THEORETICAL ISSUES IN NUU-CHAH-NULTH PHONOLOGY AND MORPHOLOGY

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Abstract

The goals of the dissertation are documentation and description of the language, and investigation of theoretical issues raised by the language data.

Nuu-chah-nulth, which constitutes, along with Ditidaht and Makah, the Southern branch of the Wakashan family, is in immediate danger of extinction. There are many factors contributing to endangerment, but above all, there is an enormous generation-gap between people who can speak the language and people who cannot, which may ultimately be too deep and broad to bridge without significant linguistic or educational measures. The problem is compounded by the fact the there is very little documentation of the language, hampering both linguistic research and efforts in the realm of education/revitalisation of the language. This work will contribute to documentation of Nuu-chah-nulth, which will ultimately help Nuu-chah-nulth people to develop education materials for their children.

Although previous studies describe and analyse Tseshaht and Kyuquot, two of the 12 Nuu-chah-nulth dialects, there is not much comprehensive work where both the Nuu-chah-nulth sound system and related phonological phenomena and its morphology, are both well-described and analysed. Nuu-chah-nulth has unique and interesting dialect variation as well as linguistic phenomena which require organisation and generalisation. This thesis focuses on the description of the Ahousaht dialect. The documentation, in conjunction with previous work, will help us understand Nuu-chah-nulth better in terms of the different evolution between dialects as well as both linguistic and typological characteristics of the language.

It is important to investigate the phonology and morphology of Nuu-chah-nulth from the perspective of linguistic theory. Many phonological and morphological processes in Nuu-chah-nulth raise interesting questions in terms of universality, markedness, learnability, variability, and typological issues. Theoretical treatments of linguistic phenomena will help us understand the language itself better, and general characteristics of human language as well. I discuss the segmental phonology of the language in Chapter 3, including the treatment of pervasive phonological processes such as glottalisation, lenition, (de)labialisation, vowel lengthening, vowel shortening, and vowel alternation due to variable vowels; I treat prosodic phonology in Chapter 4, the morphological structure of words in Chapter 2, and morphological processes such as reduplication and allomorphy in Chapter 5. I treat these phenomena within Optimality Theory, due to its direct encoding of claims concerning universality, language variation, and typology.

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Chapter 1 INTRODUCTION

1.1 Goals of the dissertation

This dissertation is about the phonological and morphological processes of Nuu-chah-nulth (formerly known as Nootka), in particular the Ahousaht dialect, and their typological and theoretical implications. The thesis has the following goals.

1.1.1 Documentation of the language

The language of the thesis is Nuu-chah-nulth, which constitutes, along with Ditidaht and Makah, the Southern branch of the Wakashan family (Swadesh 1933, Sapir & Swadesh 1939). It is spoken along the West Coast of Vancouver Island from Barkley Sound north to Quatsino Sound in British Columbia, Canada. The Nuu-chah-nulth Tribal Council considers themselves to represent 19 groups (Hoover 2002), but the following 12 major dialects (Howe 2000: p6) seem to be spoken: Ahousaht ([ʕaaḥuusʔatḥ]), Ehattesaht ([ʔiiḥatisʔatḥ]), Hesquiat ([ḥiškʷiiʔatḥ]), Kyuquot ([qaay̓uuk̓atḥ]), Mowachaht ([muwač̓atḥ]), Nuchatlaht ([nučaaɬʔatḥ]), Ohiaht ([huuʔiiʔatḥ]), Tseshaht ([c̓išaaʔatḥ]), Clayoquot ([ƛaʔuukʷiʔatḥ]), Toquaht ([t̓uk̓ʷaaʔatḥ]), Uchuklesaht ([ḥuučuqƛisʔatḥ]), and Ucluelet ([yuuɬuʔiɬʔatḥ]). Of these dialects, I document Ahousaht, which is spoken on Flores Island located near the middle of the west coast of Vancouver Island.

Nuu-chah-nulth, as a language in immediate danger of extinction, urgently needs to be documented. There are many factors contributing to its endangerment, but above all, there is an enormous generation gap between people who can speak the language and people who cannot, which may ultimately be too deep and broad to bridge without any linguistic or educational measures. Only a few people of the older generation can speak their native tongue, while the younger generation cannot speak it at all or is familiar with only a few expressions. Nuu-chah-nulth is estimated to be spoken by between 50 speakers (Howe 2000) and 600 (Kinkade 1991). According to my language consultants, of the 800 people on the Ahousaht reserve only less than 30 people over the age of 60 speak the language. Also, when I visited Flores Island in the summer of 2002, this number was confirmed by one of the elders. Given this estimation and that Flores Island is one of the biggest native communities, I estimate that there may be 150-200 speakers left among the 12 dialects.[1] My consultants, 77 and 57 years old respectively, each lead a big family, but they are the only ones that can speak their language fluently. Unless the younger generation tries to learn their language, it will disappear in the near future.

[1] From my fieldwork with speakers from different dialects such as Ucleulet, Clayoquot, and Kyuquot, I estimate that there are 10-15 speakers of each of these dialects.

The problem is compounded by the fact that there is very little documentation of the language, hampering both linguistic research and efforts in the realm of education. Franz Boas (1910, 1911, 1928, 1932, 1947) treated many linguistic phenomena of Kwakwala, one of the Northern Wakashan languages. Very recently, much of Oowekyala, another language of the Northern Wakashan branch, has been documented by Howe (2000). The other two Southern Wakashan languages, Ditidaht and Makah, have been investigated by Terry Klokeid and William Jacobsen, Jr., respectively, greatly increasing the available written resources (see Klokeid 1969, 1977a, b, 1978a, b, c; Jacobsen 1969, 1979a, b, c, 1986, 1999). Nuu-chah-nulth, on the other hand, has not been studied as much. Nuu-chah-nulth began to attract linguists' interest when Edward Sapir's collected texts, mainly from Tseshaht (one of the 12 dialects of Nuu-chah-nulth), were published in Sapir & Swadesh (1939). Recently, a comprehensive description of Kyuquot, another dialect of Nuu-chah-nulth, was done by Rose (1981). In addition, Rose (1976) and Stonham (1994, 1999) provide systematic organization and description of Tseshaht phonology based on Sapir's work. Ahousaht and the other Nuu-chah-nulth dialects, however, have not been well-documented. Although Rose (1976) discusses glottalisation and lenition with some Ahousaht data, and Nakayama (1997a,b) discusses morphological and syntactic aspects of Ahousaht, there is no documentation that has more thoroughly established Ahousaht phonology.

This work will contribute to documentation of Nuu-chah-nulth, in particular the Ahousaht dialect, which provides research subjects for linguists and will ultimately help Nuu-chah-nulth people to develop education materials for their children. In addition, by adding a comprehensive documentation of another dialect, we will be able to understand Nuu-chah-nulth better in terms of dialectal similarities and differences.

1.1.2 Description of the language

The second goal of the dissertation is to provide a well-defined description of Ahousaht Nuu-chah-nulth in terms of phonological and morphological phenomena. Although previous studies describe and analyze Tseshaht and Kyuquot, two of the 12 Nuu-chah-nulth dialects, there is no comprehensive work where both the Ahousaht Nuu-chah-nulth sound system and related phonological phenomena, and its morphology are both well-described and analyzed. Nuu-chah-nulth has unique and interesting dialect variation as well as linguistic phenomena which require organisation and generalization. The second goal of the dissertation is closely related to the first. The documentation, in conjunction with previous work, will help us understand Nuu-chah-nulth better in terms of the different evolution between dialects as well as both linguistic and typological characteristics of the language.

1.1.3 Theoretical implications

The third goal of the dissertation is to investigate the phonology and morphology of Nuu-chah-nulth within the perspective of linguistic theory. Many phonological and morphological processes in Nuu-chah-nulth raise interesting questions in terms of universality, markedness, learnability, variability, and typological issues. Importantly, the phenomena examined are rarely found cross-linguistically, which raises many linguistically important questions, in particular, how to define 'marked' or 'unmarked' properties of linguistic elements. In the thesis, I examine what constitute (un)marked characteristics of human language as well as of Nuu-chah-nulth. In addition, all the processes I investigate are triggered by morphological factors, leading to the question of how to treat phonological and morphological aspects together under a single grammar, an interface that has raised various controversial questions among linguists. Theoretical treatments of the linguistic phenomena will help us understand the language itself better, and general characteristics of human language as well.

I briefly introduce the theories I adopt or adapt in the following section.

1. 2 Theoretical background

I adopt Optimality Theory (henceforth OT; Prince & Smolensky 1993, McCarthy & Prince 1993 et seq.) as a basic mechanism in the thesis. A full discussion of OT is not necessary; I will summarise the fundamental ideas and concepts of OT and some aspects of the theory which are relevant to my analysis.

1.2.1 Optimality Theory

OT (Prince & Smolensky 1993, McCarthy & Prince 1993) conceives of a grammar as a hierarchy of universal well-formedness constraints, which are ranked and violable. Gen and Eval, two major constituents of the grammar, create a set of candidate outputs for a given input, and choose the best of the candidates against a language-particular ranking of the constraints, respectively. The candidate output that best satisfies the ranking by violating the fewest lowest-ranked constraints, is selected as the actual surface form. Throughout the dissertation, I will discuss the consequences of key principles of OT for Nuu-chah-nulth phonology and morphology. For overall discussions of OT, refer to McCarthy & Prince (1993), Archangeli & Langendoen (1997), Kager (1999) and McCarthy (2002)..

1.2.2 "Richness of the Base"

Features as phonological primitives can be combined freely. This is a fundamental principle of OT, Richness of the Base (Prince & Smolensky 1993, Smolensky 1996). Under this principle, there is no

restriction on input forms, and thus a set of inputs to the grammar is possible (Smolensky 1996). Constraints operate only on output representations. Certain well-formed feature combinations from a rich set of feature combinations surface as an output form according to context. In cases where certain segment types exhibit variable behavior, this raises the possibility that their behavioral differences are due to the selection of different input representations for the same surface forms (Archangeli & Pulleyblank 1994). This principle provides conceptual consequences for linguistic phenomena where for a single surface segment, there are more than one input and it leads to surface alternations in some contexts. This principle is also supported by empirical consequences from real languages (see Rosen 2001). Some consequences of 'Richness of the Base' for Nuu-chah-nulth phonology will be discussed in Chapter 3, illustrating more empirical adequacy of the principle.

1.2.3 Faithfulness, markedness and grounded phonology

Since Jakobson (1941), Halle (1959) and Chomsky & Halle (1968), much theoretical attention has been given to Markedness (see also Archangeli 1984, 1988; Kiparsky 1981, 1985, 1988; Itô & Mester 1986, Archangeli & Pulleyblank 1994, Steriade 1995 among others). Feature combinations as well as individual feature values are evaluated as unmarked or marked. Within OT, cross-linguistic or intralinguistic markedness is represented by constraints and their language-specific ranking, rather than regulating the lexicon. Markedness constraints force the presence of the least-marked structures on the surface, while Faithfulness constraints require minimal differences between input and output forms. If a language maintains cross-linguistically marked features or feature combinations, then the relevant constraints will be relatively lower-ranked with respect to Faithfulness constraints in the language in question. On the other hand, if a language does not allow marked phonological elements, then the constraints will be relatively highly ranked. The question is how to evaluate whether features or feature combinations are marked. We need a principle which provides restrictions on well-formed combinations of features and accounts for a variety of patterns attested cross-linguistically. For this issue, I adopt Archangeli & Pulleyblank (1994), which claims that linguistic models should make use only of implicational relations that are grounded in their articulatory or acoustic correlates. Also, Bernhardt & Stemberger (1998) draw our attention to cognitive grounding of constraints to understand human language. In this thesis, phonological processes are discussed under both these lines, showing that surface forms are derived as a result of the interaction between Faithfulness and Markedness and that the concept of Markedness is phonetically and cognitively grounded.

