimality Theory, the binarity constraint would also need to be novel. The standard constraints Ft-Bin-σ and Ft-Bin-μ are used to enforce the binarity of trochees (syllabic or moraic, respectively) in OT. These constraints, however, do not work for Kanien'kéha. Ft-Bin-σ, which specifies that a foot should have two syllables, would count all syllables regardless of their weight. However, Kanien'kéha ignores nonmoraic syllables. The Ft-Bin-μ constraint, which specifies that a foot must contain two moras, would ignore syllables. However, this would wrongly predict that a right aligned H foot is licit when this is not the case. Another option is to highly rank both Ft-Bin-σ and Ft-Bin-μ to ensure that feet always contain two syllables and two moras. However, this would disfavour HL feet which crucially occur in Kanien'kéha, because HL feet involve three moras, violating Ft-Bin-μ.

(36) Moraic-syllable trochee



Since feet such as (LLL) and (H) do not contain two weighted syllables, they (and any other feet that do not contain minimally and maximally two weighted syllables) are avoided.

Before describing moraic-syllable trochees in more detail, it is necessary to take a step back and make clear some details about the construction of trochaic feet. Trochaic feet are bound by two constraints, a headedness constraint saying that feet should be left-headed, and a binarity constraint, saying that they contain two of some (type of) prosodic unit. For example, syllabic trochees are bound by the binarity constraint Ft-Bin-σ which says that syllabic trochees must contain minimally and maximally two syllables. Note, however, that there is no constraint on the number of moras. This means possible syllabic trochees include monomoraic L$\varnothing$, bimoraic LL or H$\varnothing$, trimoraic HL or LH, and tetramoraic HH, as the number of syllables is two. The reverse is true for moraic trochees, which are bound by the binarity constraint Ft-Bin-μ. In moraic trochees, the number of moras is restricted to minimally and maximally two, but the number of syllables is not. This not only allows for the basic types of moraic trochees — monosyllabic H and bisyllabic LL — but for feet with a much larger amount of syllables (e.g. H$\varnothing\varnothing$, L$\varnothing\varnothing$L). In this sense, there is a distinction between the prosodic units that are counted for the purposes of foot construction, and the number of prosodic units that the foot spans, with the former being limited to binarity, and the latter not. This is not to say that the prosodic units not counted by the binarity constraints are completely unrestricted, they are simply restricted by foot-external constraints (which do not necessarily revolve around binarity). For example, the number of moras in a syllabic trochee is restricted by constraints limiting the number of moras in a syllable, and the number of syllables in a moraic trochee is restricted by constraints on nonmoraic syllables. This distinction between prosodic units within a foot will play an important role in the following analysis.

In the case of moraic-syllable trochees, the prosidic units counted by the relevant binarity constraint are weighted syllables (syllables containing at least one mora). This limits the number of moraic syllables to two. However, just like syllables are irrelevant to the construction of moraic trochees and moras are irrelevant to the construction of syllabic trochees, there are prosodic units in moraic-syllable trochees that are simply not counted. The prosodic units that are not counted for the evaluation of foot well-formedness in moraic-syllable trochees are syllables and moras. This means that the number of syllables and moras is

not held to being binary (just syllables that contain a mora). This will allow for the inclusion of nonmoraic syllables in feet that may already contain two syllables, as well as the Tonic Lengthening pattern, which adds a mora to feet that may already contain two moras. Consequently, just as syllabic trochee systems can build monomoraic (e.g. L∅), bimoraic (e.g. LL or H∅), trimoraic (e.g. HL or LH), or tetramoraic (e.g. HH) feet as long as the number of syllables is two (as described above), I will argue that a moraic-syllable trochee system can build bisyllabic and trimoraic (e.g. HL), trisyllabic and bimoraic (e.g. L∅L), or even tetrasyllabic and bimoraic (e.g. L∅L∅) feet as long as they contain minimally and maximally two weighted syllables.

Since the binarity constraint in (35) does not make any specifications as to the total number of syllables in a foot, it also permits five, ten, or more syllables in a foot, as long as they contain minimally and maximally two weighted syllables.[22] I assume that constraints on the distribution of nonmoraic syllables limit the number of syllables in a single moraic-syllable trochee. For example, in Kanien'kéha, I assume that feet larger than four syllables never occur due to the Adjacency Condition (defined in (15)).[23] Since nonmoraic syllables cannot be adjacent, then feet of the shape L∅∅L∅ are not possible. Feet of the shape ∅L∅L∅ are also ruled out because they are not left-headed; the head L is not aligned with the left edge of the foot, resulting in the footing of the tetrasyllabic sequence (L∅L∅).

Note that the Ft-Bin definition in (35) does not make reference to the number of moras in a syllable, just whether it contains at least one mora or none. This means that HL, LL, LH, and HH feet (as well those including nonmoraic syllables: e.g. HL∅, L∅L, L∅H, H∅H) are equally licit feet in the eyes of moraic-syllable trochees (as long as they are left-headed). I follow Mellander (2002, 2003) in analyzing the alternations between H and L syllables as peripheral in that they are not intrinsic to the foot form (i.e. the constraints described above), but are a result of an additional process. These alternations, which are modulated by vowel lengthening, will be discussed in section 4.3.

In what follows, I will show how this analysis can account for the stress placement patterns in Kanien'kéha words. Syllabification applies first since stress is built on the representations built by syllabification. [e] epenthesis (weighted and weightless) both occur during syllabification as well. For reasons to be described shortly, the only amendments to syllable structure I assume to be possible post-syllabification will be the addition of a mora for the purposes of Tonic and Laryngeal Lengthening, which will be discussed in section 4.3, and the insertion of prothetic [i] for the purposes of satisfying word minimality.

[22]This is also the case for moras. However, there are other constraints limiting the number of moras in a foot to four. That is, syllables in Kanien'kéha cannot contain more than two moras, and since there cannot be more than two weighted syllables per foot, there will never be more than four moras in a foot.

[23]Although the Adjacency Condition was created specifically for Kanien'kéha, as shown in Chapter 3, it could be relevant to a large number of other languages. In this way, I assume that moraic-syllable trochees should (almost) never include more than four syllables. I included 'almost' in the previous sentence because, as described in Chapter 3, there are some cases where the Adjacency Condition is violated, resulting in stress on the pre- pre-antepenultimate syllable.

Let us first consider a basic word that contains no nonmoraic syllables nor codas. In these words, stress falls on the penult.

(37) /ka-nel-ũ/ → [gané:lũ] *kané:ron* 'she (animal) is pregnant'

In order to account for stress placement here, we align a moraic-syllable trochee with the right edge of the word to achieve penultimate stress.

(38) /ka-nel-ũ/ → [ga(né:lũ)] *kané:ron* 'she (animal) is pregnant'

Since a moraic-syllable trochee contains minimally and maximally two moraic syllables, the foot in (38) contains the two moraic syllables [né:] and [lũ]. The fact that [né:] is a heavy syllable (as a result of Tonic Lengthening) is irrelevant for the purposes of the binarity constraint enforcing this foot shape.

I now turn to the more challenging cases: words with nonmoraic syllables. I will first address those that end in the shape L∅L, then HL∅, and finally L∅L∅. I will address the role of Tonic Lengthening, and that of the weight contributed by the coda in section 4.3.

An example of a word that ends in L∅L is shown in (39).

(39) /ɤ̃-k-l-ɤ̃ʔ/ → [ɤ́ge̲lɤ̃ʔ] *énkeren'* 'I will put it in'

In data that takes this shape, there is a stressed monomoraic antepenult followed by a nonmoraic penult followed by a monomoraic ultima. The Ft-Bin constraint mandating that there be two weighted syllables in every foot rules out the following footings.

(40) Ft-Bin violations

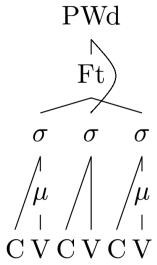
a. /ɤ̃-k-l-ɤ̃ʔ/ → [(ɤ́)ge̲lɤ̃ʔ] *énkeren'* 'I will put it in'

b. /ɤ̃-k-l-ɤ̃ʔ/ → [(ɤ́ge̲)lɤ̃ʔ] *énkeren'* 'I will put it in'

Both the footings in (40a) and (40b) only contain one weighted syllable, thus neither are licit.

In order to build a well-formed moraic-syllable trochee (i.e. a foot with two moraic syllables), the foot must contain both the stressed L syllable [dé], and the final L syllable [ni]. The question then remains, what do we do about the medial nonmoraic syllable? Alderete (1995) does not associate the medial syllable to the foot, but instead associates it directly to the PWd node above. This analysis, adapted to the current syllabification, is shown in (41).

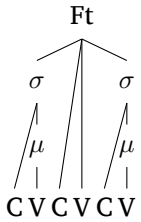
(41) L∅L and Alderete (1995)



I refrain from adopting this analysis because it involves an extraprosodic unit (a unit not linked to the immediately higher prosodic domain) that is not at a domain edge. The extraprosodic unit in this case is the medial syllable that skips the foot tier and links directly to the PWd node above. As extraprosodicity is only licensed at domain edges, and this syllable is foot-medial, this is not a licit representation (Hayes, 1981; Harris, 1983).

Hagstrom (1997) proposes a different solution, arguing that the metrically invisible syllables are actually not syllables at all, and that is why they are invisible. However, if we adapted this analysis to the current syllabification, this would result in the segmental tier being linked directly to the foot level.

(42) L∅L and Hagstrom (1997)[24]



I do not adopt this analysis because the direct association between the segmental tier and the foot tier makes incorrect predictions. For example, this would predict free (or at least much less constrained) phonotactics between these segments, and that there could be an unlimited number of segments in this unsyllabified position. Further, the syllable constituent is necessary for metrically invisible sequences to describe the Adjacency Condition pattern (amongst others).[25]

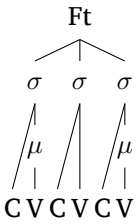
Instead, I argue that a trisyllabic foot is built in words that end in L∅L.[26]

[24]Hagstrom (1997) syllabifies the C in the unsyllabified CV sequence into the preceding coda. However, as spelled out in the preceding section, I argue that only the laryngeals are able to syllabify within the same syllable as the preceding vowel.

[25]Another option for dealing with forms of the shape L∅L is to appeal to weak local parsing (Hayes, 1995). However, weak local parsing involves unparsed syllables between feet rather than within feet. For this reason, weak local parsing is not helpful.

[26]Piggott (1995) assumes a trisyllabic foot for words of this shape as well, however only derivation-medially.

(43) Trisyllabic foot L∅L



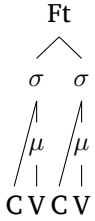
The following word contains an example of a trisyllabic (though not ternary) foot under the current analysis.

(44) /ɪ̃-k-l-ɪ̃ʔ/ → [(ɪ́ge̲lɪ̃ʔ)] *énkeren'* 'I will put it in'

Recall that I distinguish between feet that contain three units, and feet that have ternary rhythm (i.e. three of the prosodic unit counted). Whereas other languages have been argued to build trisyllabic feet that are ternary in rhythm (e.g. Cayuvava and Chugach Alutiiq (Haraguchi, 1991; van der Hulst, 1999)),[27] the foot in (43) is not ternary in rhythm in the moraic-syllable trochee system of Kanien'kéha because feet only count weighted syllables (of which there are two). As described at the outset of this section, trisyllabicity is not a problem for the current analysis as moraic-syllable trochees only count weighted syllables, and place no further constraints on the shape of the foot. Consider as an analog syllabic trochees. Even though the number of moras is restricted to two in moraic trochees, the number of moras in a syllabic trochee is irrelevant. The following representations of licit syllabic trochees illustrates this fact (ignoring feet with nonmoraic syllables for space purposes).

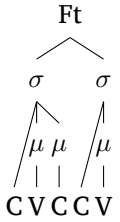
(45) Licit syllabic trochees

a. Two moras (LL)

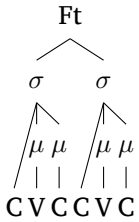


[27] Hayes (1995) and Martinez-Paricio and Kager (2015) argue that flat ternary feet (i.e. without recursive footing) do not make the correct predictions in reference to the Chugach language. However, none of the points that they bring up in reference to Chugach are relevant to Kanien'kéha. For example, flat ternary feet predict that the head of a ternary foot should be as prominent as the head of a binary foot. Whereas this is not the case for Chugach, this is the case for Kanien'kéha, thus making the correct prediction. Martinez-Paricio and Kager (2015) also argue that if Chugach has ternary feet, we would not be able to account for the differences between the two weak syllables (in a SWW foot). However, in Kanien'kéha this is not a problem because the differences can be captured by solely referring to adjacency (as will be described in section 4.3). Thus, although flat trisyllabic feet might not be able to capture the patterns in Chugach, this has no bearing on Kanien'kéha.

b. Three moras (HL)



c. Four moras (HH)

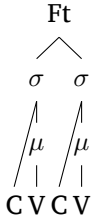


All of the structures in (45) are licit syllabic trochees, despite the varying number of moras. Whereas a moraic trochee with three moras would have ternary rhythm (or one with four moras would have quaternary rhythm), a syllabic trochee with three moras would not. This is because syllabic trochees are only counting syllables, not moras. When evaluating the well-formedness of syllabic trochees, we look at the syllable tier and count the number of syllable nodes that are associated to the relevant foot. In the same way, the trisyllabic foot in (43) does not have ternary rhythm in a moraic-syllable trochee language (despite spanning three syllables) because there are only two of the units the foot is looking for. That is, the foot in Kanien'kéha looks at the syllable and mora tiers in a moraic-syllable trochee language, and counts how many syllable-mora bundles (i.e. how many syllable nodes that are dominating at least one mora) there are associated to the foot. If there are minimally and maximally two (and it is left-headed), then it is a licit moraic-syllable trochee. Nonmoraic syllables do not impact (positively or negatively) the well-formedness of a moraic-syllable trochee.

The non-adjacency of the two weighted syllables in the trisyllabic moraic-syllable trochee in (43) is also not a problem as Ft-Bin constraints merely evaluate the number of a given unit, nothing more. That is, Ft-Bin constraints do not care about the structural configuration of the two units, as long as there are two. This can be seen in two widely accepted moraic trochees, LL and H.

(46) Moraic trochee configurations

a. LL moraic trochee



b. H moraic trochee



The two feet in (46) are both licit moraic trochees because they both have two moras, satisfying the Ft-Bin constraint. The fact that the two moras are in separate syllables in (46a) but in the same syllable in (46b) does not matter as both feet contain minimally and maximally two moras. In this sense, the configuration does not matter, only the number of the relevant unit does. In the context of moraic-syllable trochees, this means that the fact that the two weighted syllables are not adjacent is unimportant; Ft-Bin is only concerned with the number of them.

More evidence that nonmoraic syllables are irrelevant to the binarity of feet in Kanien'kéha will be presented in section 4.2.3, the section on the minimal word, in which we will see that nonmoraic syllables are not taken into account in the assessment of well-formedness in terms of foot minimality. If it is the case that nonmoraic syllables are not taken into account in foot-minimality considerations, then why should they be relevant to foot maximality (the maximal foot size) considerations?

For these reasons, I assume trisyllabic feet to be licit moraic-syllable trochees, as long as they contain minimally and maximally two weighted syllables (i.e. as long as they are binary).

Before turning to words that end in HL∅, I would like to address the potential form where the medial nonmoraic syllable becomes moraic in order to be relevant to footing (L∅L→L'LL) and build a bisyllabic foot. The way that I have defined moraic-syllable trochees actually makes this hypothetical form irrelevant. Since moraic-syllable trochees only count weighted syllables, adjusting the foot to contain two syllables total (each of them weighted) would not accomplish anything. LL and L∅L are equivalent in the eyes of the Ft-Bin constraint enforcing moraic-syllable trochees as they both contain two weighted syllables (and they are both aligned with the right edge of the word). Making the L∅L string surface as LLL would simply be adding a mora without improving the well-formedness of the foot. As a comparison, consider again syllabic trochees. When building syllabic trochees, only the number of syllables is relevant. Just as we would not expect a syllabic trochee system to adjust the number of moras in the two syllable string it spans in order to also contain two moras, we should not expect a moraic-syllable trochee system to adjust the number of syllables in a string in order to make the foot bisyllabic. The number of moras in a syllabic trochee system is irrelevant, just like the total number of syllables in a moraic-syllable trochee system is irrelevant. In this way, there would be no reason for L∅L to surface as LLL.[28] For these reasons, I will not further address the

[28]Within an Optimality Theoretic framework, it might be necessary to ensure that L∅L does not surface as LLL for the purposes of

hypothetical forms where nonmoraic syllables become weighted for the purposes of footing.

Turning now to words that end in the shape HL∅ where the final syllable is nonmoraic, an example is in (47). Recall that periods mark syllable boundaries.

(47) /ʌ̃-wak-itaʔw-ʔ/→[ʌ̃.wa.gí:.daʔ.we̲ʔ] *enwakí:ta'we'* 'I'll sleep'

There are two options for footing this type of word while satisfying Ft-Bin.[29]

(48) HL∅ footing

a. (HL)∅

/ʌ̃-wak-itaʔw-ʔ/→[ʌ̃.wa.(gí:.daʔ).we̲ʔ] *enwakí:ta'we'* 'I'll sleep'

b. (HL∅)

/ʌ̃-wak-itaʔw-ʔ/→[ʌ̃.wa.(gí:.daʔ.we̲ʔ)] *enwakí:ta'we'* 'I'll sleep'

Both of these footings would get the desired result with stress on the antepenult. However, the foot in the first form is not aligned with the right edge of the word. While this is not necessarily a problem mechanically, it misses the generalization that stress is always anchored to the right edge of the word in Kanien'kéha: it always falls two moraic syllables away from the right edge. Additionally, all else equal, assuming the foot to be (HL∅) with the right edge of the foot aligned with the right edge of the word would mean that all right edges of feet necessarily align with right edges of words in Kanien'kéha (as this is also the case with HL and L∅L feet), which is more parsimonious than if some feet involved alignment at the right edge, and some not. For these reasons, I assume that the correct analysis involves having the right edge of the foot always anchored to the right edge of the word. As previously argued, trisyllabic foot-internal

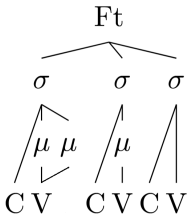
footing. This is because, although this distinction would not make a difference for the Ft-Bin constraint that motivates moraic-syllable trochees, it would make a difference to the lower ranked Ft-Bin-σ which could still have an effect.

[29]Rawlins (2006) argues that final Ce̲ʔ syllables should be treated differently than other Ce̲ syllables that avoid stress. He argues, specifically, that final Ce̲ʔ syllables are part of a separate stress domain and that this is why they are invisible to stress placement. This allows Rawlins to not address them in his analysis. Rawlins presents two main arguments for why final Ce̲ʔ should be treated differently. First, he says that final Ce̲ʔ syllables are the only case where epenthetic [e̲] is inserted into a closed and heavy syllable, but is still invisible to stress. This argument crucially rests on the assumption that post-vocalic /ʔ/ is a moraic coda (see arguments against this assumption in section 3.6). Additionally, the assertion he makes is incorrect. There are many examples of CʔC sequences being broken up by invisible [e̲] resulting in the "closed" syllable Ce̲ʔ(e.g. /la**k-**ʔni/→[láge̲ʔni] *ráke'ni* 'father (voc)'). His second argument is that, in the closely related language Oneida, final Ce̲ʔ syllables trigger stress shift, but other syllables with epenthesis do not. However, Rawlins does not mention that the OR/RO/RR sequences that trigger weightless epenthesis in Kanien'kéha are *not broken up in Oneida*. This means that there are no equivalent Ce̲ syllables to even be invisible in Oneida. Additionally, even if we accept his arguments that Ce̲ʔ should be in a separate stress domain, it does not quite work in his analysis: he already is claiming that final syllables are extraprosodic in order to have an H foot on the penult (although he does not specify in what way), meaning that in the cases of words ending in HL∅ he has to make the undesirable claim that both final syllables are extraprosodic.

Two more arguments that final Ce̲ʔ syllables should not be in a separate stress domain and should instead be treated like all other invisible Ce̲ syllables in the language are the following. Firstly, Cʔ sequences are broken up in every position in the word, and they are always broken up by weightless epenthesis (see section 3.6). In this way, it is more parsimonious to treat all Ce̲ʔ syllables in any position of the word the same. Secondly, final Ce̲ʔ syllables are sensitive to the Adjacency Condition (i.e. the weight of the preceding syllable) like all other Ce̲ syllables in the language (see section 3.5.3). Thus, they should be treated like all other Ce̲ syllables in the language. Additionally, it is unclear how Rawlins would account for why an invisible Ce̲ syllable could not immediately precede a final Ce̲ʔ that is in a different domain.

spans are not problematic in moraic-syllable trochees as the system only counts moraic syllables. Thus, I assume the footing in (48b) to be correct.[30] The structure for the footing in (48b) is shown in (49).

(49) HL∅ footing



To reiterate, the foot in (49) does not have ternary rhythm because it only contains two of the relevant units: syllables nodes that are dominating moras.

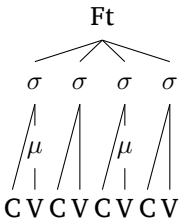
I will now discuss words of the shape L∅L∅, where stress is on the pre-antepenultimate syllable as a result of there being two weightless syllables intervening between the penultimate weighted syllable and the right edge. In these forms, I assume there to be a tetrasyllabic foot.

(50) Pre-antepenultimate stress

/io-nlaht-ʔ/ → [(óne̲lahde̲ʔ)] *ónerahte'* 'leaf'

As argued above, the number of syllables is irrelevant to feet in Kanien'kéha as only moraic syllables are being counted. Thus tetrasyllabic feet are not a problem.[31] As far as I am aware, quarternary feet have not been proposed in the literature prior to this project.[32] A tetrasyllabic foot is represented in (51).

(51) L∅L∅ foot



[30]While I assume this to be the case, it is not crucial. Final nonmoraic syllables may or may not be included in the foot and it would not affect the analysis. See the discussion of this in the conclusion.

[31]Up until this point Internally-Layered Ternary (ILT) feet could have been used (albeit with some hiccoughs) (Prince, 1980*a*; Selkirk, 1980; Davis, 1999; Martinez-Paricio and Kager, 2015). An ILT analysis is challenged by the Kanien'kéha data in two ways. First of all, whereas ILT feet have been argued to be built as a result of the requirement of a particular string to be footed (e.g. via some constraint like Parse-σ that says that all syllables must be parsed) (Bennett, 2012), Kanien'kéha trisyllabic and tetrasyllabic feet exist purely because of requirements of the foot (via the Ft-Bin constraint which says that a foot must contain two weighted syllables). In this sense, the feet in Kanien'kéha are built for different reasons. Although this is not necessarily a fatal problem, it does mark a difference between Kanien'kéha and the languages that have been argued to build ILT feet. More problematically, as far as I am aware, no one has argued that recursive feet exist with two layers of recursion (i.e. quarternary feet), which would be necessary to capture Kanien'kéha forms in which stress is on the pre-antepenult. In fact, Martinez-Paricio and Kager (2015) go so far as to say that foot recursion is limited to one layer (i.e. no quarternary feet). Lastly, even if ILT feet worked for Kanien'kéha, the central claim made in this chapter would still need to stand: that Kanien'kéha builds a novel type of trochee that only counts weighted syllables.

[32]Feet that are larger than three syllables have been proposed under the guise of unbounded feet (Hayes, 1980; Halle and Vergnaud, 1988; Nespor and Vogel, 2007).

To sum this section up, I have accounted for stress placement by assuming that Kanien'kéha builds moraic-syllable trochees — trochees that only count moraic syllables — and that feet are always aligned with the right edge. Since feet only count moraic syllables, I have argued that feet in Kanien'kéha can be di- tri- or tetrasyllabic, as long as they can contain minimally and maximally two moraic syllables. Larger feet are ruled out by the Adjacency Condition. In the next section, I will discuss the relevance of the foot to the word-minimality effects in the language, and show that these effects provide further support for the current foot analysis.

4.2.3 Minimal word

A common argument is that all word-minimality effects are a result of the constraints on the prosodic hierarchy, as well as foot binarity (Prince, 1980*b*; Blumenfeld, 2011; McCarthy and Prince, 2017). While this position has been shown to be too strong in that there are many languages where the minimal word does not correspond to the foot (Garrett, 1999; Piggott, 2010), I will show in this section that the minimal word in Kanien'kéha corresponds to the minimal foot and that this provides further support for the foot analysis proposed above. The main piece of evidence I will use is the prothetic [i] which surfaces to satisfy the minimal word constraint.

As argued in the previous section, the foot in Kanien'kéha is maximally and minimally two weighted syllables. Some footed data are shown in (52).

(52) Binary feet in Kanien'kéha

a. HL

/ka-nel-ũ/ → [ga.(né:.lũ)] *kané:ron* 'she (animal) is pregnant'

b. L∅L

/ʌ̃-k-l-ʌ̃ʔ/ → [ʌ́.ge̲.lʌ̃ʔ] *énkeren'* 'I will put it in'

c. HL∅

/ʌ̃-wak-itaʔw-ʔ/→[ʌ̃.wa.(gí:.daʔ.we̲ʔ)] *enwakí:ta'we'* 'I'll sleep'

d. L∅L∅

/io-nlaht-ʔ/ → [(ó.ne̲.lah.de̲ʔ)] *ónerahte'* 'leaf'

If the minimal word corresponds to the minimal foot, then we would expect that lexical words[33] can never be smaller than two weighted syllables. This prediction is borne out in Kanien'kéha as the prothetic vowel

[33]Recall from section 2.3 that there are three classes of words in Kanien'kéha: verbs, nouns, and particles. Verbs and nouns are lexical words while particles are not (Michelson, 1988). Particles do not respect word-minimality, nor the other metrical processes.

[i] is inserted if the word only contains one weighted syllable. The data in (53) shows that there cannot be any words with a single syllable.

(53) Minimal word and prothetic [i]

a. /w-a/→*[wá:] [í:.wa] *í:wa* 'it is inside it'

b. /k-e-ʔ/→*[kè:] [í:.geʔ] *í:ke'* 'I am walking'[34]

c. /hl-o/→*[ló:] [ì:.lo] *ì:ro* 'he has arrived'

Just as nonmoraic syllables are not counted for foot well-formedness considerations, they are not counted for word-minimality considerations. This is shown in (54), which includes examples of nonmoraic syllables that are Ce̲, and others that are purely consonantal (e.g. [ks:]).

(54) Prothetic [i] and nonmoraic syllables

a. /k-ek-s/→[í:.ge.ks:] *í:keks* 'I eat'

b. /s-liht/→[í.ze̲.lih.t^{h}] *íseriht* 'Cook!'

c. /k-ehl-ʔ/→[í:.geh.le̲ʔ] *í:kehre'* 'I think so, I want to'

The data in (54) shows that the prothetic [i] surfaces in order to avoid having a word with a single weighted syllable (regardless of the presence of nonmoraic syllables). For example, in (54a), there are two syllables excluding the prothetic [i]: [ge] and [ks:]. Since this form only contains one moraic syllable ([ge]), [i] must be inserted in order to make another moraic syllable.

Whereas weightless epenthetic [e̲] is invisible to stress, weighted epenthetic [e̲] is not.

(55) Weighted epenthetic [e̲] and prothesis

a. /s-k-ahkt-s/→[sgáhge̲ts] *skáhkets* 'I got back'

b. /k-ks-o-s/→[gékse̲:os:] *kéksos* 'I put the dish in water'

These data have shown that the PWd is minimally two weighted syllables, just like the foot. This follows if every lexical word must contain a well-formed foot in Kanien'kéha, and the minimal foot is two weighted syllables. This means functional words (i.e. particles), which do not form PWds, do not have to contain at least two moraic syllables. In this way, I attribute the minimal word effects in Kanien'kéha to the minimal foot.

[34]There is a falling tone in this form because stressed vowels that are followed by underlying nuclear laryngeals are lengthened and pronounced with a falling tone. I discuss this in section 4.4.

Prothetic [i] also provides strong evidence that nonmoraic syllables are irrelevant to foot well-formedness in Kanien'kéha. If it is the case that nonmoraic syllables are not counted when evaluating word(foot)-minimality (as shown in (54)), then they should also not be counted when evaluating whether the upper-bounds of foot size are respected (i.e. foot maximality). That is, since nonmoraic syllables are not counted when evaluating whether a foot/word is big enough, they should also not be counted when evaluating whether a foot is small enough. In this sense, tri- and tetrasyllabic feet should not be problematic.

Note that prothetic [i] also provides additional evidence that H feet (and by extension, moraic trochees) are not licit in Kanien'kéha (cf. Houghton, 2013). If H feet were permitted, we would expect words of the shape H (see the examples in (53)) or H∅. Although it is true that H∅ cannot normally occur (regardless of the position in the word) because Tonic Lengthening cannot occur in the syllable immediately preceding a nonmoraic syllable, a different type of lengthening, Laryngeal Lengthening (described in section 4.1, and to be discussed in section 4.4) can. Recall that Laryngeal Lengthening lengthens stressed vowels when they are followed by a nuclear laryngeal (i.e. /ʔ/ in any environment, and /h/ when specifically followed by R). This lengthening occurs regardless of whether the stressed syllable is immediately followed by a weightless syllable. This means that if H feet were permitted, then H∅ (where the H is derived from L as a result of Laryngeal Lengthening) would form a licit word, but this is not the case.

(56) H feet and word-minimality

a. /k-ehl-ʔ/→*[gè:.le̲ʔ] [í:.geh.le̲ʔ] *t́:kehre'* 'I think so, I want to'

As lengthening of the stressed vowel via Laryngeal Lengthening would have resulted in a bimoraic foot, no prothesis would have been required if H feet were permitted. Instead, [i] must be inserted so as to form an additional moraic syllable.

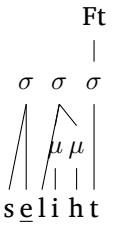
The next question that arises as to word-minimality is the location of insertion of epenthetic [i]. That is, if [i] is merely augmenting the word size, why is it necessarily inserted at the left edge and not at the right edge, which is the case in Lardil, for example (Piggott, 2010), or in another position? Further, in words like in (56a), why doesn't a weightless [e̲] become weighted rather than inserting [i]? I argue that these patterns fall out of the right-to-left footing process. That is, since footing (just like syllabification) scans the string from right to left, finding the final two weighted syllables to foot, epenthetic [i] is only inserted when and where scanning is complete (i.e. at the left edge). How this works is shown in (57).

(57) /s-liht/→[í.ze̲.lih.t^{h}] *[ź̲e.lih.t^{h}] *íseriht* ‘Cook!’

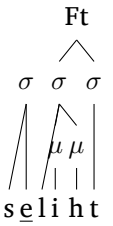
a. Complete syllabification[35]



b. Footing the ultima



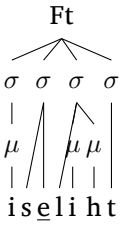
c. Footing the penult



d. Footing the antepenult: Illicit footing



e. Prothesis and footing



In (57), footing proceeds from right-to-left, footing first the nonmoraic final syllable [t^{h}] in (57b), then the weighted penult [lih] in (57c), then finally the nonmoraic antepenult [se̲] in (57d). However, footing cannot be completed in (57d) because only one weighted syllable is included. The weightless [e̲] cannot become weighted because this syllable is already footed. In order to make a well-formed foot, prothetic [i] is inserted where footing left off, at the left edge, resulting in a well-formed foot in (57e).

[35]In Chapter 3, I derive weightless epenthesis as the projection of a syllable node from a [SV] feature on an adjacent sonorant consonant. For the purposes of space and clarity, I do not illustrate this derivation here.

I have argued so far that the minimal foot contains two moraic syllables and that the placement of the prothetic [i] follows from the right-to-left footing process. The last question that arises concerns the quality of the prothetic vowel. Why is the epenthetic vowel that breaks up OR/RO/RR clusters and militates against the Adjacency Condition [e] (of varying weight) while the prothetic vowel is [i]? I propose that the two epenthetic vowels are different qualities to signal that they occur for different purposes. [e] is inserted in order to make the string well-formed for syllabification purposes (57a), while [i] is inserted in (57e) for foot well-formedness considerations.

With respect to why [i] and [e] specifically are used, I propose a historical explanation. I suggest that the vowel quality difference between epenthetic [e] and [i] is a result of the historical pressure by the phonological environments in which these epenthetic vowels have occurred. First of all, I already suggested in Chapter 3 that epenthetic [e] is front due to the high proportion of coronals in the consonant inventory. That is, epenthetic [e] is presently pronounced as [e] because the (presumably) historically more central vowel was pulled forward over time. This explanation extends to prothetic [i] is well. I suggest that the height difference between these epenthetic vowels has to do with the fact that epenthetic [e] has always been surrounded by consonants, where [i] has only ever been followed by consonants. Since [e] has always surrounded by consonants, there has been less articulatory and temporal space for the tongue to reach a height target in addition to a frontness-backness target, as it is also coordinating the gestures of the surrounding segments. Thus, a front vowel that does not involve the movement of the tongue to a distant position in the mouth (i.e. [e]) gradually arose historically (from the more central vowel). On the other hand, [i] is inserted word-initially where, although it is always followed by a consonant, it is never preceded by one. In this sense, there has been more articulatory and temporal space to reach a high front target, allowing [i] to be become the pronunciation.[36]

In this section, I have argued that the minimal word corresponds to the minimal foot. In doing so, I have provided support for the proposed analysis that Kanien'kéha builds feet that only count moraic syllables.

4.3 Tonic Lengthening

4.3.1 Head-prominence

Up until this point, I have ignored the fact that the stressed vowel is lengthened in open syllables, resulting in L-H alternations. Some examples are shown in (58).

[36] Another explanation for the quality of the prothetic vowel comes from psycholinguistics. Since the left edge of the word is crucial for lexical retrieval as it is the first thing one hears (Cho, 2016), the phonology inserts the shortest and least sonorous vowel [i] so as avoid disrupting the profile of the left edge. However, prothetic [i] may undergo lengthening, challenging this theory.

(58) Tonic lengthening

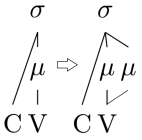
a. /wak-halatat-ũ/→[wakhala(dá:dũ)] *wakharatá:ton* 'I have raised it up'

b. /k-hiatũ-s/→[kh(já:dũs:)] *khiá:tons* 'I write'

c. /io-nũt-aʔ/→[o(nű́:daʔ)] *onón:ta'* 'hill'

I follow Alderete (1995), Piggott (1995), and Rawlins (2006) in assuming that Tonic Lengthening involves the addition of a mora (Broselow, Chen and Huffman, 1997), and occurs to make the head of the foot (i.e. the stressed syllable) heavy. I assume that this occurs after footing, as the stressed syllable needs to be identified in order to lengthen the vowel.[37]

(59) Tonic Lengthening adds a mora



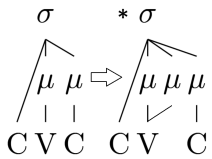
Evidence for the assertion that Tonic Lengthening adds a mora is that Tonic Lengthening is blocked before coda consonants, implying that the coda is accomplishing the goal which Tonic Lengthening is attempting to achieve. That is, as described in Chapter 3, codas must be moraic (via Weight-by-Position), thus nullifying the need for length.

(60) Coda blocks Tonic Lengthening

a. /a-k-ta**hk**o-ʔ/ → [ak^{h}(dáhgoʔ)] *aktáhko'* 'I ought to take it out'

b. /waʔt-iaki-ala**ht**at-ʔ/→[waʔgjagja(láhdade̲ʔ)] *wa'kiakiaráhtate'* 'we two are running'

(61) Coda blocks mora insertion



Since Tonic Lengthening involves the addition of a mora, the resulting foot in forms such as those in (58) is HL (uneven). Hayes (1995) argues for the Iambic-Trochaic Law which states that while uneven iambs are optimal, uneven trochees are ill-formed. While the Iambic-Trochaic Law rules out uneven trochees, much research has shown that HL trochees do in fact exist cross-linguistically (albeit less frequently than other types of trochees). For example, van der Hulst and Klamer (1997) argue that uneven trochees are

[37] Since Tonic Lengthening occurs after footing, the footing process is still building 'balanced feet', feet with a head and dependent of the same weight. McCarthy and Prince (2017) argue that balanced feet are left-headed, correctly predicting the Kanien'kéha pattern.

the optimal foot in Kambera, and Jacobs (2000) argues that they must also be present in Latin. Many authors have also argued for HL trochees in Kanien'kéha (Alderete, 1995; Mellander, 2002, 2003; Elfner, 2016). Hyde (2011) discusses phonological reasons why the Iambic-Trochaic Law should not be considered absolute, while Moghiseh, Sonderegger and Wagner (2023) and Iversen, Patel and Ohgushi (2008) do so from a psycho-acoustic perspective. Mellander (2002) also lists several languages that seem to optimize HL trochees: Gidabal, Oromo, and Central Slovak undergo trochaic shortening (HH→HL) (see (62)) while Icelandic, Chimalaya Zoque, Chamorro, Gilbertese, Selayarese, and some Italian dialects undergo trochaic lengthening (LL→HL) (see (63)) (Mellander also lists Kanien'kéha here).

(62) Trochaic shortening in Central Slovak (Mellander, 2002; Kenstowicz and Rubach, 1987)

a. /stra:ʒɲi:k/→[(stra:ʒɲik)] 'guard, n.'

b. /da:va:ʃ/→[(da:vaʃ)] 'give, 2p.sg'

(63) Trochaic lengthening in Selayarese (Mellander, 2002; Mithun and Basri, 1986)

a. /golo/→[(gó:lo)] 'ball'

b. /goloku/→[go(ló:ku)] 'my ball'

In order to account for the above lengthening patterns, Hayes (1995) argues that these patterns are phonetic rather than phonological. While this may be the case in some of these languages,[38] lengthening in Kanien'kéha is unequivocally phonological. As pointed out by Mellander (2002), this is for three reasons. Firstly, Tonic Lengthening is blocked before weightless syllables even when the weightless syllable contains a vowel (64). This shows that Tonic Lengthening is sensitive to the weight of the following syllable.

(64) Tonic Lengthening blocked before weightless syllable

a. /w-akla-s/→[wá.ge̲.la.s:] *wákeras* 'it smells'

b. /io-kste-ʔ/→[jó.ks:.deʔ] *iókste'* 'it is heavy'

Secondly, Tonic Lengthening is sensitive to the weight of the following syllable in that when an otherwise weightless syllable becomes weighted because it is followed by another weightless syllable (see the discussion in Chapter 3 on the Adjacency Condition), Tonic Lengthening is able to occur on the preceding stressed syllable. This is shown in (65).

[38] See Mellander (2002) for arguments that these patterns must be seen as phonological.

(65) Lengthening before weightless syllable that gets weight

a. /t-io-alesl-ũ/→[gjolézɛ̲lũ] *tioréseron* 'it has overflowed'[39]

b. /t-a-w-alesl-ʔ/→[dũlé:zɛ̄lɛ̲ʔ] *tonré:sere'* 'It boiled, flowed over'

In (65a), the stressed syllable is followed by a weightless syllable so there is no Tonic Lengthening. In (65b), the syllable [ze] that was weightless in (65a) is now weighted because it is followed by the weightless syllable [lɛ̲ʔ]. Consequently, Tonic Lengthening is able to occur on the stressed syllable. This shows clearly that Tonic Lengthening is sensitive to the weight of the following syllable.

Lastly, lengthening is blocked before a coda (see (60a)).