1.2.4 Correspondence

Faithfulness in OT is instantiated as a set of constraints on corresponding elements (McCarthy & Prince 1993, 1994a,b, 1995). Correspondence theory has evolved with significant work such as Urbanczyk (1995, 1996, 1999), Spaelti (1997), Struijke (1998, 2000), Gafos (1998), Pulleyblank (to appear) among others, in particular in terms of the treatment of reduplication. Although some of their detailed arguments are different, they are basically in the same line in that they use correspondence relations between two related strings, the input-output relation and/or the base-reduplicant relation, to deal with the phonological identity of the reduplicant. I develop correspondence between Base and Reduplicant as well as one between Input and Output (cf. Pulleyblank to appear). Both conceptual and empirical consequences of correspondence theory for Nuu-chah-nulth phonology, in particular reduplication, will be discussed in chapter 5.1. In addition, I introduce MAX and DEP only, against the implementation of IDENT (for a detailed discussion, see Shaw 1994, Lombardi 1997, 1998; Zhang 2000).

1.3 An outline for the dissertation

The remainder of chapter 1 presents an outline for the rest of the dissertation.

Chapter 2 provides an overview of Nuu-chah-nulth morphology, describing the morphological structure of words and the properties of each morphological category such as root, and suffix. Morphological information is important in understanding Nuu-chah-nulth phonological phenomena, as we will see in the following chapters.

Chapter 3 discusses the segmental phonology of the language, including the treatment of pervasive phonological processes such as glottalisation, lenition, delabialisation, vowel lengthening, vowel shortening, and vowel alternation due to variable vowels.

Chapters 4 and 5 treat prosodic phonology and morphological processes such as reduplication and allomorphy, respectively.

Finally, chapter 6 provides a summary and conclusion with implications for further research.

Chapter 2 OVERVIEW OF NUU-CHAH-NULTH MORPHOLOGY

In chapter 2, I show the internal structure of Nuu-chah-nulth words and the morphological properties that are related to phonological phenomena. It is important to understand both the characteristics of morphemes (lexical items) themselves and the relationship between morphemes in order to find out how and/or to what extent morphology is involved in phonological alternations. However, I will only provide basic morphological information which is essential for phonological issues. (See Sapir & Swadesh 1939, Swadesh 1939, 1948, Haas 1969, Rose 1981, Nakayama 1997, Stonham 1994, 1999, Stonham & Yiu 2000, Davis & Sawai 2001, and Wojdak 2002 for more detailed discussion.)

Nuu-chah-nulth is what is called a '(poly)synthetic' language where ideas are in general delivered by morphologically complex, long word-forms by affixation, primarily suffixation. The following statement from Swadesh (1939:78) about the morpho-syntactic properties of the language will help us understand its structural property.

> The expression " [Nootka] internal syntax"... is based on the recognition of the fact that the combination of morphemes into a single word in a synthetic language has the same function as the juxtaposition of independent words in an analytic language. This function is the putting together of semantic units or "lexemes" into semantic complexes expressing communications or parts of communications... we may apply the term syntax to the process in general, and designate the semantic theory of unit-word combination as internal syntax....

The schematic internal structure of the Nuu-chah-nulth word is as follows:

(1) The internal structure of the word in Nuu-chah-nulth

[Prefix(Reduplicant)-Root-Lexical suffixes-Grammatical suffixes]$_{Word}$

Each word includes a root morpheme as a core, which may be followed by lexical and/or grammatical suffixes. The language does not have prefixes except for adding some part of a root morpheme by the process of reduplication. That is, a prefix can be attached by copying the first syllable of the root morpheme in; in some cases, the coda of the first syllable is not be copied; the process can be performed without a trigger or by attaching certain suffixes. In Ahousaht Nuu-chah-nulth, double reduplication is not observed (cf. Sapir & Swadesh 1939, Stonham 1999, 2003: These studies provide examples of double reduplication in Tseshaht Nuu-chah-nulth).

For the internal structure, there have been controversial issues with respect to how each predicative lexical suffix is combined with the root: morphological treatments (see Sapir & Swadesh 1939, Swadesh 1939, Rose 1981, Davidson 2002), syntactic treatments (see Stonham 1994, 1999, Yiu & Stonham 2000, Stonham & Yiu 2000, Davis & Sawai 2001) and a post-syntactic treatment (see Wojdak 2002). Since this issue is beyond the scope of the thesis, I do not support or argue for any one of these arguments, but will simply use a morphological treatment, where morphemes are simply linearly combined.

2.1 Roots

Typically, a polymorphemic word contains a central morpheme, which contributes the basic meaning of a word and sometimes cannot stand by itself (see Spencer 1991). This kind of morpheme has been called 'root'. In Nuu-chah-nulth, the root is a morpheme which cannot stand by itself and needs at least one lexical or grammatical suffix to be attached in order to function as an independent word in sentences. However, as shown in (2), roots do not always provide the lexical meaning for a whole word and instead, lexical suffixes often play such a role. This property leads to controversy: whether some Nuu-chah-nulth roots are really roots. (see Davis & Sawai 2001).

(2) a. ʔuʔiic
ʔu-ʔiic
it-to eat
'to eat'

b. ʔukʷiiɬ
ʔu-kʷiiɬ
it-to make
'to make'

In this thesis, I simply consider a morpheme which stands at the left edge of the non-reduplicated word as the root, whether it has a lexical meaning or not, without taking a position on this issues.

Nuu-chah-nulth roots mostly consist of one syllable. According to Rose (1981:29), almost 60 percent of Kyuquot Nuu-chah-nulth root morphemes consist only of one syllable; in particular, verb roots are remarkably monosyllabic (85%). (See also Haas 1969 for Tseshaht). I would suppose that Ahousaht exhibits similar ratios, given the fact that the dialects share almost the same lexicon.

A root begins with one and only one consonant, which is derived by constraints on syllable structure. (This issue will be discussed in detail in chapter 4.) There has been controversy over Nuu-chah-nulth roots/words with respect to word classes such as noun, verb, etc. While Swadesh (1939), Jacobsen

(1979), and Nakayama (1997) treat Nuu-chah-nulth as a category-neutral language, Wojdak (2001) claims that Nuu-chah-nulth words should be distinguished according to syntactic categories, by demonstrating that there are modification constructions in the language which are sensitive to a [+/-N] categorical restriction (see Wojdak 2001 for detailed discussion). The following examples are presented according to syntactic categories such as noun, verb, and adjective/adverb, following Wojdak (2001).[1]

I. Noun root

(3) Monosyllabic root

a. k̓ʷis- 'snow'
b. č̓iḥ- 'spirit'
c. nuukʷ- 'song'
d. x̓aaq- 'whale blubber'
e. čapx̣- 'man'
f. sikt- 'eggs of head lice'
g. siič- 'maggot'
h. ḥiix- 'small purple sea urchin'
i. niis- 'liquid'
j. č̓is- 'rope'
k. cisq- 'meat'
l. ʔuuš- 'something'
m. ʔuḥ- 'it'[2]

(4) Bisyllabic root

a. ḥiyi- 'snake'
b. k̓aaʔin- 'crow'
c. č̓aʔak- 'river'
d. taač̓a- 'belly'
e. čamas- 's.t. sweet'

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[1] What I mean by 'syntactic' is that each root morpheme can play a syntactic role as a noun, verb, adjective, or adverb in a sentence. Most root morphemes have lexical meaning; the usages of 'lexical' should not be considered as the same as 'lexical' as a counter term against 'syntactic'. Many of these root morphemes, specially nouns, can appear without suffixes: e.g. k̓ʷis, nuukʷ, etc.

[2] Very frequently, this root does not provide any semantic information but plays only as a place holder: in such a context, a lexical verbal suffix semantically plays a central role. Davis & Sawai (2001) claim that in addition to this, incorporated objects into a set of morphologically dependent verbs are in fact not roots.

f. ʔaqi- 'what'

II. Verb root

(5) Monosyllabic root

a. tux^{w}- 'to jump'

b. cix^{w}- 'to fry'

c. ƛiḥ- 'to drive'

d. m̓aa- 'to bite'

e. w̓aa- 'to speak'

f. c̓a- 'to flow'

g. c̓itk- 'to twist'

h.yac- 'to walk

i. yaqƛ- 'to dislike'

j. cuc- 'to scratch'

k. mitx- 'to spin'

l. ƛ̓iix̣^{w}- 'to smile/laugh'

(6) Bisyllabic root

a. waʔič- 'to sleep'

b. tamis- 'to drift'

c. w̓asaq 'to cough'

d. ʔusum- 'to need/want'

e. kaaʔa- 'to give (here)'

f. č̓uḥii- 'to be extinguished'

III. Adjective/adverb root

(7) Monosyllabic root

a. čim- 'properly'

b. m̓aɬ- 'cold'

c. ƛ̓up- 'hot/warm'

d. č̓uš- 'new'

e. ʔiiḥ- 'big'

f. ƛaḥ- 'now'

g. ƛuɬ- 'nice'

h. čišx̣- 'dirty'

i. ḥačxʷ- 'deep'

j. λ̓atx̣- 'flat'

k. k̓aač- 'short (time)'

l. wis- 'dim'

(8) Bisyllabic root

a. kuum̓a- 'barely, few'

b. ʔuṅaaḥ- 'small'

c. taʔiɬ- 'sick'

d. č̓aʔuuš- 'raw'

e. hiitkin- 'different (from standard)'

2.2 Suffixes

Nuu-chah-nulth suffixes must be classified into lexical or grammatical morphemes. Their distinction provides important clues for understanding phonological processes treated in the thesis. Many phonological processes, triggered by suffixes, exhibit different aspects depending on morphological categories.

Sapir & Swadesh 1939, and Swadesh 1948 call lexical and grammatical suffixes 'formative' and 'incremental,' respectively, and Swadesh 1939 calls them 'stem suffixes' and 'word suffixes,' respectively, following the theoretical distinction made by Boas (1911). In addition, Rose (1981) identifies the relevant classes of suffixes as non-inflectional (derivational) and inflectional. I follow Rose (1976), using the terms lexical and grammatical without any argument for their usage.

Rose (1976) and Stonham (1999) provide the following distinction between these two kinds of suffixes. Lexical suffixes provide an independent part of the word's meaning or a dependent meaning which is completed only in conjunction with the total meaning of the root-suffix combination. Linearly, they are ordered between a root and any grammatical suffixes. On the other hand, grammatical suffixes consist of elements which indicate aspect such as durative, momentaneous, causative, inceptive, iterative, repetitive, and graduative; voice such as active, and passive; tense such as present, past, and future; modality such as absolutive, quotative, indicative, interrogative, purposive, dubitative, inferential, conditional, subordinate, relative and imperative; person information on the predicate; possessive and definite on the noun.[3] The grammatical functions of lexical and grammatical suffixes do not seem to be exactly the same as those of derivational and inflectional suffixes, respectively, from well-known

[3] The terms are taken from Sapir & Swadesh (1939).

languages such as English, French, and so on (cf. Spencer 1991).[4] Therefore, I make use of the terms 'lexical' versus 'grammatical' in the thesis.

(9) and (10) illustrate lexical and grammatical suffixes, respectively.

(9) Lexical Suffixes[5]

a. -aaʔa 'on the rock'
b. -kumɬ 'round'
c. -qʔičḥ 'for … year(s)'
d. -iɬ 'inside, on the floor, in the house'
e. -ẇiṭ'as 'be about to'
f. -qaq 'very much'
g. -ya 'continuously'
h. -š 'continually'
i. -matak 'probably'
j. -k̓uk 'to resemble'
k. –(a)ap 'to buy'
l. -kɬaa 'to be called'
m. -k̓ʷap 'to love'
n. -qs 'vessel'
o. -y̓ak 'instrument'
p. -ḥta 'foot'

(10) Grammatical Suffixes

a. -ap 'Causative'
b. -šiƛ 'Momentaneous'
c. -aa 'Durative'
d. -at 'Passive'
e. -mit 'Past'
f. -ʔaqƛ 'Future'
g. -wa 'Quotative'
h. -ʔiš '3person singular'
i. -uk/ak 'Possessive'

[4] See Davidson (2002) for a detailed discussion.

[5] I do not divide the data by the number of syllables as with roots, because as we will see in the following chapters, while the number of syllables within the root is important for some phonological alternations, the number of syllables within the suffix does not affect aspects of alternations.

j. -i 'Definite'

The following three morphemes, which are called enclitics in Sapir & Swadesh (1939), can be attached as a final element on the predicate, which consists of a verb, adjective, or adverb root followed by lexical or grammatical suffixes.

(11) -ƛa 'again, also'

yacyacmiɬʔaƛʔišƛa
RED-yac-miɬ-ʔaƛ-ʔiš-ƛa
RED-to walk-on the floor-SEQ-3sg/IND-again
'S/he is walking around again now.'

(12) -ʔaaɬ 'always'

taakšiʔaqƛʔišʔaaɬ kaapap Mary John.
taak-šiƛ-ʔaqƛ-ʔiš-ʔaaɬ kaapap
all the time-MOM-Future-3sg/IND-always to love
'Mary will always love John.'

(13) -ʔaɬ 'plural'

yaaʔak̓apʔišʔaɬ kʷakuucukqs ʔuukʷiɬ Eun-Sook.
yaaʔak-ʔap-ʔiš-ʔaɬ kʷakuuc-uk-qs ʔuukʷiɬ
to like-CAUS-3sg/IND-PL grandchildren-POSS-1sg/POSS for/to
'My grandchildren like Eun-Sook.'

The above examples, especially (11) and (12), seem to have independent lexical meaning like lexical suffixes, although their semantic properties can be interpreted as grammatical: for example, 'repetitive' and 'durative' respectively. The plural suffix in (13) is mainly used with the 3rd person singular markers such as -ʔiš 'indicative', and -ḥ 'interrogative', creating the 3 person plural marker -ʔišʔaɬ, and -ḥʔaɬ. It always indicates plurality of the subject. This grammatical function can be a property of grammatical suffixes. These suffixes are attached after all the grammatical suffixes, but it seems unclear if all of them should be treated as grammatical suffixes. For example, -ƛa triggers reduplication and only lexical suffixes can cause such a morphological process in Nuu-chah-nulth. Although their morphological

identity is not yet clear, it does not affect my treatment of the phonological alternations discussed in the thesis. I leave this issue for further research.

The examples in (14-16) illustrate how each morpheme type combines to deliver ideas. Note that morpheme order is strict between the same set of suffixes as well as between different sets of suffixes. The sentence is ungrammatical if the positions of each suffix are switched between the same set of suffixes. Switching orders between grammatical suffixes, -ʔat 'PASSIVE' and -mit 'PAST' in (14b), and -šiƛ 'MOMENTANEOUS' and -mit 'PAST' in (15b), causes the sentences to be ungrammatical. Also, (16b) shows that lexical suffixes cannot switch their positions with respect to each other with the same meaning. As shown in (16c), if a grammatical suffix stays between lexical suffixes, the sentence is ungrammatical.

(14) a. kaapapšiʔanitʔišʔaɬ John.
kaapap-ši(ƛ)-ʔat-mit-ʔiš-ʔaɬ
to love-MOM-PASS-PAST-IND-3rd-PL
'John was loved (by some people)/(some people) loved John.'

b. *kaapapapšiƛit̓atʔišʔaɬ John.
kaapap-šiƛ-mit-ʔat-ʔiš-ʔaɬ
to love-MOM-PAST-PASS-IND-3rd-PL

(15) a. naatsiičiƛitwaʔiš Eun-Sook ʔuušḥy̓umsukʔi.
naatsii-čiƛ-(m)it-wa-ʔiš ʔuušḥy̓ums-uk-ʔi
to see-MOM-PAST-Quo-3sg. Friend-POSS-3sg/Poss
'It is said that Eun-Sook saw her friend.'

b. *naatsiimitčiƛwaʔiš Eun-Sook ʔuušḥy̓umsukʔi.
naatsii-mit-čiƛ-wa-ʔiš ʔuušḥy̓ums-uk-ʔi
to see-PAST-MOM-Quo-3sg friend-POSS-3sg/POSS

(16) a. ʔayanakcḵinitʔiš ʔuḥ.
ʔaya-nak-cḵin-(m)it-ʔiš ʔuḥ
many-to have-a little bit more-PAST-3sg/IND it
'S/he had a little bit more (i.e. money than me).'

b. *ʔayacḵinnakitʔiš ʔuḥ.

ʔaya-cḵin-nak-(m)it-ʔiš) ʔuḥ

many-a little bit more-to have-PAST-3sg it.

c. *ʔayanakitcḵinʔiš ʔuḥ.

ʔaya-nak-(m)it-cḵin-ʔiš) ʔuḥ

many-to have-PAST-a little bit more-3sg/IND it

While ordering requirements between lexical and grammatical suffixes in Nuu-chah-nulth are also common morphological properties cross-linguistically, I have not found any clues to what constraints govern the order of morphemes between lexical suffixes. Kim (2000b: 252 (19)) provides morpheme orders between grammatical suffixes as shown in (17).

(17) Stem-	Transitive	- Aspect	- Voice	- Tense	- Mood	- Agreement
	Causative	Sequential	Active	Present	Indicative	1sg/pl
		Durative	Passive	Past	Interogative	2sg/pl
		:		Future	:	3sg/pl

The morphological properties we have looked at so far will provide important clues in order to understand the Nuu-chah-nulth phonological phenomena to be discussed in the following chapters.

Chapter 3 SEGMENTAL PHONOLOGY

3.1 Phonemic inventory

This section treats the phonemic distribution of Nuu-chah-nulth sounds. As is standard practice for research in this language, I mostly follow the transcription of Sapir & Swadesh (1939) except for vowel length, and provide IPA counterparts for symbols which may cause confusion for people unfamiliar with the transcription system.

3.1.1 Consonants

Consonants show extensive contrasts in place of articulation in Nuu-chah-nulth, which is one of the typical phonological properties of indigenous languages spoken on the northwest coast of North America (Sapir 1938, Maddieson 1984). Consider the following consonant chart:

(1) The phonemic consonant inventory of Nuu-chah-nulth

Place / Manner	Labial	Alveolar	Alveo-Palatal	Velar	Labio-Velar	Uvular	Labio-Uvular	Pharyngeal	Laryngeal
Stops	p	t		k	k^w	q	q^w		
Glottalised	p̓	t̓		k̓	$k̓^w$			ʕ[1]	ʔ
Affricates		c [ts]	č [tʃ]						
Lateral		ƛ [tɬ]							
Glottalised		c̓ [ts']	č̓ [tʃ']						
Lateral		ƛ̓ [tɬ']							
Fricatives		s	š [ʃ]	x	x^w	x̣ [χ]	$x̣^w$[$χ^w$]	ḥ [ħ]	h
Lateral		ɬ [ɬ]							
Sonorants	m	n	y [j]		w				
Glottalised	m̓	n̓	y̓ [j']		w̓				

As shown in the chart, i) Nuu-chah-nulth does not have voiced obstruents: sonorants are the only voiced

[1] A pharyngeal stop /ʕ/ behaves in the same way as glottalised consonants in that it cannot occupy the coda position of the syllable as motivated in chapter 4. Also, as exemplified in this chapter, in the glottalisation context, it appears as the glottalised counterpart of uvular and labio-uvular stops, /q, q^w/. I, therefore, put it in the 'glottalised' row, indicating its phonological status as one of the glottalised consonants. However, it differs from other glottalised consonants in that it is voiced intervocalically, which leads to a controversial issue as to whether it is a sonorant or an obstruent (see Shank & Wilson 2000 for more detail).

consonants, ii) each stop (except for the uvular and the labio-uvular stops), affricate, and sonorant has a glottalised counterpart, whereas a fricative does not, and iii) velar and uvular obstruents exhibit a labial contrast. While the absence of glottalised fricatives is not surprising, given the fact that they are cross-linguistically marked (Maddieson 1984, Ladefoged & Maddieson 1996), the lack of glottalised uvular and labio-uvular stops /q̓, q̓ʷ/ requires a diachronic account. Proto-Nuu-chah-nulth (and Ditidaht) glottalised uvular and labio-uvular stops *q̓ and *q̓ʷ were merged into a pharyngeal stop /ʕ/, an independent phoneme, although Makah, the other Southern Wakashan language, preserves these two sounds (Haas 1969). Jacobsen (1969) provides Southern Wakashan correspondences involving pharyngeal (both stop and fricative) phonemes. I cite examples of pharyngeal stops in (2) (See Jacobsen (1969:129-132) for a more comprehensive set of data):

(2) Correspondences in pharyngeal stops in Southern Wakashan

Proto-Nootkan (Proto-Southern Wakashan)	Nootka (Nuu-chah-nulth)	Nitinat (Ditidaht)	Makah
*q̓	/ʕ/ ʕakʷ- 'to cut with a knife'	/ʕ/ ʕakʷ- 'to cut with a knife'	/q̓/ q̓akʷ- 'to cut sideways with a knife'
*q̓ʷ	/ʕ/ ʕac̓aq 'white and wrinkled of body from soaking in water'	/ʕ/ ʕac̓aqk 'fresh fish'	/q̓ʷ/ q̓ʷac̓aq 'soft or partly dried fish'

The examples in (3-12) illustrate morphemes including each phoneme from Ahousaht Nuu-chah-nulth, in particular, exhibiting the contrast between a plain consonant and its glottalised counterpart.

(3) Labials

a. /p/: [p]iiš[p]iš 'cat'

b. /p̓/: [p̓]išaq 'bad, immoral'

c. /m/: [m]aa 'here'

d. /m̓/: [m̓]aa 'to bite

(4) Alveolars

a. /t/: [t]aana 'money'

b. /t̓/: [t̓]aṅa 'child'

c. /c/: [c]ixʷ- 'to fry'

d. /c̓/: [c̓]ix^{w}atin 'eagle'

e. /s/: [s]apnii 'bread'

f. /n/: taa[n]a 'money'

g. /n̓/: t̓a[n̓]a 'child'

h. /ƛ/: [ƛ]iḥ- 'to drive'

i. /ƛ̓/: [ƛ̓]iḥ 'red'

j. /ɬ/: [ɬ]uucma 'woman'

(5) Alveo-palatals

a. /č/: [č]ičiči 'teeth'

b. /č̓/: [č̓]i 'to cut'

c. /š/: [š]uuwis 'shoes'

d. /y/: ʔu[y]i 'later'

e. /y̓/: ʕu[y̓]i 'medicine'

(6) Velars

a. /k/: [k]aaʔa 'Give!'

b. /k̓/: [k̓]aaʔin 'crow'

c. /x/: [x]uučaa 'tipsy'

(7) Labio-velars

a. /k^{w}/: [k^{w}]api 'coffee'

b. /k̓^{w}/: [k̓^{w}]apii 'broken back'

c. /x^{w}/: [x^{w}]akak 'swollen

d. /w/: suuḥ[w]aɬ 'doing s.t. with hands'

e. /w̓/: su[w̓]a 'you'

(8) Uvulars

a. /q/: [q]aḥak 'dead

b. /χ/: [χ]utaayu 'paring knife'

(9) Labio-uvulars

a. /q^{w}/: [q^{w}]ayač̓iik 'wolf

b. /χ^{w}/: šu[χ^{w}]ak 'rusty'

(10) Pharyngeals

a. /ʕ/: [ʕ]aṁiit 'spoon'

b. /ḥ/: [ḥ]aa 'there!'

(11) Laryngeals

a. /ʔ/: [ʔ]aḥkuu 'here'

b. /h/: [h]upaɬ 'moon/sun'

The distribution of Nuu-chah-nulth consonants raises many interesting questions. In particular, the phonemic status of glottalised consonants requires a detailed discussion. (I will discuss other issues in § 3.2, where the unique properties of Nuu-chah-nulth consonants can be understood better with the discussion of phonological processes.) The plain/glottalised pairs show that in Nuu-chah-nulth glottalic constriction plays a phonologically significant role. One might ask, therefore, what the evidence is that the relevant part of each word including a glottalised consonant in (3-7) is a single consonant, not a sequence of a plain consonant and a glottal stop: e.g. /-pʔ-/.