Taken together, these examples show that Tonic Lengthening must be phonological as it is sensitive to the weight of the following syllable as well as to coda weight.[40] This means that Tonic Lengthening results in a true HL trochee (rather than an LL trochee with phonetic lengthening). Since HL trochees are marked cross-linguistically, length should not be motivated by amending a foot shape constraint to optimize HL trochees, as this would suggest that uneven trochees are a common foot type in the world's languages. To account for this as well as various other Head-Dependent asymmetries (Dresher and van der Hulst, 1998), Piggott (1998) and Mellander (2002, 2003) use a constraint — Head-Prominence (briefly described above) — which is concerned with the relative prominence between the head of a foot and the dependent rather than any properties inherent to the foot system being used. This constraint ensures that the stressed syllable will be heavier than the dependent. Head-Prominence is formally defined in (66), as outlined by Mellander (2002, 2003).

[39]The / u/ in the underlying form of the root in (65a) and (65b) only surfaces in some forms. It is marked as optional in Michelson, Michelson and Deer (2024). I have not seen any patterns to determine when it surfaces and when it does not.

[40]Qu (2013) hypothesizes that the reason a language might use uneven trochees is because of its use of tone. The argument goes as follows. Languages utilize many methods to make the stressed syllable more prominent: duration, amplitude, pitch. If one of the cues is being used contrastively elsewhere in the language, then it cannot be utilized for the stressed syllable. Qu argues, specifically, that in languages that utilize tone contrastively, tone cannot be also be used to cue stress without disruption the tonal patterns of the language. Since pitch cannot be used to cue stress the language must more heavily rely on duration.

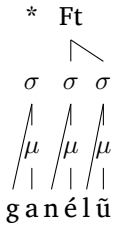
Problematically, Kanien'kéha seems exactly the opposite to the type of language described by Qu that can build HL troochees because Kanien'kéha uses pitch to cue stress. However, related languages use tone more extensively and more disjointedly from the stressed syllable: In Tuscarora, there is falling tone on the syllable immediately preceding (Williams, 1974), in Cherokee, there are more complex tonal patterns outside the stressed syllable (Uchihara, 2016), and in Oneida the tone shifts away from the stressed syllable under certain conditions (Michelson, 1988, 2016). These examples suggest that tone plays a larger role than just being associated with stress in the Iroquoian languages and that tone and stress might be disconnected in Kanien'kéha. The analysis in this thesis treats tone and stress as two separate systems that interact, but it could also be the case that tone and stress were separate historically and the remnant of this system is tonic lengthening.

(66) HeadProminence (HdProm): The head of a foot must be more prominent (heavier) than its dependent (Mellander, 2002, 2003).

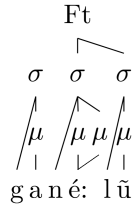
This constraint straighforwardly accounts for the surface form of cases where the stressed syllable is open and followed by a weighted CV syllable. This is shown in the representation in (67).

(67) Tonic Lengthening[41]
/ka-nel-ũ/ → [ga.né:.lũ] *kané:ron* 'she (animal) is pregnant'

a. Illicit: No Tonic Lengthening



b. Licit: Tonic Lengthening



The representation in (67a) is illicit because the stressed syllable [né] is not heavier than the dependent syllable [lũ], as they are both light (i.e. monomoraic). On the other hand, the representation in (67b) is licit because the bimoraic head [né:] is heavier than the monomoraic dependent [lũ], thus satisfying HdProm. Prothetic [i] is also subject to HdProm.

I assume that the HdProm constraint is one of the few forces that is able to alter syllable structure after it has been completed. That is, due to the constraint HdProm, a mora is added to the syllable structure. The only other conditions under which syllable structure can be altered are when the word is submininal and when the stressed vowel is followed by a laryngeal (to be discussed in section 4.4).

While HdProm as defined by Mellander (2002, 2003) can straightforwardly account for forms shaped like the one in (67), it cannot account for cases where the stressed syllable is followed by a nonmoraic syllable. Recall that the stressed vowel does not undergo Tonic Lengthening when immediately followed by a nonmoraic syllable (even if it is in an open vowel). This is shown in (68), repeated here from (20).

[41] The first syllable in each of these representations would be associated to the higher PWd. I do not show this for the interests of space.

(68) Tonic Lengthening blocked before nonmoraic syllables

a. /te-k-lik-s/ → [(dé.ge̲.li.ks:)] *tékeriks* 'I put two things together'

b. /ak-laʔwist-aʔ/→[(a.ge̲.laʔ.wí.s:.daʔ)] *akera'wísta* 'my pancakes'

c. /io-kste-ʔ/→[(jó.ks:.deʔ)] *iókste'* 'it is heavy'

In the cases in (68), Tonic Lengthening is blocked because the syllable immediately following the stressed syllable is weightless. It is not obvious what HdProm would predict for these forms as it is not immediately clear which non-head syllable inside the foot is the dependent. For example, in (68c), the head of the foot is the stressed syllable [jó]. The dependent could either be the adjacent nonmoraic syllable [ks:], the other moraic syllable [deʔ], or both. Based on how moraic-syllable trochees, and more specifically, the binarity constraint was defined in section 4.2 where feet in Kanien'kéha are made up of two weighted syllables with nonmoraic syllables being irrelevant to the determination of foot well-formedness, the dependent in (68c) should be the weighted syllable [deʔ]. In this sense, the dependent of a foot is determined by weight rather than position. However, if [deʔ] is the dependent, then HdProm makes an incorrect prediction concerning the well-formedness of the forms in (68). This is because the monomoraic head [jó] is not heavier than the dependent [deʔ] (/ʔ/ forms a light diphthong with the preceding vowel — see section 3.6 for more details), thus violating HdProm as defined in Mellander (2002, 2003). In this way, HdProm cannot be evaluating the relative prominence of the head and the dependent (i.e. the non-head weighted syllable in the foot).

Given that HdProm fails to account for the data in (68), I propose that HdProm should be adjusted to refer to the relationship between the head and the adjacent within-foot syllable rather than a head and its dependent. HdProm is defined here as in (69).

(69) HeadProminence (HdProm) (revised): The head of a foot must be more prominent (heavier) than the immediately adjacent within-foot syllable.[42]

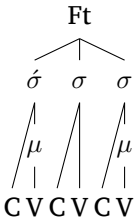
In this sense, although nonmoraic syllables are invisible to the foot building process, they are not invisible to all metrical processes, crucially playing a role in HdProm evaluations.

Some representations showing what is licit and what is illicit based on the definition of HdProm in (69) are presented in (70).

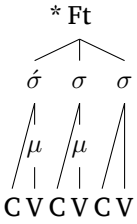
[42]The 'within-foot' qualification in this definition is to ensure that the head does not strive to be heavier than a foot-external syllable (e.g. H(LL)).

(70) HdProm representations

a. Licit



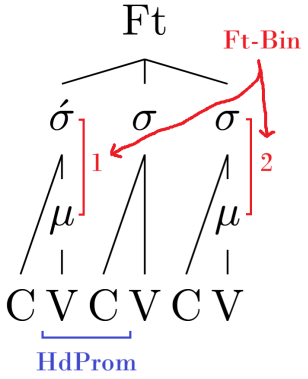
b. Illicit



The representation in (70a) is licit because the monomoraic head is heavier than the adjacent nonmoraic syllable. This is despite the analysis that the final monomoraic syllable is the dependent. On the other hand, the representation in (70b) is illicit because the monomoraic head is not heavier than the monomoraic adjacent syllable (which is also coincidentally the dependent).

In defining HdProm as in (69), I am acknowledging that the head is nearly always adjacent to its dependent cross-linguistically (Dresher and van der Hulst, 1998), so there has been no need historically to distinguish between head-adjacent relations and head-dependent relations. The peculiarity about Kanien'kéha that brings into light the distinction between adjacent syllables and dependent syllables is that Kanien'kéha allows more than two syllables in the foot, and so the dependent syllable and the syllable immediately following the head are not necessarily one and the same. Since the dependent syllable and syllable adjacent to the stressed syllable are not the same, we can see that the stressed syllable wants to be heavier than the adjacent syllable rather than the dependent syllable. The way in which the assessment methods of the Ft-Bin constraint described above and HdProm differ is shown in (71).

(71) Ft-Bin vs HdProm evaluation

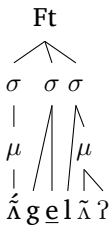


We can see in (71) that the Ft-Bin constraint relevant to moraic-syllable trochees counts syllable nodes dominating at least one mora, ensuring there are minimally and maximally two. On the other hand, HdProm is only concerned with the relationship between the head and the immediately following syllable, where the head is heavier.

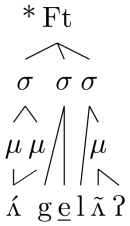
In cases where the stressed syllable is open and followed by a moraic syllable, the stressed syllable undergoes lengthening in order to be heavier than the adjacent within-foot syllable (LL)→(HL). In cases where the foot consists of an open syllable followed by a nonmoraic syllable followed by a moraic syllable (L∅L), the stressed vowel does not need to be lengthened because it is already heavier than the following nonmoraic syllable.[43] This is shown in (72).

(72) L∅L and Tonic Lengthening[44]

a. L∅L and no Tonic Lengthening
/ɶ̃-k-l-ɶ̃ʔ/ → [ɶ́̃.ge̲.lɶ̃ʔ] *énkeren'* 'I will put it in'



b. L∅L and Tonic Lengthening



There is nothing motivating the lengthening in (72b), so the representation in (72b) involves gratuitous lengthening. This is because regardless of whether the head of the foot [dé] is heavy, HdProm is satisfied as the following syllable is nonmoraic. In this sense, there is no need to lengthen in the stressed vowel in (72b). This makes the representation in (72a) more optimal because it also satisfies HdProm, but does not enact the gratuitous operation of adding a mora.

Forms of the shape L∅L∅ can be dealt with in the same way.

[43]Mellander (2002) assumes that words that end in L∅L involve the footing (L∅)L with ∅ as the dependent, so although he does not have to contend with the complications of trisyllabic feet, the HdProm constraint does the same work for him. See section 4.2.1 for a discussion of his analysis.

[44]There is a simplified representation of the nonmoraic syllable in the trees (for illustrative purposes). The syllable node should really be associated to a [SV] feature on the adjacent sonorant consonant. See Chapter 3 for more details.

(73) /tn-t-ʔ/→[í.de̲.nē̲.de̲ʔ] *ítenete'* 'you and I are standing'

In the form in (73), the stressed syllable [i][45] remains light because the following syllable [de̲] is nonmoraic, satisfying HdProm.

Feet of the shape HL∅ also can be dealt with straightforwardly with the HdProm constraint.

(74) /ɬ̃-wak-itaʔw-ʔ/→[ɬ̃.wa.gí:.daʔ.we̲ʔ] *enwakí:ta'we'* 'I'll sleep'

In the form in (74), the stressed syllable [gí:] is heavy in order to be heavier than the adjacent monomoraic syllable [daʔ] (recall that /ʔ/ does not contribute weight). If Tonic Lengthening did not occur, the stressed syllable would be the same weight as the following syllable, violating HdProm.

In sum, I have shown in this section that the Tonic Lengthening pattern can be easily derived by adjusting the HdProm constraint in Mellander (2002). The feet permitted by the two main constraints discussed thus far, Ft-Bin and HdProm, are the following: HL, HL∅, L∅L, L∅L∅.

In the following subsection I will adjust the HdProm constraint to account for the moraicity of the coda. I will also show that this accounts for the behaviour of Cj and kw syllables.

4.3.2 Vocalic moras

A problem that arises with the above analysis of Tonic Lengthening has to do with the moraicity of the coda. As argued in section 3.6, the coda is limited to /h/, and /h/ can only be in the coda when it is followed by an obstruent (for licit syllable contact). I also argued that coda /h/ gets Weight-by-Position and that this is why it blocks Tonic Lengthening (e.g. /a-k-tahko-ʔ/→[ak^{h}d**áhg**oʔ] *aktáhko'* 'I ought to take it out'), whereas nucleic /h/ (in VhR sequences) is not moraic and consequently does not block Tonic Lengthening. Recall that according to the current analysis, Tonic Lengthening occurs in order to make the stressed syllable heavier than the immediately adjacent syllable. This analysis comes into conflict with data where the adjacent syllable is bimoraic (CVh), yet Tonic Lengthening of the stressed vowel occurs anyways. This is shown in (75).

[45] Prothetic [i] has already been inserted because footing has already occurred.

(75) Codas and feet

a. /sa-s-hlien-ɤ̃ht/→[za.z[e]h.l.(jé:.nɤ̃h.t^{h})] *sasehrié:nenht* ‘Knock it down again’

b. /a-k-hthar-a-hkw-ʔ/→[a.kh.(thá:.lah.gwe̲ʔ)] *akhthá:rahkwe’* ‘I ought to talk about it’

In the data in (75), there are feet where the syllable adjacent to the head is heavy, yet the stressed vowel still lengthens. For example, assuming moraic-syllable trochees, the head of the foot in (75a) is the light syllable [jé] (before Tonic Lengthening) while the dependent, and adjacent within-foot syllable is the heavy syllable [lah] (/h/ contributes weight because it is in the coda).[46] This is a problem for the current analysis of moraic syllable feet and HdProm in Kanien’kéha because, under the current analysis, Tonic Lengthening occurs in order to make the stressed syllable heavier than the adjacent within-foot syllable. However, despite the fact that the adjacent within-foot syllable is bimoraic, the stressed vowel still undergoes Tonic Lengthening. Not only does this form violate HdProm because the head is not heavier than the adjacent within-foot syllable, but another form, where the stressed syllable does not lengthen, is in fact predicted to occur. This is because if Tonic Lengthening is not satisfying HdProm, then it is needlessly inserting a mora with no effect. The more parsimonious form would not undergo Tonic Lengthening, as HdProm is violated either way.

One potential solution is that the specified footing HH∅ for the forms in (75) is not correct. In order to capture the Tonic Lengthening on the stressed vowel, the alternative would still need to include an H syllable.[47] One option is that the stressed syllable constitutes an H foot, where Tonic Lengthening occurs in order to make the foot bimoraic instead (disregarding HdProm). However, if Kanien’kéha built an H foot, we would expect it to be closer to the right edge (*[zazehlje(nɤ̃́h)t^{h}] or *[zazehlje(nɤ̃́ht^{h}])). If we wanted to hold on to the H foot analysis, we could assume that the final two syllables are extrametrical (*[zazehl(jé:)<nɤ̃ht^{h}>]), or form their own foot (*[zazehl(jé:)(nɤ̃ht^{h})]), but we have no evidence of final extrametricality of moraic syllables nor words with multiple feet elsewhere in the language. For these reasons, I assume the footing in (75) to be correct, and the problem to lie in the analysis of HdProm.

I argue that HdProm does not count coda moras, along the lines of Paramore (2025), who discusses coda moraicity. Paramore discusses how languages like Lhasa Tibetan do not exhibit weight effects of codas consistently. Consider the variability in the treatment of codas in the following three Lhasa Tibetan processes: (1) Stress is weight sensitive, treating CVV as heavy but not CVC, (2) Tone is weight sensitive, treating CVV and CVR as heavy but not CVO, and (3) compensatory lengthening is weight sensitive, treating CVV and CVC (regardless of coda quality) as heavy. Paramore presents the striking table in (76) that shows

[46] /h/ is only in the coda when preceded by a vowel and followed by an obstruent. When followed by a sonorant consonant, it is in the nucleus, like /ʔ/. See section 3.6 for more details.

[47] The alternative where, instead of HH∅ feet in (75), there are HH feet would not solve the problem as we would still be at a loss in explaining why Tonic Lengthening occurs.

that out of the 107 languages identified by Gordon (2006) that have weight sensitive stress (e.g. CVV attracts stress) and codas, only 5 show no weight effects of codas at all. The columns in (76) show how many languages with weight sensitive stress also have codas contributing weight in stress computations. The left column includes the number of languages where codas are relevant to stress computations (i.e. are moraic) while the right column shows the numbers of languages where codas are not relevant (i.e. nonmoraic). The rows show how many languages with weight sensitive stress have codas contributing to weight in any process other than stress. The first row shows how many languages where codas contribute weight to some process other than stress, while the second row shows the number of languages in which codas are not relevant to processes other than stress.

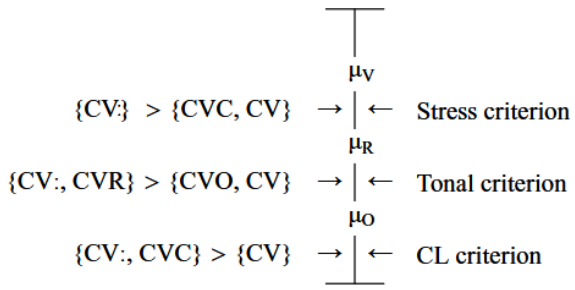
(76) Variable weight effects of codas (adapted from Paramore (2025))

	Coda relevant for stress	Coda irrelevant for stress
Coda relevant to other processes	36	32
Coda irrelevant to other processes	34	5

Paramore's main point with this table is to show how few weight-sensitive-stress languages exhibit no weight effects of codas at all (5). The important part of this table for the purposes of this chapter, however, is that 66 (34 + 32) of the 107 languages with weight sensitive stress exhibit variable weight effects of codas (i.e. codas that are relevant to some processes but not others). That is, more than half of the languages in this typology involve codas sometimes contributing weight and sometimes not, depending on the process. This is striking as it suggests that if a language has weight sensitive stress and codas, it is more likely that the coda will exhibit variable weight effects than not. I argue that Kanien'kéha falls into this majority: codas are relevant to some processes but not others. Specifically, I will propose that codas are relevant for syllable size constraints but not for the comparison of head and dependent weight.

Paramore argues that variable coda weight effects can be accounted for by encoding moras with the sonority of the segment that they dominate (vocalic, sonorant, or obstruent) (following similar proposals in Steriade (1991); Blumenfeld (2011); Davis (2017) and Hyman and Leben (2020)). Rules or constraints (depending on the framework) will refer to moras of a specified sonority. As in Zec (1995, 2007), if a rule/constraint/operation refers to a mora of a specified sonority it must also make reference to all moras of higher sonority. Consider the graphic in (77) illustrating mora sonority effects in Lhasa Tibetan.

(77) Lhasa Tibetan bifurcations (Paramore 2025)



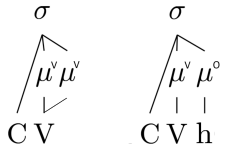
The graphic in (77) is illustrating the following. Since stress counts CVV as heavy but CVC as light, stress will only count vocalic moras (i.e. the moras above the arrow next to 'stress criterion'). Tone counts CVR and CVV as heavy while counting CVO as light, meaning that contour tones can only be hosted by syllables containing two sonorant/vocalic moras. Compensatory lengthening counts CVV and CVC as heavy, so all obstruent moras, sonorant moras, and vocalic moras would be counted. An impossible constraint/rule would address only obstruent moras because, as stated above, if moras of sonority n are referred to by a given rule, all moras of higher sonority must also be referred to.

Let us now return to the problem at hand for Kanien'kéha. Summarizing, coda /h/ behaves like a weighted coda in reference to Tonic Lengthening on the preceding stressed vowel (as it blocks Tonic Lengthening), but like it is weightless with respect to HdProm. To account for the observation that Tonic Lengthening is blocked by coda /h/, I assume, essentially, what I have been assuming until this point, that there is an undominated syllable size constraint (defined in (78)) that limits the syllable size to two moras of any sonority.

(78) Syllable binarity (SyllBin): Syllables must contain no more than two moras (of any sonority).

This constraint will ensure that there are never more than two moras in a syllable (no long vowels followed by weight-bearing codas). The trees in (79) show syllables that do not violate SyllBin because they do not include more than two moras (although, bear in mind that Kanien'kéha only permits /h/ in the coda).

(79) Tonic lengthening and mora sonority



A structure where the coda shares a mora with the preceding long vowel is not possible here because coda /h/ has already received Weight-by-Position by the time HdProm is assessed, and I assume that a vowel cannot spread to a non-vocalic mora. This contrasts with the laryngeals which, as specified in Chapter 3, I assume can link to a vocalic mora. In this way, this constraint on which segments can link to which moras is one constraining the derivation rather than the output representation.

To account for the fact that Tonic Lengthening ignores coda weight, I assume that the HdProm constraint is only sensitive to *vocalic moras*. Vocalic moras are defined here as moras that contain a segment with the feature [voc] (i.e. all underlying vowels). HdProm is redefined in (80).

(80) HeadProminence (HdProm) (final): The head of a foot must contain more vocalic moras than the immediately adjacent within-foot syllable.

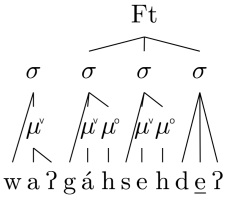
Since HdProm is defined as such, feet of the shape CV:CVh will satisfy HdProm because the head has more vocalic moras than the adjacent syllable as the mora dominating coda /h/ no longer counts for HdProm. Repeating (75a) here as (81), we can see how this adjustment to HdProm makes the correct prediction.

(81) /sa-s-hlien-ɬ̃ht/→[zaz͡ehl(jé:nɬ̃ht^{h})] *[zazehl(jénɬ̃ht^{h})] *sasehrié:nenht* 'Knock it down again'

In (81) (and forms like it), the head [je] only has one vocalic mora before Tonic Lengthening occurs, as does the adjacent within-foot syllable [nɬ̃h] (as the /h/ does not contain the necessary feature [voc]).[48] Without Tonic Lengthening then this form violates HdProm because the head is not heavier than the adjacent within-foot syllable. In order to satisfy HdProm, the stressed vowel undergoes Tonic Lengthening.

This adjustment to HdProm also means that feet of the shape CVhCV(h) violate HdProm because both syllables contain only one vocalic mora. This is shown in the representation in (82).

(82) HdProm and mora sonority
/waʔ-k-ahseht-ʔ/→[waʔ(gáhsehde̲ʔ)] *wa'káhsehte'* 'I hid it'[49]



[48]See Chapter 3 for arguments why /h/ is an obstruent.

[49]In the case of a Vʔ sequence dominated by the same mora, we can say that a mora takes on the sonority of its head. This means that in a Vʔ V is the head, and so the dominating mora is vocalic.

Although the form in (82) violates HdProm, I assume it would be more costly to violate SyllBin by lengthening the vowel regardless of the following coda. Additionally, I assume that deleting the /h/ in order to have the stressed vowel undergo Tonic Lengthening is more costly as well.[50]

Happily, the new definition of HdProm in (80) also accounts for the behaviour of Cj and kw syllables in reference to Tonic Lengthening. Recall from section 3.7 that despite the analysis that Cj and kw syllables are moraic, they block Tonic Lengthening on the preceding stressed vowel. Some examples are shown in (83) and (84).

(83) Cj blocks Tonic Lengthening

a. /k-ka**li**aʔk-s/→[kʰgáljaʔks:] *kkária'ks* 'I pay'

b. /tʌ̃k-nũ**ni**-a-hkw-ʔ/→[dʌ̃gɛ̱nɛ̱́̃njahgwɛ̱ʔ] *tenkenónniahkwe'* 'I will dance'

(84) kw blocks Tonic Lengthening

a. /io-ne**ko**-aʔ/→[onégwaʔ] *onékwa'* 'pea', 'pill'

b. /k-iʌ̃t-a-**ko**-as/→[gjʌ̃dágwas:] *kientákwas* 'I collect wood'

In section (3.7) I argued that the glides in Cj and kw sequences are underlyingly vowels and thus contain moras (as well as the vowel feature [voc]). This accounted for why Cj and kw syllables do not pattern with the nonmoraic syllables in reference to the Adjacency Condition. However, I also argued that the glides in these sequences are ambisyllabic; they are the nucleus of the Cj/kw syllable, as well as the onset of the following syllable (jV and wV). I suggested that the feature [voc] cannot be syllabified into a non-nucleic syllabic constituent (i.e. the onset or coda), and so consequently when the glide is syllabified into the onset of the following syllable, [voc] delinks. This means that, although Cj and kw syllables are moraic, they do not contain a vocalic mora (as the mora does not contain a [voc] feature), and are thus nonmoraic for the purposes of HdProm. This correctly predicts that Cj and kw syllables pattern with the nonmoraic syllables in 'blocking' Tonic Lengthening on the preceding stressed syllable; Tonic Lengthening does not need to occur to satisfy HdProm when the following syllable is Cj or kw because a foot head that contains one vocalic mora already contains more vocalic moras than Cj and kw syllables.

In fact, this analysis can be extended to account for the behaviour of Cj and kw syllables in reference to stress placement (and, by extension, word-minimality). Recall that Cj and kw syllables are invisible to stress placement. Some examples are shown in (85) and (86).

[50] In Optimality Theory terms, SyllBin and MAX are ranked higher than HdProm.

(85) Cj syllables and stress

a. /te-k-iaʔk-s/→[dégjaʔks:] *tékia'ks* 'I break it in two'

b. /tʌ̃k-nũni-a-hkw-ʔ/→[dʌ̃gẹ̲nű́njahgwẹ̲ʔ] *tenkenónniahkwe'* 'I will dance'

(86) kw syllables and stress

a. /ie-l-a-ko-as-kwʔ/→[jelágwas:gwẹ̲ʔ] *ierákwaskwe'* 'she used to choose'

b. /io-neko-aʔ/→[onégwaʔ] *onékwa'* 'pea', 'pill'

The current Ft-Bin constraint that has been defining moraic-syllable trochees in Kanien'kéha states that feet must contain two weighted syllables, regardless of the quality of the mora. However, this incorrectly predicts that Cj and kw syllables should be counted for stress, as they contain weighted syllables. This is shown in (87).

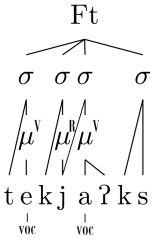
(87) /te-k-iaʔk-s/→*[degjaʔks:] [dégjaʔks:] *tékia'ks* 'I break it in two'

However, if the moraic-syllable trochee Ft-Bin constraint in Kanien'kéha only refers to vocalic moras, these problems are cleared up.[51] The revised Ft-Bin constraint is shown in (88).

(88) Ft-Bin-$\sigma_\mu\sigma_\mu$ (revised): The foot contains minimally and maximally two vocalic-mora syllables. A vocalic-mora syllable is a syllable that contains at least one vocalic mora.

The revised Ft-Bin constraint in (88) is only concerned with vocalic moras, and ignores all syllables that do not contain at least one vocalic mora. This accounts for the behaviour of Cj and kw syllables with respect to stress placement: Cj and kw syllables, despite being moraic, are not counted for foot construction because they do not contain vocalic moras. A foot structure with a Cj syllable is shown in (89) as an example.

(89) /te-k-iaʔk-s/→[dégjaʔks:] *tékia'ks* 'I break it in two'[52]



As shown in (89), the final syllable is nonmoraic and thus does not contribute to the well-formedness of the foot. Additionally, although the kj syllable is moraic, the mora is not vocalic, so the syllable is not counted

[51] I assume that this is a particularity about the Kanien'kéha footing system. Other languages may still employ the original Ft-Bin constraint defined in section 4.2.2.

[52] The R on the second mora indicates that it is a sonorant mora.

for the purposes of foot well-formedness. This results in stress on the pre-antepenultimate syllable, and a tetrasyllabic foot. In this way, adjusting the Ft-Bin constraint to only taking into account vocalic moras correctly predicts how Cj and kw syllables pattern in reference to stress. Since the minimal word is the minimal foot (see section 4.2.3), this analysis also accounts for why Cj and kw syllables are invisible to word-minimality computations.

In this section, I have followed Paramore (2025) in assuming that phonological operations may target moras of a specified sonority, arguing that this is the case in Kanien'kéha. Specifically, I have argued that whereas some constraints in Kanien'kéha (i.e. Adjacency Condition and SyllBin) are sensitive to all moras regardless of the quality, the constraints motivating Tonic Lengthening and stress placement in the language are only sensitive to vocalic moras, moras that dominate at least one segment with a [voc] feature. This analysis accounts for the behaviour of heavy CVh syllables and Cj and kw syllables with respect to the aforementioned constraints.

4.4 Laryngeal Lengthening

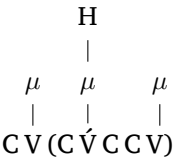
In this section, I will show that vowel lengthening can occur in Kanien'kéha as a result of something other than the constraint HdProm: as a result of the underlying tones in Kanien'kéha. Specifically, I will argue that lengthening is occurring in order to host a falling tone. In order to analyze the relationship between falling tone and length, I will first provide an analysis of the distribution of high tone, followed by an analysis of the falling tone.

I will start by providing an overview of the tonal system in Kanien'kéha, followed by an analysis of the relationship between tone and length.

4.4.1 High tone

Recall that all stressed vowels involve a high tone (even in the case of a falling tone, the pitch rises at the beginning of the stressed vowel, which will be discussed in the following section). To account for this, I assume, following Michelson (1988) that a high tone attaches to the stressed vowel. Departing slightly from the analysis of Michelson (1988), I assume that the high tone attaches to the mora of the stressed vowel, and that tones can only associate to moras as their TBU (Odden, 1995). This is shown in (90). In order to show the tones directly linking to moras, I do not include the syllable tier.

(90) H attached to stressed short V mora representation

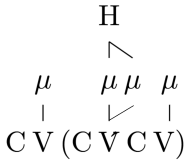


Mandating that a high tone be associated to the stressed mora essentially motivates the obligatoriness of high tone — if a high tone must always associate to the stressed vowel then there must always be a high tone in the word — while also restricting it to the stressed syllable (Hyman, 2011).

I also assume that tone can never associate to a syllable/mora outside of the stressed syllable. This effectively motivates the so-called 'pitch accent' system where there is always tone associated with the stressed syllable but never elsewhere. Keeping in line with Hyman (2006, 2009), I have kept tone separate from stress and merely assumed that they interact.

When the stressed vowel is long, I assume that the high tone spreads to the second mora to reflect the high tone surfacing across the whole of the stressed vowel. This is shown in (91).

(91) High tone spreads in long vowels



The assumption described above, that tone can never surface outside of the stressed syllable ensures also that the high tone does not spread past the stressed syllable onto any of the post-tonic syllables.

Thus, these three assumptions — high tone is aligned with the stressed mora, tone cannot surface outside the stressed syllable, and high tone spreads throughout the stressed vowel — derive the distribution of high tone in Kanien'kéha. In the following section, I derive the falling tone.

4.4.2 Falling tone and length

In this section, I will analyze the falling tone in Kanien'kéha as a composite tone of the high tone introduced in the preceding section on the stressed syllable, followed by a low tone underlyingly hosted by the laryngeals. I will argue that the lengthening that always accompanies falling tone occurs in order to provide the two moras necessary to host the composite falling tone, thus analyzing this lengthening process as distinct from the Tonic Lengthening process described in the previous section. I will start by discussing the lengthening process, then the involvement of tone.

Recall that when a stressed vowel is underlyingly followed by a tautosyllabic nuclear laryngeal (/ʔ/ or /h/), it undergoes lengthening and surfaces with a falling tone. Additionally, the laryngeal does not surface. Some examples are shown in (92).

(92) Falling tone

a. /h/ and falling tone

i. /i**o-h**nial-ʔ/→[ò:njale̲ʔ] 'snake'

ii. /io-k**ah**l-aʔ/ → [ogà:laʔ] *okà:ra'* 'eye'

a. /ʔ/ and falling tone

i. /te-k-teni-**a-**ʔt-haʔ/→[dek^{h}denjà:thaʔ] *tektenià:tha'* 'I exchange it'

ii. /k-alũʔtat-s/→[gall̃ù:dats:] *karòn:tats* 'I blow', 'I shoot'

For example, in (92a-i), the stressed vowel is underlyingly followed by the nuclear laryngeal /h/ (see Chapter 3 for argumentation for this analysis), and so it lengthens and gets a falling tone. Since this thesis assumes Moraic Theory, 'nuclear laryngeal' refers to a laryngeal that shares a mora with the preceding vowel (or a laryngeal that has projected a syllable node, which is less relevant for our purposes in this section).

The lengthening that occurs in forms such as those in (92) is called Laryngeal Lengthening (Michelson, 1988). A representation of Laryngeal Lengthening (ignoring tones for now) is shown in (93). The representations in (93) include a /ʔ/ for the sake of illustration; nuclear /h/ behaves the same way.

(93) Laryngeal Lengthening

a. Before Laryngeal Lengthening



b. After Laryngeal Lengthening



In (93a), syllabification, but not yet footing, has occurred so there has been no lengthening (this is also the representation of an unstressed CVG syllable (G = laryngeal)). The laryngeal is in the nucleus so it is sharing a mora with the preceding vowel. In (93b), Laryngeal Lengthening has occurred (for reasons to be discussed shortly) so an additional mora is added. The laryngeal relinks to the second mora, which is

not subject to the constraint blocking a vowel spreading to a coda mora because the laryngeal is attaching to the vowel's mora as opposed to the opposite. Note that the laryngeal is still linked to the second mora despite the fact that it is not present in the surface forms in (92). While Michelson (1988) considers the absence of the laryngeal on the surface to be phonological deletion of the laryngeal, I argued in Chapter 3 that the deletion is merely phonetic (as a result of the difficulty of pronouncing a laryngeal following a low tone and preceding a consonant) and that it is still present phonologically. Evidence for this assertion comes from the observation that in some cases the laryngeal is still pronounced following the falling tone (see section 3.6 for extended arguments).

Although Laryngeal Lengthening only occurs in the stressed syllable, it cannot be motivated by the same force that motivates Tonic Lengthening (i.e. HdProm).[53] Michelson (1988) comes to a similar conclusion. Recall that Tonic Lengthening does not occur when the stressed vowel precedes a nonmoraic syllable because the monomoraic stressed syllable is already heavier than the nonmoraic adjacent syllable, thus satisfying HdProm. Interestingly, unlike Tonic Lengthening, Laryngeal Lengthening can occur when the following syllable is nonmoraic. This is shown in (94).

(94) Lengthening before nonmoraic syllables

a. /k-ũ-kaliaʔk-hse/→[gũ.ga.l.jà:.kh.se] *konkarià:khse* 'I have paid you'

b. /waʔ-k-l-ʌ̃ʔ/→[wà:.ge̲.lʌ̃ʔ] *wà:keren'* 'I put it in', 'I filled it up'

c. /k-ate-ʔsko-s/→[ga.dè:.s:.go.s:] *katè:skos* 'I get into water'[54]

In (94a), for example, Laryngeal Lengthening occurs on the stressed syllable [ja] despite the fact that the following syllable [kh] is nonmoraic. If HdProm were motivating Laryngeal Lengthening, we would not expect lengthening to have occurred as monomoraic [ja] is already heavier than nonmoraic [kh] without lengthening.

So why is Laryngeal Lengthening occurring? I argue that the reason has to do with the following laryngeal and the low tone I assume to be underlyingly associated to it, following Michelson (1988). Specifically, I argue that Laryngeal Lengthening occurs in order to host the low tone on the laryngeal. In fleshing out this analysis, I will first provide grounding for the assumption that the laryngeal is underlyingly associated with a low tone, followed by an illustration of how this assumption (in addition to a few others regarding the nature of tone in Kanien'kéha) can account for the Laryngeal Lengthening pattern.

As mentioned above, to account for the observation that when a stressed vowel is followed by an under-

[53]Phonetic tests should be conducted to investigate whether a vowel that has undergone Laryngeal Lengthening has a different duration from a vowel that has undergone Tonic Lengthening.

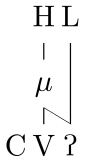
[54]Michelson, Michelson and Deer (2024) transcribe this root with a final /h/ or /hw/, but the speakers that I have worked with do not pronounce this form with the [h] or [w].

lying nuclear laryngeal, a low tone surfaces, I follow Michelson (1988) in assuming that the laryngeals have an underlying low tone. This assertion is supported cross-linguistically as the laryngeals are often associated with tone (high or low) (Kingston, 2011; Ta, 2023). For example, [spread glottis] (i.e. /h/) is associated with high tone in Mulao (Lee, 2008), whereas it is associated with low tone in Gurung (Glover, 1970).[55] [constricted glottis] (i.e. /ʔ/) on the other hand is associated with high tone in Vietnamese (Kingston, 2011) whereas it is associated with low tone in Burmese (Lee, 2008). Kingston (2005) argues that /ʔ/ may be associated with high or low tone depending on its precise articulation in a given language. If /ʔ/ is pronounced with just the thyroarytenoid muscle, then it is associated with creak and low tone whereas if it is pronounced with the thyroarytenoid *and* the cricothyroid muscles, then it is associated with high tone. If Kingston (2005) is correct, then /ʔ/ in Kanien'kéha would be articulated solely with the thyroarytenoid muscle as /ʔ/ in Kanien'kéha is associated with both low tone and creak. Further research should be conducted to investigate this.[56]

As specified in the previous section, I assume that tones must link to moras if they are to be phonologically present on the surface. I also assume that there cannot be two tones associated to the same mora (see Yip (2002) and references cited therein), and that this is the constraint that motivates Laryngeal Lengthening. This works as follows. The low tone on the laryngeal needs a mora to associate to, but cannot associate to the sole mora that the vowel is associated to because a high tone is already linked to it (an implicit assumption here is that two tones cannot link to a single mora).[57] In order to host the low tone, the vowel lengthens. This is shown in (95). As with the representations in (93), I only show /ʔ/, but /h/ behaves in the same way. Additionally, in (95), I do not include the syllable tier in order to illustrate the tones linking directly to the moras.

(95) Laryngeal Lengthening and tone

a. Low tone needs mora



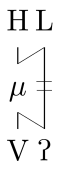
[55]It is unclear from Glover (1970, 62-63) whether the consonants need to be in the onset or the coda or either.

[56]Whereas there is plenty of research on the relationship between /ʔ/ and high and low tones, I am not aware of any that has described why it is phonetically the case that /h/ has a relationship with both high and low tone.

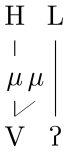
[57]If a single mora were able to host two tones, we would expect that short vowels could host contour tones so that in stressed CVh syllables, the low tone would delink from the /h/ to attach to the short V.

b. Illicit: Low tone associates to first mora

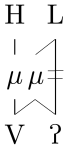
*



c. Laryngeal Lengthening occurs



d. Low tone links to second mora



In (95a), both syllabification and footing have occurred, resulting in /ʔ/ syllabifying under the same mora as the preceding vowel (i.e. in the nucleus), and a high tone associating to the stressed mora. The low tone associated to the laryngeal needs to link to a mora. An illicit option is shown in (95b) in which the low tone links to the stressed mora (delinking from the laryngeal in the process), resulting in two tones associated to the same mora, forming an illicit structure (as described above). In (95c), Laryngeal Lengthening occurs to provide an additional mora to which the low tone can attach. Since Laryngeal Lengthening occurs, /ʔ/ delinks from the first mora. In (95d), the low tone (and the laryngeal) associates to the second mora. This explains the falling tone in the output. There is a vowel and high tone on the first mora, so it is pronounced as a high-toned vowel. Attached to the second mora is the vowel, the laryngeal, and the low tone that is associated to the laryngeal. This surfaces as a low-toned vowel.[58] As described above, the laryngeal is not pronounced for phonetic (rather than phonological) reasons. In this way, I analyze the falling tone in Kanien'kéha as a sequence of level tones. This captures the observation that the low tone and the high tone have different sources (i.e. the laryngeals and stress, respectively).