The first evidence for a distinction between glottalised consonants and clusters is from the examples in (12). We find a contrast between glottalised consonants and clusters with a glottal stop in the same phonological context. It is important to note that perceptually, the glottalised consonants and clusters sound very different. For obstruents, while a plain (preceding a glottal stop) obstruent sounds soft (without any strong aspiration in general unlike their counterparts of, e.g., English) and is followed by a relatively long pause (which is a perceptual impression of a glottal stop), a glottalised obstruent sounds very strong and a shorter pause follows. This exactly corresponds to acoustic results, as will be seen below. For sonorants, a plain sonorant (preceding a glottal stop) sounds the same as its counterpart from familiar languages such as English followed by a relatively long pause, while a glottalised sonorant sounds like an abrupt silence preceding a normal production for a plain sonorant. As a result, a glottalised sonorant sounds shorter than a plain sonorant preceding a glottal stop. Note that in Nuu-chah-nulth, there is no glottal stop followed by a plain consonant, which will be discussed in detail in chapter 3.2 and chapter 4.

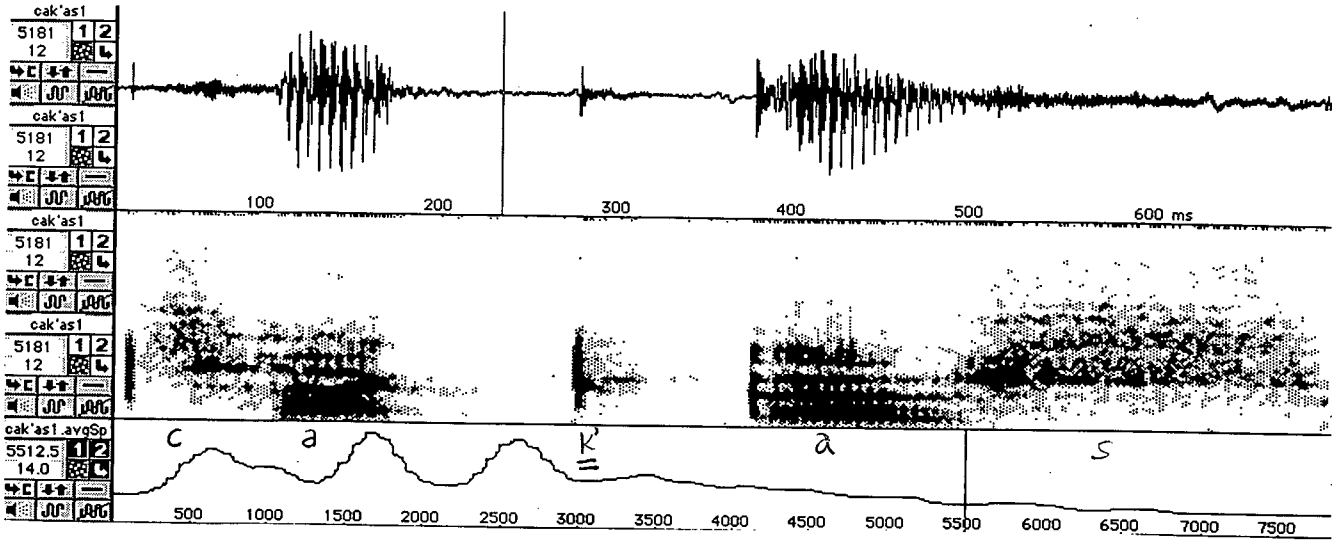
	Glottalised consonants	Clusters with /ʔ/[2]
(12) a. /a/___/u/	t̓a[t̓]uus 'star'	pisa[tʔ]ukt 'running around'
		(< pisat-ʔukt)
b. /u/___/a/	ʔuu[c̓]aƛ 'to belong to'	ʔuu[cʔ]aqƛ 'belong to (Future)'
	(<ʔuuc-ʔaƛ)	(<ʔuuc-ʔaqƛ)
c. /a/___/a/	ca[k̓]as 'to fall down'	ma[kʔ]atu 'to sell'
	(<cak-ʔas)	(<mak-ʔatu)
d. /u/___/a/	ʔu[m̓]aaqƛ 'to be able to do s.t.'	ʔoo[mʔ]a 'mom!'

Further support that Nuu-chah-nulth has underlying glottalised consonants comes from acoustic evidence. A plain obstruent (preceding a glottal stop) shows more tensed acoustic energy (aspiration) than its glottalised counterpart, as seen in (13). In addition, the duration of silence (between the release of a stop and the onset of a following vowel), one acoustic property of both glottalised consonants and a glottal stop, is longer for a glottal stop than the portion of silence for a glottalised consonant as in (15). To measure silence duration, I recorded the same token for each case ten times and took an average. The results provide evidence that there is a clear distinction between a glottalised consonant and a sequence of a plain consonant and a glottal stop. Also, a glottalised sonorant exhibits shorter duration of voicing than its plain counterpart (preceding a glottal stop). This is due to the initial glottalic constriction during its production, as shown in (14) and (16).[3]

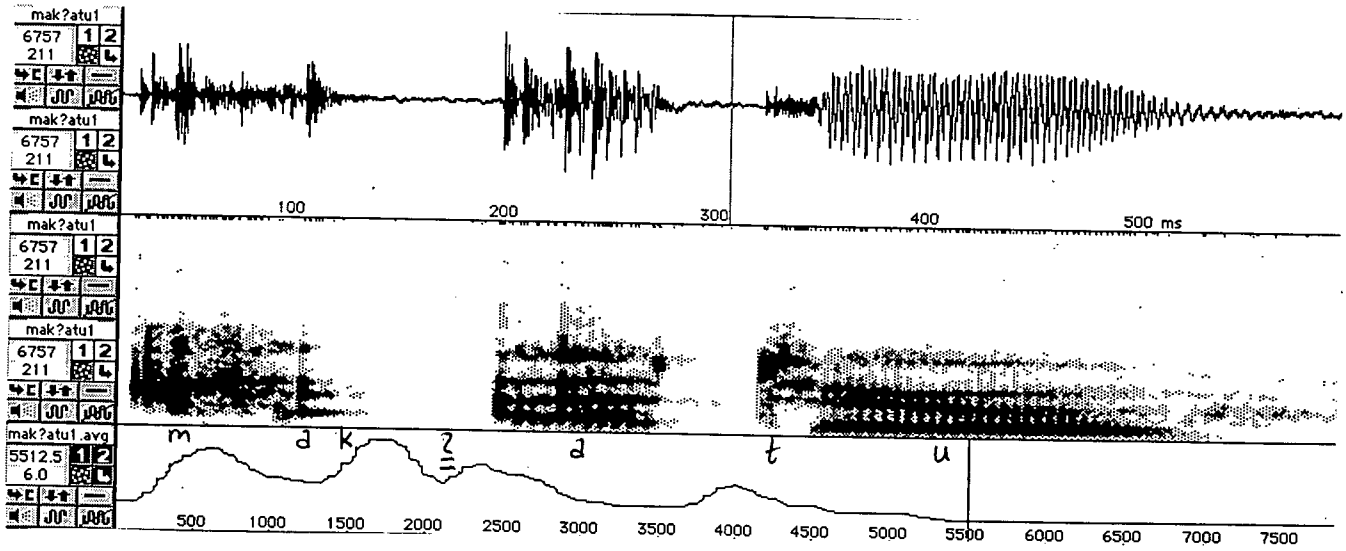
[2] There seems to be no morpheme-internal sequence of /Cʔ/ in Nuu-chah-nulth. I have not found any cases yet.

[3] In Nuu-chah-nulth, glottalised obstruents, ejectives, are post-glottalised, while glottalised sonorants are pre-glottalised as shown in the spectrograms below. See Kim 2001c for the detailed discussion.

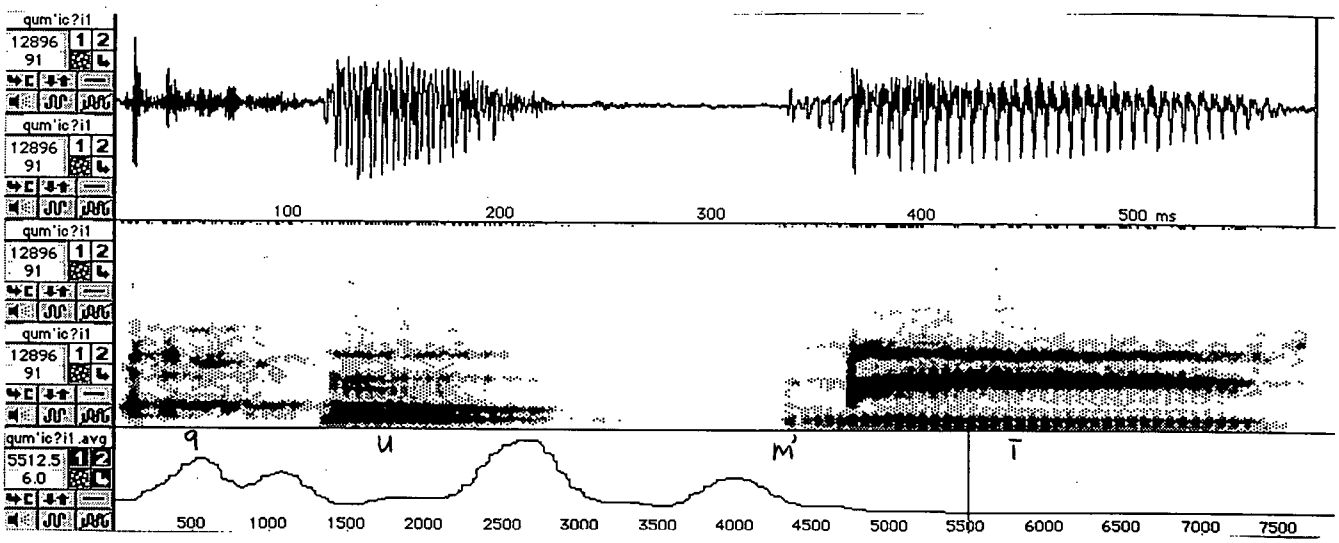
(13) a. Spectrogram of [cak̓as]



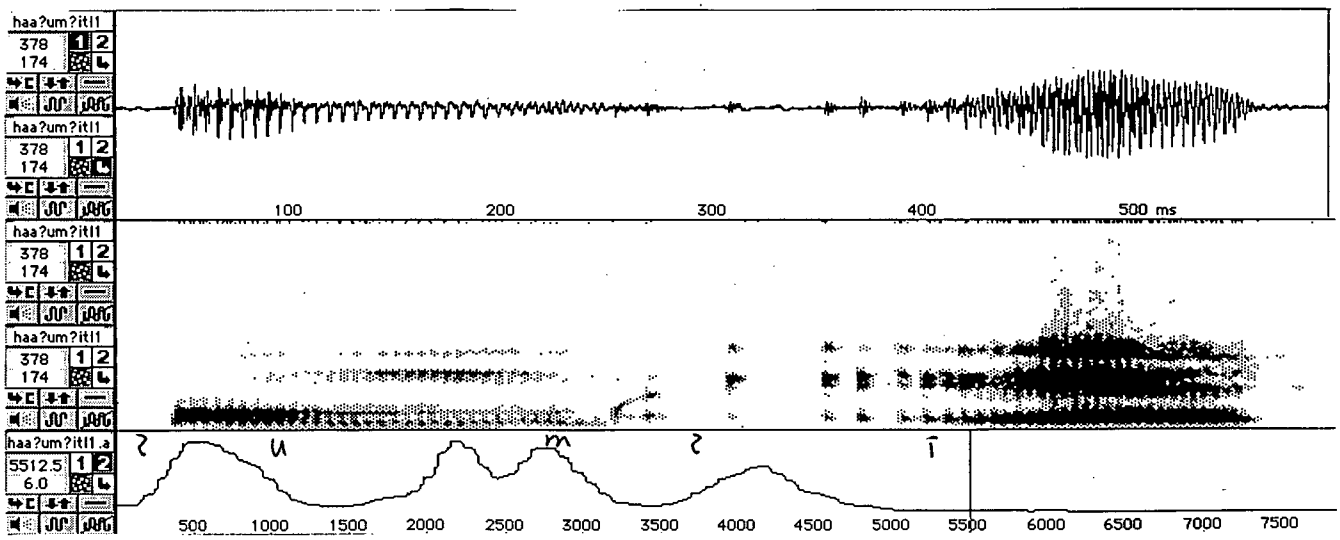
b. Spectrogram of [makʔatu]



(14) a. Spectrogram of [qum̓icʔi]



b. Spectrogram of [haaʔumʔiƛ]



(15) Duration of silence for a glottalised stop and a glottal stop

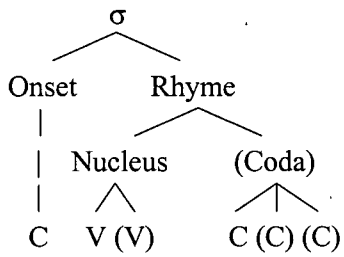
Token	cak̓as	makʔatu
#1	85.90 ms	112.34 ms
#2	66.08	181.32
#3	82.81	163.13
#4	87.53	126.30
#5	80.54	157.87
#6	68.84	112.52
#7	44.26	107.71
#8	98.82	149.71
#9	87.21	128.93
#10	88.16	143.90
Average	79.01 ms	138.37 ms

(16) Duration of voicing for a plain and a glottalised nasal

Token	qum̓icʔi	haaʔumʔiƛ
#1	12.70 ms	137.01 ms
#2	43.63	137.60
#3	22.54	149.75
#4	39.14	148.44
#5	21.59	140.32
#6	20.23	125.49
#7	36.46	148.39
#8	21.59	149.75
#9	29.71	137.64
#10	33.74	148.39
Average	28.13 ms	142.27

The third piece of evidence comes from Nuu-chah-nulth syllable structure. (I will just give a brief overview of the structures here, but return to a more detailed discussion of prosodic structures in ch. 4.) In Nuu-chah-nulth, only one consonant can occupy the onset position in the syllable, as seen in the schematic syllable structure in (17) (see also Haas 1969, Stonham 1994).

(17) The Nuu-chah-nulth syllable[4]



If a glottalised consonant were underlyingly a sequence of two consonants, this would violate the otherwise well-founded constraint that onsets are limited to a single consonant. Therefore, we would expect no stem to start with a glottalised consonant. The examples in (3)-(7) show, however, that every glottalised consonant can occupy a root-initial, and thus onset, position. Given the requirement that an onset is limited to a single consonant in Nuu-chah-nulth, a glottalised consonant must be considered a single consonant with a glottal constriction, not a consonant cluster.

One might suggest that the only possible onset clusters word-initially can be /Cʔ/ as observed in other languages (e.g. in English some consonant clusters allow only a sonorant as a final element: st[r]ing, c[l]ing, t[w]in etc.). As seen above, however, the acoustic evidence does not support this possibility. Consequently, the contrast shown in (12) is never found in word-initial positions.

In sum, both phonetic and phonological aspects provide the evidence supporting the fact that a glottalised consonant is independently phonemic in Nuu-chah-nulth.

3.1.2 Vowels

Unlike the consonant system, the Nuu-chah-nulth vowel system is very simple, with only three vowel phonemes, /i, u, a/, cross-cut by a length contrast, as shown in (18). (19)-(21) illustrate near minimal pairs, where differences in vowel length lead to lexical distinctions.

[4] This is a word-initial constraint, in particular on onset, but there seems to be no clear requirements on onset clusters morpheme/word internally. In addition, as we will see in ch. 4, the Sonority Sequence Principle does not seem to provide a clue regarding syllable structure. In that case, as is conventional, the word-initial constraint seems to apply, although it is not always the case as seen in English (an initial /str/ sequence vs. an internal /str/, for example. (See Clements 1991 for relevant discussion.) Moreover, (17) supports my treatments of some issues such as the form of a glottalising suffix: see § 3.2.

(18) The phonemic vowel inventory

	Front	Central	Back
High	i, i:		u, u:
Mid	(e, e:)		(o, o:)
Low		a, a:	

(19) a. haẇ[i]k 's.o. who always has a big appetite'

b. haẇ[ii]qƛ 'hungry'

(20) a. ṗ[u]ʔis 'tide water fish trap'

b. ṗ[uu]ʔi 'halibut'

(21) a. ʕ[a]tiq 'to thank someone'

b. ʕ[aa]tx^{w}ik 'curly hair'

Mid vowels phonemically appear on the surface only in some loan words, as in (22), vocatives, as in (23), and speech-act relevant expressions, as in (24).

(22) Loan words

a. č[e]sno 'Protestant'

b. ʔ[ee]pinis 'apple'

c. p[o]stinʔatḥ (postin 'Boston'+ ʔatḥ 'people from... residing at...')

'people from Boston/America'

d. t[o]stiiɬẏik (tostiiɬ 'to toast'+ẏik 'instrument') 'toaster'

(23) Vocatives[5]

a. ʔ[oo]mʔa	'Mom!'	(<ʔumʔiiqsu)
b. ṅ[oo]ẇa	'Dad!'	(<ṅuẇiiqsu)
c. ṁ[ee]ṁa	'Older brother!'	(<ṁaaṁiiqsu)
d. ɬ[oo]čṁ[o]p[6]	'Sister!'	(<ɬuucṁuup)

[5] I am not sure yet if the use of mid vowels in vocatives is restricted to close relatives or applying to vocatives in general.

e. ḥ[ee]č[e]ms[e][7]	'Brother!'	(< ḥačumsiqsu)
f. n[ee]n	'Grandpa/-ma!'	(naniiqsu)
g. t̓eeṅa[8]	'Child!'	(<t̓aaṅa)
h. n[ee]ʔa	'Aunt!'	(< naʔiiqsu)
i. w[ee]ʔ[o]	'nephew!'	(<wiiʔuu)

Vocatives seem to follow a certain pattern. First, the initial syllable of the vocative word is long and the other syllables are short. I suppose that this phonological property might be related to a templatic property. In Nuu-chah-nulth, the stress system, vowel alternation, and reduplication are subject to metrical templates, which will be discussed in detail later in this chapter and chapter 5. Vocatives seem to require a trochaic foot structure, lengthening the first syllable. Second, there is a predictable alternation between vocatives and non-vocatives in terms of vowels: /a/ in non-vocatives becomes (is raised to) /e/ in vocatives; /u/ in non-vocatives becomes (is lowered to) /o/ in vocatives; /i/ in non-vocatives becomes (is lowered to) /e/. Backness of vowels, except for /a/, are maintained; only height is changed: from [+High], /i/, /u/, to [-High] /e/, /o/, respectively.

(24) Expressions for speech-act

a. ƛ̓[ee]k[oo] 'Thanks!'

b. ʔ[e]n 'that…'

c. x[ee]mš 'End of story (usually 4 times repeated)

d. hišukč[ee] 'All'

e. makaʔ[ee]k 'Expression when something unusual happens'

The use of mid vowels observed in (22) is for the purpose of adjustments to loan words which include sounds Nuu-chah-nulth does not have, while (23-24) are lexically idiosyncratic. On the other hand, phonetically, non-low vowels, /i, u/, are 'lowered' before/after a uvular or pharyngeal consonant as shown in (25). That is, unlike (23-24), this kind of lowering has a phonological motivation.

(25) a. čim-y/ii/q/u/ɬ ➔ čimy[iɛ]q[ə]ɬ

proper-sense/feeling 'someone who is sober'

---

[6] This is a kinship term used by brothers, but not by sisters.

[7] This is used by sisters, but not by brothers.

[8] This can be used only by parents when they call their child.

b. čišx̣-/ii/ɬ → čišx̣[əə]ɬ
dirty-inside 'the house is dirty inside'

c. c/i/-ʕ /i/k (ciq-ʔik) → c[iɛ]ʕ[ə]k
to talk-Habitual 'one who talks a lot'

d. ƛ̓/i/ḥ-/u/k → ƛ̓[iɛ]ḥ[ə]k
red-DUR 'red'

e. ƛ̓/u/ḥ/ii/c-mas → ƛ̓[uɔ]ḥ[əə]cmas
to bounce-surface 'to bounce s.t. on the ground'

Wilson (2003) found that a high vowel preceding uvular or pharyngeal consonants acoustically shows a formant transition from [i] to [ɛ] and [u] to [ɔ], and one following them a schwa-like vowel, [ə], with a single target. This is an argument that lowered vowels are phonetically not the same as the mid vowels of (21-23). (See Wilson (2003) for the detailed discussion).

3.2 Phonological Processes

Many phonological processes in Nuu-chah-nulth raise interesting questions in terms of universals, markedness, and typological issues. Moreover, most phonological alternations in the language are triggered by suffixes, leading to the issue of how to treat phonological and morphological aspects together under a single grammar. In this section, I will discuss some pervasive phenomena: glottalisation in § 3.2.1, lenition in § 3.2.2, labialisation in § 3.2.3, delabialisation in § 3.2.4, and vowel alternation including vowel lengthening, shortening and variable vowels in § 3.2.5.

3.2.1 Glottalisation

One of the largest geographical regions in which glottalised sounds are found is the Pacific coast area from California to Alaska (see Maddieson 1984 for the distribution of glottalised sounds). In Nuu-chah-nulth, as in other Wakashan languages, each plain consonant except fricative sounds has a glottalised counterpart. The language exhibits a unique glottalisation process, traditionally called "hardening", where a plain consonant becomes its glottalised counterpart when preceding certain suffixes: e.g. /p/ ➔ [p̓] (Sapir 1933, 1938). Phonetically, a glottalised sound involves a constriction of the glottis, the aperture between the vocal folds. (See section 3.1 for detailed phonetic properties of Nuu-chah-nulth glottalised consonants.) The triggering factor for this morpho-phonological process in Nuu-chah-nulth has been considered to be an adjacent glottal stop /ʔ/ (Sapir 1938, Rose 1976).[9]

The patterns observed in Nuu-chah-nulth are significant because glottalisation is relatively rare in the world's languages, and because the particular patterns of glottalisation in this language exhibit unique properties. (See Maddieson 1984, Kingston 1985, 1990, Steriade 1997, Plauche et al 1998, Caldecott 1999, among others, for the patterns of glottalised consonants in other languages). First, Nuu-chah-nulth glottalisation is only triggered by specific suffixes, and those suffixes drive different patterns depending on morphological categories: whether lexical or grammatical. This raises questions of how to distinguish the glottal element of a glottalising suffix from that of a non-glottalising suffix, and how to phonologically define the morphological scope where glottalisation occurs. Second, the target consonants are affected in different ways, exhibiting an asymmetry between them: stops/affricates are consistently glottalised, creating an ejective, as in (26a-b), fricatives are sometimes glottalised, surfacing as a glottalised glide, as in (26c), but sometimes not, surfacing as a plain fricative followed by a glottal

[9] See also Gamble 1977, Howe & Pulleyblank 2001, which deal with some properties of glottalisation in Nuu-chah-nulth.

stop, as in (26d), and sonorants are rarely affected, surfacing as a plain sonorant followed by a glottal stop, as in (26e):[10]

(26) a. tup/k/-ʔaqƛ	➔	tup[k̓]aqƛ
black-inside		'(something) black inside'
b. ma/ƛ/-ʔaaʔa	➔	ma[ƛ̓]aaʔa
tied-on the rock		'being tied to the rock'
c. t̓u/ḥ/-ʔaqƛ	➔	t̓u[ẇ]aqƛ
head-inside/consuming		'eating (fish) head'
d. ƛ̓i/ḥ/-ʔaqƛ-y̓ak	➔	ƛ̓i[ḥ]ʔaqƛy̓ak
driving-inside-instrument		'shirt'
e. haʔu/m/-ʔaqƛ	➔	haʔu[m]ʔaqƛ
food-inside		'food inside (of something)

As shown above, stops/affricates, fricatives, and sonorants each exhibit different behaviour with respect to glottalisation, and thus we need to identify the phonetic properties of each consonant group and develop a mechanism by which the phonetic characteristics are phonologically interpreted.[11] I will discuss these issues in terms of two pervasive phonological principles: Markedness (Archangeli & Pulleyblank 1994), for the question of why some consonants are more easily affected by a trigger depending upon its phonetic/phonological properties; and 'Richness of the Base' (Prince & Smolensky 1993, Smolensky 1996), for the question of how to interpret patterns where different instances of the same surface segments exhibit different behaviour depending on the morpheme in which they are found, as in the dual aspects of fricatives.