Note that the assumption that the laryngeals are in the nucleus (i.e. sharing a mora with the preceding vowel) in instances of Laryngeal Lengthening is crucial to this analysis. As described in Chapter 3, I assume that coda consonants get Weight-by-Position, meaning coda consonants are moraic. Since the laryngeals involved in Laryngeal Lengthening are nuclear, they do not have their own mora, thus forcing the lengthening of the stressed vowel. In contrast, coda laryngeals do not prompt lengthening because they already

[58]See Prince (1983) for an alternative analysis of Kanien'kéha tone. Prince suggests that Kanien'kéha has an LHL word melody, with the high tone associating to the stressed vowel and the low spreading to all other syllables. Without proper phonetic testing, I am hesitant to accept the proposal that all unstressed syllables have a low tone. Additionally, as described by Kager (2012), floating melodies should be evidenced by the detachability of the melody and the stress.

provide weight (e.g. /a-k-t**ah**ko-ʔ/→[ak^{h}dáhgoʔ] *aktáhko'* 'I ought to take it out'). This is shown in the following example in which a stressed CVh syllable with coda /h/ (and consequently, Weight-by-Position) is contrasted with a stressed CVh syllable where /h/ is in the nucleus.

(96) Coda /h/ and low tone



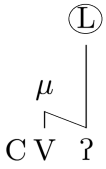
(97) Nuclear /h/ and low tone



In (96), the high tone is associated to the stressed mora. The low tone that was associated to the /h/ has relinked to the mora on /h/. Since the low tone is attached to a mora to which there is only a voiceless segment attached (i.e. /h/), the low tone cannot be pronounced. This contrasts with (97), in which the low tone is attached to a mora to which there is also a vowel attached, allowing the tone to be pronounced.

The analysis that Laryngeal Lengthening occurs to host the low tone on the laryngeal also accounts for why Laryngeal Lengthening never occurs outside of the stressed syllable. In unstressed syllables, the low tone on the laryngeal is delinked due to the constraint discussed in the previous section militating against tone surfacing outside of the stressed syllable. Consequently, Laryngeal Lengthening does not need to occur. A representation of the low tone deleting in an unstressed syllable is shown in (98).

(98) Unstressed syllable with laryngeal



In (98), the laryngeal is linked to the mora dominating the vowel (because the laryngeal is in the nucleus) and to a low tone. However, since this syllable is unstressed, the low tone is deleted (indicated by the circle). This captures the observation that tone is not pronounced outside of the stressed syllable.

Almost all other accounts of Kanien'kéha stress that I have seen are unable to account for the observation that Laryngeal Lengthening can occur before consonant clusters (analyzed here as involving nonmoraic syllables).[59] This is because other accounts assume CC sequences to be coda-onset clusters, and that the

[59]The data in (99) are partly accounted for by Rowicka (1999) in her strict CV analysis of Kanien'kéha stress. She assumes that

coda is what is blocking lengthening when the stressed vowel is followed by a CC sequence (e.g. Michelson, 1988; Alderete, 1995; Hagstrom, 1997; Rawlins, 2006) (contrary to my analysis that most CC sequences involve an initial nonmoraic syllable and that this is what is blocking Tonic Lengthening). If the coda-onset analysis were correct, we would have to assume one of the representations in (99).

(99) Coda-onset analysis with Laryngeal Lengthening

/waʔt-k-nak-ʔ/→[wà:t^{h}genageʔ] *wà:tkenake'* 'I scratched it'

a. Trimoraic



b. Sharing a mora



In (99a), an additional mora would be added to lengthen the vowel while /t/ would retain its coda mora. This would result in a trimoraic syllable. In (99b), the length is represented as the stressed vowel sharing the mora of the /t/. Both of these representations are problematic under the assumption that the coda blocks Tonic Lengthening due to its weight. If Laryngeal Lengthening is permitted before a coda in the examples in (99), why should Tonic Lengthening ever be blocked before a coda? Since I do not assume that CC clusters form coda-onset clusters, lengthening before them is not a problem.

Before concluding this section, I would like to address the possibility that Laryngeal Lengthening is actually compensatory lengthening, as suggested by Rawlins (2006). This interpretation has the laryngeal delete, and lengthening occur in order to maintain the mora. However, it is unclear why the deletion of the laryngeal would occur in the first place. That is, why would it be the case that /ʔ/ and /h/ delete in the stressed syllable, only when they are in coda, and in the case of /h/, only when followed by a sonorant consonant? I do not see why this would be the case. Further, given that stressed syllables tend to preserve contrast more than unstressed syllables (Beckman, 1997, 1998), it would be surprising if the laryngeals

lengthening is normally blocked before clusters/weightless syllables because the stressed vowel needs to license those empty positions. Since the target of lengthening needs to also be licensed (Scheer, 2004), and the stressed vowel cannot license two things at once, length cannot occur. Due to the special ability of the laryngeals to license the following empty nucleus in her analysis, she argues that the stressed vowel no longer needs to license the empty nucleus and is thus freed up to lengthen. However, this analysis does not account for why this occurs with hR but not with hO.

deleted in the stressed syllable but were preserved in unstressed syllables. Additionally, as pointed out by Rowicka (1999), the compensatory lengthening story incorrectly predicts that the laryngeals should never be pronounced following a stressed vowel that has undergone Laryngeal Lengthening but this is not the case. As described in Chapter 3, underlying /ʔ/ and /h/ are sometimes pronounced following a stressed vowel that has undergone Laryngeal Lengthening.[60]

The diachronic facts suggest that my analysis can account for Kanien'kéha historically as well: Julian (2010) argues that lengthening occurred first, then the laryngeal deleted. If this is the case, then there must have been a point in time at which lengthening occurred and the laryngeal was still present, which is clearly unanalyzable as compensatory lengthening. This also indicates that the laryngeals were not syllabified in the coda historically, allowing for lengthening. The argument made by Julian (2010) also provides support for the above articulatory analysis, that the loss of the laryngeal is because of the difficulty of articulating (as well as perceiving) a laryngeal in between a low tone and a following consonant.

In sum, I have shown that Laryngeal Lengthening should be analyzed as occurring in order to host the low tone on the laryngeal, resulting in a composite of the high tone on the stressed mora and the low tone underlyingly associated to the laryngeal.

4.5 Conclusion

In this chapter, I have argued based on evidence from Kanien'kéha stress and syllable structure that a third type of trochee is needed to account for the world's languages: one in which only weighted syllables are counted. Whereas trochaic systems have been divided into moraic systems in which left-headed feet contain two moras, and syllabic systems in which left headed feet contain two syllables, I proposed that a combination of the two is necessary to account for the patterns in Kanien'kéha. This new system builds what I call moraic-syllable trochees, left-headed feet that contain minimally and maximally two moraic syllables. This means that feet in Kanien'kéha can involve more (but not less) than two syllables in a foot resulting in tri- and tetrasyllabic feet. This has accounted for the relationship between nonmoraic syllables and otherwise penultimate stress in Kanien'kéha.

Along the way, I explored some implications of assuming the existence of tri-syllabic and tetra-syllabic feet. Specifically, I argued that the relationship between the head of a foot and an adjacent syllable is distinct from that of the relationship between the head and its dependent insofar as they are characterized by different patterns of behaviour.

Finally, I argued that Kanien'kéha follows the common pattern cross-linguistically of having variable

[60] In the case of /h/, this occurs in Kanehsatà:ke.

coda weight effects. That is, the weight of the coda is relevant to syllable size constraints, but not to footing constraints.

All in all, I concluded the discussion on the relationship between the metrical processes and epenthesis in Kanien'kéha. While Chapter 3 addressed the nature of the epenthetic vowels, showing that the disparity in behaviour is due to a difference in moraicity, the current chapter addressed the metrical processes, detailing how moraic syllables and nonmoraic syllables are treated differently.

While Chapter 3 and the current chapter have provided solutions to many of the challenges posed by the stress, epenthesis, and syllable structure systems of Kanien'kéha, they have not addressed any of the challenges these aspects of Kanien'kéha pose to learners. The following chapter will do so.

Chapter 5 Stress and pitch: a guide for learners and teachers

Words in most languages have one or more syllables that are more prominent than others. These more prominent syllables are *stressed*. How stress works in Kanien'kéha is very different from how stress works in English, and thus can present challenges for learners. In Kanien'kéha, the way of determining which syllable in a word is stressed (i.e. stress placement) as well as the way of pronouncing the stressed syllable is different from English. I will group these aspects of Kanien'kéha stress — stress placement and stressed syllable pronunciation — under the label *stress system*. In this chapter, I will address this stress system with the hopes of shedding some light on it with a particular lens for learners, teachers, and those involved in Kanien'kéha revitalization work. Specifically, I will discuss the impact of vowel insertion (i.e. epenthesis — to be defined in section 5.1) on stress location, and the way pitch is used in pronouncing stressed syllables. In order to make this discussion accessible, I do not use theoretical linguistics terminology, and a background in linguistics is not required. That being said, I do assume that the reader will have some familiarity with the language and with terms used in the Kanien'kéha classroom (e.g. pronominal prefix).

I will start by addressing the stress placement system in section 5.1. This section is probably most useful and relevant for advanced learners and teachers as it will discuss some of the complex interactions between stress and two types of epenthetic <e>.[1] For readers who are not advanced learners, I direct them to the second two sections in this chapter (5.2 and 5.3), which should be more accessible to any Kanien'kéha learners.

In section 5.2, I will address the pitch patterns in Kanien'kéha. Specifically, I will describe how there are three types of stressed syllables in Kanien'kéha — Short Upstress, Long Upstress, and Downstress. I will show how each of these three types are pronounced in terms of pitch, providing graphics along the way. I will also describe and illustrate how these stressed syllables are pronounced within larger contexts (i.e. sentences).

Finally, in section 5.3, I will introduce a computer program, Praat, that can be used as a tool for visualizing stress, and for language learning more generally. In this section, I will provide an introductory guide to the program, and explain how it can be used by learners to adjust accents when speaking, specifically in regards to pitch.

[1] I use angle brackets <> when referring to sounds or sound sequences that are written in the orthography. When referring to full words, verb roots, noun roots, prefixes, or suffixes, I will use italics.

5.1 Stress and epenthesis

Upon first glance, it may seem like, in order to learn which syllable is stressed in each Kanien'kéha word, it is a matter of memorization. For example, learners would need to memorize that the second-to-last syllable in the word is stressed in (1), whereas the third-to-last syllable is stressed in (2). Stress is marked in the following examples with an acute accent (e.g. á), but it can also be represented with a grave accent (e.g. à); note also that while stress is marked in Kanien'kéha orthography, it is not in English orthography. The distinction between these two will be discussed in section 5.2. Boundaries between syllables will be marked throughout this Chapter with periods.

(1) *ka.ná:.ta'* 'town'

(2) *én.ke.ren'* 'I will put it in'

While it is possible to memorize the stress placement in each new word that a learner hears, this strategy of learning the stress placement patterns in Kanien'kéha is limiting. This is because of the large number of new words that learners and speakers must construct while speaking. Whereas in English it is rare that speakers or learners need to construct new words on the spot, this is commonplace for Kanien'kéha speakers and learners. This is due to the 'polysynthetic' nature of Kanien'kéha, where words are made up of many morphemes (an umbrella term for all prefixes, roots, and suffixes). Since Kanien'kéha words usually involve many morphemes, an individual Kanien'kéha word often does the same work as a whole English sentence (e.g. *kenonhsanòn:we's* 'I like the house'). In this way, constructing a new Kanien'kéha word is almost as common as constructing a new (short) English sentence. For this reason, it is not feasible to simply memorize which syllable is stressed in every word, as there are many words that speakers and learners utter that they have never said or heard before.

Consequently, it is necessary to learn the stress placement rules that L1 speakers already know implicitly.[2] More specifically, learners must learn how the stress placement system interacts with epenthesis, as it is this interaction that results in stress falling on different syllables in different words: the difference between the examples in (1) and (2) is that the word in (1) does not contain an epenthetic <e> whereas the word in (2) does (*énkeren*). The term *epenthetic*, defined in more detail in section 5.1.2, refers to sounds that are not part of any morpheme, but are added in order to aid in pronunciation. For example, the word in (2) contains the morphemes *en-k-r-en'*,[3] but since **énkren'* is not a possible word in Kanien'kéha (for

[2] As far as I am aware, most (if not all) advanced learners of the language have learned the stress placement system implicitly via osmosis. That is, with more exposure to the language, the rules that L1 speakers already implicitly know can be subconsciously learned. For many learners, this is probably the more feasible option. This chapter looks to make explicit what the stress and epenthesis rules are for any learner that might find this useful.

[3] These are the future, first person subjective, verb root for 'to put', and the stative suffix.

reasons that will be described below), epenthetic <e> must be inserted: *énkeren'*. It is the syllables with epenthetic <e> that result in stress falling on different syllables in different words. This is because the stress system counts from the end of the word to find the second-to-last syllable, but skips any syllables that contain the epenthetic <e>. All epenthetic <e>s that are skipped by the stress placement process will be underlined henceforth (<e̲>).

One potential option for learners learning the stress placement system of Kanien'kéha, then, is to memorize epenthetic <e̲> as being part of a specific variant of a morpheme. For example, learners would learn that the first person subjective pronominal prefix is *k-* when the following morpheme starts with a <t> (e.g. (3)), and that it's <ke̲-> when the following morpheme starts with an <n> (e.g. (4)).

(3) ***k**ta.ke.rì:.tas* ****ke̲**.ta.ke.rì:.tas* 'I'm frying it'

(4) ***ke̲**.nòn:.we's* ****k**nòn:.we's* 'I like it'

However, this option can be burdensome for the learner. Not only would it be necessary to memorize all of the different variants of the pronominal prefixes with and without the epenthetic <e̲>, it would be necessary to do so with all of the other prefixes, roots, and suffixes that might prompt the insertion of the epenthetic <e̲> (e.g. semi-reflexive <at-> vs <ate̲>). The memorization of the prefix, root, and suffix variants with epenthetic <e̲> adds to the rather long list of morphemes that learners must already memorize.

An additional complication is that some instances of syllables with epenthetic <e> *are in fact* counted by the stress placement system. An example of this is shown in (5), in which the morphemes are shown to the left of the arrow, and the full word as written in the orthography (after epenthesis) is shown to the right of the arrow. The epenthetic <e> that is counted by the stress placement system is represented in a box for the purpose of illustration (<e>). Unlike in (2), stress in (5) lands on the syllable with epenthetic <e>.

(5) *te-k-kha-s*→*te.k**é**.khas* 'I attach things together'

Consequently, learners would need to memorize when epenthetic <e> is counted or not counted by the stress placement system. This would add more onto the learner's plate, which is already full of the previously described patterns. Further, L1 speakers themselves do not have these morphemes memorized with and without epenthetic <e> (which may or may not be counted for stress) in different words. Rather, fluent speakers subconsciously know the regular phonological patterns which pump out words with the correct relationship between stress and epenthesis. In this section, I will describe these regular phonological patterns.

In the rest of this section, I will start by describing the basic stress placement patterns in Kanien'kéha. Then, after a short introduction to the concept of epenthesis, I will describe two types of sound sequences that cannot be pronounced in Kanien'kéha (sections 5.1.2.1 and 5.1.2.2), illustrating how two types of epenthetic <e> make each of the two types easier to pronounce.

5.1.1 Stress placement

Stress refers to syllable prominence, which is usually indicated by a combination of loudness, duration, and pitch (see section 5.2 for more details). That is, stressed syllables are generally louder, longer, and higher in pitch than unstressed syllables (although which of these are used and to what extent depends on the language). In Kanien'kéha, stress is most commonly on the second-to-last syllable (i.e. the second-to-last vowel). This means that the second-to-last syllable in Kanien'kéha words is generally more prominent than the other syllables.[4] Some examples are shown in (6), where, for the purposes of clarity, boundaries of syllables are marked with periods. As mentioned above, stress is either marked with an acute (for Upstress) or grave accent (for Downstress). The colon indicates that the stressed vowel is long. The different types of stressed syllables and the relevance of length will be described in more detail in section 5.2.

(6) Stress on the second-to-last syllable

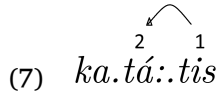
a. *ka.tá:.tis* 'I talk'

b. *o.nón:.ta'* 'hill'

c. *a.kè:.ra* 'plate', 'bowl'

Take as an example, *katá:tis* in (6a). Stress is on the second-to-last syllable <tá:>. If we think about stress placement as a process, we can say that the stress placement process counts from the end of the word and finds the second-to-last syllable to stress it. A graphic is shown in (7) representing the stress placement process.

[4]For a theoretical phonology analysis of what makes up a syllable in Kanien'kéha, see Chapter 3.

(7) 

This pattern is relatively consistent and holds across most nouns and verbs (although not particles). Whereas longer words in English have multiple stresses (e.g. írrespónsibílity - stress is marked here with acute accents for consistency), words in Kanien'kéha never have more than one stress (e.g. *wa'tekhiatonhserá:ien'* 'I played cards').

5.1.2 Epenthesis

The term *epenthetic* refers to sounds that are added in the pronunciation of certain words in order to make certain sound sequences easier to pronounce, while *epenthesis* refers to the process that adds these sounds to speech. What is 'easy' and 'difficult' depends on the language being spoken. In this chapter, I will use the term *pronounceable* to refer to sound sequences that are possible within a given language.[5] An example in English is with sound sequences created by the plural <s>. When the plural <s> is added to a word that ends in an <s> or <sh>, like *brush*, it creates the sound sequence <shs>, which is not pronounceable in English. In order to say this word then, English speakers pronounce a vowel in between the two consonants, resulting in <brushes>. The vowel (written as <e>) that is pronounced between the two <s>s is an epenthetic sound; a sound that is not actually part of any morpheme, but inserted in order to aid in pronunciation.[6]

The Kanien'kéha <e̲> and <ē̲> briefly described above are also epenthetic. In Kanien'kéha, they are used to help pronounce two types of sound sequences, both composed of consonants. In sections 5.1.2.1 and 5.1.2.2, I will describe Kanien'kéha epenthetic <e̲> and <ē̲>, and how they interact with stress. I will call these *epenthesis 1* and *epenthesis 2*, respectively.

5.1.2.1 Epenthesis 1

Before discussing epenthetic <e̲> 1, it is necessary to make a distinction between three types of consonants: sonorants, obstruents, and the glottal. These are shown in (8).

[5]This is not to say that speakers themselves are unable to pronounce the sound sequences I will discuss here. It is to say that, according to the phonological rules that make Kanien'kéha sound like Kanien'kéha, the sequences in question are not possible.

[6]Even though epenthetic <e> in English is written the same as epenthetic <e> in Kanien'kéha, they are not pronounced the same.

(8) Three categories of consonants[7]

Sonorants	**Obstruents**	**Glottal**
<n>, <r>, <w>	<k>, <t>, <s>	<’>

Sonorants are the consonants that are more vowel-like. Obstruents are the consonants that restrict air flowing out of the mouth or nose. The glottal is produced in the throat (more specifically, the vocal cords).

In Kanien’kéha, sequences of sounds containing one (e.g. <nk>) or two (e.g. <nr>) of the sonorant consonants cannot be pronounced. That is, the three sonorant consonants cannot be pronounced immediately before or after another consonant in Kanien’kéha (other than <h> and <’>).[8] This means that whereas English has words with sound sequences such as [nt] (e.g. *au[nt]ie*), [kr] (e.g. *[kr]azy*), and [tw] (e.g. *[tw]in*),[9] Kanien’kéha does not; these sequences are simply not pronounceable in Kanien’kéha. Take, for instance, <n>. <n> cannot occur next to any other consonants in Kanien’kéha other than <h> or the glottal <’>. A table showing the restrictions on sound sequences involving the sonorant consonants in Kanien’kéha vs English is shown in (9). ✓ indicates that the sequence is possible in the language while ✗ indicates that it is impossible.

(9) Restrictions on the sonorant consonants[10]

	Kanien’kéha		English	
kn	✗	-	✗	-
tn	✗	-	✗	-
sn	✗	-	✓	*snake*
rn	✗	-	✓	*barn*
nn	✗	-	✗	-
wn	✗	-	✗	-
nk	✗	-	✓	*bank*
nt	✗	-	✓	*ant*
ns	✗	-	✓	*answer*
nr	✗	-	✓	*enroll*
nw	✗	-	✓	*unwell*

Even though the sound sequences in (9) cannot be pronounced in Kanien’kéha, sometimes the Kanien’kéha

[7] I do not include the consonant <i> (English <y>) here because it is not relevant. See section 2.1 for a full list of the sounds in Kanien’kéha.

[8] <h> can be pronounced before or after any of the sonorant consonants. The glottal can only be pronounced before the sonorant consonants. It can never follow a consonant. <n> and <r> can also be pronounced immediately before <i> (English <y>).

[9] Square brackets [] indicate that the symbols inside are using the international phonetic alphabet. This is used here to avoid the ambiguity of English orthography.

[10] There are some cases of <kw> but these are different because they often are pronounced as <ko>: *enkatshó:ko’* ‘I will smoke’, *katshókwas* ‘I smoke’.

word-building process creates them. That is, to make many words, it is necessary to put two (or more) morphemes together that would result in one of the above sound sequences. As an example, let's take a look at the first person subjective C-stem pronoun. When this pronoun is followed by a morpheme that starts in an obstruent consonant (i.e. <t>, <k>, <s>), it is pronounced as *k-* (see (10a)). On the other hand, when the pronoun is immediately followed by a morpheme that starts with a sonorant consonant (<n>, <r>, <w>), it is pronounced as *ke-* (see (10b)).

(10) First person subjective pronoun

a. ***k****takerì:tas* 'I'm frying it'

b. *én****ke****ren'* 'I will put it in'

This indicates that the first person subjective C-stem pronoun is actually just <k->; if it was <ke-> then we would expect it to be pronounced as <ke-> in words like the one in (10a) (**ketakerì:tas* — * indicates that the form is incorrect). The <e>, then, is epenthetic <e> 1, and it is being pronounced because the sequence <kr> is otherwise not pronounceable in Kanien'kéha. This is what happens whenever any of the sequences in (9) are created by the morphology.

There is one other sequence of sounds that falls into this category of epenthesis 1: consonant-glottal. That is, the glottal can never be pronounced immediately after a consonant in Kanien'kéha. Just like with the sound sequences in (9), if the word-building process involves putting a morpheme that ends in a consonant right before a morpheme that begins with a glottal, then the epenthetic <e> 1 is pronounced between them.

Some examples of the illegal sound sequences in Kanien'kéha being pronounced with epenthetic <e> 1 are shown in (11). The text on the left of the arrow in each example shows the morpheme breakdown of each word whereas the text on the right shows the written word.

(11) Sonorant consonants and epenthetic <e>

a. ***s-w****a-k-ahkt-on*→*se****w****akáhkton* 'I have gone back'

b. *io-****wr****-a'*→*ówe****r****a'* 'wind', 'air'[11]

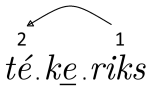
c. *wak-a****t-w****ihr-****r-'*→*wakate****w****ì:rare****'*** 'I have a scar'

Epenthetic <e> 1 interacts with the stress placement process in interesting ways. Recall that the stress placement process counts from the end of the word, finding the second-to-last syllable. Syllables with the epenthetic <e> 1, however, are not counted. That is, they are *invisible* to the stress placement process. This results in words having stress on the third-to-last, or even fourth-to-last syllable. An example is shown in

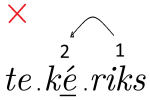
[11] In this case, epenthetic <e> 1 is being inserted in a middle of a morpheme.

(12a), with the wrong stress placement process (counting epenthetic <e̲> 1) being shown in (12b). Syllable boundaries in the following examples are marked with periods.

(12) a.



b.



In (12a), the stress placement process counts the last syllable <riks>, skips the second-to-last syllable with epenthesis 1 <ke̲>, and is placed on the third-to-last syllable <te> (which, in the eyes of the stress placement process is the second-to-last syllable); note that the <e> in <te> is not epenthetic and is thus visible to stress. If <ke̲> was not skipped in the stress placement process, it would be counted as the second-to-last syllable as in (12b).

Some more examples of words in which stress is on the third-to-last or fourth-to-last syllable rather than the second-to-last due to epenthetic <e̲> 1 are shown in (13).

(13) Stress on third- or fourth-to-last syllable[12]

a. *o-kwir-'→ó:.kwi.re̲'* 'sapling', 'tree'

b. *te-k-nak-s→té.ke̲.naks* 'I am scratching it'

c. *en-k-r-a-hst-'→én.ke̲.rah.ste̲'* 'I will draw it'

This concludes the discussion of epenthetic <e̲> 1. To summarize: this epenthetic <e̲> is pronounced between sequences involving a sonorant consonant (<n>, <r>, <w>) and another consonant, and between a consonant and an immediately following glottal stop because otherwise, these sequences would not be pronounceable in Kanien'kéha. Epenthetic <e̲> 1 is also invisible to stress placement.

5.1.2.2 Epenthesis 2

Epenthetic <e> 2, which sounds identical to epenthetic <e̲> 1, is added in order to aid in the pronunciation of a different set of sound sequences. Generally, epenthetic <e> 2 is inserted in order to make sequences

[12]The examples above focus on epenthetic <e̲> inserted in between morphemes, but since invisible epenthetic <e̲> is invisible to the stress placement process, we can identify when certain vowels are epenthetic, even if they are in the middle of a morpheme. This is because they will still be invisible to stress, and they will always be pronounced in the middle of one of the illegal sequences. For example, we can see that the <e̲> in between the <k> and <r> in *wákeras* 'it smells' is epenthetic because stress does not count it, and it is next to sonorant consonants.

of *three consonants in a row* easier to pronounce. Epenthetic <e> 2 is inserted between the first two of the three consonants: C[e]CC (C = consonant). Sequences of three consonants are otherwise not pronounceable in Kanien'kéha. Some examples of this are shown in (14). I use a box to represent epenthetic <[e]> 2 (contrasting with epenthetic <e> 1, which is underlined).

(14) Epenthesis and sequences of three consonants

a. ***k-ks**-o-s→k[é].ksos* 'I put the dish in water'

b. ***k-ks**-a-hr-onnion-s→k[e].ksah.rón.nions* 'I am setting the table'

c. *te-**k-kh**a-s→te.k[é].khas* 'I atttach things together'

For example, epenthetic <[e]> 2 is inserted in between the first two consonants of the <kks> sequence in (14b) in order for it to be pronounceable (<k[e]ks>).

Almost all sequences of three consonants (e.g. ktk, tkh, kts) fall into this pattern of being not pronounceable in Kanien'kéha without epenthetic <[e]> 2 being inserted between the first two. However, there are two main exceptions.[13] First, if the first consonant in the three consonant sequence is <h> or <'>, then the sequence is pronounceable in Kanien'kéha, and there is no need for epenthesis. Examples of this are shown in (15).

(15) hCC and 'CC

a. *s-wa-k-a**hkt**-on→se.wa.káh.kton* 'I have gone back'

b. *wa'-**k-s**ahe't-a-ienthw-a-ko-'→wa'.ksa.he'.ta.ien.thwá:.ko'* 'I did harvest beans'

The second exception involves the second consonant in the three consonant sequences: when the second consonant is <s> or <h>, epenthetic <[e]> 2 is not inserted. That is, CsC and ChC sequences are pronounceable without the epenthetic <[e]> 2. Some examples are shown in (16).

(16) CsC and ChC

a. ***k-st**ath-a-'t-ha'→ ksta.thà:.tha'* 'I make it dry'

b. *en-**k-ht**ehr-o-'→en.khtè:.ro'* 'I will put the root in water', 'I will boil the root'

Interestingly, epenthetic <[e]> 2 crucially differs from epenthetic <e> 1 with respect to stress placement. While syllables with epenthetic <e> 1 are invisible to the stress placement process, syllables with epenthetic <[e]> 2 are not. This is shown in the following examples (some of which are repeated from above).

[13] An exception that is less common includes sequences where the final two consonants are <th> (e.g. kth). Additionally, while in some cases sequences with a final <i> (English <y>) are broken up (see (14a)), they sometimes are not.

(17) <ə> and stress

a. ***k-ks****-o-s*→*k*ə́*.ksos* ‘I put the dish in water’

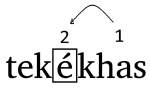
b. *te-****k-kh****a-s*→*te.k*ə́*.khas* ‘I atttach things together’

c. *s-k-ah****kt-s***→*skáh.k*ə*ts* ‘I got back’

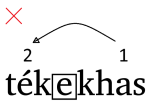
In all the examples in (17), stress is on the second-to-last syllable, despite the fact that one of the final two syllables in each of the examples contains epenthetic <ə> 2. The visibility of epenthetic <ə> 2 to stress placement is represented in (18).

(18)

a.



b.



One way that the difference in relationship between the two epenthetic <e>s and stress placement can be explained, and that the reader may find intuitive, has to do with the ordering in which the three relevant processes — stress placement, invisible epenthesis, and visible epenthesis — take place. We can understand these relationships as epenthetic <ə> 2 being inserted before stress placement, making it visible to stress placement, and epenthetic <e̲> 1 being inserted after stress placement, making it invisible to stress placement. This is shown in (19), in which there are three words — one without epenthesis (*kaná:ta’* ‘town’), one with epenthesis 1 (*énke̲ren’* ‘I will put it in), and one with epenthesis 2 (*tek*ə́*khas* ‘I attach things together’) — undergoing the three ordered processes. In the top row, neither epenthetic <e> has been inserted yet, and stress has not yet been placed. In the subsequent rows, epenthesis and stress placement occur (the leftmost column indicates precisely when stress and epenthesis occurs). The words in the bottom row are what is pronounced. For the sake of clarity, I will label epenthesis 1 as ‘Sonorant <e̲>’ (as it breaks up consonant sequences involving a sonorant consonant), and epenthesis 2 as ‘CCC <ə>’ (as it breaks up consonant sequences involving three consecutive consonants).

(19) Epenthesis and process ordering

	ka-nat-a'	en-k-r-en'	te-k-kha-s
CCC <ə>	kanata'	enkren'	tekəkhas
Stress	kaná:ta'	énkren'	tekékhas
Sonorant <e>	kaná:ta'	énkeren'	tekékhas
	ka.ná:.ta'	én.ke.ren'	te.ké.khas

In the second column, there is the word *kaná:ta'*. It does not undergo epenthesis, but it gets stress on the second-to-last syllable in the third row.

In the third column, there is the word <énkeren'>, which, before epenthesis and stress placement, is <enkren'>. There are no changes to this word in the second row because there are no sequences of three consonants to be broken up by epenthetic <ə> 2. In the third row, stress placement occurs, placing stress on the second-to-last syllable. Since epenthetic <e> 1 has not yet been inserted, the second-to-last syllable is the first syllable in the word, <en>. In the last row, epenthetic <e> 1 that breaks up consonant sequences involving a sonorant consonant is inserted, resulting in the final form of the word, <énkeren'>, with stress on the third-to-last syllable.

In the fourth column, the word before epenthesis and stress placement is <tekkhas>. In the second row, epenthetic <ə> 2 is inserted to break up the sequence of three consonants (in this case <kkh>), adding another syllable, and resulting in <tekəkhas>. Next, stress placement takes place, placing stress on the second-to-last syllable. Since epenthetic <ə> 2 has already been inserted at this point, it is counted by the stress placement process. This results in the final form of the word <tekékhas>.

To summarize this section, epenthetic <ə> 2 crucially differs from epenthetic <e> 1 in two ways. Firstly, whereas epenthetic <e> 1 helps speakers pronounce sound sequences involving the sonorant consonants <n>, <r>, and <w>, epenthetic <ə> 2 helps speakers pronounce sequences of three consonants. Secondly, while epenthetic <e> 1 is invisible to stress placement, epenthetic <ə> 2 is not. The differences between these two epenthetic <e>s are summarized in (20), in which 'clusters' refers to the types of consonant sequences that are broken up by the <e>s.

(20) Summary of epenthetic <e>s

	<ə̲> 2	<e̲> 1
Clusters	Three consonants	Any involving sonorant
Stress	Visible	Invisible

5.2 Pitch in Kanien'kéha

While working with Kanien'kéha learners, teachers, and those involved in the revitalization of the language, the aspect of Kanien'kéha pronunciation that has frequently been mentioned as the most challenging for learners is the pronunciation and perception of the stressed syllable, and more specifically, the pitch associated with it. This is because Kanien'kéha stressed syllables are pronounced quite differently from English stressed syllables and, like learning any language, learning the specific aspects that are most different from one's first language will be the most challenging.

As mentioned in the previous section, stressed syllables are generally more prominent than unstressed syllables. This prominence can manifest in multiple different ways, but usually stressed syllables are more prominent than unstressed syllables in terms of loudness, duration (the length), pitch (the musical note), or any combination of these (Gordon and Roettger, 2017). For example, stressed syllables in English are more prominent than unstressed syllables in all three of these ways: they are louder in volume, longer in duration, and higher in pitch (Plag, Kunter and Schramm, 2011). In Kanien'kéha, this is also the case. However, Kanien'kéha stressed syllables differ from English stressed syllables in having three different types of stressed syllable (whereas English only has one) which all differ in their use of duration and pitch — Short Upstress, Long Upstress, and Downstress.

(21) Three types of stress

a. Short Upstress

ktáhkwas 'I'm taking it out'

b. Long Upstress

wa'onte'nién:ten' 'she tried'

c. Downstress

enhsà:ronke' 'you will know a language', 'you will learn a language'

In terms of duration, stressed vowels can either be long (Long Upstress and Downstress) or short (Short Upstress). As mentioned earlier, long vowels are marked with a colon <:> immediately following the stressed vowel.

(22) Long vs short stressed vowel

a. Long

akià:tawi 'shirt'

b. Short

kkária'ks 'I pay'

In terms of pitch, stressed vowels can either be pronounced with high pitch (Short Upstress and Long Upstress) or with a falling pitch (Downstress). As mentioned above, high pitch is marked with an acute accent (see the example in (22b)), whereas falling pitch is marked with a grave accent.

(23) Falling pitch

waktsi'tsiarò:ron 'I have collected flowers'

Further, the pitch can be contrastive. This means that there are some cases where two words are identical in every way except pitch, and yet the two words diverge in meaning (e.g. *oká:ra'* 'story' vs *okà:ra'* 'eye'). This is very different from languages like English in which, although pitch is used to indicate the attitudes of the speaker, for example, it can never change the meaning of a word. Linguists call the type of pitch that can distinguish between words tone. Other languages with tone include Mandarin, Japanese, and Norwegian.

This use of pitch can be quite challenging for learners who have never spoken a language with tone (i.e. monolingual English speakers), as they are not accustomed to it. In this section, I will describe the three types of stressed syllable in Kanien'kéha, providing in-depth descriptions of how they are pronounced in terms of pitch. I will also describe how these stressed syllables and pitch patterns are pronounced within larger contexts, such as in sentences. Accompanying all of these descriptions will be graphics, displaying the pitch patterns.

Before getting started, it is necessary to note that all fluent speakers of Kanien'kéha (and any language) speak slightly differently from each other. Accordingly, in this section I will describe the overall pitch patterns that tend to be observed in the speech of many speakers, but not necessarily all. This means that, while most speakers might fit into the patterns to be described, some may not. In section 5.3, I introduce a tool, Praat, that can be used by learners to investigate the pitch in the speech of individual speakers.

5.2.1 Pitch and stressed syllables

As described briefly above, Kanien'kéha words only contain one stressed syllable, and that stressed syllable must be pronounced with one of three different types of stresses: Short Upstress (e.g. <á>), Long Upstress (e.g. <á:>), or Downstress (e.g. <à:>). In this section, I will describe these three types of stressed syllables,

and the pitch patterns that accompany each. I will start with Short Upstress, then Long Upstress, then Downstress. Note that while the pitch patterns to be described in this section pertain to the whole stressed syllable, they are usually contained to just the stressed vowel.

Short Upstress refers to a stressed vowel that is short. In most cases, Short Upstressed vowels only occur when the stressed vowel is followed by two or more consecutive consonants.[14] Note that when <i> is pronounced like English <y>, it counts as a consonant (e.g. (24b)). As described above, Short Upstressed vowels are marked with an acute accent and, unlike Long Upstressed vowels, are not followed by a colon. Some examples are in (24).

(24) Short Upstress examples

a. *kan**é**hon* 'skin', 'hide'

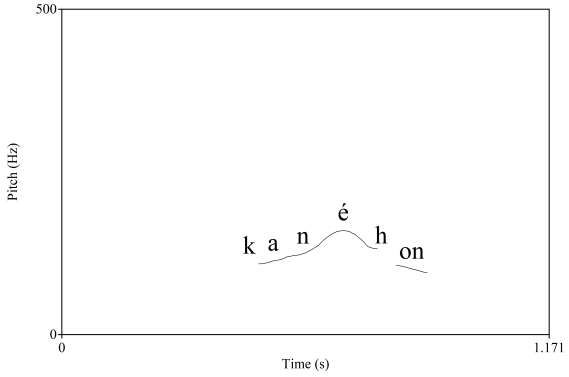
b. *rak**á**ria'ks* 'he is paying'

c. *kera'nent**á**ktha'* 'I make it stick on'

Short Upstress typically involves a rise in pitch. That is, the Short Upstressed syllables usually have higher pitch than the rest of the syllables in the word. This is shown in the graphics in (25) in which the pitch over the course of the words has been drawn using Praat. Note that while the whole syllable is pronounced with Short Upstress, the pitch peak is usually during the vowel.

(25) Short Upstress pitch[15]

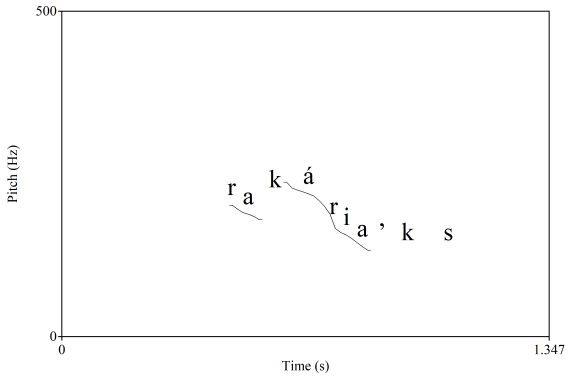
a. *kan**é**hon* 'skin', 'hide'



[14]There are a handful of exceptions to this rule, but I will mention the two most common here. First, when the stressed vowel is immediately followed by an <h> that is sandwiched between vowels (e.g. *wahawénhahse'* 'he called him names'), Short Upstress occurs. Second, Short Upstress also occurs when the vowel in the following syllable is the invisible epenthetic <e̲> discussed in section 5.1 (e.g. *wákȩ̲ras* 'it smells').

[15]Hertz (Hz) is represented on the Y axis. This measures the frequency of the pitch (i.e. how high or low). Time is on the X axis, and is measured in seconds.

b. *rakária'ks* 'he is paying'



In (25), the line indicates the pitch. The higher the line is, the higher the pitch is. The lower the line is, the lower the pitch is. Some sounds do not carry pitch, so there will be no line during these sounds (see section 5.3 for a more detailed description of which sounds carry pitch). The letters over the line indicate what sound is being pronounced at each point. For example, in (25b) the pitch during the first sound in the word <r> is higher than the pitch during the immediately following sound <a>. (Note: While Praat can very easily draw the pitch like in (25), it cannot tell you which sounds are occurring at which time; I manually inputted the written form using the annotation tool in Praat.)