Another major issue dealt with in this section is the relationship between fricatives and glides. When a fricative is affected by a trigger, the resulting form is a glottalised glide as in (25c), not a glottalised fricative (*t̓uḥ'aqƛ). The absence of glottalised fricatives, whether underlying or derived, can be dealt

[10] For the form of the glottalising suffix, I show /ʔ/ as its initial element until I establish its proper form as discussion goes by.

[11] Adopting Clements (1985, 1987, 1999), Steriade (1989), Shaw (1992), LaCharite (1993), I assume that affricates are a kind of stop, and they are distinguished from plain stops by features such as stridency and laterality, not by the status of contour segments (cf. Sagey 1986). Therefore, I treat stops and affricates as a single class in terms of glottalisation.

with under Markedness, because cross-linguistically glottalised fricatives are rare. Then, the question arises how a glottalised glide can be a glottalised counterpart of a plain fricative in Nuu-chah-nulth. This question will be explained in terms of the interaction between Faithfulness and Markedness under OT.

3.2.1.1 Description

In morphologically complex Nuu-chah-nulth words, some suffixes trigger glottalisation of an immediately preceding consonant. (27) exemplifies lexical glottalising and non-glottalising suffixes -*ʔaqƛ* 'inside' and -*ʔatu* 'to sink', respectively, and (28) grammatical glottalising and non-glottalising suffixes -*ʔap* 'CAUSATIVE' and -*ʔaqƛ* 'FUTURE', respectively.

(27) Lexical

a. Glottalising suffix

tup/k/-ʒ̲aqƛ	➔	tup[k̓]aqƛ
black-inside		'There is s.t. black inside (of the container).'

b. Non-glottalising suffix

ƛ̓as/k/-ʒ̲atu	➔	ƛ̓as[k]ʔatu
To slip-to sink into		'to slip into water'

(28) Grammatical

a. Glottalising suffix

yaaʔa/k/-ʒ̲a/p/	➔	yaaʔa[k̓]ap
care-CAUS-3sg/IND		'to like'

b. Non-glottalising suffix

p̓usaa/k/-ʒ̲aqƛ-siš	➔	p̓usaa[k]ʔaqƛsiš
tired-FUT-1sg/IND		'I will be tired.'

When a glottalising suffix attaches to a stem, an immediately preceding plain consonant becomes glottalised. However, the triggering behaviours of a glottalising suffix vary according to morphological category: i.e. lexical vs. grammatical.[12] Lexical suffixes provide an independent part of the word's

[12] Joe Stemberger (p.c.) points out that lexical phonology uses the ordering of different classes of affixes such as lexical and grammatical into different strata. Phonological rules can be different at different strata. However, this kind of ordering mechanism does not work for the Nuu-chah-nulth case, because affixes of both types can trigger or fail to trigger glottalisation.

meaning or a dependent meaning which is completed only in conjunction with the total meaning of the root-suffix combination (Rose 1976). Linearly, they are ordered between a root and any grammatical suffixes. On the other hand, grammatical suffixes consist of elements which provide Tense, Mode, Modal, and Person information. (I will discuss the internal structure of word in more detail in section 3.5.) While glottalising suffixes, whether lexical or grammatical, consistently glottalise a stop/affricate, only lexical glottalising suffixes affect a preceding fricative. Phonetic factors also play a role in Nuu-chah-nulth glottalisation: not every preceding consonant is affected. In the following sections, data are given to motivate these morphological and phonetic categories.

3.2.1.1.1 Glottalisation triggered by a lexical suffix

Stops/affricates

In Nuu-chah-nulth, the glottal element of a lexical glottalising suffix always causes a preceding stop/affricate, whether it is root-final or stem-final, to be glottalised as follows: voiceless stops /p, t, k, kʷ, q, qʷ/ become their glottalised counterparts /p̓, t̓, k̓, k̓ʷ, ʕ, ʕ/, as shown in (29a-f), and voiceless affricates /ƛ, c, č/ become glottalised into /ƛ̓, c̓, č̓/, as shown in (29g-i).[13] Note that each consonant of interest in a different morphological environment surfaces without change.

(29) a. wik-stu/p/-ʔaqƛ → wikstu[p̓]aqƛ
not-thing-inside 'nothing inside'

cf. wik-stu/p/ → wikstu[p]
not-thing 'nothing'

b. hap/t/-ʔaaʔa → hap[t̓]aaʔa
to hide-on the rock 'hiding (among) the rocks'

cf. hap/t/-šiƛ → hap[t]šiƛ
to hide-MOM 'to hide'

c. tup/k/-ʔaqƛ → tup[k̓]aqƛ
black-inside '(something) black inside'

[13] A uvular and a labio-uvular stop, /q/ and /qʷ/, become a pharyngeal stop /ʕ/ when preceding a glottalising suffix. As mentioned above, Nuu-chah-nulth does not have glottalised uvular or labio-uvular stops and a pharyngeal stop behaves as the glottalised counterpart of a plain uvular and labio-uvular stop.

cf. tup/k/-ak-ʔiš → tup[k]akʔiš
black-DUR-3sg/IND 'it is black'

d. haʔu/kʷ/-ʔas → haʔu[k̓ʷ]as
to eat-to go s.w. to do. s.t. 'going s.w. to eat s.t.'

cf. haʔu/kʷ/-(m)it → haʔu[kʷ]it 'ate'
to eat-PAST 'ate'

e. kamat/q/-ʔas → kamat[ʕ]as
to run-to go s.w. to do. s.t. 'going s.w. to run'

cf. kamat/q/-šiƛ → kamat[q]šiƛ
to run-MOM 'to run'

f. t̓i/qʷ/-ʔaaʔa → t̓i[ʕ]aaʔa
to sit-on the rock 'sitting on the rock'

cf. t̓i/qʷ/-aas → t̓i[qʷ]aas
to sit-on the surface 'sitting'

g. ma/ƛ/-ʔaaʔa → ma[ƛ̓]aaʔa
tied-on the rock 'being tied to the rock'

cf. ma/ƛ/-šiƛ → ma[ƛ]šiƛ
tied-MOM 'to be tied'

h. čii/c/-ʔas → čii[c̓]as
to fish-to go s.w. to do s.t. 'going s.w. to fish'

cf. čii/c/ 'to fish'

i. waʔi/č/-ʔas → waʔi[č̓]as
to sleep-to go s.w. to do. s.t. 'going s.w. to sleep'

cf. waʔi/č/-uƛ	➔	waʔi[č]uƛ
to sleep-DUR		'sleeping'

Fricatives and sonorants (nasals)

While stops/affricates never fail to be glottalised when immediately preceding a lexical glottalising suffix, fricatives and nasals exhibit different patterns of glottalisation: fricatives show an alternation, while nasals are rarely affected by a glottalising suffix.[14] When a fricative precedes a lexical glottalising suffix, it is sometimes affected, surfacing as a glottalised glide, and sometimes not, surfacing as a fricative followed by a glottal stop. Nasals surface as plain nasals followed by a glottal stop in most cases when it precedes a glottalising suffix.

Given that fricatives and nasals exhibit variation with respect to glottalisation, it is useful to investigate the extent of variation by examining frequency of glottalisation in order to understand the phenomenon completely. (I did not examine the frequency for glottalisation of stops/affricates, since the distribution of glottalised stops/affricates is consistent: there are no exceptional cases.)

Frequency of glottalisation in fricatives and sonorants

For this test, I collected 251 stem morphemes (189 ending with a fricative and 62 ending with a nasal), and asked two Ahousaht speakers to attach each glottalising suffix to a stem (19 suffixes as shown in (30)). The total number of tested words (combinations of a stem and a glottalising suffix) is 4,769 (251 stems X 19 suffixes). When the speakers feel more comfortable with the combination within a sentence rather than a word, the data tested are sentences which include the combination of interest. That is, I limited the experiment to words/sentences that can be used in natural speech acts.

The actual stems from which I collected statistics are 175 out of 251, with a total of 3,325 combinations (175 stems X 19 suffixes: 118 for fricatives and 57 for nasals). 76 words, with a total of 1,444 combinations, are not available for the test for either morphological (due to an insertion of another

[14] Nuu-chah-nulth has plain glides and their glottalised counterparts in the phonemic inventory. However, there is no morpheme, either a root or suffix, that ends with a glide, and thus it is not possible to test glides for glottalisation. Given Richness of the Base, we would expect morphemes ending with a glide in the input. In order to prevent such a morpheme from surfacing in Nuu-chah-nulth, we would need a constraint which disallows [-Cons, +Cont] morpheme-finally in the output, which outranks the relevant faithfulness constraint. In addition, we would need another constraint which prevents a glide from appearing in the coda. Recall that glides, whether plain or glottalised, are frequently found in the onset in Nuu-chah-nulth, while they are not in the coda, even morpheme-internally. The reason we need these two constraints is that if we have only the coda-condition constraint, then it would be possible to have a glide-final morpheme in Nuu-chah-nulth and glottalisation of a glide preceding a glottalising suffix. For the glide would surface as an onset: as we will see below, the trigger of glottalising suffixes, [+C.G.], is followed by a vowel.

morpheme between a stem and a suffix) or semantic (due to unnaturalness of the meaning in the derived word) factors. For fricative-final stems, a total of 2,242 combinations (118 stems X 19 suffixes) are possible in principle, but only 364 combinations were available for the test for morphological and semantic reasons mentioned above. For nasal-final stems, a total of 1,083 combinations (57 stems X 19 suffixes) are possible in principle, but only 114 combinations were available for the test for the same reasons.

(30) List of Ahousaht lexical glottalising suffixes

SUFFIX	GLOSS	SUFFIX	GLOSS
-ʔaaʔa	On the rock	-ʔaḥs	Vessel/constainer
-ʔ(a)ap	To buy	-ʔiḥta	At the end
-ʔakƛi	At the rear	-ʔiic	To eat
-ʔaɬuk	To look after	-ʔiiḥ	To hunt/fish
-ʔaqa	Happening/result	-ʔiik	Someone who always..
-ʔaqƛ	Inside	-ʔiiƛ	On the ground (process)
-ʔaqƛ'as	In a house/forest	-ʔiƛ	To take/get
-ʔas	On the ground (status)	-ʔinɬ	To serve
-ʔas	To go somewhere to do something	-ʔuup	Vehicles like canoes and cars
-ʔaḥi	Thing		

The following chart illustrates the number of stems tested according to segments, fricative and nasal:

(31) The distribution of fricatives and nasals in the tested stems

Stem-final fricative	Number of stems	Stem-final nasal	Number of stems
s	30	m	26
š	14	n	31
ɬ	35		
x	3		
x^w	8		
x̣	3		
$x̣^w$	1		
ḥ	24		
TOTAL	118	TOTAL	57

Stem-final fricatives in 53 of 118 morphemes (45 %) consistently become glottalised glides no matter what glottalising suffix is attached, whereas they are never glottalised in 57 morphemes (48 %). Also, there are 8 cases where a stem-final fricative becomes a glottalised glide only with some glottalising suffixes. That is, stem-final fricatives with certain lexical glottalising suffixes are always glottalised, but not with others.

On the other hand, glottalisation rarely affects a nasal, with 94.7 % exhibiting no glottalisation (54 out of 57 stems) and 5.3 % showing glottalisation (3 cases). In addition, unlike fricatives there is no suffix-dependent case in glottalisation of nasals.

The table in (32) shows the proportion of glottalisation in fricatives and nasals in Nuu-chah-nulth.

(32) Glottalisation of fricatives and nasals in Nuu-chah-nulth (Ahousaht)

Aspects of glottalisation	Fricatives		Nasals	
	Stems	%	Stems	%
Consistent glottalisation	53	**45**	3	**5.3**
Suffix-dependent glottalisation	8	7	0	0
No glottalisation	57	**48**	54	**94.7**
TOTAL	118	100	57	100

The following sections illustrate each of these types of cases involving fricatives and nasals.

Fricatives

Unlike stops/affricates, fricatives are only glottalised in certain lexical items as seen in (33) and (34). In fact, when affected, they become glottalised glides: a coronal fricative becomes a coronal glottalised glide /y̓/ as in (33a), and a non-coronal fricative a labio-velar glottalised glide /w̓/ as in (33b). On the other hand, when a stem-final fricative is not affected by a glottalising suffix, the surface form is a sequence of a fricative and a glottal stop as in (34a and b).

(33) a. k̓ʷi/s/-ʔic ➔ k̓ʷi[y̓]ic
snow-eating 'eating snow'

cf. k̓ʷi/s/-aa ➔ k̓ʷi[s]aa
snow-DUR 'snowing'

b. t̓u/ḥ/-ʔaqƛ ➔ t̓u[w̓]aqƛ
head-inside/consuming 'eating (fish) head'

cf. t̓u/ḥ/-c̓iti ➔ t̓u[ḥ]c̓iti
head-? 'head'

(34) a. ƛ̓i/ḥ/-ʔaqƛ-y̓ak ➔ ƛ̓i[ḥ]ʔaqƛy̓ak
to drive-inside-instrument 'shirt'

cf. ƛ̓i/ḥ/-šiƛ → ƛ̓i[ḥ]šiƛ
to drive/move-MOM 'to start to move'

b. ciyapux/s/-ʔic → ciyapux[s]ʔic
hat-eating 'biting a hat'

cf. ciyapux/s/-ʔi → ciyapux[s]ʔi
hat-DEF 'the hat'

Also, when a fricative precedes a lexical glottalising suffix, its behaviour is in most cases consistent with respect to glottalisation. The examples in (35-37) illustrate examples of each case shown in the chart (32). In (35), the stem-final fricative /ɬ/ changes consistently into a glottalised glide /y̓/ whatever glottalising suffix is attached:

(35) Consistent glottalisation: hiɬ 'Locative' (cf. hi[ɬ]aas 'there is something on the surface')

a. hi/ɬ/-ʔaaʔa → hi[y̓]aaʔa
LOC-on the rock 'on the rock'

b. hi/ɬ/-ʔaqƛ → hi[y̓]aqƛ
-inside 'inside'

c. hi/ɬ/-ʔaḥs → hi[y̓]aḥs
-vessel 'in a boat/car/bowl'

d. hi/ɬ/-ʔakƛi → hi[y̓]akƛi
-rear 'at the rear (of a boat/car)'

e. hi/ɬ/-ʔakƛ̓as → hi[y̓]akƛ̓as
-in a house 'in a house'

f. hi/ɬ/-ʔiḥta → hi[y̓]iḥta
-at the end 'located at the end'

In (36), the stem-final fricative /ɬ/ changes into /y̓/ only with some glottalising suffixes:

(36) Suffix-dependent glottalisation: c̓aawumɬ 'one left'

a. c̓aawum/ɬ/-ʔaaʔa	➔	c̓aawum[y̓]aʔa
one left-on the rock		'One (person) left on the rock'
b. c̓aawum/ɬ/-ʔakƛi	➔	c̓aawum[ɬ]ʔakƛi
-rear		'One left at the rear (of a boat)'
c. c̓aawum/ɬ/-ʔiḥta	➔	c̓aawum[y̓]iḥta
-at the end		'One person left at the end (of a wharf)'

In (37), the stem-final fricative /ɬ/ is consistently not affected by any glottalising suffixes:

(37) No-glottalisation: ƛuɬ 'nice'

a. ƛu/ɬ/-ʔaqƛ	➔	ƛu[ɬ]ʔaqƛ
nice-inside		'clean inside (e.g. oven)
b. ƛu/ɬ/-ʔaḥs	➔	ƛu[ɬ]ʔaḥs
-vessel		'clean inside (of a boat/bowl)
c. ƛu/ɬ/-ʔiḥta	➔	ƛu[ɬ]ʔiḥta
-at the end		'(s.t.) clean at the end'
d. ƛu/ɬ/-ʔas	➔	ƛu[ɬ]ʔas
-on the ground		'clean yard'
e. ƛu/ɬ/-ʔiic	➔	ƛu[ɬ]ʔiic
-eating		'eating (s.t.) good'
f. ƛu/ɬ/-ʔaap	➔	ƛu[ɬ]ʔaap
-buying		'buying (s.t.) good'

Nasals

As the chart (32) above and the examples in (38) show, nasals are rarely affected by a glottalising suffix. When a stem-final nasal precedes a lexical glottalising suffix, the surface form is a sequence of a nasal and a glottal stop. (39) takes (38d) and examines it with different glottalising suffixes. A nasal is

consistently not glottalised, no matter what glottalising suffix is attached. That is, there is no suffix-dependent glottalisation, unlike the pattern observed with fricatives.

(38) a. haʔu/m/-ʔaqƛ → haʔu[m]ʔaqƛ
food-inside 'food inside (of something)

b. siicmi/n/-ʔaqƛ → siicmi[n]ʔaqƛ
maggot-inside 'maggot inside (of something)

c. ḥuqsu/m/-ʔaaʔa → huqsu[m]ʔaaʔa
goose-on the rock 'geese on the rock'

d. ḥiči/n/-ʔaaʔa → ḥiči[n]ʔaaʔa
little-neck clam-on the rock 'little-neck clams on the rock'

(39) ḥičin 'little neck clam'

a. ḥiči/n/-ʔaaʔa → ḥiči[n]ʔaaʔa
l. n. clam-on the rock 'little neck clams on the rock'

b. ḥiči/n/-ʔaḥs → ḥiči[n]ʔaḥs
l.n. clam -vessel 'little neck clams in a boat/bowl'

c. ḥiči/n/-ʔic → ḥiči[n]ʔic
-eating 'eating little neck clams'

d. ḥiči/n/-ʔap → ḥiči[n]ʔap
-buying 'buying little neck clams'

There are, however, three cases of glottalisation as in (40), where a nasal becomes its glottalised counterpart:

(40) a. t̓aa/n/i̱ɬ-ʔaaʔa → t̓aa[n̓]aaʔa
stacked-on the rock 'stacked (s.t.) on the rock'

b. č'a/m/-ʔaqƛ-um ➔ č'a[m̓]aqƛum
ʔ- inside-instrument 'oven/bread pan'

c. ʔa/m/-ʔakƛi ➔ ʔa[m̓]akƛi
ʔ- rear 'buttock'

One potential explanation for these exceptional cases is that while most affixation in Nuu-chah-nulth is morphologically or semantically compositional, these three cases are not. That is, in (40) each word seems to be lexicalised as a single morpheme. In (40a) the suffix *-ʔaaʔa* 'on the rock' is attached to the stem morpheme *t'aaniɬ* 'stacked', where part of the morpheme, *iɬ*, is truncated.[15] For some reason, it may have led to the emergence of a glottalised nasal.[16] In (40b-c), although each suffix can be identified, the two Nuu-chah-nulth speakers do not identify each morpheme, *č'am* and *ʔam*, and in fact, they are not sure about the underlying form of the nasal. I assume that there must be a diachronic restructuring, which might have caused current native speakers to consider each example in (40b-c), *č'am̓aqƛ*, and *ʔam̓akƛi*, as one meaningful unit rather than a combination of two morphemes. This still needs further research.

3.2.1.1.2 Glottalisation triggered by a grammatical suffix

A grammatical glottalising suffix causes a plain stop/affricate to be glottalised as shown in (41), while it never affects a fricative and a nasal as shown in (42) and (43).

(41) Stops/affricates
a. k'uupu/p/-ʔaƛ ➔ k'uupu[p̓]aƛ
hanging-SEQ 'to hang (something)'

[15] There is a morpheme -iɬ 'on the floor, inside', but it is not clear if the part 'iɬ' in (40a) is the same morpheme, for semantically their combination does not make sense, floor/inside+on the rock,: in Nuu-chah-nulth there are semantic restrictions for usage of morphemes with apparently the same meaning. For example, nawaas- 'to sit' must be used in the context where the activity of sitting is performed only indoors. Therefore, *t'aaniɬ* does not transparently consist of two morphemes. Interestingly, when a grammatical glottalising suffix is added, the -iɬ part is not deleted: t'aaniɬʔaƛʔiš <t'aaniɬ-ʔaƛ-ʔiš 'It is already stacked', (*t'aan̓aƛʔiš), and t'aaniɬʔap̓i < t'aaniɬ-ʔap-ʔi 'Stack them up!' (*t'aan̓ap̓i). One of the consultants said that it seems impossible to use t'aaniɬ with any lexical suffixes whether glottalising or not, although she identifies it as a single morpheme. See also Aronoff (1976) for discussion of truncation occurring within a morpheme.

[16] In Nuu-chah-nulth, it is not rare that part of a morpheme is truncated when a suffix is attached to it (see Aronoff 1976). Therefore, the deletion of *iɬ* is not surprising, although why the nasal is glottalised in (40a) still is not clear.

cf. k̓uupu[p] 'to hang'

b. ʔuu/c/-ʔaƛ → ʔuu[c̓]aƛ
belonging to-SEQ 'to belong to (someone)'

cf. ʔuu[c] 'to belong'

(42) Fricatives

a. k̓ʷi/s/-ʔaƛ-uk-ʔick → k̓ʷi[s]ʔaƛukʔick[17]
snow-SEQ-POSS-2sg 'You have snow.'

b. wik-pa/ɬ/-ʔaƛ → wikpa[ɬ]ʔaƛ
NEG-around-SEQ 'None around now'

(43) Nasals

a. waa-cu/m/-ʔaƛ-sa → waacu[m]ʔaƛsa
say-would-SEQ-1sg/NEU 'I would say…'

b. hini/n/-ʔaƛ-ʔiš → hini[n]ʔaƛʔiš
arrive-SEQ-3sg/IND 'S/he arrived finally.'

3.2.1.2 Analysis

We have seen so far that glottalisation in Nuu-chah-nulth exhibits complex properties both phonologically and morphologically. I summarise the questions these data raise as follows:

1. How do we distinguish the glottal element of a glottalising suffix from that of a non-glottalising suffix? That is, why do only some suffixes with a glottal element trigger glottalisation?

2. How is the form of a glottalising suffix explained? All glottalising suffixes consist of an initial glottal element followed by a vowel, but not by a consonant.

3. How do we account for the difference in triggering power between a lexical glottalising suffix and a grammatical one?

[17] -*ʔick* in (42a) and -*ʔiš* in (43b) are non-glottalising suffixes.

4. How do we explain the consistent glottalisation of stops/affricates, the variable glottalisation of fricatives, and the rare glottalisation of nasals?

5. How do we explain the emergence of a glottalised glide, or the suppression of a glottalised fricative, when an underlying fricative is affected by a glottalising suffix?

In this section, I discuss the issues raised. Sections 3.2.1.2.1 and 3.2.1.4 treat the morphological aspects of glottalisation, discussing the first three issues; sections 3.2.1.2.2-5 discuss Richness of the Base, which provides the answers to the remaining questions.

3.2.1.2.1 A floating feature [+Constricted Glottis]

The first issue, how to distinguish a glottalising suffix and a non-glottalising suffix, can be treated by a phonological implementation of a floating [+Constricted Glottis] (henceforth [+C.G.]) feature (Cf. Shaw 1989, Howe 1996, Zoll 1996).

In Nuu-chah-nulth, glottalisation is morphologically triggered, occurring only at morpheme boundaries.[18] However, as shown in (44-45), repeated from (26-27), only some suffixes with a glottal stop trigger glottalisation:

(44) Lexical

a. Glottalising suffix

tup/k/-ʔaqƛ	➔	tup[k̓]aqƛ
black-inside		'There is s.t. black inside (of the container).'

b. Non-glottalising suffix

ƛ̓as/k/-ʔatu	➔	ƛ̓as[k]ʔatu
To slip-to sink into		'to slip into water'

(45) Grammatical

a. Glottalising suffix

yaaʔa/k/-ʔap	➔	yaaʔa[k̓]ap
care-CAUS-3sg/IND		'to like'

[18] We are concerned with derived glottalisation here; (underlying) glottalised consonants can be found within morphemes.

b. Non-glottalising suffix

p̓usaa/k/-ʔaqƛ-siš	➔	p̓ussa[k]ʔaqƛsiš
tired-FUT-1sg/IND		'I will be tired.'