In these pictures, we can see that the Short Upstressed vowel is much higher than the rest of the word. For example, in (25a) the stressed vowel <é> is much higher than the preceding syllable <ka> or the following syllable <hon>.

The second type of stressed syllable is the Long Upstressed one. Long Upstress only occurs when the stressed vowel is followed by a single consonant. Long Upstressed vowels are marked with an acute accent and are always represented with an immediately following colon. Some examples are in (26).

(26) Long Upstress examples

a. *enkatsh**ó:**ko'* 'I will smoke'

b. *kwahr**ó:**ris* 'I tell you (pl)'

c. *ow**í:**ra'* 'baby animal'

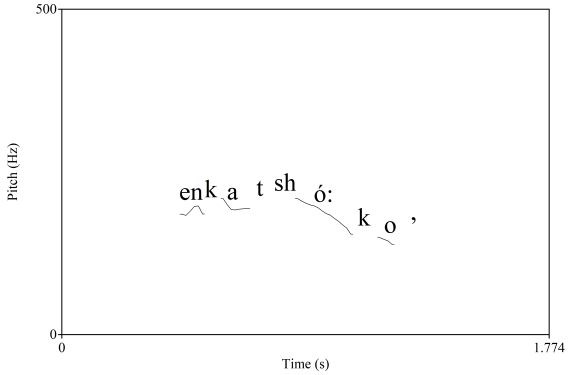
There are some examples where Long Upstress and Short Upstress are almost constrastive. This means that there are some word pairs where one of the only differences is that one has Long Upstress and the other has Short Upstress. For example, *ionkeniniá:kon* 'we are married' and *ionkeniniákon* 'we have gotten married', and *rawenhé:ion* 'he is dead' *rawenhéion* 'he has died'.[16]

[16]Niá:wen to Akwiratékha' Martin for pointing this out to me. Karin Michelson (p.c.) notes that this length difference is probably because there is a glottal stop at the end of the words with Short Upstress, and the word has undergone *vowel twin* (see section 3.6 for a discussion of vowel twin).

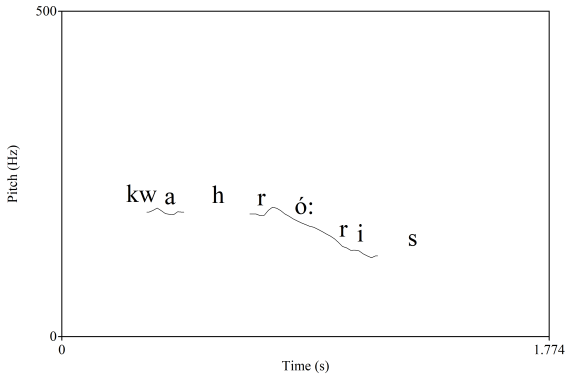
Long Upstress is generally pronounced with a slight rise in pitch at the beginning of the stressed vowel, and then a gradual fall in pitch over the course of the stressed syllable. Some graphics of Long Upstress are shown in (27).

(27) Long Upstress pitch

a. ***enkatshó:ko'*** 'I will smoke'



b. ***kwahró:ris*** 'I tell you (pl)'

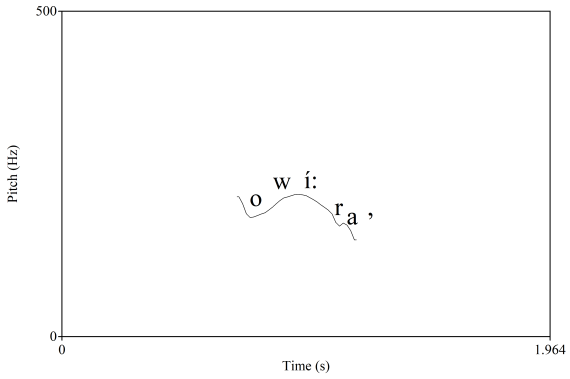


As shown in (27), the pitch rises slightly at the beginning of the Long Upstressed vowels. For example, the beginning of the stressed vowel <ó:> in *enkatshó:ko'* is slightly higher than the pitch during the preceding vowel <a>. Interestingly, this differs from Short Upstressed syllables which show a considerable difference in pitch between the stressed and unstressed syllables (see (25) above). Following the slight rise in pitch at the beginning of the stressed vowels, the pitch then slowly falls over the course of the stressed syllables. For example, in *enkatshó:ko'*, the stressed vowel <ó:> falls in pitch between the preceding sound <h> and the following sound <k>. Although there is a fall in pitch, Long Upstress is still distinct from and contrasts with Downstress, which falls in pitch much more steeply.

While in most cases Long Upstressed vowels differ from Short Upstressed vowels in only being slightly higher in pitch than the unstressed syllables, there are some cases when Long Upstressed vowels are con-

siderably higher than the surrounding unstressed syllables. This seems to occur when the word is being emphasized. An example of this is shown in (28).

(28) Emphasized Long Upstress: *owí:ra'* 'baby animal'



The third type of stressed syllable is the Downstressed one. Downstress occurs under specific circumstances that have to do with the sounds <h> and <'>. Let's first take a look at unstressed syllables involving a <h> or <'>. When an unstressed vowel is immediately followed by <h> or <'>, it is simply pronounced as a sequence of vowel-h or vowel-'. Some examples are in (29).

(29) Vowel-h and vowel-' sequences

a. *atk**ah**ránha* 'glasses'

b. *kahtsi**a'**nó:kon* 'under my hand'

However, if we take the same morphemes containing the <ah> and <a'> sequences (*-kahr-* and *-htsia'n-*, respectively),[17] and place stress on the vowel immediately preceding the <h> or <'>, something different happens: the vowel becomes a Downstressed vowel, and the <h>/<'> is not pronounced. This is shown in (30), in which the same morphemes containing the bold sequence in (29) are present.

(30) Downstress from <h> and <'>

a. *ok**à:**ra'* 'eye'

b. ohtsi**à:**na' 'hand', 'palm of the hand'

As shown in (30), vowel-h and vowel-' sequences are realized with Downstress when they are selected for stress.[18] For example, the unstressed vowel <a> was followed by <h> in (29a), but since it is stressed in

[17] In Kahnawà:ke, <-htsa'n-> is the root for the 'palm of the hand'

[18] There are a few exceptions to this. They are the following: when the stressed vowel is followed by <ht>, <hk>, or <hs>, Short Upstress occurs instead.

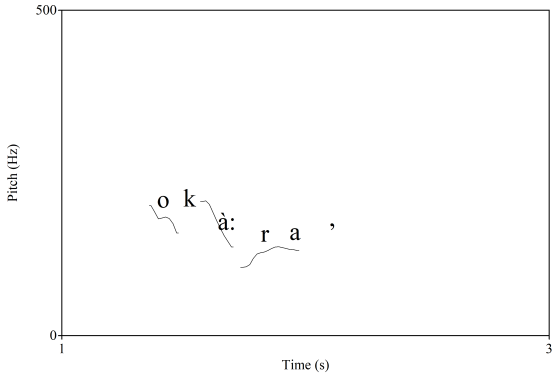
(i) *aktáhko'* 'I ought to take it out'

(30a), it is pronounced with Downstress <à:>, and the <h> disappears.[19]

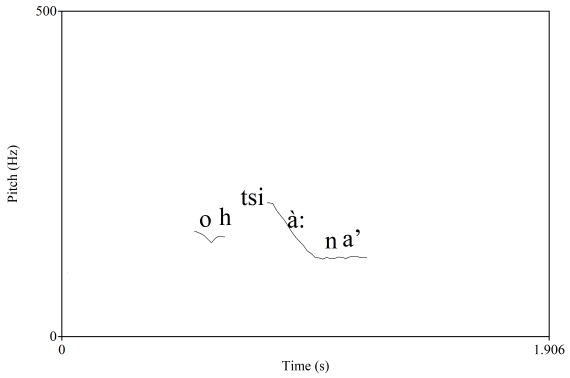
Downstressed vowels are pronounced with a rise in pitch at the beginning of the stressed vowel, followed by a steep fall in pitch on that same vowel. Some examples are shown in (31).

(31) Downstress pitch

a. *okà:ra'* 'eye'



b. *ohtsià:na'* 'hand'



As can be seen, Downstressed vowels start higher than the preceding syllable, then they fall very steeply. This means that the pitch is falling very fast. Note also that although the pitch falls in Long Upstressed vowels as well, it does not fall nearly as fast as it does in Downstressed vowels. It is extremely important to be able to produce and hear this difference because, as mentioned above, Downstress and Long Upstress are contrastive. This means that there are some words that differ only in whether the stressed syllable receives

Short Upstress also occurs when the stressed vowel is followed by an h-vowel sequence.

(ii) *kahi* 'berry', 'fruit'

When the stressed vowel is followed by a '-vowel sequence, Downstress occurs, but the glottal is also pronounced.

(iii) *à:'are'* 'curtain', 'net', 'veil'

There are also individual words that do not follow these patterns such as the verb *-io'ten-* 'work' and the noun *-i't-* 'excrement'.

[19]For some speakers, the <h> or <'> is still pronounced following the vowel with Downstress.

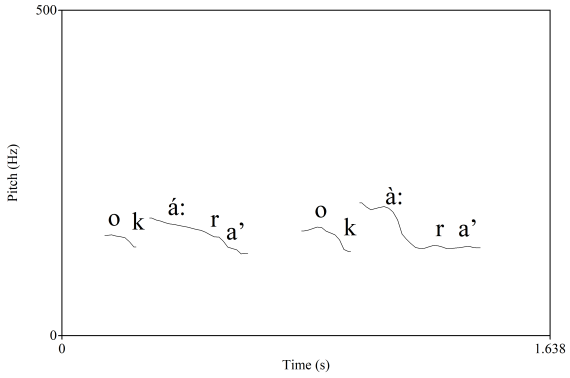
Downstress or Upstress. Some examples are shown in (32), where the only difference between the words in the left column and the right column is that those in the left column contain Long Upstress, whereas those in the right column contain Downstress.

(32) Constrative pitch

Long Upstress		Downstress	
oká:ra'	'story'	*okà:ra'*	'eye'
onón:ta'	'hill'	*onòn:ta'*	'milk'

We can see the difference in pitch between *oká:ra'* 'story' and *okà:ra'* 'eye' in the graphic in (33).

(33) *oká:ra'* 'story' versus *okà:ra'* 'eye'



As shown in (33), the pitch falls over the course of both stressed vowels. However, there is a clear difference between the first word where there is Long Upstress and in the second word where there is Downstress. In *oká:ra'* the pitch falls slowly, whereas in *okà:ra'* the pitch falls very quickly.

In this section, I have shown how the different types of stress in Kanien'kéha are pronounced using pitch; Short Upstress involves the pitch being higher in the stressed syllable than the rest of the word, Long Upstress involves a slight rise in pitch at the beginning of the stressed vowel followed by a shallow fall, and Downstress involves a rise in pitch at the beginning of the stressed syllable followed by a steep fall.

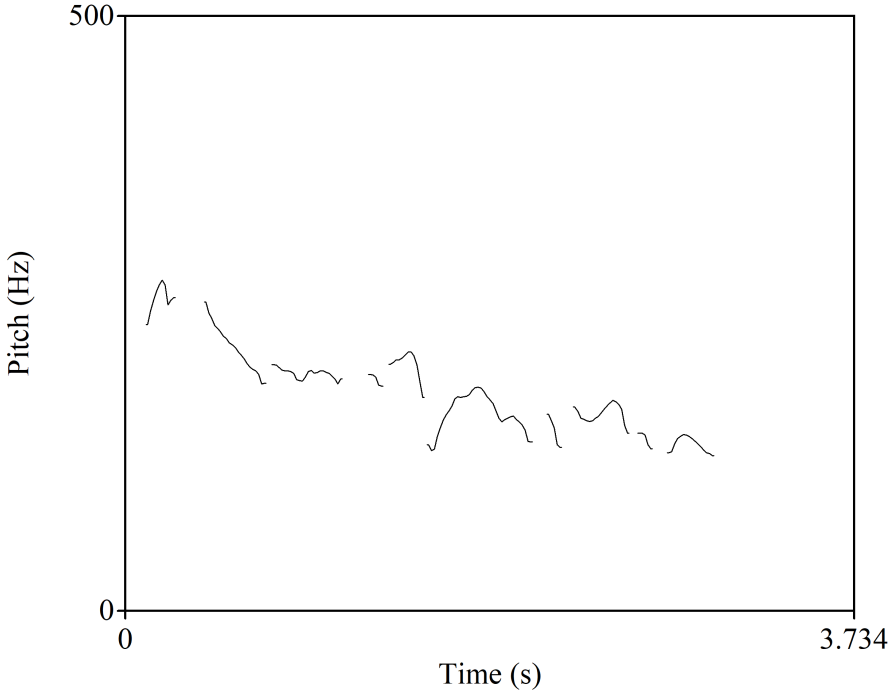
5.2.2 Pitch over sentences

It may feel unnatural to pronounce the different types of stressed syllables in full utterances (i.e. declarative sentences, questions, etc.) because it may seem too much like singing, or too expressive. It is important, however, to pronounce each stressed syllable and pitch pattern in longer utterances because this is how L1 speakers typically talk. This is especially the case for Short Upstress and Downstress. I will show this to be the case in this section, starting by discussing Short Upstress, then Long Upstress, then Downstress.

Before showing how the different stresses appear and sound in full utterances, it is necessary to note that the pitch in Kanien'kéha (as well as in many other languages) generally falls over the course of an utterance.[20] This is called declination. An example of declination is shown in (34).

(34) *Iáhten tewakenaktotà:'on nòn:wa ne thetén:re aonkwatawénhon.*

'I didn't have time now or yesterday to have gone swimming'



While there many 'detours' so-to-speak, the general trend from this graphic is clear: the pitch falls over the course of an utterance. Throughout this section, I will use examples that are yes/no questions,[21] which also involve declination. The only difference between yes/no questions and sentences is that yes/no questions also rise in pitch during (part of) the first word in the utterance.

I will show that, when pronounced in utterances such as the one in (34), the three types of stressed syllables usually result in deviations from the overall pitch contour, albeit in different ways. We will also see that when a word is at the end of an utterance, the stressed syllable is less accentuated.

As described above, in a word with Short Upstress, the pitch jumps up for the stressed syllable, and then comes back down after, resulting in the Short Upstressed syllable being higher in pitch than the rest

[20]Declination will almost always occur, as far as I am aware. However, there may be various detours from the overall declination depending on the social and linguistic context.

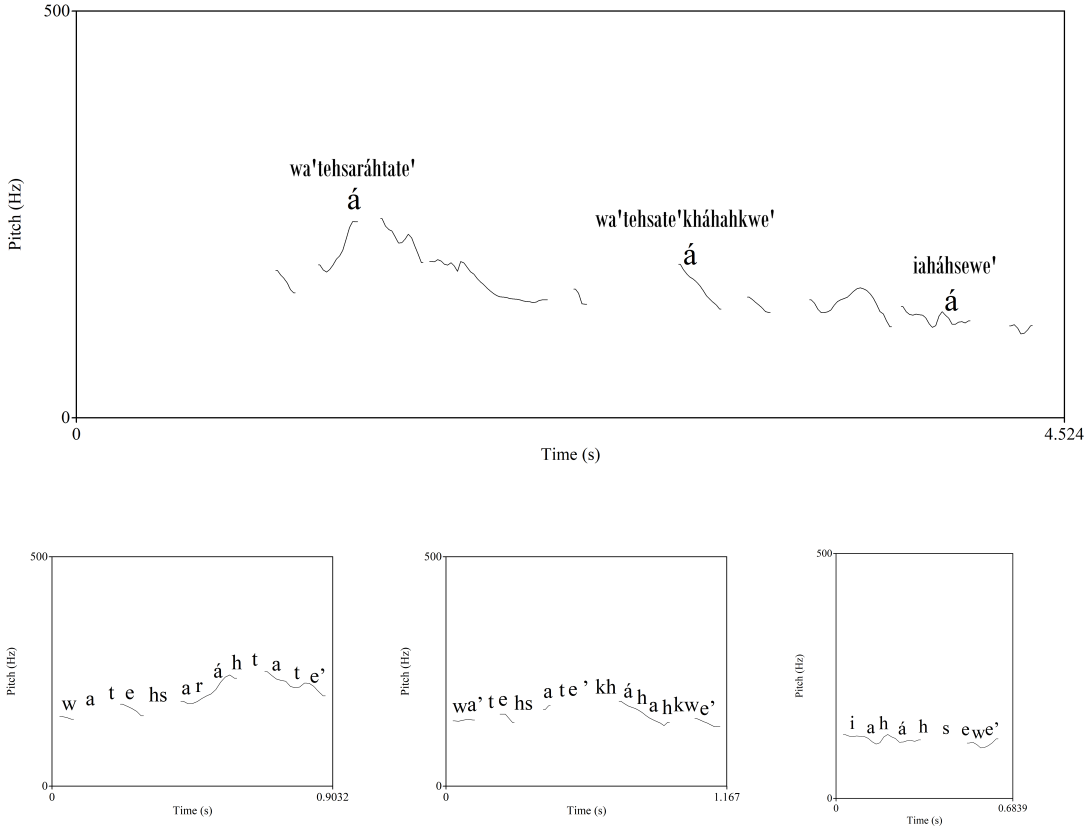
[21]In looking for examples, I wanted to make sure that each example had multiple instances of each type of stressed syllable. This meant that the utterances had to be quite long. Longer non-question utterances (e.g. declarative sentences) were much more likely to involve false starts, hesitation, and stuttering from the speakers. This made it difficult to find and elicit non-question utterances that were useable for this section. For this reason, the examples in this section all involve questions.

of the syllables in the word. In sentences and other types of longer utterances, this is almost always the case. That is, as the sentence is progressing, and the pitch is generally falling, the pitch will jump up for the Short Upstressed syllable, and come back down for the subsequent syllables of the word, continuing the declination afterward. In (35), there are multiple words with Short Upstress. The exact position of the Short Upstressed vowel is marked above the pitch line, and the corresponding word written above it. Below the graphic of the entire utterance are smaller graphics of the individual words and where each sound in each word is being pronounced in reference to the pitch line.

(35) Short Upstress in an utterance[22,23]

wa'tehsaráhtate' káton wa'tehsate'kháhahkwe' tsiontenhninòn:tha' iaháhsewe'?

'Did you run or walk to the store?'



The pitch patterns shown in the example in (35), where Short Upstress involves a jump in pitch are extremely common in Kanien'kéha. In (35) the pitch rises over the beginning of the first word because it is a question, peaking around the Short Upstressed syllable (and some of the following syllable) in

[22]*káton* is not included in the words with Short Upstress because it is a particle. It is not clear to me what role the particles play in the pitch in longer utterances.

[23]The pitch rise and quick fall preceding the word *iaháhsewe'* is the Downstress in the preceding word *tsiontenhninòn:tha'*.

wa'tehsaráhtate'. After the initial rise in pitch, the pitch trajectory falls over the course of the rest of the question. During this fall, the pitch jumps up several times. Two of those instances are associated with the Short Upstressed vowels. The first of the two Short Upstressed vowels, in *wa'tehsate'kháhahkwe'*, is visibly higher than what surrounds it (although there is no pitch immediately before it because the preceding sounds do not involve vocal cord vibration). Although the Short Upstressed syllable in *iaháhsewe'* is only slightly higher in pitch than the surrounding sounds, it is also higher.[24] As briefly mentioned above, it is quite common for the stressed syllable in the last word of an utterance to be less accentuated in terms of pitch, which is the case in *iaháhsewe'*.

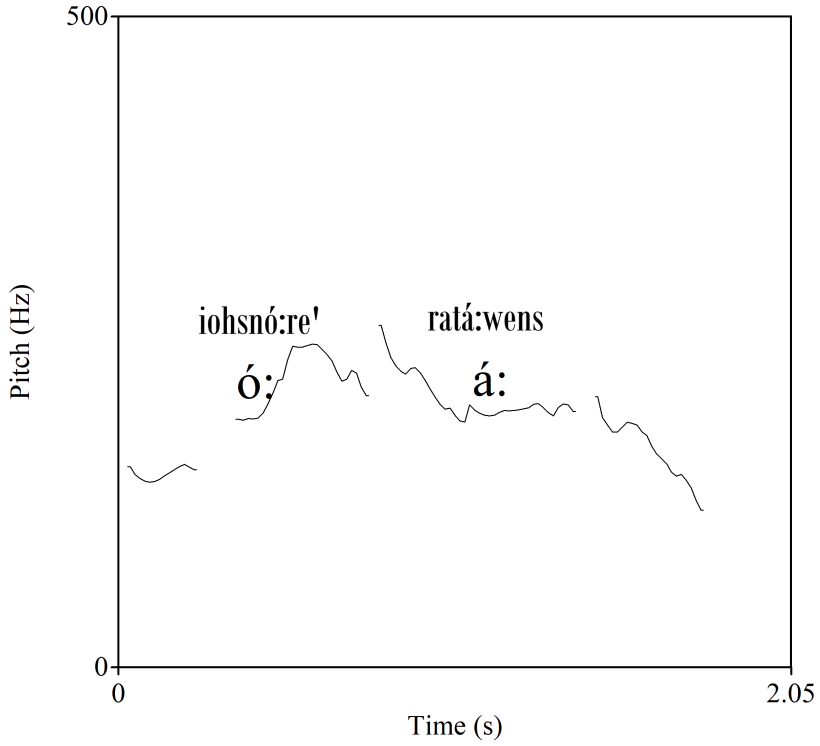
Long Upstressed syllables generally involve much less divergence from the overall declination in an utterance. That is, if we were just listening to the pitch in a given utterance, it would be difficult to tell where the Long Upstressed vowels were. This is because it is their length, rather than their pitch, that makes them identifiable as stressed syllables. We can see this in the graphics in (36), in which there are two words with Long Upstressed syllables in the question being asked.

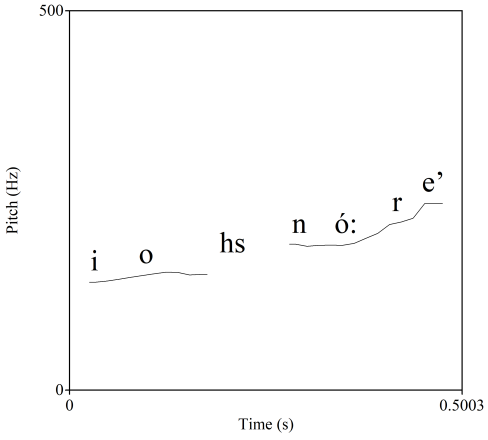
[24]We can see that the pitch jump in *iaháhsewe'* is in between the <h> and <á>. This is probably because the speaker was speaking at a high rate of speed, which sometimes results in pitch movements being a little unaligned.

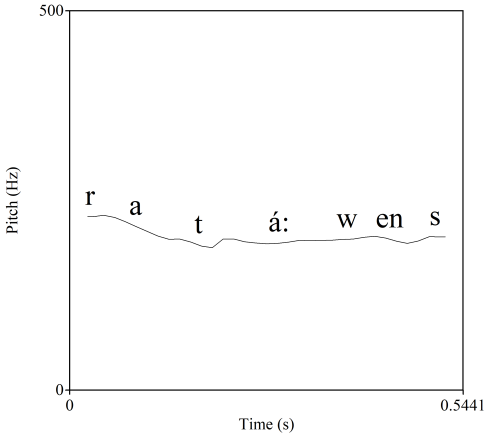
(36) Long Upstress in sentences

iohsnó:re' ken thí: ratá:wens thí: Kó:r?

'Does Paul swim fast?'







In (36), the pitch rises over the first word, indicating that the utterance is a question. Interestingly, unlike in (35) where the rise in pitch ended at the stressed syllable, here the pitch continues to rise after the Long Upstressed vowel until the end of the first word. In this sense, the pitch of the Long Upstressed vowel does not matter here, as long as the rising pitch for the question is maintained. After the initial rise

in pitch is complete, the pitch falls over the rest of the question. When the speaker reaches the second Long Upstressed vowel, there is no substantive change in pitch. There is a small jump in pitch before the vowel, but this is due to the quick release of air involved im the preceding <t>. In this sense, Long Upstressed vowels do not impact the overall pitch of an utterance to the same extent as Short Upstressed vowels.[25]

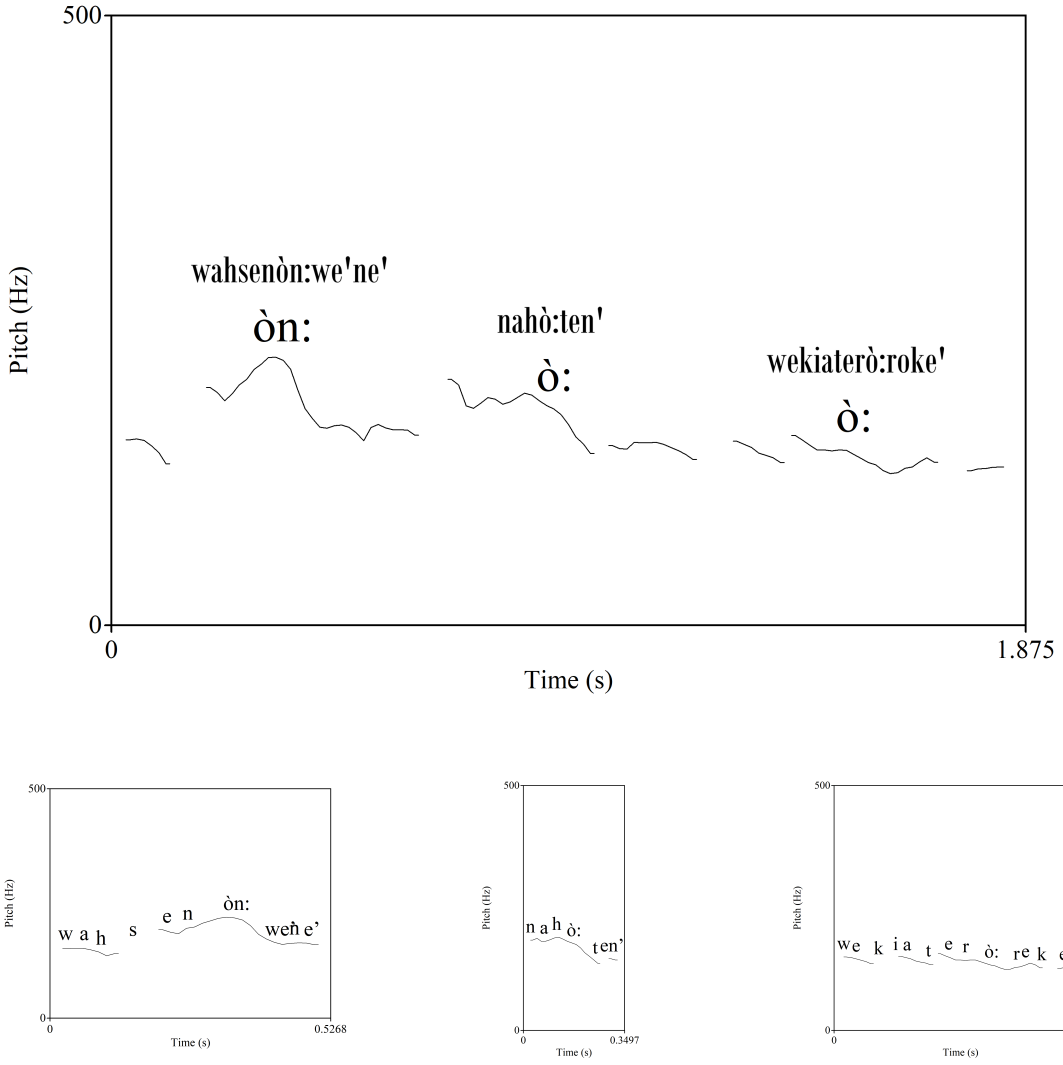
Finally, Downstressed syllables in long utterances look very similar to how they look on their own. This means that in an utterance, when the pitch reaches a Downstressed vowel, the pitch jumps up for the beginning of the Downstressed syllable, and then proceeds to fall sharply, ending with a low pitch. After the Downstressed vowel, the pitch will rise back up to continue the declination. We can see this in the graphics in (37).

[25]While Short Upstress and Downstress vowels have a very similar pitch profile when speakers are telling stories, Long Upstressed vowels are slightly different. In stories, the pitch tends to rise during Long Upstressed vowels, peaking at the following syllable.

(37) Downstress in sentences

wahsenòn:we'ne' ken thí: nahò:ten' wekiaterò:roke'

'Did you like what we watched?'



We can see in (37) that there is overall declination; the pitch falls over the course of the utterance. Since the utterance is a question, the pitch rises over a section of the first word. Like in the case of Short Upstress (and unlike Long Upstress), the pitch peaks at the Downstressed syllable. At this point, the pitch falls very steeply (i.e. fast). Over the rest of the utterance, there is declination. During this declination, there are two more Downstressed syllables. At the word *nahò:ten'*, the pitch jumps up at the Downstressed vowel (albeit only slightly in this case), and then falls in pitch quite fast over the course of the vowel. The last instance of Downstress is less accentuated because it is at the end of the word. In *wa'kiaterò:roke'*, the pitch does not jump up at the beginning of the Downstressed vowel, and while it falls during the vowel, it

does not fall steeply.

To summarize this section, Short Upstressed and Downstressed vowels generally maintain their specific pitch patterns when uttered in larger sentences, while Long Upstressed vowels do not. Additionally, the pitch contours involved in stressed syllables are de-accentuated when the word is the last one in a sentence.

As a final note, all speakers speak differently and consequently use pitch slightly differently. The patterns I have presented here are what I have found to be the general trends in speakers that I have worked with. In the following section, I will show how a computer program, Praat, can be used to illuminate the differences between speakers, and how it can be used as a pronunciation tool for learners.

5.3 A guide to Praat

In the previous section, I described the pitch patterns in Kanien'kéha, showing how fluent speakers of the language use pitch and stress while speaking. We also saw some aspects of the pitch system that might be challenging for learners, such as the similarities between Long Upstress and Downstress. There are many ways that learners can improve their pronunciation of the pitch patterns in Kanien'kéha. One way is to imitate speakers; just like toddlers imitate other speakers when learning their first language, adult learners can (and should) do the same (e.g. imitating speakers on the radio). However, for many this is easier said than done. For example, if one cannot hear the difference between Upstress and Downstress, how can they produce the difference? Further, even if a given learner can perceive the differences in pitch, it does not necessarily mean that they can pronounce the differences, nor does it mean that they can even assess and evaluate their own speech while speaking to determine whether they are pronouncing the differences precisely.

In this section, I will introduce a tool that can aid in improving your, the reader's, pronunciation of the pitch and stress patterns in Kanien'kéha. Improving your pronunciation will improve your accent in Kanien'kéha. I define 'accent' here as all of the characteristics in the pronunciation of Kanien'kéha speech that make L1 speakers sound like L1 speakers. Ideas in section (5.3) and Appendix C grew out of workshops co-developed by myself and Akwiratékha' Martin in Summer 2025 in the communities of Kahnawà:ke and Ahkwesáhsne and have benefited from feedback from all participants in these workshops.

As mentioned above, the tool under focus is called *Praat* (Boersma and Weenink, 2024). Praat is a free and easy-to-use computer program that allows us to look at the speech in any .wav or .mp3 file "under a microscope". More specifically, Praat allows us to visualize as well as more carefully listen to speech. Some of the examples of visualizations were shown in the preceding section. Because of these abilities, Praat allows us to more carefully and attentively compare (both aurally and visually) our own speech to

that of fluent speakers to determine the differences that are harder to hear in real-life interactions, and adjust our pronunciation accordingly.

Please note that, although Praat can be helpful in adjusting your accent, it may not be for everyone; learners should find what is most useful for them, Praat is just one of the options. Some other options include imitating sounds that you hear in every day speech (as mentioned above), asking first language speakers to assess your speech (and your accent), and recording yourself and listening closely.

In what follows, I will provide an introductory guide to Praat and discuss how you can use it to help improve your pronunciation of the pitch and stress patterns, and consequently your accent in Kanien'kéha. I will start by describing the basics of Praat (e.g. downloading it, uploading files, etc.) in section 5.3.1. I will then describe how you can use Praat as an enhanced audio player to train your ears and mouths to adjust pitch. This process only involves listening and repeating and thus does not necessitate an in-depth knowledge of Praat. Then I will discuss how you can use the visuals generated by Praat to analyze and adjust your pitch. While using the visuals in Praat is a more involved process than using Praat as an enhanced audio player, it is also more likely to yield results as it trains your ear visually and aurally (Hardison, 2004; Molholt and Hwu, 2008; Liu et al., 2011). In Appendix C, there is a similar guide to using Praat to help pronouncing the vowels and consonants of Kanien'kéha like a fluent speaker.

5.3.1 Basics

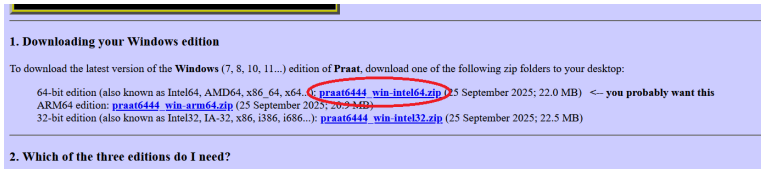
In this section, I will describe the basics of Praat; how to download it, how to open files in it, how to listen to audio files in it, and how you can use it to analyze any audio file. *Disclaimer: Praat and its various functions may look slightly different on your computer depending on what version of Praat you have and what type of computer you have.*

5.3.1.1 Downloading praat

For Windows (i.e. basically anything other than a Mac):

- Search **Download Praat**
- Click **Download Praat for Windows** also available here: `https://www.fon.hum.uva.nl/praat/download_win.html`
- Click the recommended zip file for Windows (64 bit) — it is circled in red in (38).

(38) Downloading Praat for windows



- Once the file is downloaded, click on it in your downloads folder to open it.

For Macs:

- Search **Download Praat**
- Click **Download Praat for Macintosh** also available here: `https://www.fon.hum.uva.nl/praat/download_mac.html`
- Click the zip file (64 bit) — it is circled in red in (39).

(39) Downloading Praat for mac

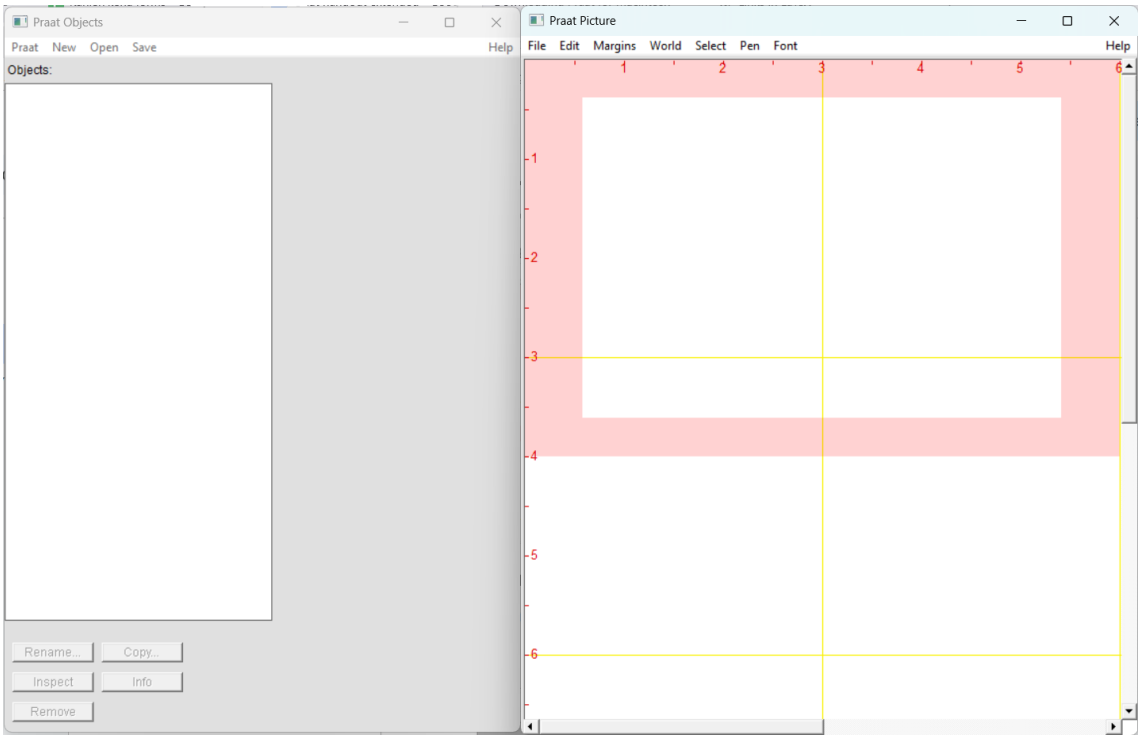


- Once the file is downloaded, click on it in your downloads folder to open it.

5.3.1.2 Opening audio files

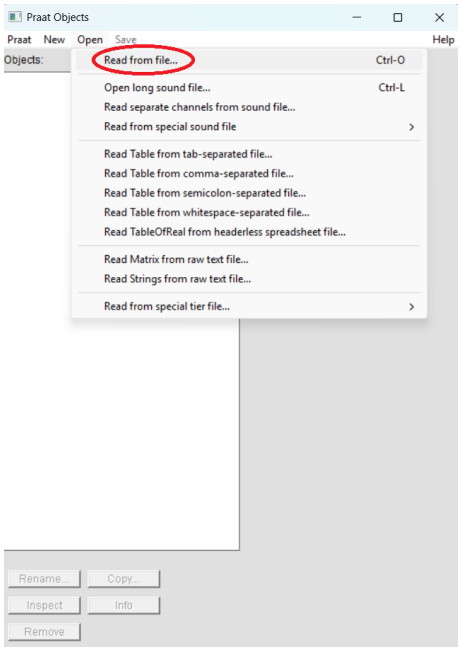
When Praat is open, there are two windows that pop up: Praat Objects (left) and Praat Picture (right).

(40) Praat windows



- In Praat Objects, click the **Open** tab at the top.
  - In the drop down menu under **Open**, click **Read from file**.

(41) Opening a file

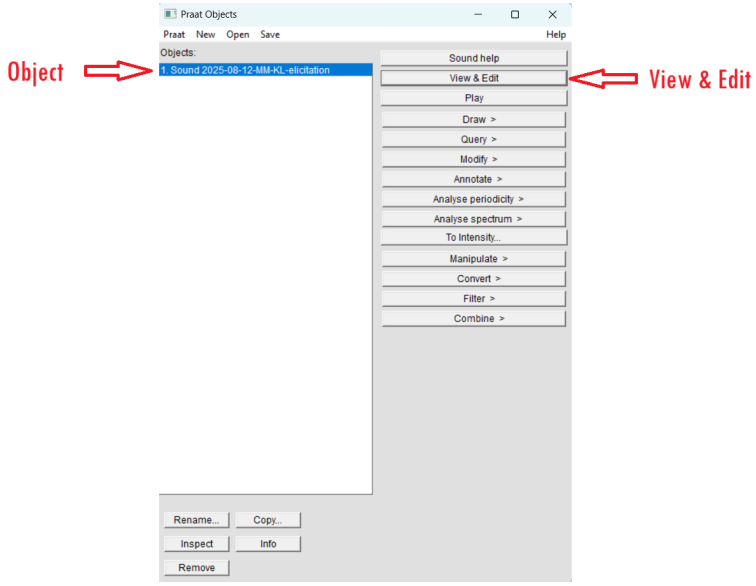


- In your files, select whatever audio file you want to open, and click **Open**.

– Audio files should be .wav or .mp3. If the audio file is not of this type, you can use one of the many free online file conversion websites to convert audio files to .wav or .mp3.

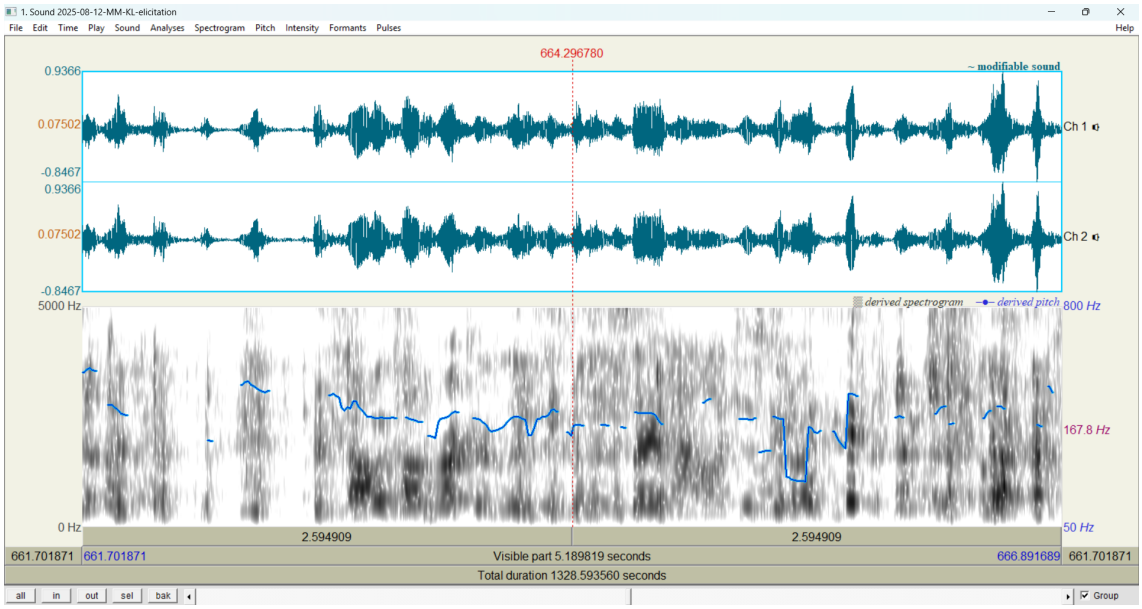
- The file should appear as an object in the Praat Objects window.
- Once the audio file is an object in the Praat Objects window, select the audio file object you want to open (it will turn blue once selected), and click **View & Edit** on the right side.

(42) Opening an object



– A window should pop up like the one in (43)

(43) Viewing an object



– The window you open will not look exactly like the one in (43) because every audio file looks different. For example, you may not see the squiggly blue lines over the 'static', and you may see different colour lines or dots instead. These lines and dots will be discussed in section 5.3.3, as well as in Appendix C.

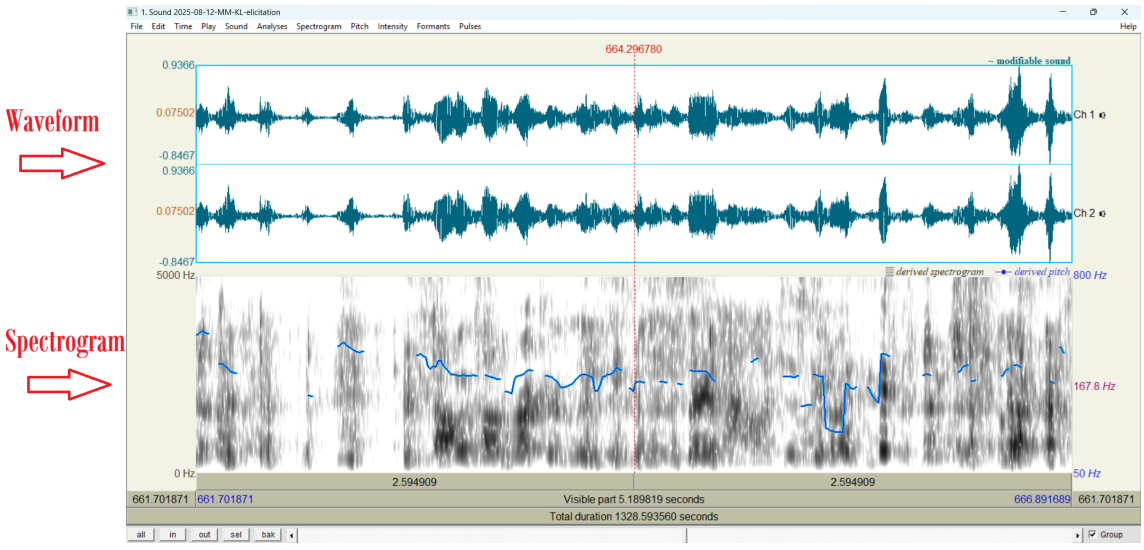
– If the audio file you are viewing is over 20 seconds (which you can check at the bottom of the window, next to **Total duration**), you will not see anything on the bottom half of the screen because the program is too zoomed out. In order to zoom in, click the **in** button in the bottom left corner (you may have to do so a few times depending on how long the audio file is). See the section on navigating audio for more information on zooming in and out.

- On a mac, you can also open a file by opening Finder, then clicking any audio file you are interested in, and dragging it to the Praat icon on the Dock. The audio file will then appear in the objects window.

5.3.1.3 Getting acquainted with spectrograms and waveforms

When viewing an audio file, the top half will show the waveforms, while the bottom half will show the spectrogram.

(44) Waveforms and spectrograms



- Waveforms mostly show loudness (amplitude) over the course of the audio file. The louder the audio is, the higher and lower the waves will be.

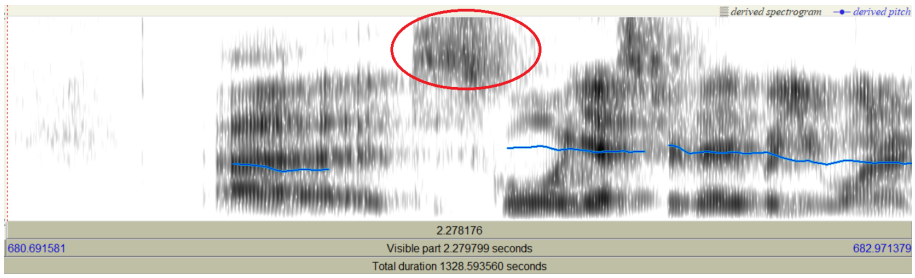
- Spectrograms show the information that we are interested in in this section.

– Frequency in Hertz (Hz) is on the Y axis

– Time in on the X axis

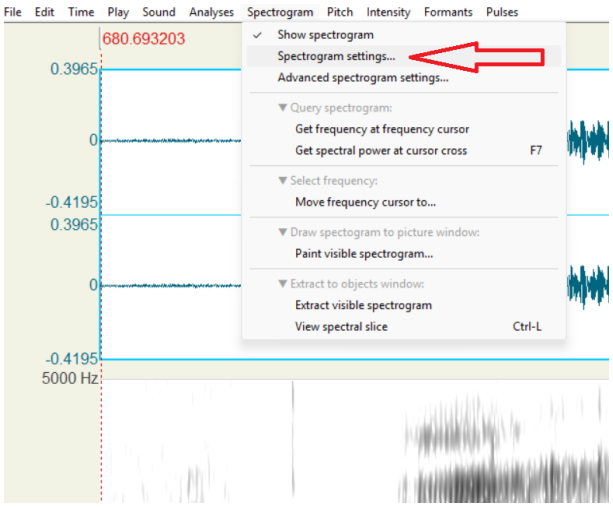
– The shading indicates loudness. The darker the shading, the louder the audio is at that time and frequency. For example, in (45) there is darker shading near the top of spectrogram (circled in red). This indicates that at that point in time, there was a lot of high frequency noise. This is also what <s> looks like on a spectrogram.

(45) Loudness and frequency



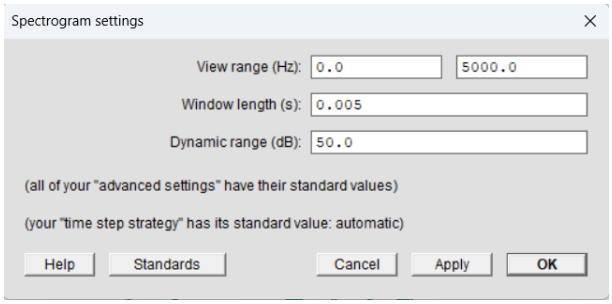
– As mentioned above, every audio file has its own unique spectrogram, so yours will look different than the above spectrograms. To ensure that yours is different solely because it is a different audio file and not because something is wrong, click the **Spectrogram** tab at the top of the screen and then click **Spectrogram settings…** in the dropdown menu.

(46) Opening spectrogram settings



– The settings should be set to the following:

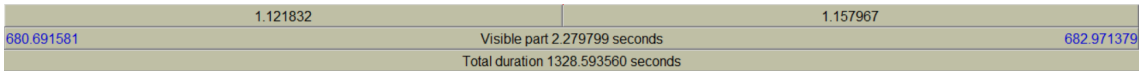
(47) Spectrogram settings



5.3.1.4 Playing audio

- The three grey bars at the bottom of the spectrogram allow you to play the audio.

(48) Playing audio



  - Clicking the bottom bar that says **Total duration** will play the whole audio file, regardless of whether you are only viewing a certain section of it.
  - Clicking the middle bar that says **Visible part** will play the section of the audio file that is displayed on your screen (depending on how zoomed in you are).
  - The top bar allows you to play selected portions of the audio visible on the screen.
    - Clicking anywhere on the spectrogram or waveform (red crosshairs will appear) will select that point in time and you can play anything before or after it.
    - If you highlight a section of the audio (see the next section for details on highlighting), this bar will also allow you to play that selected portion.

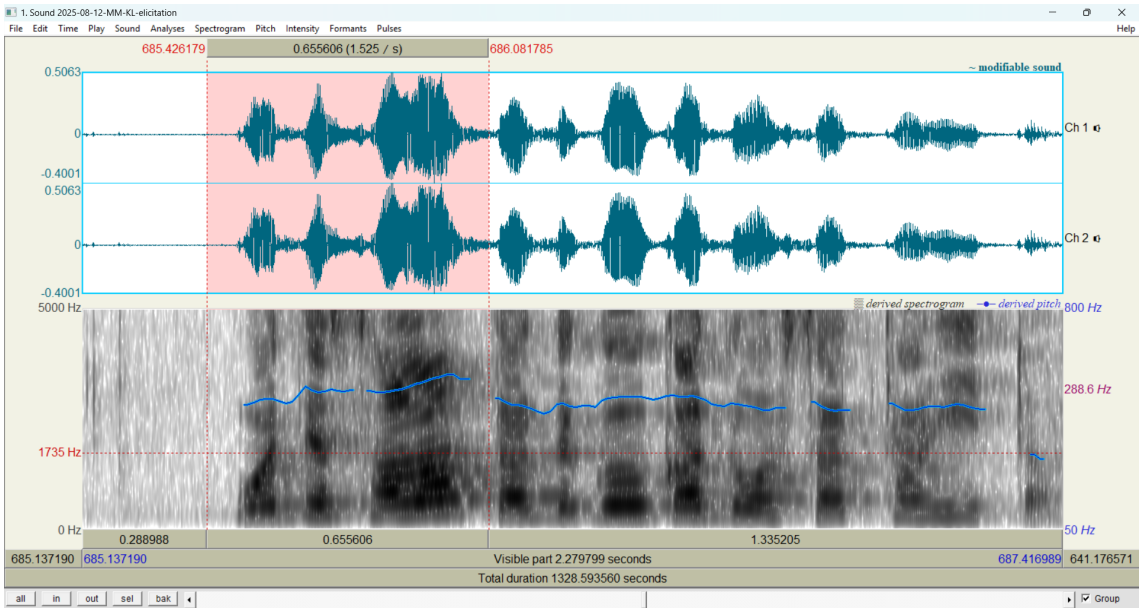
- You can also play the audio with the **tab** key on your keyboard. This key will play the audio from wherever your cursor last clicked on the spectrogram.

5.3.1.5 Highlighting

In Praat, you can highlight certain sections of the audio file. This will allow you to listen to and examine the specific highlighted portion. The following describes and shows how you can highlight speech in Praat.

- Click and drag on the spectrogram or waveform from one time point to another time point to select any portion of the audio.

(49) Highlighting



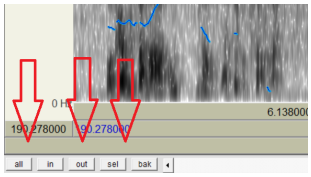
- Another way of highlighting is clicking one of the edges of the portion of the audio you would like to highlight, then holding shift while clicking on the other edge.

5.3.1.6 Navigating audio

Zooming in and out:

- At the bottom left, there are the buttons **all**, **in**, **out**, **sel**, and **bak** that allow you to zoom in and out of different sections of the audio files.

(50) Zooming

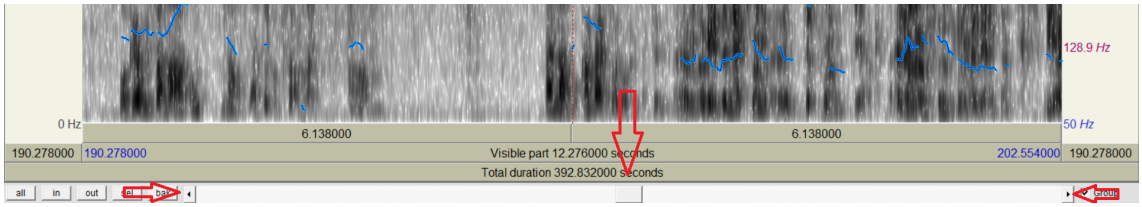


- Click the **in** button to zoom in. This will zoom in to the middle of the visible audio.
- Click the **out** button to zoom out.
- The **all** button will return you to viewing the entire audio file.
- The **sel** button will zoom in to the highlighted audio.
- The **bak** button returns you to the portion you were viewing previously.

Scrolling:

- When viewing a piece of the total audio file, you can scroll to the left and right using the scroll bar at the bottom.

(51) Scrolling



- The left arrow will scroll the audio left, while the right arrow will scroll right. The grey bar can be clicked and dragged to more quickly scroll left and right.

- If you are on a mac, you can scroll in the same way you would scroll on any page, but doing so from side to side.

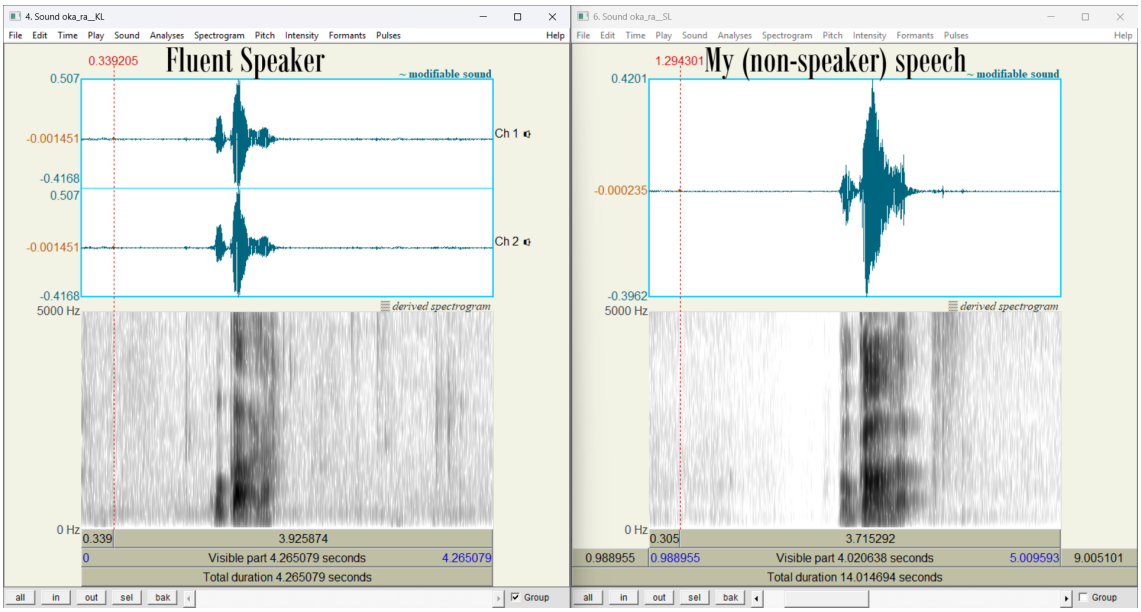
5.3.2 Praat as an enhanced audio player

As mentioned at the outset of this guide to Praat, one way of improving your accent is to simply imitate the pronunciation of fluent speakers, either while hearing them speak in real life interactions, or in recordings (which is probably the less awkward option) (Messum, 2007). However, audio players are often imprecise and consequently, ineffective. For example, if you are interested in a specific word that occurs from 5-6 seconds in a 10 second recording, you can either replay the whole recording over and over again, imitating the word each time, or estimate where the 5 second mark in the recording is, clicking that point each time to replay the word/syllable of interest. This can be time consuming and ineffective. There are many programs that can aid in more precise listening, such as Audacity. Here, I will show how to more precisely listen using Praat, and how you can use this feature of Praat to train your ear and mouth to hear and produce Kanien'kéha sounds more efficiently. In this section, I will show how to do so specifically with pitch, but see Appendix C for how you can use it to improve your pronunciation of other Kanien'kéha sounds as well.

In order to use Praat as an enhanced audio player to adjust your pitch/stress to be more similar to that of a fluent speaker, you first need to get an audio file (.wav or .mp3) of a speaker that you want to sound more similar to. This could be a family member, a friend, an elder, or someone else. In choosing a person to compare your speech to, I recommend that the person have a similar pitch range to you when speaking (i.e. someone of the same height and/or gender), as it will be easier to compare pitch patterns. You should then record yourself saying the words or sentences that are in the audio file of the fluent speaker you are

working with.[26] For example, if the audio file involves your aunt saying the words *skennen'kó:wa ken?* 'Are you well?', then you should record yourself saying this phrase as well (making sure this recording is a .wav or .mp3 file). Then open the two audio files (of the speech of the fluent speaker, and your speech) in Praat. You should then open (i.e. View and Edit) these files to view the spectrograms and waveforms. I find it easiest to keep both spectrograms open next to each other. As an example, I have a recording of a fluent speaker saying the word *okà:ra'* 'eye', and I recorded myself saying this word as well. The waveforms and spectrograms of the two recordings are shown in (52).

(52) *okà:ra'* 'eye'[27]

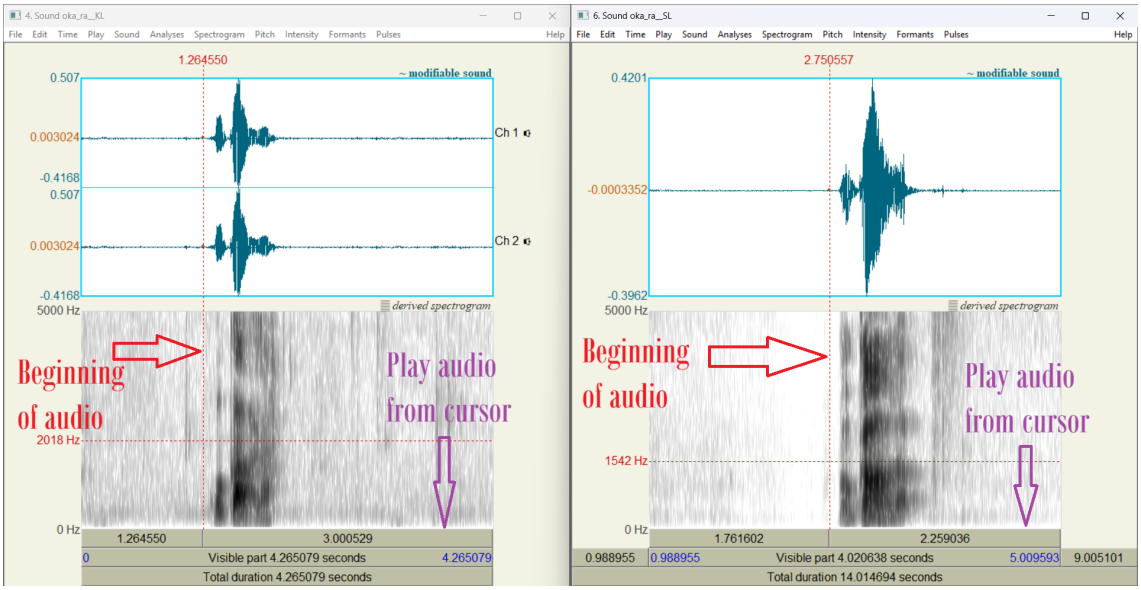


When the spectrograms of the two audio files are open (like in (52)), you should listen to both files (if the file is quite long, you can do this in phrase-sized chunks) several times back to back. You can do this by clicking the cursor at the beginning of the speech (i.e. where the spectrogram gets darker and the waveform shows activity), and then clicking the third-to-lowest grey bar at the bottom. This is shown in (53).

[26] You can also record yourself using Praat. In the Praat Objects window, click **New**, and in the dropdown menu, click **Record mono Sound...**. Make sure after recording yourself to click **Save to list**. This will add the audio file to the Praat Objects window.

[27] Note that there are two waveforms on top of one another in the window on the left, whereas there is only one waveform in the window on the right. This is because the file on the left is in *stereo* while the file on the right is in *mono*. Whether a file is in mono or stereo will depend on how it was recorded. It does not matter for our purposes.

(53) Listening from specific points



While listening to these audio files back to back, you should try to hear how the pitch differs between them at various points across the audio file. The idea of this is to train your ear to hear why your speech sounds like a non-fluent speaker. Building up this skill can help you adjust pronunciation in real time when talking with fluent speakers or listening to the radio (rather than needing to rely on recordings). While listening to the pitch in the audio files, you should imitate both yourself and the fluent speaker as much as possible, trying to mimic the pitch over the course of the audio files. You can imagine this as a singing exercise, where you are matching the pitch of the audio files. For example, you can hum the melody of the two audio files back to back so as to ignore the speech itself (i.e. the sounds represented by the letters). This will help you get a sense of what exactly the differences in pitch are between your own speech and that of the fluent speaker. By imitating the two audio files back to back, we are training our mouths and vocal cords to be sensitive to the small differences in pitch between our own speech and the fluent speaker's speech, so that we develop the ability to adjust our pitch by very small amounts. The process described thus far can be done using most audio players. You can also use this process to better adjust your accent in reference to consonants and vowels (see Appendix C).

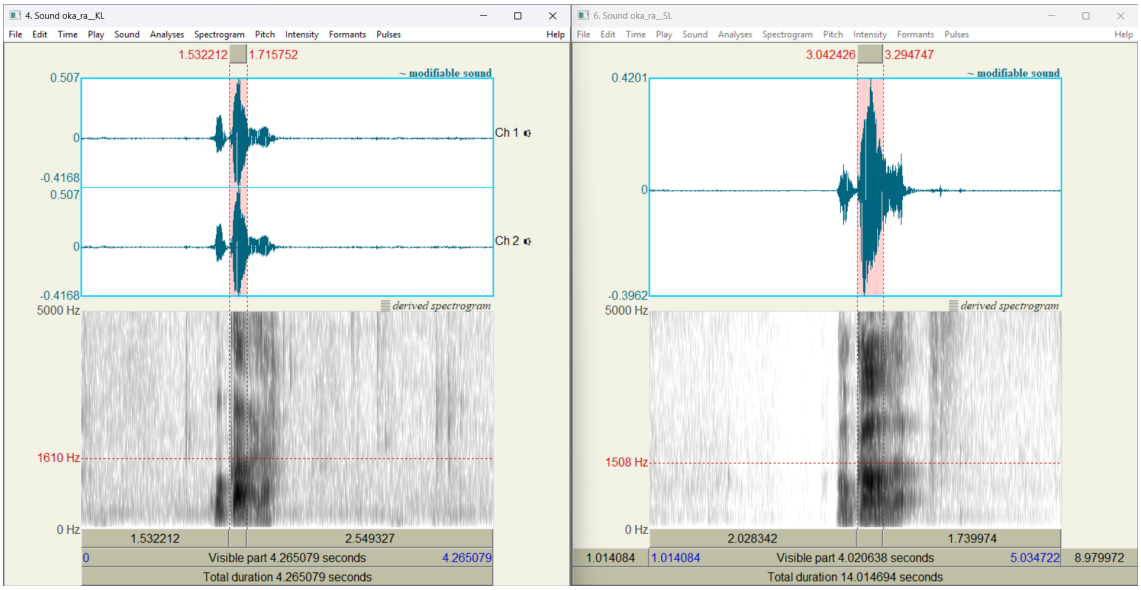
It might feel counter-productive to imitate a single person when all fluent speakers speak slightly differently. To remedy this, you can repeat the process just described but with other audio files and other speakers. In this way, you would be mimicking the process that humans (especially children) subconsciously go through every day; we are constantly picking up different particularities of the speech of people that surround us so that we sound like mosaics of all our environments over the course of our lives.

Working on the pitch of whole words or phrases at a time such as the one in (52) can be difficult as

the details in pitch can get lost when trying to hear the whole word/phrase. We can use Praat to solve this problem: by highlighting certain parts of the audio file, we can isolate different parts of speech, listening to only the parts we are interested in or challenged by. For example, in words with Downstress, you might find it more manageable to pronounce the pitch of the non-stressed syllables, but more challenging to pronounce the syllable with Downstress itself, because the pitch drops so fast. In this case, you could spend more time mimicing the pitch of the Downstressed vowel specifically.

To work specifically on certain pieces of words or phrases, you should highlight the piece of interest in both audio files (yours and that of the fluent speaker) and repeat the process described above (i.e. repeatedly listening to the highlighted section in both audio files back to back by clicking the highest grey bar, and imitating both to get a sense of how to hear and pronounce the differences). In order to highlight a specific section of the audio when it is not clear when this section starts or ends, you should first find where the section starts by placing the cursor at different points in the audio file and clicking play to hear if that is the correct starting place. Once you have found the beginning of the section of interest, you should look for the end of the section by highlighting from the beginning of the section to different points in the audio file and listening to determine where the section ends. This process of finding where a specific piece of speech is in order to highlight it might be tedious the first couple times you do it, but it will quickly become easier.

(54) Comparing specific vowels



By focusing on smaller pieces of speech, you can focus on imitating the pitch in those pieces in more detail, before moving on to other pieces. You should be aware that in natural speech, people often cut words short, blend words together, and don't fully articulate all the syllables. In these cases, it can be difficult to narrow down to what exactly is being said at a precise moment. In these cases, it would be

useful to highlight the most easily chunk-able pieces of the audio file, and work with that.

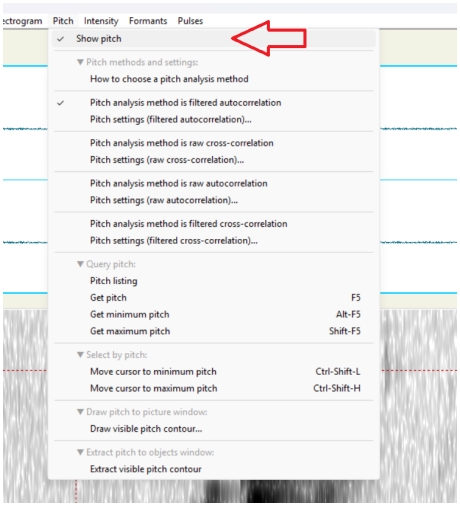
During the imitation process, if you feel like your pitch is sounding closer to that of the fluent speaker you are listening to, you can record another audio file of yourself with your 'updated' pronunciation, and repeat the above process to see if there has been improvement, and see what there still is left to improve.

The process described in this section can greatly improve your perception of Kanien'kéha pitch and consequently, your pronunciation and accent. That being said, it can still be difficult to rely solely on your ears to adjust your speech in the desired direction. In what follows, I will show how you can use Praat's visualization component (i.e. the spectrograms) to adjust your pitch.

5.3.3 Praat as a visualization tool

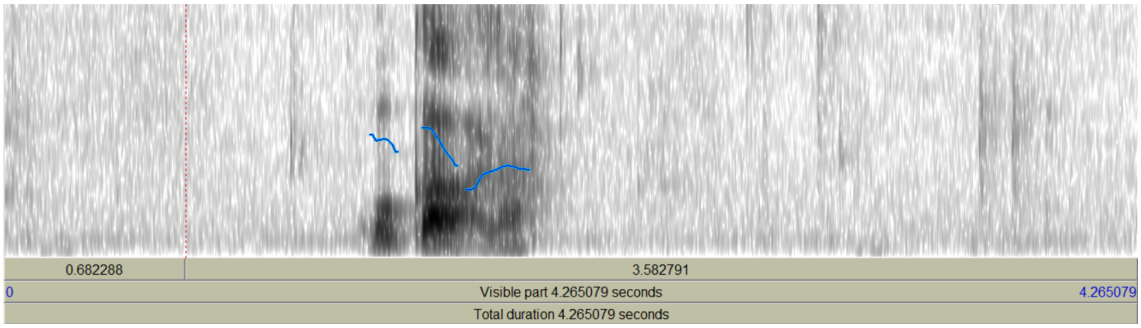
Learning how to use pitch in a language with tone (like Kanien'kéha or Mandarin) for a speaker of a language without tone (like English or French) can be very challenging as it involves paying attention to aspects of speech that you may not be accustomed to. This can mean that solely listening to the speech very carefully can be a less efficient way to learn the accent of the language. Many research projects have shown that visualizing the pitch while hearing and pronouncing it can be very beneficial to learning these languages (e.g. Hardison, 2004; Liu et al., 2011; Wiener, Chan and Ito, 2020). In this section, I will show how you can use Praat's visualization capabilities to improve your pronunciation of the pitch and intonation (pitch over the course of phrases or sentences) in Kanien'kéha. Specifically, I will show how you can use the pitch tracker as a visual guide (accompanying the audio) to pronouncing the pitch patterns. To turn on the pitch tracker in an opened audio file, click the **Pitch** tab at the top of the window. In the dropdown menu, make sure that the option **Show pitch** has a checkmark on its left. If there is no checkmark, click **Show pitch**. To remove the pitch tracker, click the **Show pitch** option again.

(55) Show pitch



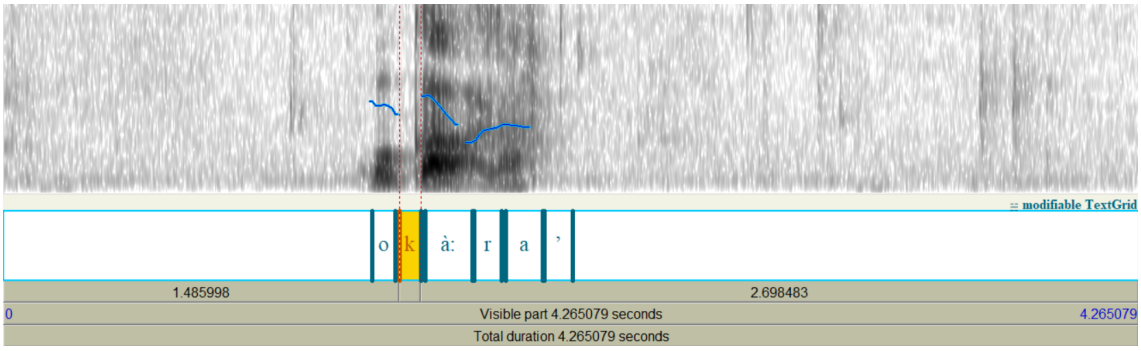
Once the **Show pitch** option is checked, a blue line should appear over the spectrogram (see (56)).[28,29] This is the pitch tracker.

(56) *okà:ra'* 'eye'



The pitch tracker indicates two things. First, it indicates how high or low the pitch is at any given point in the audio file. The higher the blue line is at a given point, the higher the pitch is at that point. For example, in (56), there is a shallowly falling pitch over the first piece of speech, followed by a steep fall in pitch over the next piece of speech, followed by a shallow rise in pitch in the last piece of speech. Second, the pitch tracker shows which parts of the audio file have pitch (i.e. involve vocal cord vibration). The blue line will not appear over parts of the audio file that do not contain pitch. For example, before and after the word in (56) there is no speech, so there is no blue line because there is no pitch. There are also parts of speech that may not contain pitch. Specifically, the Kanien'kéha sounds <k>, <t>, <s>, <h>, and <'> tend to not be pronounced with vocal cord vibration and thus do not have pitch. We can see this in (57), where I've annotated the spectrogram so we can see what sound is being pronounced at each point.

(57)



[28]If it is difficult to see the blue line over the spectrogram, you can make the spectrogram disappear, viewing only the pitch track. You can do this by clicking the **Spectrogram** tab at the top of the screen, and in the dropdown menu, clicking **Show spectrogram**. To make the spectrogram reappear, you can click **Show spectrogram**.

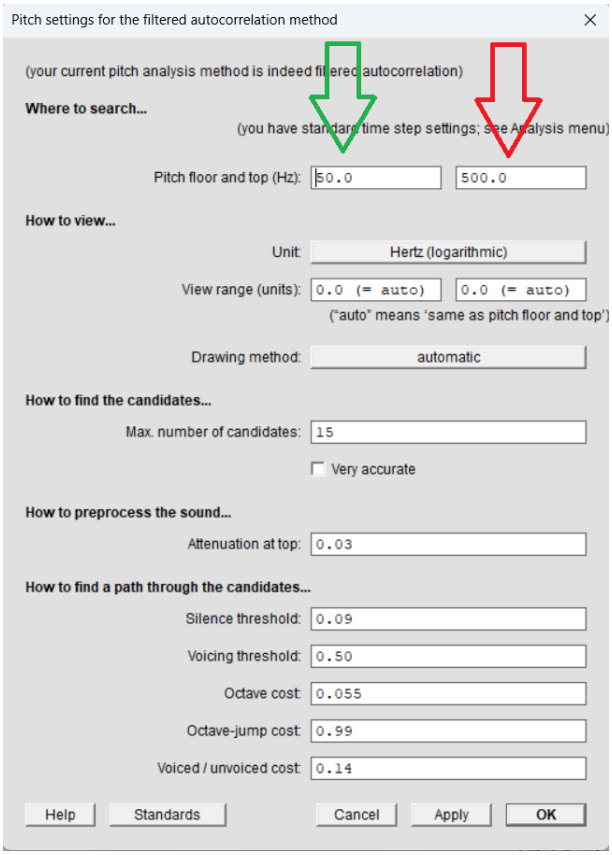
[29]There may be an additional green line over the spectrogram, as well as red dots. To get rid of the green line, click the **Intensity** tab (immediately to the right of the **Pitch** tab), and click the **Show intensity** option in the dropdown menu so that the checkmark next to its left disappears. To get rid of the red dots, click the **Formants** tab (immediately to the right of the *Intensity* tab), and in the dropdown menu click **Show formants** so that there is no checkmark immediately to its left.

As shown in (57), there is pitch over all three vowels, and in <r>, but there is no blue line (i.e. there is no pitch) at three points in the word. There is no pitch over the sounds <k> and <'> (which confirms the statement made above about the sounds without pitch). Additionally, at the end of the stressed vowel <à:>, there is a small break in pitch. This is common for vowels with Downstress: when the pitch drops in a Downstressed vowel, the vocal cords sometimes start vibrating so slowly, they produce 'creak' or 'vocal fry', which does not carry pitch.[30]

You should also ensure that the pitch range is correct, as if it is not, the pitch track can be extremely unhelpful. For people with lower voices (i.e. most men), the pitch floor (the lower bound) should be around 50 Hz, whereas for people with higher voices (i.e. most women), the pitch floor can be around 70-80 Hz. The pitch ceiling for most people can be anywhere between 500-800 Hz (I keep mine at around 800 Hz for the purposes of this guide). You can change the pitch range by clicking the **Pitch**, as shown in (55), then clicking the clicking the option **Pitch settings (filtered autocorrelation)...** in the dropdown menu. In the box that pops up, you can change the pitch range, labelled as pitch floor and top in the top of the box. This is shown in (58), in which the green arrow is pointing to the pitch floor value and the red arrow is pointing to the pitch ceiling value.

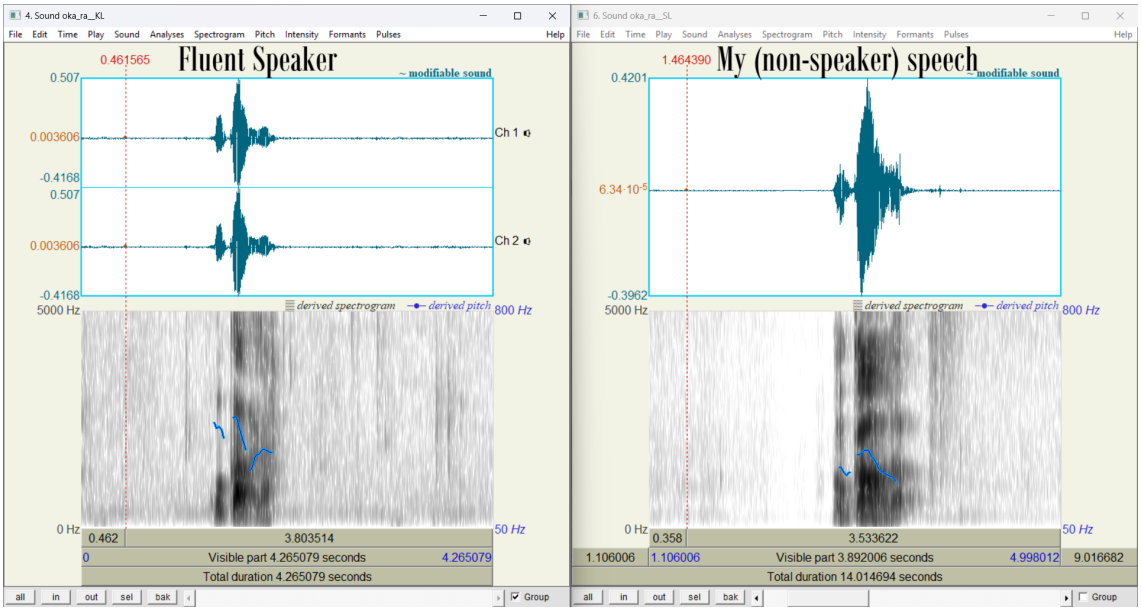
[30]Even though creak or vocal fry is stigmatized in North American speech, there is nothing wrong with this type of vocal cord vibration. Creak is extremely common and normal in the world's languages and does not negatively impact one's voice.

(58) Change pitch range



The blue pitch line can be used to visualize the pitch patterns over the course of words or sentences. Additionally, while we were only using our ears to compare our own tone versus that of a fluent speaker in the preceding section, using the pitch tracker we can now accompany our aural comparison with a visual comparison. One way we can do this is by comparing the overall pitch track in both words. This is shown in (59), in which my (non-speaker) tone in the word *okà:ra'* is compared with that of a fluent speaker. In this case, the fluent speaker is female, and I am male, so the fluent speaker pitch track is higher than mine overall.

(59)



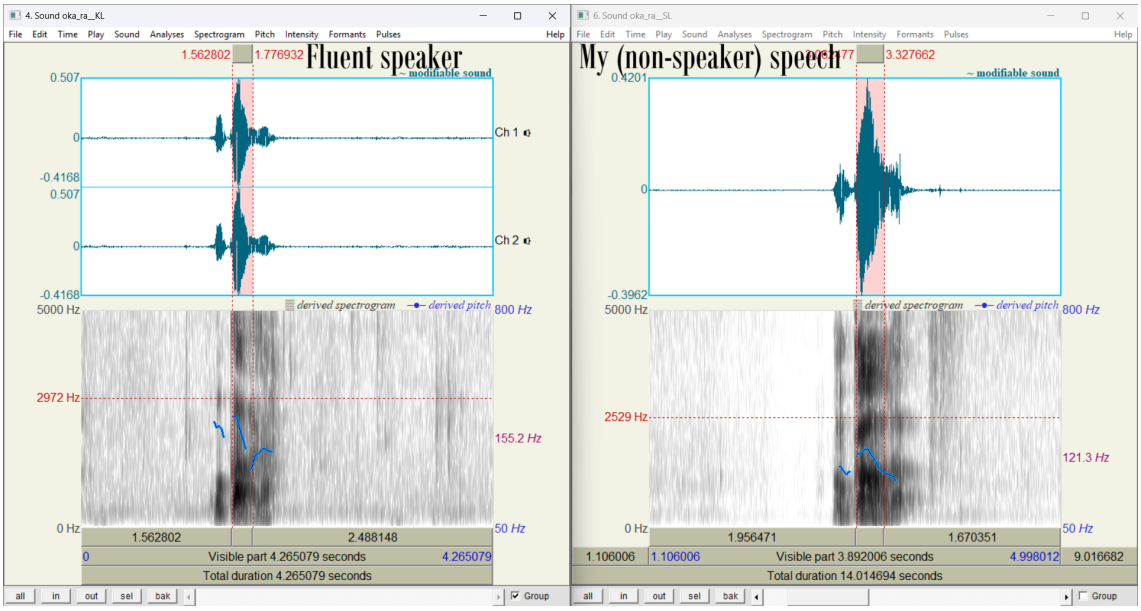
As discussed in section 5.2, Downstress involves the pitch falling steeply over the course of the stressed vowel. We can see that in both the fluent speaker's speech as well as my own that the pitch is falling. However, just by eyeballing it, we can already see that the Downstress in the fluent speaker's speech falls much more steeply and a lot farther than my Downstress. This knowledge can help the process described in the previous section, in which you listen to the audio files back to back and imitate both. For example, now that I know from the graphic in (59) that my Downstress isn't falling fast enough or far enough, I could try to make my Downstress more dramatic in imitating the fluent speaker. If you are unsure, when you are adjusting you pitch, if your new pronunciation is closer to that of the fluent speaker or if you are still off, you can record yourself again with your 'updated' pronunciation and compare your new recording with that of the fluent speaker.

It is also important to note that in adjusting your speech to that of a fluent speaker using visuals, you are only trying to mimic the general trends rather than the specific numbers. For example, in the case of the above spectrogram of the speech of the fluent speaker in (57), it is important that the pitch jumps higher at the beginning of the stressed vowel (although other speakers may not pronounce Downstress like this), and then falls fast. However, it is not important that the pitch jumps exactly 15 Hz, and falls exactly 40 Hz. These numbers will vary from person to person.

While solely eyeballing the pitch tracks can be very helpful, it can sometimes be difficult to see the differences between speakers. For example, what if your Downstress falls steeply and far, but does not occur over the course of the stressed vowel? What if, instead of occurring over the course of the stressed vowel, your Downstress occurs over the course of the last piece of the vowel and the following consonant?

We can check this by examining exactly what the pitch is during each consonant and vowel in the word. For example, in the case of (24), we can find where the stressed vowel is and highlight it to see if I am pronouncing the Downstress over specifically the stressed vowel, and in the same way that the fluent speaker is pronouncing it.

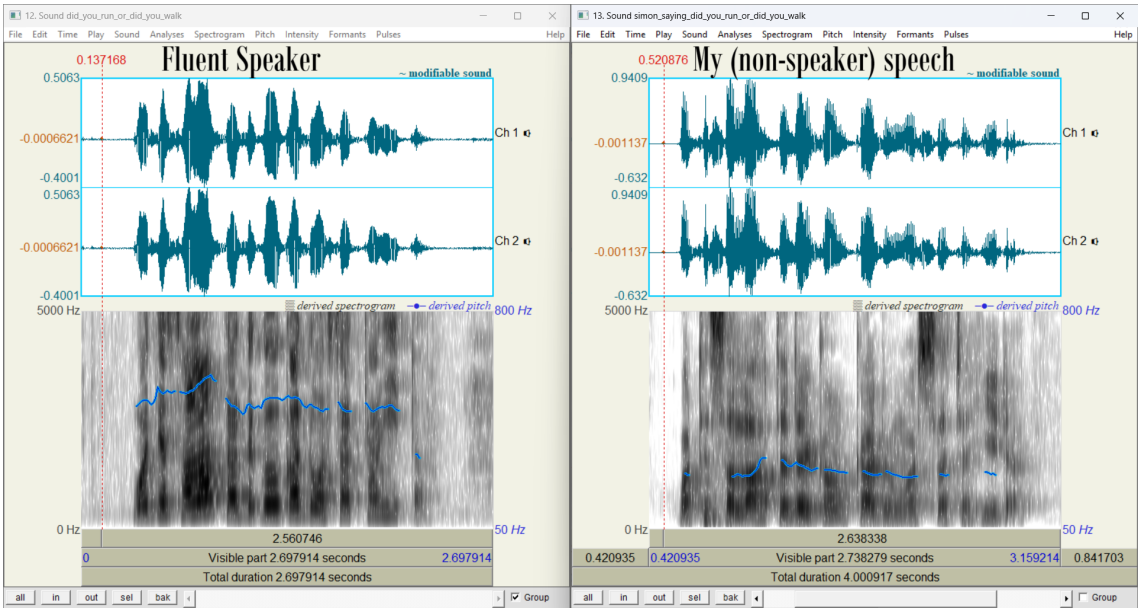
(60)



In (60), the stressed vowels in the two audio files are highlighted. This illuminates another aspect of my Downstress that I can change to sound more like a fluent speaker: whereas the fluent speaker's Downstress starts falling at the beginning of the stressed vowel, mine rises for the first half of the vowel before falling. When practicing, I can take this into account and try to start the fall in pitch at the very beginning of the vowel. In order to practice this, I could speak more slowly.

This process of aurally and visually comparing your pitch over the course of words to that of a fluent speaker can be extended to adjusting your pitch over the course of sentences (i.e. intonation — see section (5.2)). For example, I have a recording of a fluent speaker saying the question *wa'tehsaráhtate' ken káton wahsathahíta'*? 'Did you run or did you walk', so I recorded myself saying this question as well. In (61) are the two spectrograms with pitch tracks.

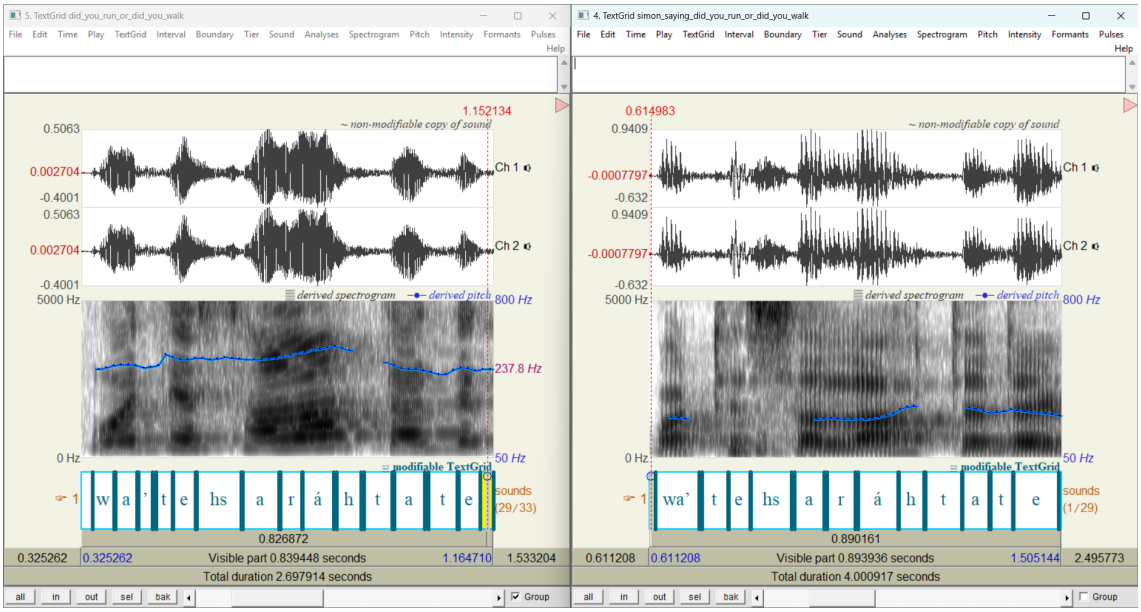
(61) *wa'tehsaráhtate' ken káton wahsathahíta'*? 'Did you run or did you walk'



Like when comparing the tone in individual words, you can simply listen to the audio files repeatedly back to back while imitating the two to get a sense of the differences and similarities between your own speech and that of a fluent speaker. However, unlike visually comparing the pitch in individual words, we cannot simply eyeball the pitch over the course of the two audio files to see what is different and what is the same because the audio files are too long. While we can see differences in pitch between the two (e.g. the speech of the fluent speaker fluctuates in pitch a lot more than mine), it is not clear how I can use that to improve my own accent.

Instead, it is necessary to break sentences up into chunks — preferably words or small groups of words — in order to examine the pitch contours in more detail. For example, we can start with the first word or small group of words — in this case I chose the word *wa'tehsaráhtate'* — highlighting them in both audio files and comparing aurally and visually. In (62) I have zoomed in on this word as well to more clearly see the differences and similarities. Additionally, for the sake of illustration I have annotated these audio files so we can see what the pitch looks like at each sound in the speech chunk. You can easily see what sound corresponds to each section of the pitch track by highlighting the section of interest and listening to it — you do not need to annotate the files to be able to examine the speech in them.

(62)



In (62), we can see some similarities and some differences between the pitch tracks in the two audio files. First of all, the pitch track in my speech is much lower because I have a lower voice. I do not need to change this because this is simply an aspect of my voice and is not relevant to my accent in Kanien'kéha. Second of all, I did not produce any pitch during the second syllable <teh>. This is most likely due to how quietly and quickly I was speaking and is thus not something that I need to focus on. There is, however, a difference between the two pitch tracks that I should work on. Namely, the pitch rises steadily throughout the whole first word in the speech of the fluent speaker, while in my speech the pitch track stays flat until hitting the stressed syllable, where it rises a little. You can use this visualization of the pitch as an aid in pronunciation. While imitating both audio files repeatedly, "singing along" so-to-speak, you can use the pitch track to adjust your pitch. In this example, I can practice raising my pitch over the course of the first word until the stressed syllable, then dropping over the last two syllables.

Once your pitch over the first chunk of speech has been adjusted, you can move on to a slightly bigger chunk, move on to another chunk in the audio file, or return to working on the pitch over the whole audio file. You can also use the pitch track over the whole audio file as a guide to determine what you should work on next: as shown in (61), the chunk following *wa'tehsaráhtate'* rises in pitch slightly before falling, but other than that there is not much pitch movement. This means that there might not be much more work to do in improving my pitch in reference to this specific audio file. I could check what words are being pronounced when the pitch rises after the first word, and then practice saying the whole sentence, recording myself to check the improvement in pitch.

Just like I can use Praat to adjust my pitch in the above examples, you can do so with any audio file.

In sum, I have shown here how you can use Praat to help you improve your pronunciation of the pitch patterns in Kanien'kéha. I showed two principal methods to do so. First, I showed how Praat can be used as an enhanced audio player in order to more precisely listen to the pitch being produced, and adjust accordingly. Second, I showed how Praat can be used to visualize the speech, and how this can be used to make fine-tuned adjustments to your pronunciation of pitch in Kanien'kéha.

5.4 Conclusion

In this chapter, I addressed two central pieces of the Kanien'kéha stress system which can be challenging for learners. The first of these pieces had to do with the relationship between stress and epenthesis. I showed how otherwise complex patterns involving the relationship between stress and epenthesis can be captured via a few regular phonological rules; there are certain consonant sequences that are unpronounceable in Kanien'kéha and therefore must be broken up by epenthetic <e>. If <e> is inserted in a consonant cluster involving a sonorant consonant, it is invisible to stress placement. If <e> is inserted in a sequence of three consonants, it is visible to stress placement. The second aspect of the stress system that can challenge learners had to do with the pitch patterns involved in pronouncing stressed syllables. To address this, I provided in-depth descriptions of the different types of stressed syllables, showing visualizations of the pitch contours involved in each as well. Finally, in the last section I showed how you can use the software Praat to improve your pronunciation of the different stressed syllables and, consequently, your accent.

Appendix D: Using Praat to learn Kanien'kéha vowels and consonants

I showed in section 5.3 how the computer software Praat can be used to improve your pronunciation of the tonal aspects of Kanien'kéha. Specifically, I described how you can use the audio and visual capabilities of Praat to compare your own speech to that of a fluent speaker, in order to improve your accent. Praat can also be used to improve your pronunciation of the vowels and consonants. In this appendix, I will provide pictures of the different Kanien'kéha consonants and vowels in Praat, describing them along the way. I will start with the vowels, then proceed to the consonants.

Vowels

In discussing vowels, I will first describe how to distinguish between vowels and consonants, then how to identify specific vowels. Finally, I will show how you can use these descriptions to adjust your own vowels.

Distinguishing vowels from consonants

There are six vowels in Kanien'kéha: <a, e, i, o, en, on>.[31] There are three ways of distinguishing between vowels and consonants:

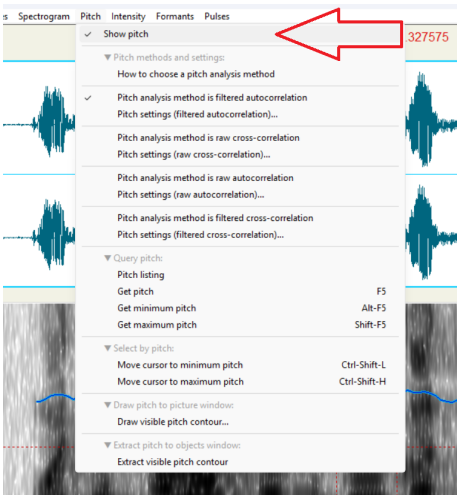
- 1: Voicing and pitch
- 2: Loudness
- 3: Formants

Voicing refers to whether or not there is vocal cord vibration during a specific sound. Voiced sounds involve vocal cord vibration while voiceless sounds do not involve vocal cord vibration. While all vowels in Kanien'kéha are voiced, only some consonants are. You can test whether a sound is voiced or not by placing your fingers on the throat while pronouncing a sound. If there is vibration, it is a voiced sound, if not, it is voiceless. For example, <s> in English is voiceless whereas the vowel <a> is voiced.

In Praat, we can tell which sounds are voiced using the pitch tracker, because all voiced sounds carry pitch. To use the Pitch tracker, click the **Pitch** tab at the top of the window. In the dropdown menu, make sure that the **Show pitch** option has a checkmark to its left. If it does not, click **Show pitch**. You can remove the checkmark by clicking **Show pitch** again.

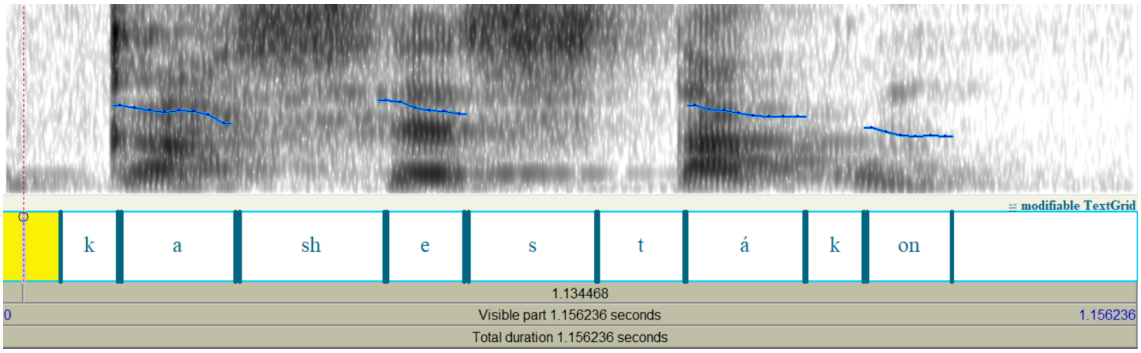
[31] Angle brackets refer to sounds that are written with the Kanien'kéha standard orthography.

(63) Show pitch



When **Show Pitch** is checked, blue lines will appear over the spectrogram. This is the pitch tracker and it tells you what the pitch is over that segment of speech. The higher the blue line is, the higher the pitch is. A blue line will appear only over portions of the spectrogram which carry pitch. This can be seen in the spectrogram in (64), in which the spectrogram is annotated for the sake of clarity.

(64) Pitch tracker

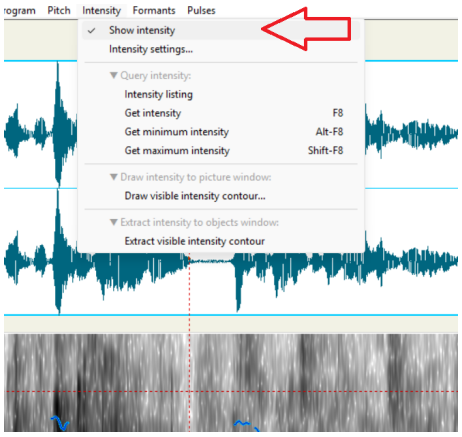


As shown in (64), only the vowels have a blue pitch line over it, while none of the consonants do. This is one way of identifying where the vowels are in a spectrogram. However, as mentioned above, some consonants are also voiced, such as <r>, <w>, <n>, and <i> (y). For this reason, you should not rely on this method.

The second way of identifying vowels in spectrograms is with loudness. When speaking, the vowels are generally the loudest parts of speech. This means that when looking at a spectrogram, the loudness over the course of the recording can help us identify where the vowels are. In Praat, we can do this by using the Intensity tracker (intensity = volume). To use the Intensity tracker, click the **Intensity** tab at the top of the window. In the dropdown menu, make sure that the **Show intensity** option has a checkmark next to

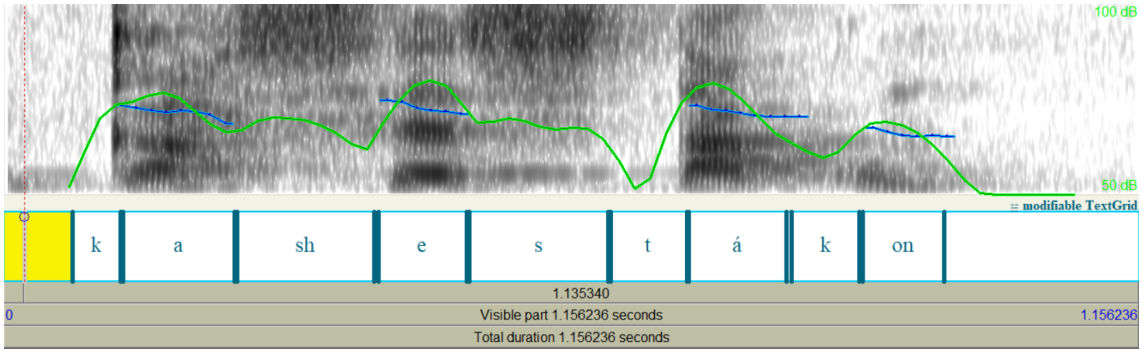
it. If it does not, click **Show intensity** to check it. You can click **Show intensity** to remove the checkmark again.

(65)



When **Show intensity** is checked, a green line will appear over the spectrogram. This is the Intensity tracker, and it tells you how loud the recording is at that specific moment in time. The higher the green line is, the louder the volume is. Since vowels are generally the loudest parts of speech, the Intensity tracker will be the highest over them. This is shown in (66).

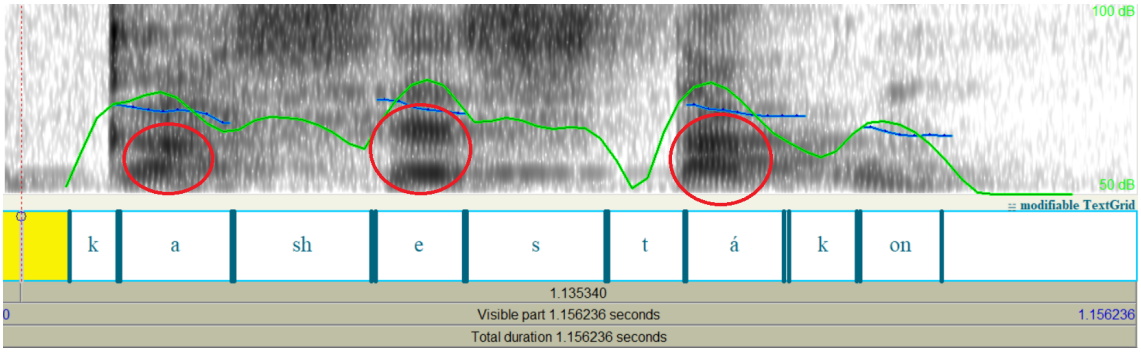
(66)



As shown in (66), the highest peaks of the green line occur over the vowels. This means that we can use the green line to help identify where the vowels are. Like the Pitch tracker, we cannot rely on the Intensity tracker because other sounds can also be loud, and in some cases vowels can be quieter. For example, the nasal vowels <en> and <on> are significantly quieter than the oral vowels.

The third way of identifying which sounds in a spectrogram are vowels is with formants. Formants are darker horizontal bars that go through the vowels. As I will show subsequently, formants not only help identify which sounds are vowels, but which vowel is which. These bars appear darker near the bottom of the spectrogram; the lowest two will be particularly pronounced. Formants are circled in red in the spectrogram in (67). Formants are not visible in the final vowel because it is too quiet.

(67)



As shown in (67), there are only formants where the vowels are occurring. In this way, we can use them to help identify where vowels are in a spectrogram; the areas of a spectrogram with formants might be vowels. Like the other methods for identifying vowels, we cannot rely on this method alone. This is because the sonorant consonants like <n>, <r>, <w>, and <i> (y) also may contain formants. The formants in vowels, however, will in most cases be darker than the formants in consonants.

Combined, the three methods of identifying vowels — pitch, loudness, and formants — are fairly consistent in determining which sounds are vowels. In the following section, I will discuss how you can distinguish between different vowels on a spectrogram.

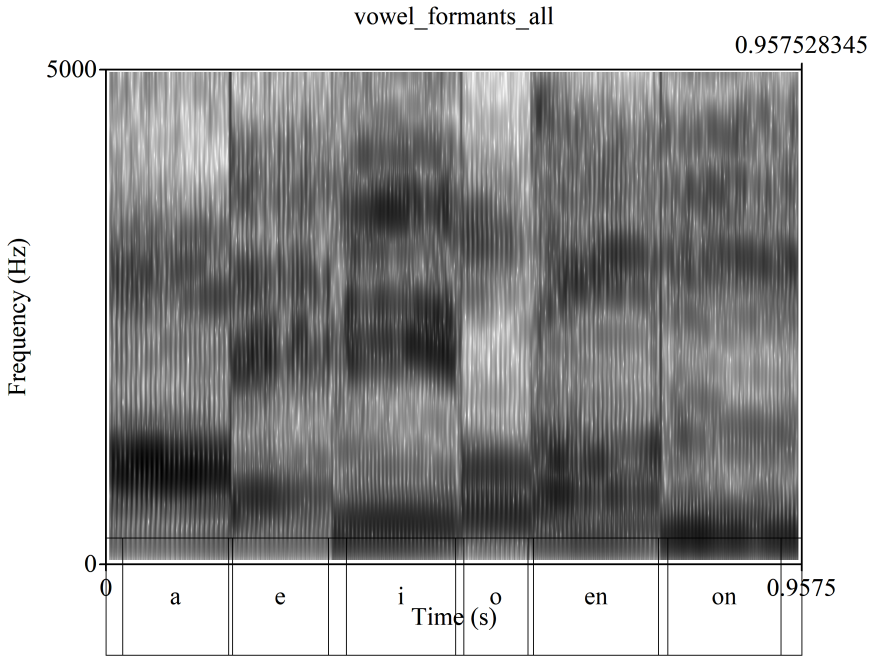
Distinguishing between different vowels

There are two main ways to distinguish between vowels in a spectrogram:

- Formants
- Nasality

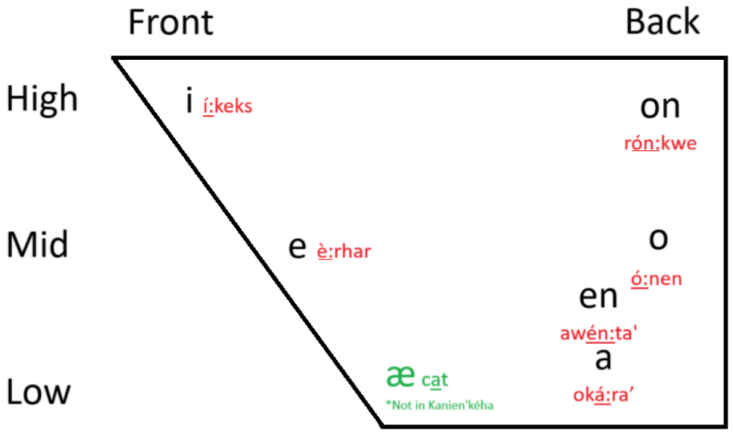
I will first discuss how you can use formants to distinguish between vowels in a spectrogram. Recall that formants are dark horizontal bars that go through vowels. These formants create a sort of barcode for each vowel that helps us identify them. This is because, for each vowel, the formants will be in a different location. For example, in the vowel <i>, the lowest two formants will be far apart from each other, whereas in the vowel <a> they will be very close to each other (if not right next to each other). The different formant patterns for each vowel is shown in (68).

(68)



Although the formants will be in slightly different locations depending on the size of the speaker, and other factors like their sex, there are consistent patterns that hold across all speakers. Before describing these patterns, it is necessary to describe how the vowels in Kanien'kéha are pronounced differently. A vowel chart is presented in (69), which maps where your tongue is for each vowel in Kanien'kéha (and one English vowel, for the sake of comparison).

(69)



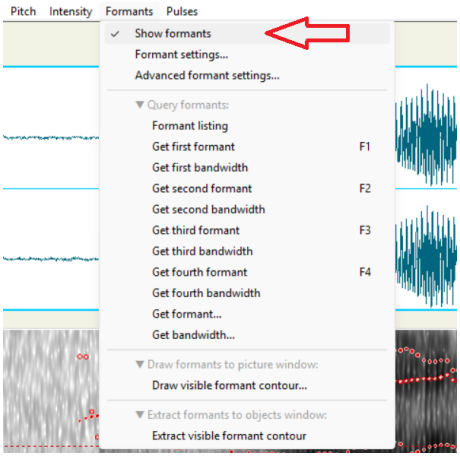
Front refers to the front of the mouth (near the teeth), while High refers to the top of the mouth. This means that, for example, <i> ir pronounced with the tongue at the front of the mouth, near the top whereas <a>

is pronounced with the tongue at the back of the bottom of the mouth.

Knowing where the tongue is for each vowel is important because the lowest two formants in a spectrogram correspond to where your tongue is in your mouth. The lowest formant corresponds to how high or low your tongue is while the second lowest formant corresponds to how far front or back your tongue is. All higher formants are much less relevant to identifying vowels (although we will come back to the third lowest formant when identifing <r> in the non-Ahkwesáhsne dialects of Kanien'kéha).

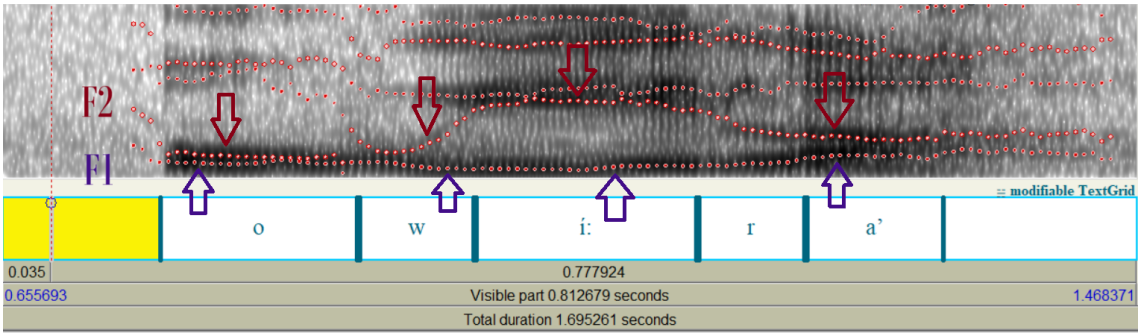
In order to have Praat make clear where the formants are on the spectrogram, click the **Formants** tab. In the dropdown menu, make sure that the **Show formants** option has a checkmark to its left. If it does not, click **Show formants** to insert the checkmark. You can remove the checkmark by clicking **Show formants** again.

(70)



When **Show formants** is checked, red dots organized in lines will appear over the spectrogram. This is the formants tracker. Each line made up of red dots constitutes a formant. For identifying vowels, we are interested in the bottom two. The lowest formant is the first formant (F1), the second lowest is the second formant (F2), and so on.

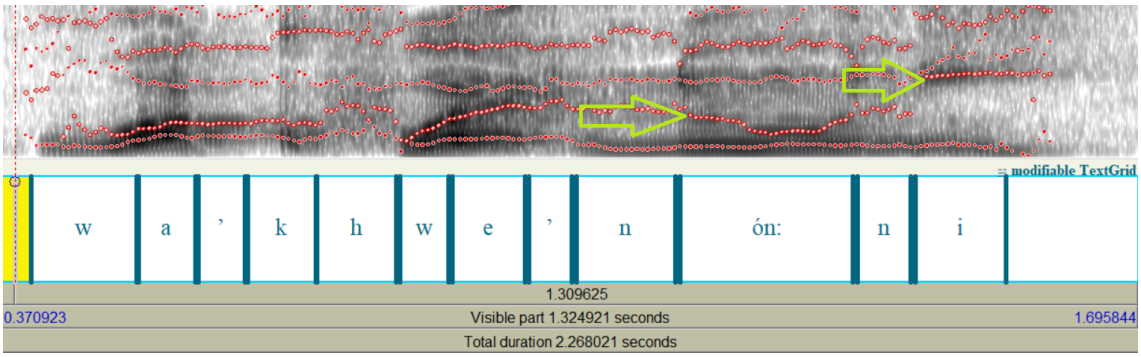
(71)



We can see in (71) how the first two formants can be useful in distinguishing between vowels in Praat. As mentioned above, the first formant (i.e. the lowest red line) helps us identify how high the tongue is when pronouncing a vowel. The higher the first formant is, the lower the tongue is. The lower the first formant is, the higher the tongue is. We can see this in the spectrogram in (71). The first formant is at its lowest point when pronouncing the vowel <i>. This means that during <i>, the tongue is at its highest point. This makes sense when consulting the vowel chart in (69), as we can see that when pronouncing <i>, the tongue is higher than when pronouncing the other two vowels in (71): <o> and <a>. It might be difficult to see, but the first formant is also lower in <o> than it is in <a>, meaning that the tongue is higher in <o> than in <a>. The above vowel chart confirms this as it shows that <o> is higher than <a> but lower than <i>.

The second formant (i.e. the second lowest one) helps us identify how close to the front or back of the mouth the tongue is when pronouncing a vowel. The higher the second formant is, the farther front the tongue is. The lower the second formant is, the farther back the tongue is. We can see this in the spectrogram in (72). The green-yellow arrows are pointing to the second formants in the front vowel <i> and the back vowel <on>.

(72)



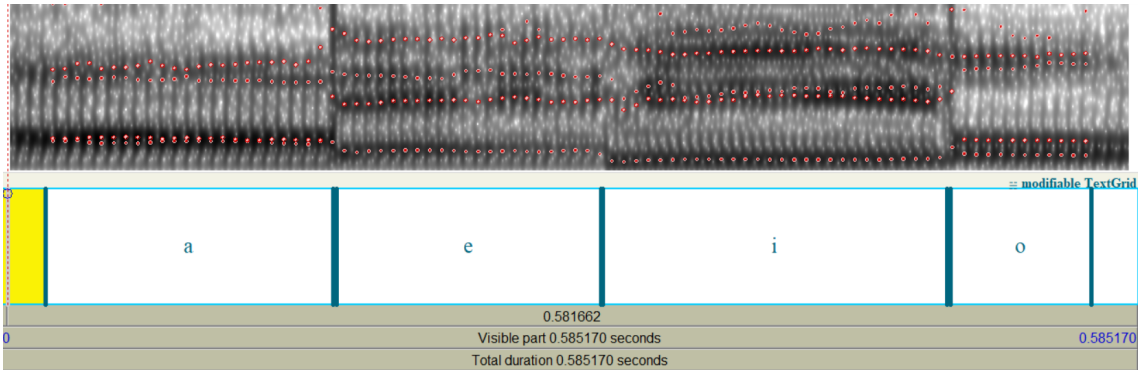
We can see in (72) that the second formant is much higher in <i> than in <on>. This indicates that the tongue is farther forward when pronouncing <i> than when pronouncing <on>. This is confirmed when we look at the vowel chart in (69) as pronouncing <i> involves the tongue the farthest forward and pronouncing <on> involves the tongue at the farthest back point.

We can also see in (72) that the second formant shifts lower over the first part of the <on> vowel, then stays lower, then goes back up at the end of the vowel. This shows us that the speaker's tongue was moving back over the first part of the vowel (towards the back position for <on>), then staying back, and then moving forward at the end of it (towards the position for the following consonant). That is, This makes sense as our tongues can't teleport from position to position. In this way, the lowering and raising of the

formants in Praat allows us to "see" the tongue moving to the desired positions for a specific pronunciation.

Now that we know how the formants can tell us where the tongue is, we can see how to distinguish between the oral vowels (i.e. the non-nasal vowels <a>, <e>, <i>, <o> — I will discuss the nasal vowels shortly) in Praat. We can see this in the picture of the oral vowels in Praat in (73).

(73)



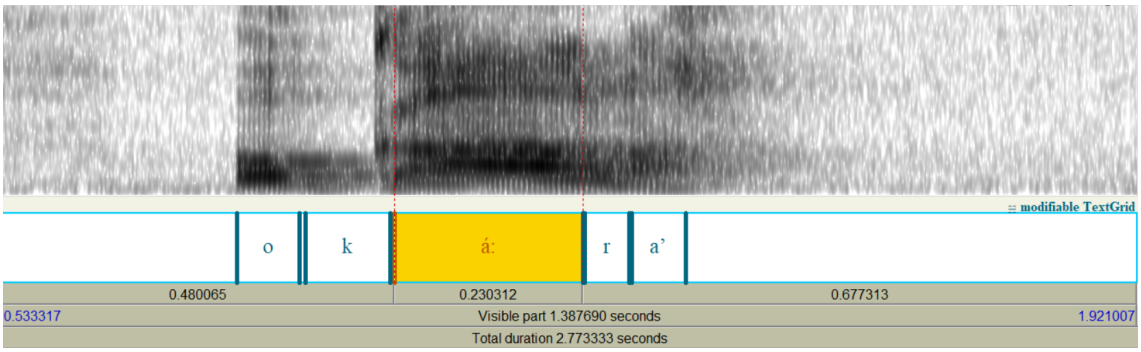
In (73), the first formant is the highest in <a>. This correctly indicates that <a> is the vowel pronounced with the tongue position at the lowest point. We can also see that the first formant is the lowest during the vowel <i>. This correctly indicates that <i> is pronounced with the tongue position at its highest point. The first formant is around the same point for <e> and <o>, correctly indicating that they are pronounced with the tongue at the same height: in between <a> and <i>. While the first formant (i.e. height) in <e> and <o> is very similar, the second formant is not. The second formant in <e> is much higher than the second formant in <o>, correctly indicating that the tongue is farther forward in the mouth when pronouncing <e> then when pronouncing <o>. <i> has roughly the same position of the second formant, indicating that <e> and <i> are pronounced with the tongue at the same frontness point (although with the tongue higher in <i> than <e>). It is difficult to tell from this picture but the second formant for <a> is slightly higher than the second formant in <o>, confirming the placement of the vowels in the vowel chart in (69). In this way, not only can we use the formants to distinguish between different vowels in Praat, we can identify precise placements of the tongue, even though we cannot feel these differences when we produce the vowels. Please note that although the location of the formants will be roughly the same for each speaker, they will vary depending on factors like size and sex.

The second way to distinguish between vowels in Praat is nasality. Specifically, this will help distinguishing between the nasal vowels <en> and <on> and the oral vowels discussed above. When pronouncing oral vowels, the airflow passes solely through the mouth. When pronouncing nasal vowels, on the other hand, the airflow passes simultaneously through the mouth and the nose. Consequently, the nasal vowels are quieter. This is how we can distinguish between nasal and oral vowels in Praat; while the formants in

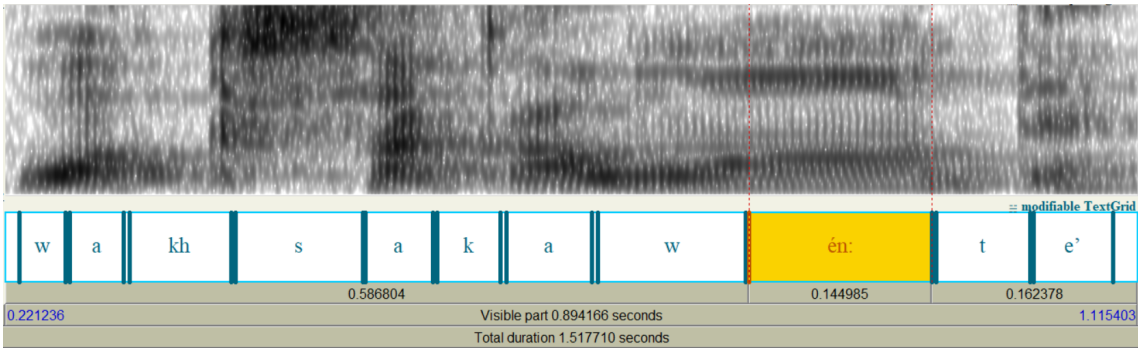
oral vowels will be dark throughout the whole vowel, the formants in nasal vowels will be lighter in parts of the vowel, if not throughout the whole vowel. We can see this in (74).

(74) Nasal vs oral vowel

a.



b.

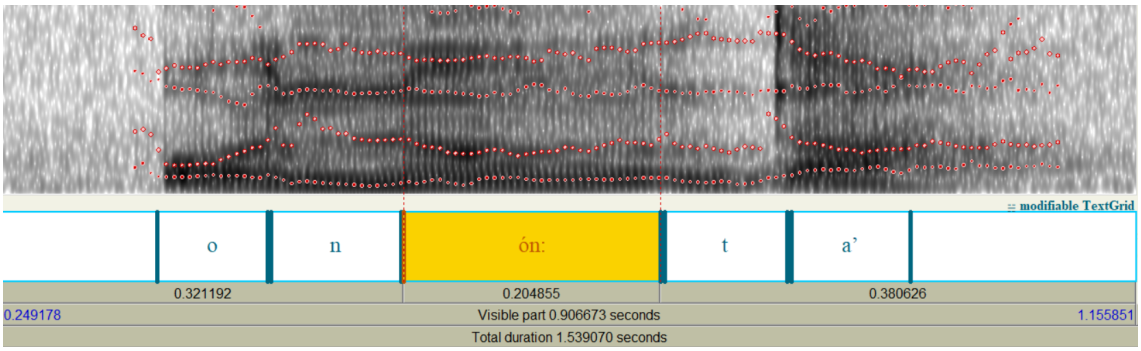


As shown in (74), the formants in the stressed vowel <en> in the word *wakhsakawén:te'* 'I have a high pitched voice'[32], are much lighter than the formants in the stressed vowel in the word *oká:ra'* 'story'.

The nasality can be used in conjunction with the formants to identify the specific vowel. For example, pronouncing the vowel <on> involves the tongue high and towards the back of the mouth (similar to <o>, but higher). This means that the first formant will be very low (for a vowel where the tongue is high), the second formant will also be low (for the tongue to be far back), and the formants will be more faint. We can see these qualities of the formants of <on> in (75).

[32]This can also mean 'I have a loud voice'.

(75)



In (75), we can see that the formants on <on> are quite faint, showing us that this is a nasal vowel. It might be difficult to see in (75) but the first formant is lower than for the other vowels, showing that it is pronounced with a high tongue position. Somewhat surprisingly, in this example the second formant is much higher than that of <o>, and almost as high as it is in <a>, indicating that the tongue position is farther forward than is typically the case for the back position of <o> in this word. Nevertheless, in this way looking at the placement and faintness of the formants can be helpful in identifying vowels.

Please note that although the faintness of the vowel formants can often help us to distinguish between nasal and oral vowels, in some cases this technique is not as useful. This is because in some cases nasal vowels are pronounced with low amounts of nasality (such as in fast speech), resulting in darker formants. In other cases, oral vowels can be pronounced quietly, making the formants more light. For example, see the final vowel in (74b).

Adjusting your vowels using Praat

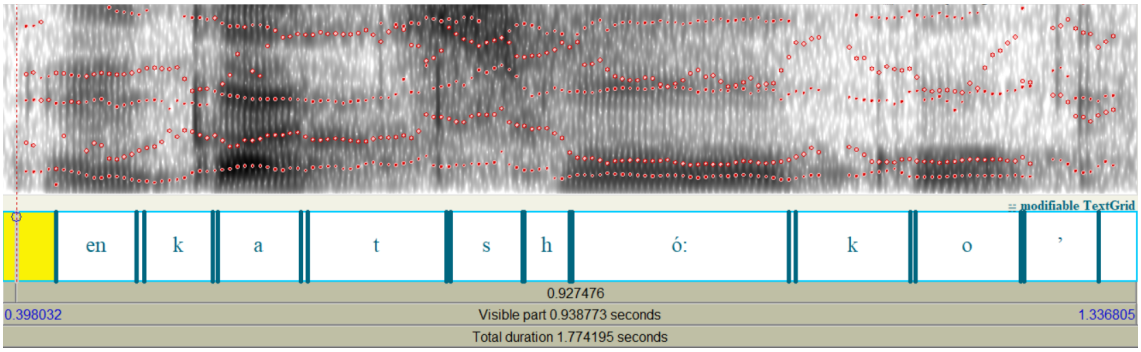
Now that we can distinguish between the different vowels in Kanien'kéha in Praat, we can use it to adjust our own vowels. Although the more you know about Praat, the more informative it will be, it is also sufficient to just know that the formants are important for identifying vowels. We can use the factors described above — the location of the first two formants, and the faintness of the vowel — to examine our own vowels in relation to those of a fluent speaker. Comparing and imitating are important skills because it is one factor in how children learn to speak.

In order to adjust your vowels to be more similar to that of a fluent speaker, we first need to get the audio files, as described in Chapter 5. I will repeat this process again here for the sake of illustration. You should first get an audio file of a speaker that you want to sound more similar to (as different fluent speakers sound different from each other). This could be a family member, a friend, and elder, or someone else. I recommend that the person should be the same sex as you, as it will be easier to compare your speech with theirs. Audio files should be .wav or .mp3 in order for Praat to be able to read them. You

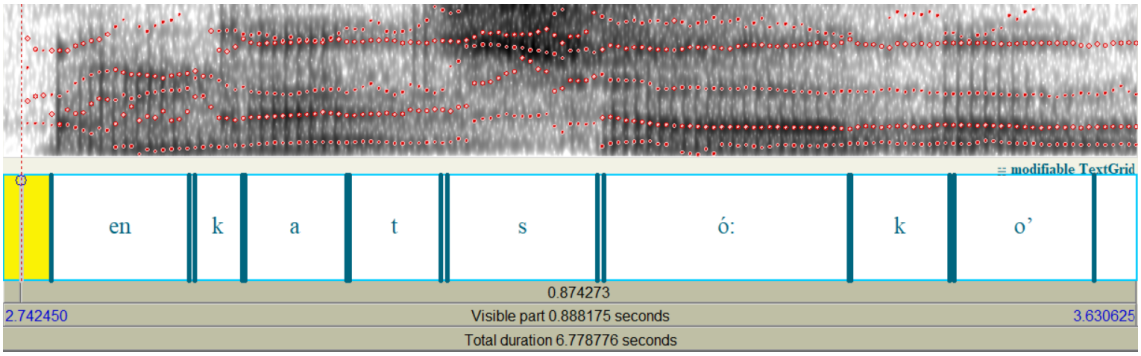
should then record yourself saying the words or sentences that are in the audio file chosen. For example, if the audio file includes your aunt saying the words *skennen'kó:wa ken?* 'Are you well?', then you should record yourself saying this phrase. Once recorded, ensure that the audio file is saved as a .wav or .mp3 file, and upload it to Praat. You can then open these files to view the spectrograms, and compare the formants to see what is different. This can be a visual as well as an auditory comparison. As an example, I have a recording of a fluent speaker saying the word *enkatshó:ko'* 'I will smoke', and I recorded myself saying this word as well. The two spectrograms are shown in (76).

(76) Comparing my vowels to those of a fluent speaker

a. Fluent speaker's speech



b. My speech



There are many differences between these two pronunciations of the same word, but for the purposes of illustration, I will focus on the stressed vowel <ó:>.

Using the spectrograms, we can actually see if we are pronouncing something different from the fluent speaker, and in some cases get a sense of what we can do to adjust our own pronunciation. Specifically, since formant placement corresponds to tongue placement, we can use the formants to adjust our pronunciations. In the case of the stressed vowel <ó:> in (76), we can see that the first two formants in my stressed vowel are farther apart than the first two formants in those of the fluent speaker. That is, the first formant is too low and the second formant is too high. The first formant being too low means my tongue is too high. The

second formant being too high means my tongue is too far forward. This means that, in order to better pronounce this vowel, I need to lower my tongue and move it back more. Now, this is easier said than done, as it is not always clear where your tongue is in your mouth, and how to move it to another position. To aid in this process of finding the 'correct' tongue position, I recommend using the Kanien'kéha vowels as points of reference. For example, I know that my vowel in this word needs to involve a lower tongue position. The lowest vowel in Kanien'kéha is the vowel <a>. I can practice pronouncing the <o> vowel next to the <a> vowel, saying 'oaoaoaoa' to get a sense of what the tongue movement feels like when moving up and down (*Note: the lips are also rounded in <o> but not in <a>*, so this will also be a difference). Once you have a sense of this motion, you can do this lowering motion a little bit from <o> so that the tongue is just a little bit lower. You can then re-record themselves to see if this sounds and looks closer to that of the fluent speaker.

Even if you do not want to work with the specifics of what each formant shows, you can still work with the visual to see if your own pronunciation is different from that of the fluent speaker. This technique, in combination with closely listening to each vowel can greatly improve your pronunciation of vowels in Kanien'kéha. In the following sections, I will show how similar techniques can be used for adjusting your consonants and tone.

Consonants

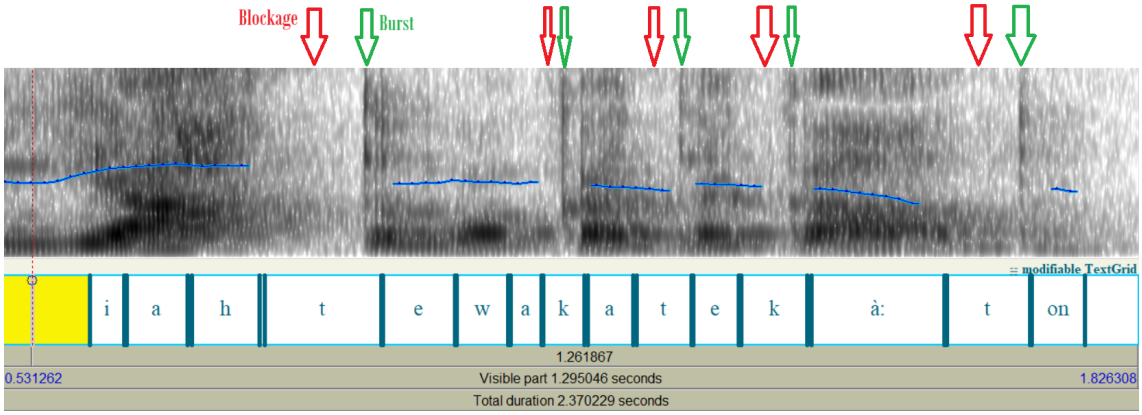
In this section, I will describe how you can use Praat to improve your pronunciation of the consonants in Kanien'kéha. Unlike the vowels, the consonants cannot be identified with solely the formants. For this reason, I will go through each consonant (or group of consonants), describing how they look in Praat, and how we can use this information to adjust our pronunciation of said consonants. Since the specific comparison processes described in the previous section as well as in section 5.3 (i.e. using Praat as an enhanced audio player and as a visual comparison tool) are applicable here as well, I will not repeat them. Instead, for each consonant I will point to some aspects that might be challenging for learners and how these aspects appear in Praat.

<t> and <k>

The two consonants <t> and <k> (pronounced like English <d> and <g>, respectively) are pronounced in very similar ways, and so consequently they look very similar in Praat. While all other sounds in Kanien'kéha involve air flowing through the mouth or nose, <t> and <k> involve a blockage. That is, the tongue blocks all airflow in the mouth (in the case of <t> the tongue blocks the front of the mouth

and in the case of <k>, the tongue blocks the back of the mouth). Since there is still air coming up from the lungs and it has nowhere to go, pressure starts building up. Then the tongue releases the blockage, resulting in all of the pent up air bursting out of the mouth. In this way, there are two parts of these sounds: the blockage and the burst of air. This is exactly what we can see in Praat. <t> and <k> will look like spaces with light shading (i.e. near-silence) during the blockage, followed by a dark vertical line during the burst. This is shown in the spectrogram in (77).

(77) *iah tewakatekà:ton* 'I didn't start a fire'



In (77) we can see that each <t> or <k> consists of a lighter area during the blockage followed by a vertical line during the burst of air.

As with the vowels, if you are interested in if your <t>s and <k>s are sounding like those of a fluent speaker, you could record yourself and compare your blockages and bursts to those of a fluent speaker in Praat. However, since these two sounds are quite similar to the English sounds <d> and <g>, it is unlikely that these sounds will contribute to learners sounding like non-fluent speakers. That being said, in certain contexts, they might. Namely, when <t> or <k> is pronounced immediately before another <t> or <k>, the sound is different in Kanien'kéha than it is in English.

(78) <t> and <k> sequences

a. *a**tk**ahráhnha* 'glasses'

b. *a**kt**áhko'* 'I ought to take it out'

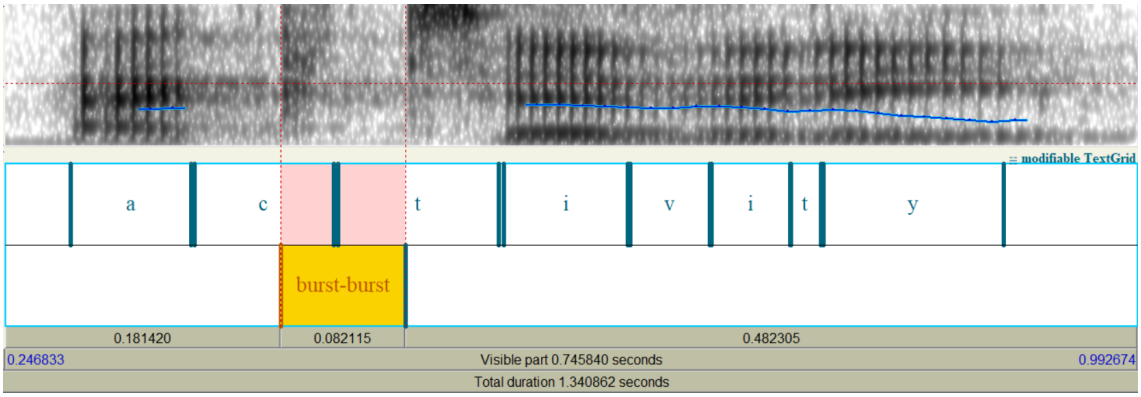
c. *wa'ka**tt**akwaríhsion* 'I'm a straight person'

d. *a**kk**à:ra'* 'my glasses'

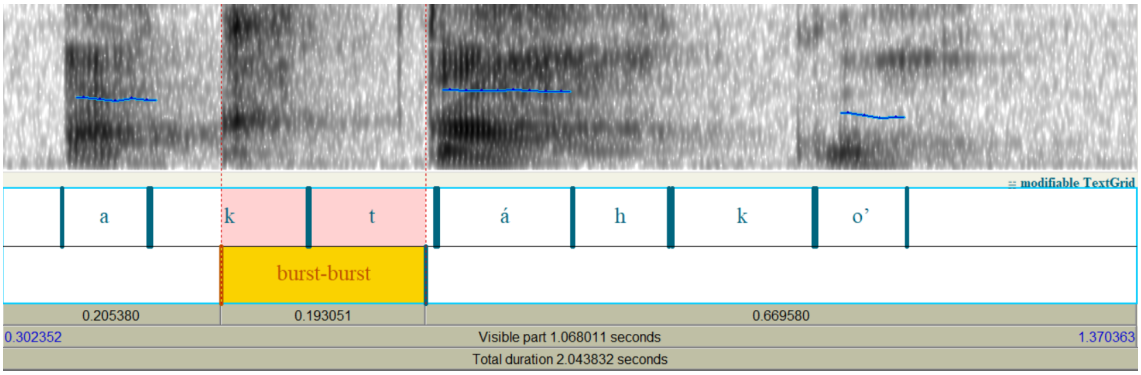
In these contexts, <t> and <k> are pronounced closer to English <t> and <k>. That being said, the only sound sequence of those in (78) that exists in English is <kt> (<ct>) such as in *tractor* and *activity*. However, the <kt> sequences in Kanien'kéha are not pronounced like the <ct> sequences in English.

Specifically, the <k/c> sound is pronounced with much more force in Kanien'kéha <kt> sequences than in English <ct> sequences. This results in there being more time in between the burst of the <k/c> and the following sound. We can see this in the spectrograms in (79) in which there is much more time between the burst (the vertical line) of the <k/c> and the following burst in Kanien'kéha than there is an English. For the purposes of clarity, I call the time between the burst of the <k/c> and the following burst burst-burst time.

(79) a. English



b. Kanien'kéha



Before discussing the differences in strength of the burst in English versus Kanien'kéha, it is necessary to point out that the Kanien'kéha word was pronounced more slowly than the English one. For this reason, we should not be comparing absolute values (e.g. the burst-burst time in English is 0.1 second whereas the burst-burst time in Kanien'kéha 0.2 sec), but rather we should be comparing the burst-burst times to the rest of the words they are part of.

As shown in (79) the burst-burst time is proportionately much longer in Kanien'kéha than in English. The burst-burst time in the English word is about the same length as the longest vowels in the word (<a> and <i>). In Kanien'kéha, on the other hand, the burst-burst time is significantly longer than the longest vowel (<á>) in the word. The reason the burst-burst time is so much longer proportionately in Kanien'kéha

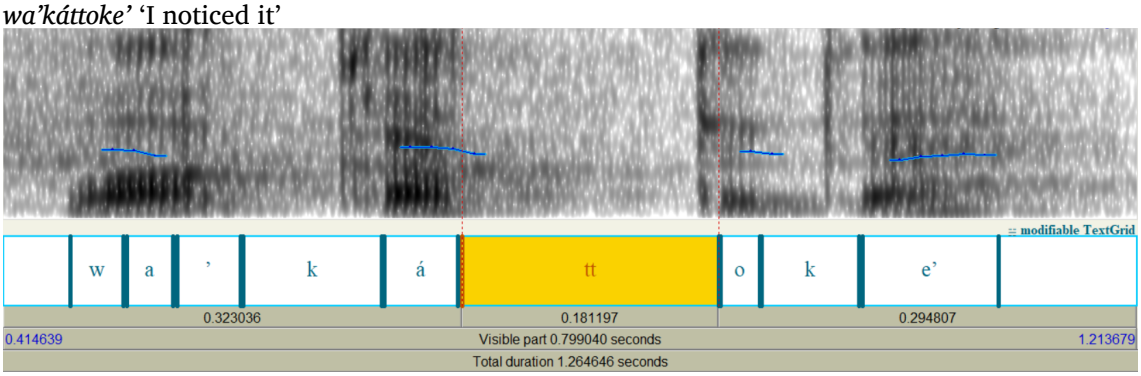
is because it is pronounced with more force than the same consonant sequence in English. This is the case with <tk> sequences (e.g. (78a)) in Kanien'kéha as well.

Since we can see the amount of force put into pronouncing <k> or <t> in Praat, you can record themselves pronouncing words with <kt> or <tk> sequences and compare the burst-burst time with the burst-burst time in a recording of a fluent speaker. You can then adjust the force put into pronouncing these consonants depending on the burst-burst times.

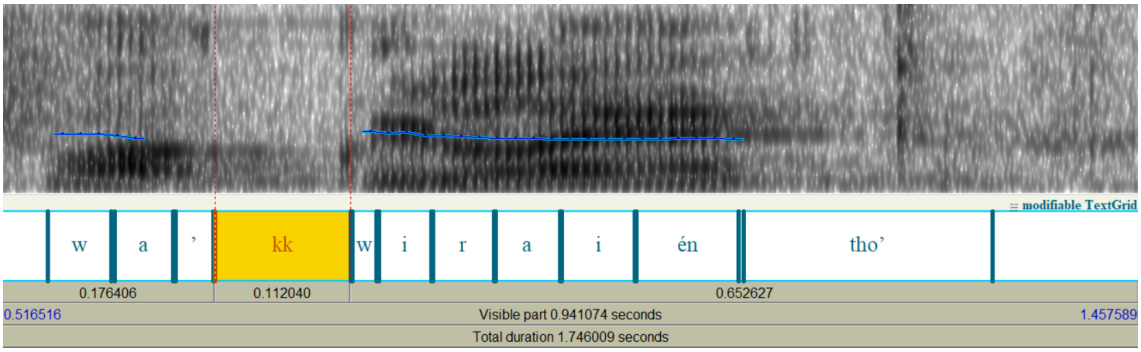
<kk> (e.g. (78d)) and <tt> (e.g. (78c)) sequences are pronounced differently depending on the community you come from. In Kahnawà:ke and Kanehsatà:ke, the first consonant in <kk> and <tt> sequences is pronounced with more force, like in <tk> and <kt> sequences. In Ahkwesáhsne, some speakers will pronounce these sequences like in Kahnawà:ke, but others will pronounce them differently. For these speakers, the first <k> or <t> is softened so that there is no burst. The closest English equivalent for this way of pronouncing <tt> would be in a phrase like *cat dance*, when there is no burst from the <t>. The closest English equivalent for this way of pronouncing <kk> is in a word like *backgammon* where there is no burst from the <ck>. In Praat, a <kk> or <tt> sequence where the first sound is softened will look like one <k>/<t> with an extra long blockage. Examples are shown in (80).

(80) softened

a. *wa'káttoke'* 'I noticed it'



b. *wa'kkwiraiéntho'* 'I planted a tree'



The spectrograms in (80) show that <tt> and <kk> look like one <k>/<t> with an extra long blockage.

The fluent speaker saying the word in (80b) whispers everything after the stressed vowel <én> which is why we can only see the burst of the <t>.

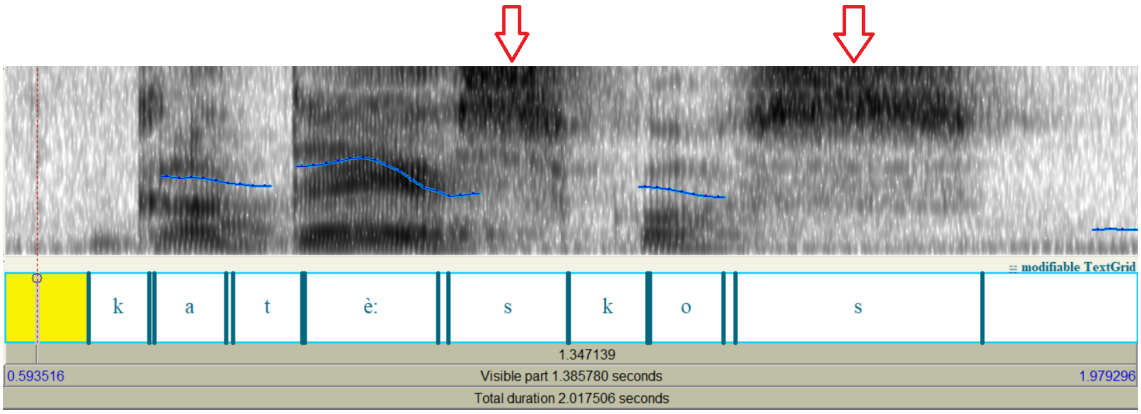
When using Praat to improve your pronunciation of the softened <tt> and <kk> sequences, you could compare the blockage time to see if it is comparable to that of the fluent speaker of whom you have a recording.

In this section, I have described how to identify the two sounds <t> and <k> in Praat, and drawn attention to some differences between these sounds and the corresponding ones in English. You can use this knowledge to know what to look for when comparing your speech to that of a fluent speaker using Praat. If there are other differences between your <t>/<k> and that of a fluent speaker in Praat, you should highlight those pieces of the audio and listen to them to see if you can hear a difference, and then practice saying the difference to adjust your pronunciation.

<**s**>

The Kanien'kéha consonant <s> can either be pronounced like English <s> or English <z>.[33] These sounds are pronounced by placing the tongue tip quite close to the upper teeth so that it creates a small space where the airflow goes through. This creates the high pitch hissing noise that we know as <s>. Since <s> is high pitched, it appears on Praat as a thick black bar at the top of the spectrogram. An example of this is shown in (81).

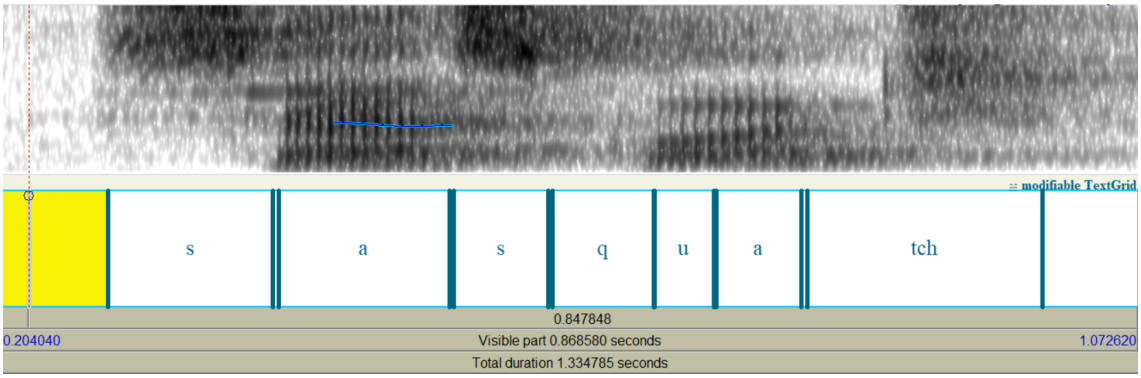
(81) *katè:skos* 'I get into water'



The pronunciation of <s> in Kanien'kéha is very similar to that of <s> in English. However, there is one difference that you should be attentive towards. In Kanien'kéha, <s> tends to be much longer than English <s>. We can see this by comparing the spectrogram in (81) where <s> can be quite long to the spectrogram in (82) of me (an English speaker) saying the word *sasquatch*.

[33]Kanien'kéha <s> is pronounced like English <z> when followed by a vowel and preceded by either a vowel, a glottal <'>, or nothing (i.e. at the beginning of a word).

(82) *sasquatch*

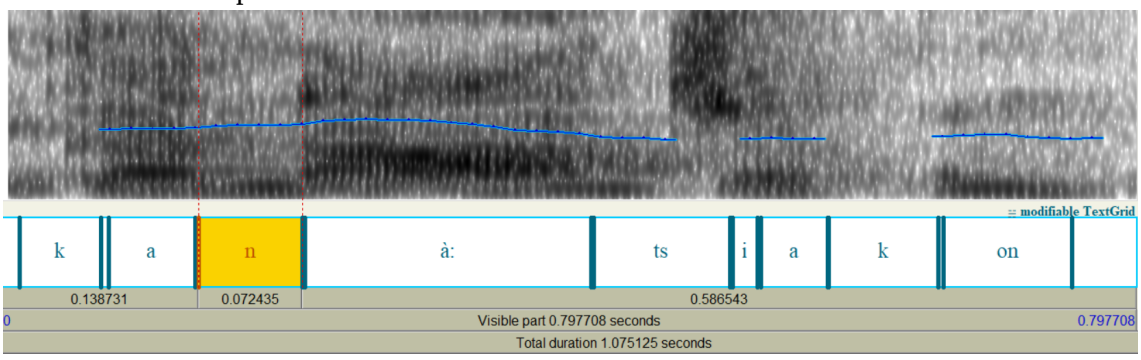


While the <s> at the beginning of the word in (82) is longer, the second one is much shorter. In this way, not all <s>s in Kanien'kéha are longer than English <s>s, but it is something you should look out for when analyzing one's speech using Praat. For this reason, when comparing one's speech to that of a fluent speaker, you should be attentive to how long one's <s> is in comparison to that of the fluent speaker, and adjust accordingly.

<**n**>

The Kanien'kéha consonant <n> is pronounced the exact same as the English consonant <n>. The tongue touches the roof of the mouth near the upper teeth to block the airflow (like with <t>), but unlike with <t>, the airflow redirects to the nose. In Praat, this looks like a light vowel. This is shown in (83).

(83) *kanà:tsiakon* 'in the pail'



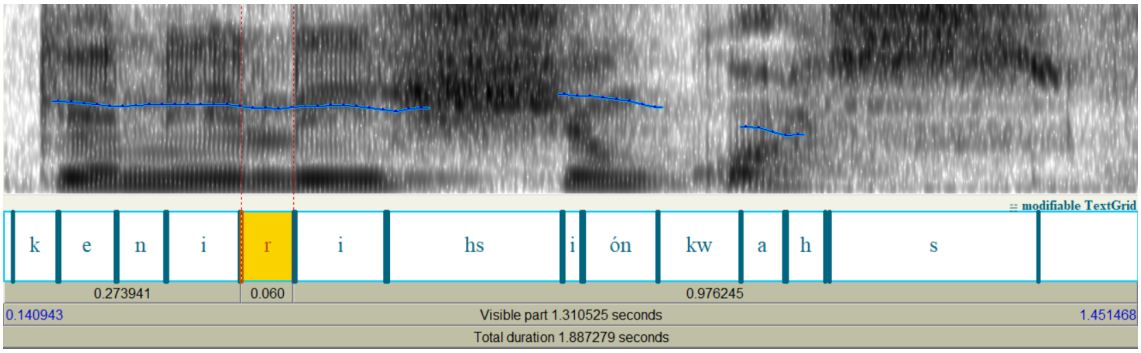
Since Kanien'kéha <n> is so similar to English <n>, I will not compare my <n> to that of a fluent speaker in Kanien'kéha. You could still verify in Praat that your <n> looks the same as the <n> pronounced by fluent speakers.

<r>

<r> in Kanien'kéha is pronounced differently depending on the community you come from. In most of the communities, <r> sounds closer to English <r>, but in Ahkwesáhsne it is pronounced closer to English <l>. Since this thesis focuses on the Ahkwesáhsne dialect, I will begin by discussing the English <l>-sounding <r>.

Ahkwesáhsne <r> in Praat looks like a light vowel. That is, it will have formants (thick black bars) running through it, but the formants will be a lighter shade of grey. While Ahkwesáhsne <r> is a lighter shade of grey than the vowels, it is a darker shade of grey than <n>. This is shown in (84).

(84) *kenirihsiónkwas* 'them two women take it all apart'

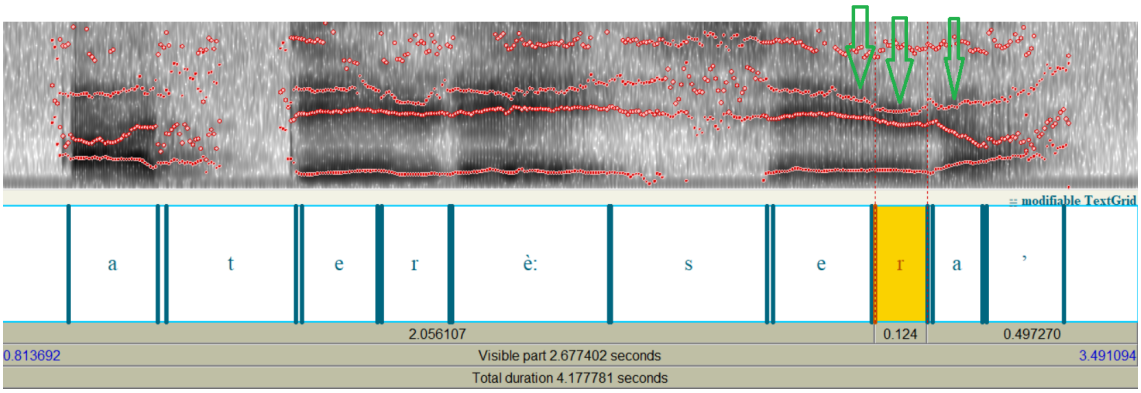


As with <n>, I will not describe how to adjust one's Ahkwesáhsne <r> because it is so similar to English <l>. That being said, many fluent Kanien'kéha speakers in Ahkwesáhsne pronounce <r> as something in between the English <l> sound and the <r> sound in the other dialects. If you would like to sound like one of these speakers, you should take a recording of that speaker and record themselves, and listen closely while examining the <r> sound on Praat to find differences.

The <r> in the other dialects (which I will call the Kahnawà:ke <r> for the sake of parsimony) looks different than Ahkwesáhsne <r>. Just like vowels, Kahnawà:ke <r> can be identified using the formants. Specifically, the third formant (the third lowest) is much lower in Kahnawà:ke <r>. This means that you can also see the third formant dropping in the preceding sound towards the <r>, and then going back up after. We can see this in the following spectrogram in which the third formant is indicated by the green arrows. The low third formant is visible in both <r>s in the following example, but the more clear example is the second one.

(85) Kahnawà:ke <r>

aterè:sera' 'grandchildren'

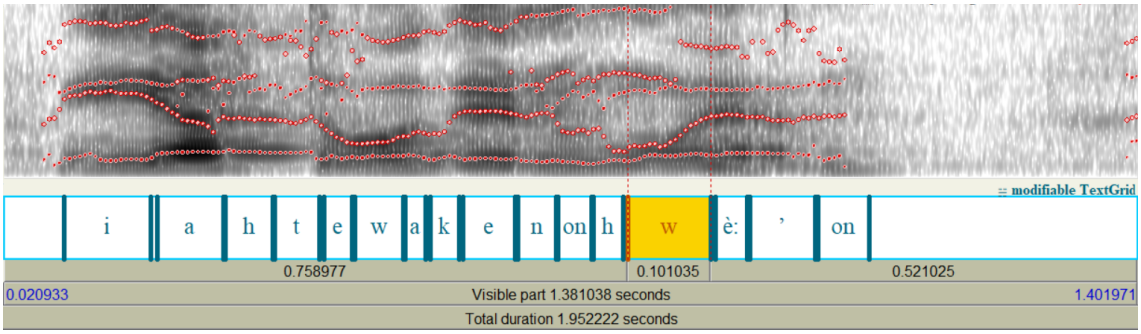


Since this sound is not in English, it can be quite challenging for learners. This might result in you pronouncing Kahnawà:ke <r> either like English <r>, or like a flap (like the <t> in the English word *water*). You can check whether you are pronouncing Kahnawà:ke <r> correctly by looking at the third formant. If the third formant in your <r> falls much more steeply than the third formant of an L1 speaker, then your pronunciation is closer to an English <r>. If the third formant does not drop enough (or at all), your pronunciation is probably closer to a flap.

<**w**>

Kanien'kéha <w> is quite similar to English <w>. It is similar to pronouncing Kanien'kéha <on> in that it involves simultaneously raising the back of the tongue and protruding the lips (although there is less protrusion in Kanien'kéha <w> than in English <w>). In Praat, <w> can be identified by the second formant (i.e. the second lowest one). In <w>, the second formant starts very low and rises towards the next vowel.

(86) *iah tewakenonhwè:'on* 'I didn't like it'



As shown in (86), the second to lowest red line (i.e. the second formant) starts low for <w> and moves

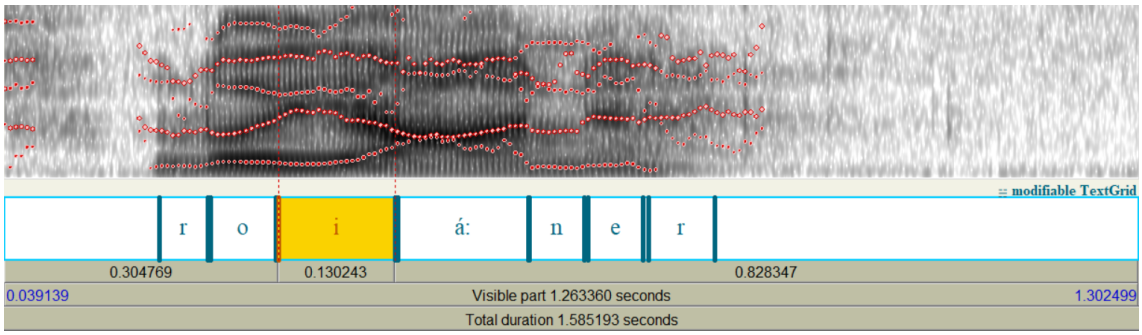
higher during the course of it.

Since Kanien'kéha <w> is so similar to English <w>, I will not compare my speech here. Some things you could look out for include the rate at which the second formant lowers at the beginning of <w>, and the rate at which it rises at the end.

<**i**> (**y**)

When <i> is followed by a vowel, it is pronounced like English <y>. It is also similar to the Kanien'kéha vowel <i> in that it involves the front of the tongue moving to the front of the roof of the mouth. In Praat, <i> can be identified by its second formant. The second formant starts high, and falls over the course of the consonant.

(87) *roiá:ner* 'chief'



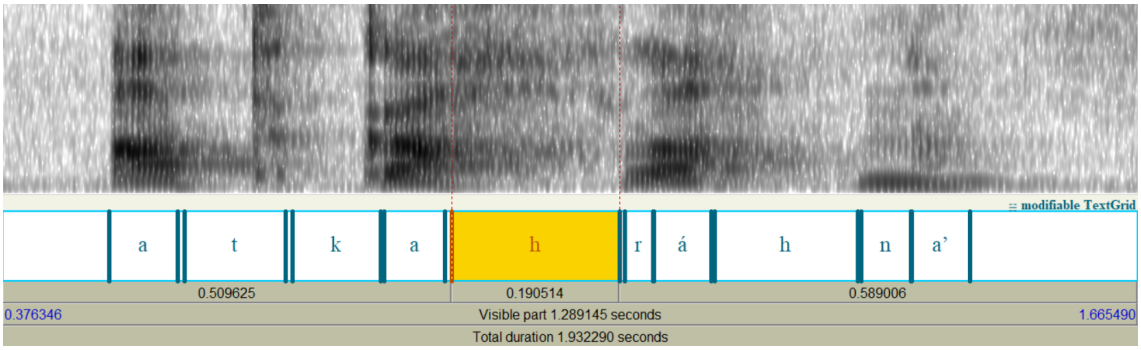
I do not compare my own speech here because Kanien'kéha <i> is very similar to English <i>. Like with <w>, some things you could look out for when comparing your <i>s to that of a fluent speaker include the rate at which the second formant rises at the beginning of <i>, and the rate at which it falls at the end.

<**h**>

Kanien'kéha <h> is pronounced basically identically to English <h>.[34] <h> is pronounced, essentially, by passing air through the vocal cords. Consequently, in Praat <h> looks like light static (and potentially with light formants).

[34]The difference between the two has to do with where it can be pronounced in a word. Whereas English <h> is very restricted in terms of where it can be pronounced (at the beginnings of words or between vowels, and only at the beginning of stressed syllables), Kanien'kéha can be pronounced almost anywhere in the word (other than at the beginning or the end).

(88) *atkahráhnha'* 'glasses'



While there are two <h>s in (88), the first is a better example of what <h> tends to look like.[35]

As stated above, <h> is pronounced very similarly to English <h>. However, there are certain contexts in which Kanien'kéha <h> is pronounced, but English <h> is not. The most common of these in Kanien'kéha is when <h> is immediately preceded by a vowel and immediately followed by a consonant (like in the two instances of <h> in (88)). Since <h> is never pronounced in this context in English, English speakers might find it difficult. Specifically, you might either over-enunciate the <h> so that it is way too long, or under-enunciate it, in which case it is not audible. You can use Praat to check these things.

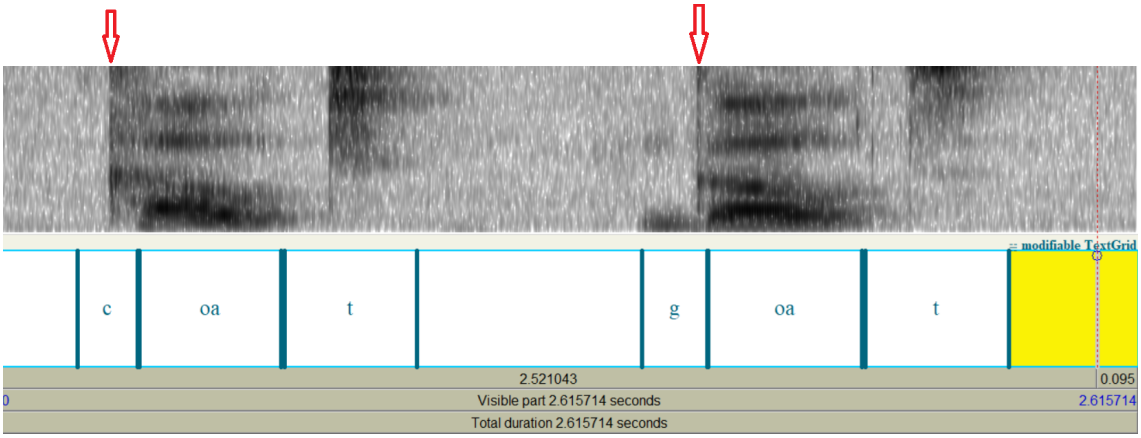
Also unlike English, Kanien'kéha <h> is pronounced following consonants such as <t>, <k>, and <s>, creating the consonant sequences <th>, <kh>, and <sh>.[36] Interestingly, these consonant sequences sound very similar to the way that the first consonant sounds in English. That is, Kanien'kéha <th>, <kh>, and <sh> sounds like English <t>, <k>/<c>, and <s>. From what I have found, however, these Kanien'kéha consonant sequences do not always sound identical to their English counterparts (although they sometimes do). I will discuss the stop-h sequences <th> and <kh> first.

Recall that stops are made up of two components: a blockage and a burst. The blockage is when the air is blocked from passing through the mouth, letting air pressure build up, and the burst is when the air is released. This shown in the following spectrogram of the English words *coat* and *goat*. The burst of each stop (<c> and <g>) is indicated with red arrows.

[35]The second <h> is pronounced when the word is quieter (as words tend to get quieter towards the end), so it looks like silence for much of it.

[36]I have not been able to find a difference between ChC sequences and the corresponding CC sequences. For example, I cannot hear or see a difference between <kht> and <kt> sequences.

(89) English stops

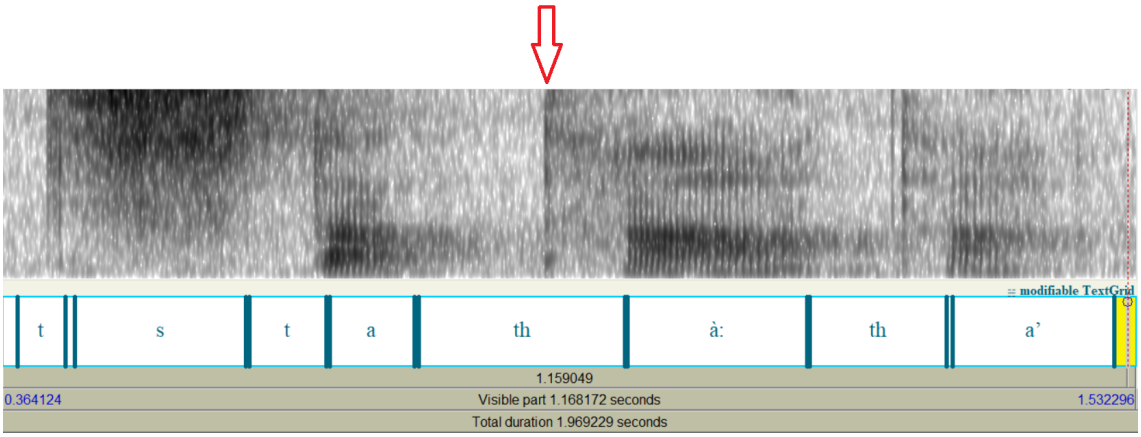


Notice that the burst of the stop in *coat* is much farther from the beginning of the vowel than the burst of the stop in *goat*. The time between the burst and the beginning of the vowel is called the Voice Onset Time (VOT). So, we can say that the stop <c> in English has a longer VOT than the stop <g>.

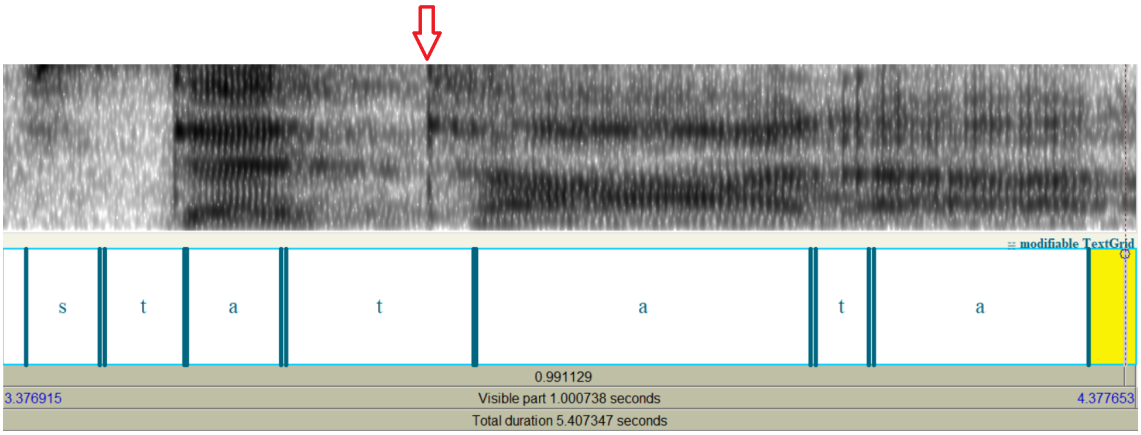
For the most part, Kanien'kéha <t> and <k> have the same VOT as English <d> and <g>. However, this is not the case for Kanien'kéha <th> and <kh> and English <t> and <k>/<c>. Kanien'kéha <th> and <kh> have about the same VOT as word-initial English <t> and <k>/<c>. However, in all positions, Kanien'kéha <th> and <kh> have a much longer VOT than English <k>/<c>. We can see this in the following spectrograms, where the Kanien'kéha word *tstathà:tha'* 'you make it dry' (uttered by an L1 speaker) is juxtaposed with an anglocized version of the same word *statata* (with stress on the same syllable) uttered by an English speaker. Red arrows mark the burst of the stop in the stressed syllable.

(90) VOT in Kanien'kéha <th> vs English <t>

a. Kanien'kéha <th>



b. English <t>

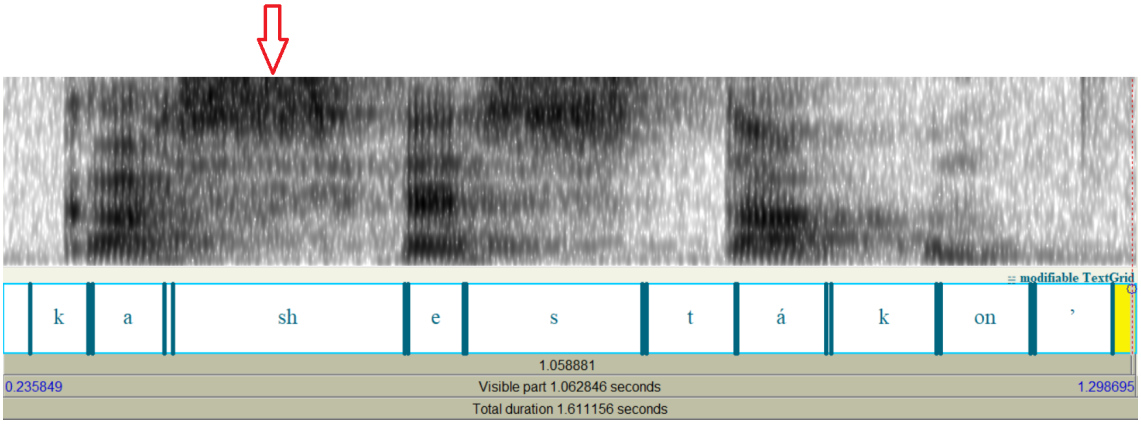


As you can see in (90), the VOT is much longer in the Kanien'kéha <th> sequence than the equivalent English Kanien'kéha <t>. That is, the burst is farther from the beginning of the vowel in Kanien'kéha <th> than in English <t>.

In using Praat to improve your pronunciation, you could check the VOT to see if you are pronouncing <th> and <kh> sequences correctly.[37]

Kanien'kéha <sh> sequences are also different from the English equivalent <s>. However, it is much harder to distinguish between the two in Praat. Recall that <s> (in Kanien'kéha or English) can be identified with the dark bar at the top of the spectrogram. This is shown in the following word with an <sh> sequence, *kashestákon'* 'it is tasty syrup'.

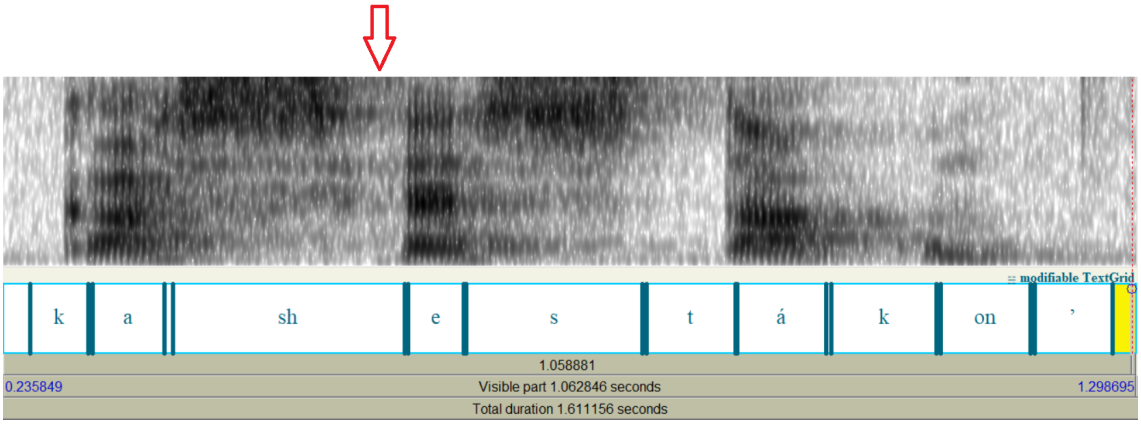
(91) *kashestákon'* 'it is tasty syrup'



Notice that at the end of the period marked <sh>, the dark bar at the top of the spectrogram almost entirely lightens and it appears like just grey static. This section is pointed by a red arrow in (92)

[37]When L1 speakers speak very slowly, they tend to pronounce both the <t>/<k> and the following <h>. It is not clear to me if this is also the case when speakers are not speaking so slowly. When they are speaking at a normal rate or faster, it seems much more like English <t> and <k>.

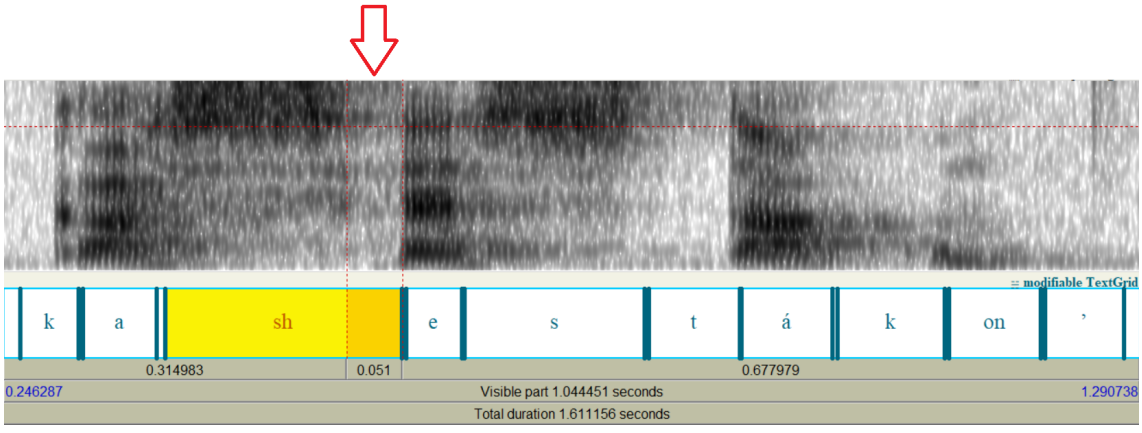
(92)



Most <s>s in Kanien'kéha or English have a period of lightness. It is the transition between the <s> and the following vowel. We can tell the difference between a more English sounding <s> and a more Kanien'kéha sounding <sh> using this faint period. We can do so in two ways, although it should be noted that neither are effective all of the time. Firstly, we can look at the length of this faint period. In Kanien'kéha <sh>, the lighter period tends to be longer than the same period in English <s>. We can see this in (93), in which the <sh> in *kashestákon'* is compared with the <s> in the anglicized *gaséstagu* uttered by an anglophone.[38]

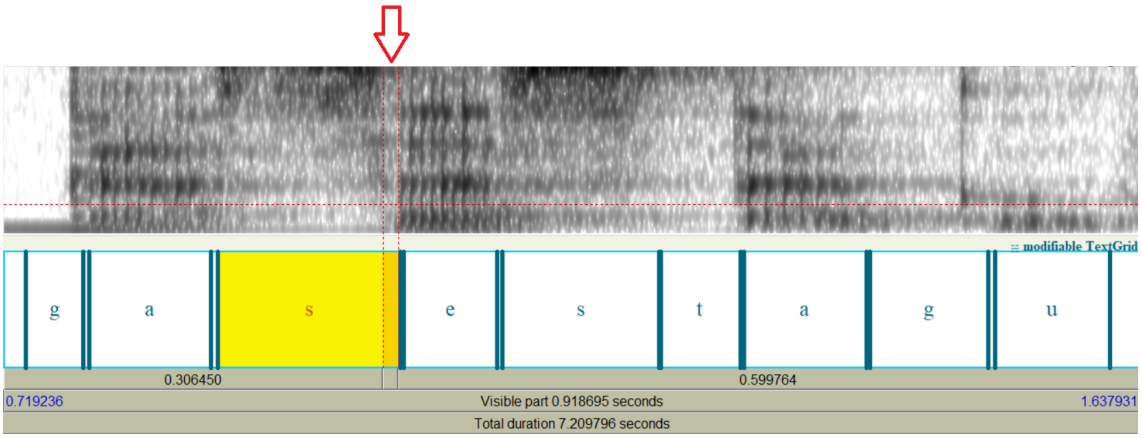
(93) Comparing length of faint period

(93) Kanien'kéha



[38]I moved the stress in the anglicized word because otherwise the vowel would barely be pronounced in between the two <s>s.

(94) English



As we can see in (93), the faint period in Kanien'kéha <sh> is proportionately much longer than in English <s>. You can test your own pronunciation by checking how long this period is and comparing with that of first language speakers.

In many cases, however, the faint period is just as long in English <s>. In these cases, you can highlight this section and listen to it. In Kanien'kéha, it should sound like someone breathing in or out quickly. This is the <h>. In English, it will sound more like a faint hissing noise, or a part of the following vowel. You can use this to improve your pronunciation as you can check if the faint period following the dark bar in your <sh> sounds more like breathing/<h> or more like a faint hissing noise (i.e. the <s>).

It should be noted that <sh> sequences are tricky. Two factors that may contribute to this are the following. Firstly, Kanien'kéha <sh> sequences are often pronounced without the <h> in fast speech. Secondly, telling <sh> and <hs> apart in Kanien'kéha can be very challenging as both involve a period of 'breathiness'.

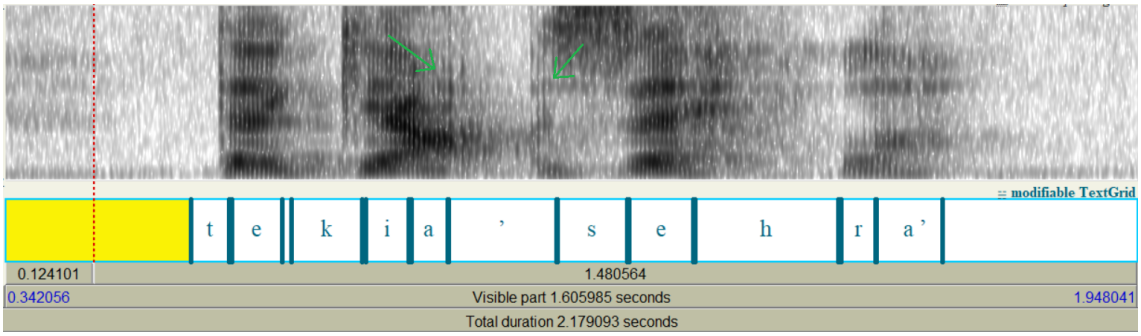
<'> (glottal)

Kanien'kéha <'> (the glottal stop) is pronounced like the sound in the English interjection *uh-oh*, where the hyphen is. It involves the vocal cords closing, blocking airflow, then bursting open to allow airflow again (similarly to <t> and <k>). In Praat, this generally looks like a period of light shading (during when the vocal cords are closed). Consequently, <'> often looks very similar to <h>. There are two ways of telling these apart. The first has to do with *creak*. Creak, or vocal fry, refers to speech where the vocal cords are vibrating extremely slowly (and irregularly).[39] This naturally occurs when pronouncing a glottal stop; when the vocal cords are closing to form the glottal, they must slow down in vibration first, thus creating

[39]While creak/vocal fry is often stigmatized and looked down upon in North American English, there is nothing wrong with it. It is a perfectly natural type of speech that occurs in the majority of languages.

creak. We can see this on Praat: creak will look like short black vertical lines on the vowel immediately preceding the space where the glottal blockage is (and sometimes immediately following it). We can see this in the following spectrogram.

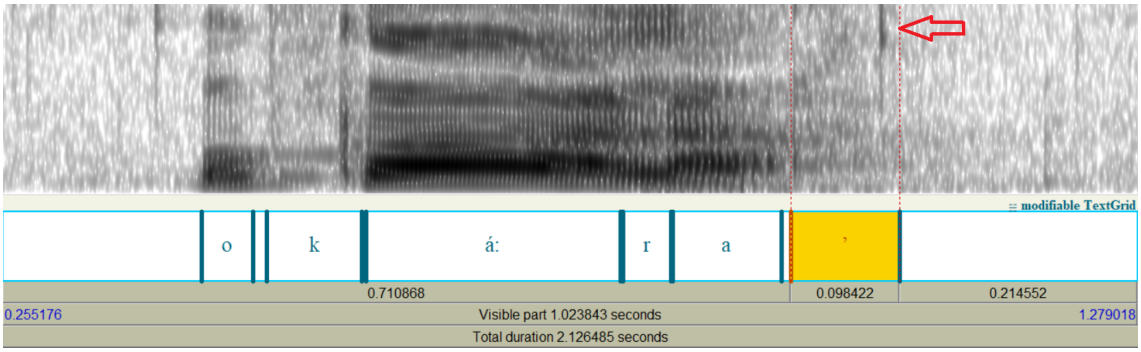
(95) *tekia'séhrha'* 'I stack it'[40,41]



As shown in (95), there is a period of light static where the glottal is (i.e. where the blockage is), and there is also creak before and after the blockage.

The second way to distinguish a glottal and <h> is with the *burst*. After the vocal cords close, they must open for the next sound. This sometimes occurs audibly with a burst of air. In Praat, this looks like a small vertical black line at the top of the specrogram after a period of light static (i.e. blockage).

(96) *oká:ra'* 'story'



As indicated by the red arrow in (96), there is a small line where the glottal burst is.[42] Note that while creak is very common in glottal pronunciations, bursts are much less so.[43]

While instances of the glottal being sandwiched by vowels might be straightforward to pronounce for most English speakers, glottals pronounced at the ends of words or before consonants might be challenging. You could then use Praat to help practice pronouncing the glottal in this context, using the visuals and the audio player to match one's creak and burst.

[40] <hrh> sequences are most often pronounced as <hr> in Ahkwesáhsne, which is what this spectrogram shows.
[41] Final glottals are often not pronounced, or are much quieter, as seems to be the case in this word.
[42] There is a similar line at the beginning of the word. This might have been the speaker getting ready to speak. It is very common cross-linguistically for words with vowels at the beginning to be pronounced with a glottal stop.
[43] This tends to vary depending on context and on the speaker; some speakers enunciate the glottal more than others.

Chapter 6 Conclusion

In this thesis, I have discussed and analyzed the stress system and syllable structure in Kanien'kéha, addressing the challenges these systems pose to theoretical phonology as well as the Kanien'kéha classroom. In what follows, I will conclude the theoretical and pedagogical components of this thesis individually, providing for each a summary of the main findings and contributions as well as possible directions for future research.

6.1 The theoretical component

The theoretical component of this thesis (Chapters 3 and 4) centered around the puzzle presented by the interactions between the metrical processes and syllable structure in Kanien'kéha. The puzzle started with the interactions between metrical processes and the two epenthetic [e]s. The first, which is inserted to break up underlying sequences of three consonants (CCC→C[ə̲]CC), behaves like any other vowel in the language. The second, which is inserted to break up consonant clusters involving a sonorant consonant (e.g. OR→O[e̲]R), does not. This can be exemplified by the interactions between the two epenthetic [e]s and stress assignment: while [[ə̲]] (which breaks up CCC clusters) is visible to stress assignment, [[e̲]] (which breaks up clusters with a sonorant consonant) is not. This is shown in (1) in which canonical penultimate stress occurs when the final two vowels either contain underlying vowels or epenthetic [[ə̲]], but not when one of the final vowels contains the invisible [[e̲]].

(1) Stress and epenthesis

a. All underlying vowels

/ka-nat-aʔ/ → [ganá:daʔ] *kaná:ta'* 'town'

b. Visible [[ə̲]]

/te-k-kha-s/→[deg[é]khas:] *tekékhas* 'I attach things together'

c. Invisible [[e̲]]

/ʌ̃-k-l-ʌ̃ʔ/ → [ʌ́ge̲lʌ̃ʔ] *énkeren'* 'I will put it in'

The investigation of these patterns led to an in-depth analysis of syllable structure and its relationship with the metrical processes exhibited in Kanien'kéha. In the remainder of this section, I will summarize my discussion and analyses of these patterns, and describe future directions for this research.

6.1.1 Summary

Due to the necessary implication of syllable structure in an analysis of metrical processes and epenthesis, I started my examination of the interactions between the metrical processes and epenthesis in Kanien'kéha by emphasizing the need for an analysis of the syllable structure of the language. So, before analyzing the metrical processes and epenthesis directly, I analyzed the syllable structure in Chapter 3. I argued in a Moraic Theory analysis that despite the rather long consonant clusters in the language, Kanien'kéha syllables are constrained in size. Specifically, I argued that syllables in Kanien'kéha are maximally CVX, where X is the second half of a long vowel or laryngeal. That is, there are no complex onsets, and the only consonants permitted in the rhyme are /h/ and /ʔ/. This analysis was primarily supported by phonotactics.

Consequently, I argued that all surface strings of obstruents are actually bogus clusters (Harris, 1994), as, due to the above specified constraints on syllable structure, they cannot constitute complex onsets or coda-onset sequences. I proposed, instead, that these obstruent clusters contain syllabic consonants, and that these syllabic consonants form nonmoraic syllables. An example of this is shown in (2).

(2) Nonmoraic syllable



The proposal that all obstruent clusters in fact involve syllabic consonants accounted for the free phonotactics in these clusters and intervening gestural distance.

The analysis of the invisible epenthetic [e̲] fell out of the above analysis. If the only possible coda-onset sequence is GC (G = laryngeal), and there are no complex onsets, then OR, RO, and RR sequences naturally either need to be broken up or be syllabified like OO sequences. I argued that, in order for these sequences to be syllabified, the [SV] feature on the sonorant consonant (rather than the sonorant consonant itself) projects a syllable node, resulting in a nonmoraic syllable, but since [SV] is a voicing feature, it is pronounced as a fully fledged vowel when syllabic, [e̲]. This is shown in (3).

(3) Syllabic [SV]

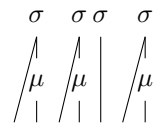


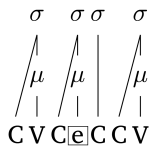
This analysis correctly predicted that C<u>e</u> syllables pattern together with the other nonmoraic syllables that are purely consonantal. The nonmoraic syllables pattern together in two ways. First, all nonmoraic syllables pattern identically in reference to the nonmoraic syllables: they are invisible to stress placement and word-minimality, and block Tonic Lengthening on the preceding stressed vowel. Additionally, unlike the true coda-onset clusters in Kanien'kéha (i.e. hO clusters), lengthening can in fact occur before the nonmoraic syllables under specific circumstances (i.e. Laryngeal Lengthening).

Second, all nonmoraic syllables obey the Adjacency Condition, a constraint limiting the distribution of nonmoraic syllables. The Adjacency Condition says that a nonmoraic syllable cannot be immediately adjacent to another nonmoraic syllable. This constraint holds for C<u>e</u> nonmoraic syllables as well as all the purely consonantal nonmoraic syllables. In fact, underlying sequences created by the morphology that would syllabify as adjacent nonmoraic syllables (of any type) are all dealt with in the same way. This same way is *moraic* (visible) epenthesis. That is, moraic epenthesis occurs to militate against any sequence that would otherwise be syllabified with adjacent nonmoraic syllables. This is shown in the following examples.

(4) Moraic epenthesis

a. Moraic epenthesis





b. No moraic epenthesis, a violation of the Adjacency Condition



In this way, the analysis of moraic epenthesis falls out of the nonmoraic syllable analysis, which, had fallen out of the phonotactics.

Beyond accounting for Kanien'kéha epenthesis distribution and moraicity, this analysis showed the importance of a deep investigation into syllable structure, and ignoring the temptation to indiscriminately syllabify surface consonant clusters as complex onsets and/or coda-onset clusters. In this sense, this thesis, although not employing Government Phonology (Kaye, Lowenstamm and Vergnaud, 1985, 1990; Kaye, 1990*a*), very much falls within its tradition. Additionally, this analysis is in the spirit of analyses such as Bagemihl (1991), Howe (2000), and Goad and Shimada (2014) in analyzing languages with long consonant clusters as actually having quite constrained syllable structure.

Within the context of the increase in phonetic explanations for phonotactic patterns in the phonological literature (e.g. Henke, Kaisse and Wright, 2012), this chapter showed their importance to phonological analyses. That even if phonotactics are explainable purely with phonetics, they still can provide us with a window into the phonology.

Finally, this chapter also emphasized the findings of Boroff (2007) and many others, that the laryngeal consonants prefer to be in the syllable rhyme. I showed that even in the context of Kanien'kéha, where obstruents and laryngeals alike can occur in V_C position, it is solely the laryngeals which can occur in the rhyme.

Chapter 4 followed up on the findings of Chapter 3, by building a foot-based analysis of stress in Kanien'kéha that was forced to work with the syllable structure outlined previously. Specifically, I proposed a new type of foot — moraic-syllable trochees — in order to account for the stress patterns in Kanien'kéha. Moraic-syllable trochees were defined as left-headed feet that obey the novel binarity constraint in (5).

(5) Ft-Bin-σ_{μ}: A foot contains two weighted syllables. A weighted syllable is a syllable that dominates at least one mora.

The binarity constraint in (5) is parallel to the binarity constraints in syllabic trochees and moraic trochees (Ft-Bin-σ and Ft-Bin-μ) in that they limit a certain (bundle of) prosodic unit(s) to two, while not constraining the others. For example, while moraic trochees must contain two moras, the number of syllables is not constrained by the binarity constraint. This is not to say that there can (or should) be 5, 10, or 100 syllables in a moraic trochee. The number of syllables in moraic trochees, unlike the number of moras, is constrained by foot-external constraints (e.g. constraints on the number of nonmoraic syllables). In the case of moraic-syllable trochees, the number of syllables that dominate moras is limited by the binarity constraint, but the number of moras and syllables is not. The number of moras is limited by the constraint on the number of moras in a syllable, while the number of syllables is limited by the Adjacency Condition (described above). Consequently, moraic-syllable trochees in Kanien'kéha are effectively limited to containing four moras and four syllables (albeit by foot external constraints).

Since moraic-syllable trochees only count weighted syllables, nonmoraic syllables do not improve nor degrade the well-formedness of the foot in the eyes of the binarity constraint. This accounts for the 'invisibility' of the nonmoraic syllables: they are simply not relevant to the foot construction process. This accounts for the four types of stress windows possible in Kanien'kéha: HL, L∅L, HL∅, and L∅L∅. The footings of the four types of stress windows with moraic-syllable trochees that are aligned with the right edge of the word are shown in (6).

(6) Footing

a. No nonmoraic syllables

/ka-nat-aʔ/ → [ga(ná:daʔ)] *kaná:ta'* 'town'

b. Nonmoraic ultima

/io-kwil-ʔ/ → [(ó:gwile̲ʔ)] *ó:kwire'* 'sapling', 'tree'

c. Nonmoraic penult

/ʌ̃-k-l-ʌ̃ʔ/ → [(ʌ́̃ge̲lʌ̃ʔ)] *énkeren'* 'I will put it in'

d. Nonmoraic ultima and antepenult

/io-nlaht-ʔ/ → [(óne̲lahde̲ʔ)] *ónerahte'* 'leaf'

Since moraic-syllable trochees do not count nonmoraic syllables, and the foot is always aligned with the right edge of the word, the tri- and tetra-syllabic feet in (6) are permitted.

While this may seem like a significant departure from the feet commonly employed in the phonological literature, I do not believe this to be the case. Presumably, the main concern that the reader may have with the above analysis has to do with the inclusion of tri- and tetra-syllabic feet. This is for two reasons. Firstly, when tri- and tetra-syllabic feet are discussed in the literature, it is almost always within the context of non-binary feet. However, as described above, moraic-syllable trochees are in fact binary; they contain two weighted syllables. The claim that I am making — that prosodic units not targeted by the binarity constraint are not limited to being binary — is not new. For example, no one calls into question whether moraic trochees can be monosyllabic (i.e. H), despite the fact that these feet are not binary in reference to syllable quantity. In this sense, Chapter 4 puts trochees under a microscope, pushing the idea that they are defined by a headedness constraint and binarity constraint to the next logical step.

Secondly, tri- and tetra-syllabic feet are rarely (if ever) appealed to in the phonological literature (van der Hulst, 1999). So, if they are not appealed to in the literature, the conclusion most would draw is that languages don't build feet with this many syllables. I call this conclusion into question. While it is true that feet containing three or four syllables are rarely, if ever, appealed to in the literature, I suggest that

this is because of the types of syllable structure analyses being conducted. The vast majority of syllable structure analyses of any language in the phonological literature uses syllable structure as a way to describe the data, rather than as a way to analyze it. For example, most analyses of Kanien'kéha assume that medial CC clusters are coda-onset clusters, when this is not necessarily the case. Another example involves word-initial CC clusters which are, by and large, assumed to be complex onsets. I submit that if one were to go through the world's languages, paying careful attention to phonotactics, one would find that there are a large number of languages that can be analyzed as including nonmoraic syllables. If this is the case, then surely there must be other languages where nonmoraic syllables are ignored by the footing process, resulting in tri- and tetra-syllabic feet. In this sense, I believe that the reason why we have not found more tri- and tetra-syllabic feet is because we have not been looking for them in the right way. Thus, Chapter 4 re-emphasizes the importance of syllable structure in analyzing stress patterns.

In the following section, I will discuss some ideas for future work based on the current project.

6.1.2 Directions for future research

Here, I will describe some potential avenues of future work which would build on this thesis. These include research topics related to Kanien'kéha phonology more specifically, and topics related to theoretical phonology more generally. I will go through each of these.

There are a number of questions left open in this thesis in reference to Kanien'kéha stress, epenthesis, and syllable structure. I will describe here three phonological questions, and three phonetic ones. The first of the phonological ones involves the morphological joiner, described in section 2.3. Recall that I assume the joiner to be a piece of morphology, making it outside the scope of this thesis as it would require an analysis of the morphology. Even though it is underlying, it is clearly still related to the stress-epenthesis puzzle as it displays its own unique behaviour in reference to the metrical processes. For example, it is variably visible to stress placement in a similar (although not identical) way to epenthetic [e]. In this way, examining the joiner would illuminate more details of the stress-epenthesis interactions and the role of moras.

Second, the palatal glide should be more deeply investigated. While I found that in the vast majority of cases, [j] should be analyzed as underlyingly /i/, I described how there were some cases of [j] where this is not necessarily the case. In these instances, [j] seems to behave purely consonantally. I urge future research to investigate this.

Third, I provided a cursory analysis of the vowel twin pattern in section 3.6, in which C?V sequences surface as C<u>V</u>?V or C<u>V</u>?, where <u>V</u> is a copy of the vowel that was underlyingly following the glottal stop.

I suggested that the copied vowel is nonmoraic. Further investigation into this pattern should be done to clarify and detail this analysis.

The first of the potential directions forward for phonetic research involves the quality of the epenthetic [e]s. Recall from section 3.8 that I claim that there do not seem to be any phonetic differences between weighted [e͞], weightless [e̲], and underlying [e]. This claim should be put to the test, as it has implications for the debate over whether the weightless epenthetic [e̲] is phonological, or if it is a product of excrescence.

Second, I claim, based on impressions of spectrographic forms that, in certain contexts, but not others, [s] is long. Although this is not crucial to my analysis, it is relevant to the overall claims I make with respect to gestural distance in Kanien'kéha consonant clusters.

Finally, recall that I analyze Tonic Lengthening and Laryngeal Lengthening as different phenomena. An interesting prediction that this could make is that a vowel lengthened via one of these processes is longer than the other. I encourage future research to examine this.

There are also many potential future directions for theoretical phonology more generally. I will address two potential general directions here: directions related to syllable structure, and directions related to moraic-syllable trochees. I will start with syllable structure.

Recall that, based on phonotactics, I analyze Kanien'kéha syllable structure as building maximally CVC syllables despite the long consonant clusters word-initially, word-medially, and word-finally in the language. The otherwise elusive behaviour of the two epenthetic [e]s fell out of this analysis. This showed the importance of an in-depth syllable structure analysis, as in many languages the syllable structure cannot simply be inferred from the surface string. This has important implications for stress research more broadly. For example, typological work such as Hayes (1995) and Gordon (2006) make broad claims about stress systems and their relationship with syllables, such as the relevance of codas to stress. However, as shown in this thesis, it is sometimes difficult to motivate an analysis where consonants in V_C position are codas or the first half of complex onsets. This means that many of the languages that are referenced in Gordon (2006), for example, as involving stress that is (in)sensitive to coda weight, may not actually display such a pattern if a deeper syllable structure analysis is conducted. For this reason, I encourage future research to conduct more detailed syllable structure analyses, taking into account phonotactics.

More research in the future is also necessary to examine whether moraic-syllable trochees can be appealed to in analyzing the stress systems of other languages. As described above, I assume that there are a large number of languages that can (and should) be analyzed as containing nonmoraic syllables, but that this isn't commonly done because of the lack of syllable structure analyses that take into account phonotactics. I assume that, with more in-depth syllable structure analyses, there will be more analyses involving nonmoraic syllables, which, in turn, warrant more moraic-syllable trochee analyses to account

for the invisibility of nonmoraic syllables.[1]

By finding more languages that can be analyzed as having moraic-syllable trochees, a few aspects of this type of foot could be clarified. For example, while the number of syllables in a moraic-syllable trochee is moderated by the Adjacency Condition in Kanien'kéha, this is not necessarily the case in other languages; maybe the number of syllables is moderated by something else.

Additionally, while I argued that final nonmoraic syllables should be included in moraic-syllable trochees creating tetra-syllabic (L∅L∅) and trisyllabic (HL∅) feet, I also stated that this is not crucial to the analysis and that the footings could have been (L∅L)∅ and (HL)∅. I argued for the former because there was no evidence to the contrary, and it made for a cleaner analysis with the right edge of the foot always aligned with the right edge of the word. A consequence of this is that I assumed tetra-syllabic feet to exist when this is not attested in the literature. Future research that looks at moraic-syllable trochees in other languages should look into whether final nonmoraic syllables in other languages exhibit behaviour that shows that they are or are not footed. For example, they could find that final nonmoraic syllables are more restricted in terms of what segments they can contain than other nonmoraic syllables in the language.

In sum, these potential future projects could expand on the work in the current thesis, either confirming or challenging it.

6.2 The pedagogical component

In Chapter 5, I addressed two aspects of the stress system of Kanien'kéha that pose challenges to language learners. The first involves the interactions between stress and epenthesis. Since epenthetic <e> is generally learned as a piece of the morphology that appears and disappears in different contexts, and is variably visible to stress, it greatly increases the amount of memorization tasked to the learners. The second involves the relationship between stress and pitch. Unlike English, Kanien'kéha stressed syllables are realized with one of three tonal contours, providing an obstacle to most learners (who are mostly monolingual English speakers) who do not have experience with tone. In what follows, I will summarize my discussion of these challenges posed to learners.

6.2.1 Summary

In addressing the interactions between stress and epenthesis, I showed how it is not always feasible to memorize the stress placement in each word. Since speakers (L1 or L2) must construct new words frequently,

[1] This addresses the comment I made in section 4.2.1 about HL trochees. I claimed that HL trochees should not be considered a base type of foot in the same way that syllabic and moraic trochees are due to their rarity. Since I assume there to be many moraic syllable trochee languages that simply have not been found yet because we have not been looking in the right way, this is not an argument against moraic-syllable trochees.

they cannot simply memorize the location of stress in each word, as stress placement must be computed for each new word. This computation process must be done according to the stress rules in the language. For fluent speakers, these 'stress patterns' are already subconsciously memorized (e.g. when epenthesis occurs, and which epenthetic vowels are invisible/visible to stress placement). In section 5.1 of Chapter 5, I described these stress rules using non-technical language. Specifically, I described how sequences of sounds that cannot otherwise be pronounced in Kanien'kéha are pronounced with epenthetic <e>, and that, depending on the type of sound sequence it occurs in, it is visible or invisible to the stress placement process.

In order to address the challenges posed by the tonal aspects of the stressed syllables in Kanien'kéha, I started by providing plain language descriptions of the three types of pitch profiles of the stressed syllables — Short Upstress, Long Upstress, and Downstress— in section 5.2. In this section, I also provided graphics depicting the different pitch profiles, thus showing how visuals can benefit learners in the acquisition of tone. I also provided such descriptions and graphics of longer utterances containing different pitch profiles to show how the stressed syllables are pronounced in such contexts.

Further addressing the challenges posed by tone in Kanien'kéha, I provided an introductory guide to the computer program Praat, showing how it can be used to improve one's pronunciation of tone, a consequently, one's accent. I also showed how Praat can be used to adjust the pronunciation of one's vowels and consonants.

In the following section, I will discuss some ways in which future research can build on the pedagogical component of this thesis.

6.2.2 Directions for future research

Since learning is a dynamic process that differs from person to person and changes over time, there are a large number of ways to build on the pedagogical component in helping Kanien'kéha learners with the acquisition process. Here, I will address three such ways.

Firstly, while I provided a basic description of the stress-epenthesis interactions in section 5.1, I did not go into the details. For example, I did not describe prothetic <i>, or the relationship between the epenthetic vowels and Tonic Lengthening. Future research should do so, as these phonological aspects are key to sounding like a first language speaker.

Secondly, in section 5.2.2, I provided a very brief description of the intonational patterns in Kanien'kéha (i.e. the pitch patterns over the course of longer utterances). However, just as there is a plurality of types of utterances one could produce, there is a large number of intonational patterns to accompany and frame

them. Future research should look at the intonational patterns of Kanien'kéha, and how these patterns can be taught in a classroom. This is especially important because intonation is generally not discussed in Kanien'kéha classrooms. Further, intonation can be challenging for learners because English (the first language of most learners) is more limited in its use of pitch.

Thirdly and lastly, I showed how Praat can be used to improve one's pronunciation of pitch. However, there are many tools provided by Praat that could be helpful in language learning. One example of this is the pitch extractor, which allows the user to hear the pitch of an audio file completely isolated from the speech sounds. The user can then treat learning pitch and intonation as a singing exercise, humming or singing along with the extracted pitch. Another tool that one can use in Praat is the annotator, which allows the user to make graphics of tone like those in 5.2, in which exactly what sound is being made at each point in the pitch contour is shown. I believe that both of these tools could be useful for learners, and that future work should create guides for learners so they can use these tools too. Not only would these tools help learners sound more like L1 speakers, but they would help learners acquire the phonological grammar that fluent speakers already subconsciously know.

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