A stem-final plain stop /k/ becomes glottalised to /k̓/ before the lexical suffix *-ʔaqƛ* and the grammatical suffix *-ʔap*, as seen in (44a) and (45a), while another stem-final stop /k/ is not affected by the lexical suffix *-ʔatu* and the grammatical suffix *-ʔaqƛ*, as seen in (44b) and (45b). A distinction between glottalising and non-glottalising suffixes, therefore, is not possible just by implementing morphological categories such as lexical and grammatical suffixes as in Lexical Phonology (Kiparsky 1982, 1985, Booij & Rubach 1987, Borowsky 1992, among others). Only some lexical and grammatical suffixes drive glottalisation.

One possible way of distinguishing these two kinds of suffixes, i.e. glottalising vs. non-glottalising, is to specify a morphological index of glottalisation for a suffix which triggers glottalisation. One way of doing it can be as follows:

(46) a. -ʔap [GLOTTALISATION]

b. -ʔiš [Non-GLOTTALISATION]

However, this approach has problems both phonologically and morphologically. First, there is no phonological reason why one kind of glottal stop causes a preceding consonant to become glottalised but another doesn't. Second, this indexing approach makes no distinction between lexical and grammatical glottalising suffixes in terms of triggering effects. Recall that a fricative is not affected when preceding a grammatical glottalising suffix, although it sometimes is when preceding a lexical glottalising suffix. I will discuss in section 3.2.1.4 how my analysis, a featural approach, is combined with lexical strata to deal with this problem.

The alternative is to assign a different phonological structure to each kind of suffix. I propose that for a glottalising suffix, the trigger is not the glottal stop /ʔ/ itself, but rather a floating feature [+C.G.]. A non-glottalising suffix, on the other hand, has a glottal stop (cf. Shaw 1989, Howe 1996, Zoll 1996). Consider the structural differences between the two kinds of suffixes, represented as in (47). (Here, RT represents a root node, V represents any vowel, and X indicates a variable: either a consonant or a vowel). (48) is an example where both a glottalising and a non-glottalising suffix appear.

(47) a. Glottalising Suffix: [+C.G.]VX

```
[          RT. . .]Glot.suf.
           |
[+C.G.]    |
           V
```

b. Non-glottalising Suffix: ʔ VX

```
[  RT      RT . . .]Non-glot.suf.
   |       |
[+C.G.]    |
           V
```

(48) yaaʔak-[+C.G.]ap-ʔiš John ➔ yaaʔak̓apʔiš John
like-CAUS-3sg 'S/he likes John.'

In (47a), the floating feature of a glottalising suffix needs a root node in order to appear on the surface: as glottalisation on a preceding segment or as a full glottal stop, depending on the phonological context.[19] On the other hand, a feature already linked to a root node, as shown in (48b), does not have to link to another root node, which is why a glottal stop of a non-glottalising suffix does not affect a preceding sound. This representational difference between initial elements of suffixes provides a clue to the question of why only some suffixes cause glottalisation in Nuu-chah-nulth, as compared to an analysis which assumes that both a glottalising and non-glottalising suffix have a glottal stop and thus which cannot encode the difference (cf. Sapir 1938, Rose 1976). In addition, Rose (1976) uses another rule, a deletion rule, since whenever a preceding consonant is glottalised, a glottal stop does not appear on the surface. There is no clear phonological reason for the deletion of a glottal stop. One could suggest that either the OCP (outranking relevant faithfulness constraints) or a phonotactic constraint causes the deletion, but then how can we explain the absence of /-kʔ-/ as a surface form in the context of glottalisation? This form also satisfies the OCP; in fact, it is an optimal output candidate from the perspective of OT. (49) is a portion of the constraints to treat this issue:

(49) Constraints (see McCarthy & Prince 1995, Pulleyblank 1996, 1997)

a. OCP[+C.G.]: Adjacent [+C.G.] features on the melodic tier are banned.

b. MAXPATH [+C.G.]: Any input path between [+C.G.] and an anchor must have a correspondent path in the output; that is, association lines may not be deleted.

[19] Zoll (1996) distinguishes floating features from latent (or ghost) segments, although their underlying representations have a common property, no root-node link. The former can surface only by linking to an existing root node, while the latter can surface as independent segments by inserting a root node in certain phonological contexts. It seems that whether Nuu-chah-nulth [+C.G.] is a conventional floating feature or a latent segment does not raise a crucial issue here, now that their representations are the same. Or it might be that their distinction is not necessary and the availability of insertion of a root node is simply a language-specific or morpheme-specific property. I leave this issue for further research.

c. DEPPATH[+C.G.]: Any output path between [+C.G.] and an anchor must have a correspondent path in the input; that is, association lines may not be inserted.

d. DEPRootNode: Any root node in the output must have a correspondent in the input.

e. LINK[F]: A feature must be associated to a consonant or a vowel. (See Pulleyblank 1997 for detailed discussion for the LINK family of constraints.)

If a glottalising suffix underlyingly HAS a glottal stop, as shown in (50), no constraint penalises the presence of /kʔ/ as an optimal output form. Because cases of a stop followed by a glottal /ʔ/ are frequently observed in Nuu-chah-nulth, and the OCP does not rule out the sequence /kʔ/, the OCP and other phonotactic constraints cannot account for the deletion of a glottal stop. On the other hand, if a glottalising suffix has a floating [+C.G.], as represented in (47a), then as tableau (51) shows, we could obtain the right surface form in the glottalisation context.

(50) If a glottalising suffix has an initial glottal stop, following a stop, e.g. /k/:

/ k-ʔ / | [+C.G.]	LINK[F]	OCP [+C.G.]	MAXPATH [+C.G.]	DEPPATH [+C.G.]	DEPRoot Node
a. k' ʔ | | [+C.G.][+C.G.]		*!		*	
b. k ʔ | [+C.G.]					
c. k' | [+C.G.]			*!	*	
d. k' ʔ \ / [+C.G.]				*!	
e. k [+C.G.]	*!		*		

(51) If a glottalising suffix has a floating [+C.G.].

/ k- / [+C.G.]	LINK[F]	OCP [+C.G.]	MAXPATH [+C.G.]	DEPPATH [+C.G.]	DEPRoot Node
a. k' ? [+C.G.][+C.G.]		*!		**	*
b. k ? [+C.G.]				*	*!
c. k' [+C.G.]				*	
d. k' ? [+C.G.]				**!	*
e. k [+C.G.]	*!				

To conclude, the implementation of a structural difference between a glottalising suffix and a non-glottalising suffix contributes to a comprehensive account of glottalising vs. non-glottalising suffixes. Furthermore, it encodes the surface alternations in a reasonable way: [+C.G.] on a preceding consonant and [+C.G.] in an independent segment. A floating feature can attach to different root nodes in the output, since it is not associated to any anchor in the input, exhibiting alternation. However, a glottal stop, given full representation in the input, does not exhibit such an alternation, but is consistent in all forms.

The second issue with respect to the form of a glottalising suffix is that a glottalising suffix begins always with a vowel (plus the floating [+C.G.] feature). Nuu-chah-nulth suffixes do not have any conditions on their first two segments. Abstracting away from cases where the first segment is a glottal stop or glottalised consonant, a suffix can either begin with a sequence of a consonant and a vowel as in (52a-c) or a consonant cluster as in (52d-k):

(52) a. -mit 'past'
b. -na:k 'to have'
c. -ƛa 'again, also'
d. -qʔičḥ 'for years'
e. -ḥtin 'made of'
f. -qs 'vessel, container'
g. -st'aɬ 'each other'.
h. -ckʷii 'must have been'
i. -cḥi 'to marry'

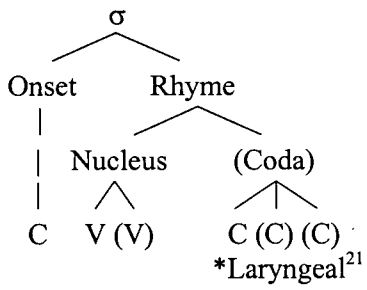
j. -ḥs '1sg/Interogative'

k. -qčs 'at a vehicle'

However, a glottalising suffix never starts with a consonant. The restriction on the morphological shape of a glottalising suffix is associated with phonological constraints on the internal structure of the Nuu-chah-nulth syllable.

Nuu-chah-nulth allows one and only one consonant in the onset position and a maximum of three consonants in the coda position, with codaless syllables available (Stonham 1994). While any consonant can be an onset, none of the glottal consonants can appear in the coda position: glottalised obstruents /p̓, t̓, k̓, k̓ʷ, c̓, č̓, x̓/, glottalised sonorants /m̓, n̓, y̓, w̓/, glottal consonants /ʔ, h/, and a pharyngeal stop /ʕ/ are all impermissible as codas. Nuu-chah-nulth has only three vowel phonemes cross-cut by a length contrast and their distribution is not restricted. The properties of the syllable structure in Nuu-chah-nulth can be schematised as in (53), with some examples, in
(54): here '.' refers to a syllable boundary.[20]

(53) Nuu-chah-nulth syllable structure (cf. (16))



(54) Examples

a. CV	→	ha . ʔum	'food'
b. CVC	→	ha . ʔum	'food'
c. CVCC	→	m̓uks . ʔi	'the rocks'
d. CVCCC	→	c̓u . c̓umɬḥ . ta	'to wash feet'
e. CVV	→	m̓aa	'to bite'
f. CVVC	→	wiiq . siɬ	'stormy'
g. CVVCC	→	yaack	'to kick'

[20] The schema in (53) just describes numbers of possible segments and distributional restrictions in the syllable in Nuu-chah-nulth, without any intension of an argument for a specific syllable theory.

[21] *Laryngeal is a constraint which simply disallows a consonant with LAR specification in the coda, without considering the effects of any theories of underspecification.

h. CVVCCC ➔ yaaqƛs . ʔiš 'S/he despises (someone).'

The fact that a glottalising suffix begins always with a vowel results from restrictions on Nuu-chah-nulth syllable structures as shown in (53). Note, again, that the onset allows only one consonant and the coda allows no glottal consonant.

If there were a glottalising suffix with an initial consonant as in (55) in Nuu-chah-nulth, and if the suffix were to be attached to a stem ending with a consonant, e.g. /t/, then we would expect an output form like (56). Such a form might be syllabified in two ways: either as a coda as in (57a) or as an onset as in (57b).

(55) [+C.G.]
[CX]$_{\text{Glot. suf.}}$

(56) [... Yt]$_{\text{Stem}}$ + [[+C.G.] CX]$_{\text{Suffix}}$ ➔ ...Yt'CX

(57) a. ...Xt'. C .... Or b. ...X . t'C ...

However, it is ill-formed in Nuu-chah-nulth to have a glottalised consonant in coda position, ruling out (57a), and ill-formed to have an onset cluster, ruling out (57b). Hence, it is not possible in Nuu-chah-nulth to have a glottalising suffix that starts with [+C.G.] followed by a consonant. If such a morpheme were posited, the [+C.G.] feature would not surface.

On the other hand, if a suffix of the type in (55) attaches to a vowel-final stem, then an output like (58) might be expected, since there are no glottalised vowels in Nuu-chah-nulth.

(58) [...YV]$_{\text{Stem}}$+ [[+C.G.] CX]$_{\text{Suffix}}$ ➔ ...YVC'X

This leads to a well-formed syllable structure, if 'X' is a vowel, as follows.

(59) YV. C'V.

This is possible only if the floating [+C.G.] is allowed to link to the suffix itself, and also the same effect would happen to consonant-final stems. It would lead to the following output form, which is well-formed as well in Nuu-chah-nulth (cf. (56)).

(60) [...YC]Stem + [[+C.G.] CV]Suffix ➔ ...YCC'V (YC.C'V.)

The principle 'Richness of the Base', which I will discuss in detail in the following section, would allow such suffixes in some languages. A possibility with the Nuu-chah-nulth case is that such suffixes might be indistinguishable from suffixes starting with a glottalised consonant. Consequently, we do not need any stipulation to rule out such input morphemes. In Nuu-chah-nulth the floating [+C.G.] feature can only link to a stem-final consonant, when there is an available anchor, which will be discussed in detail in the next section.

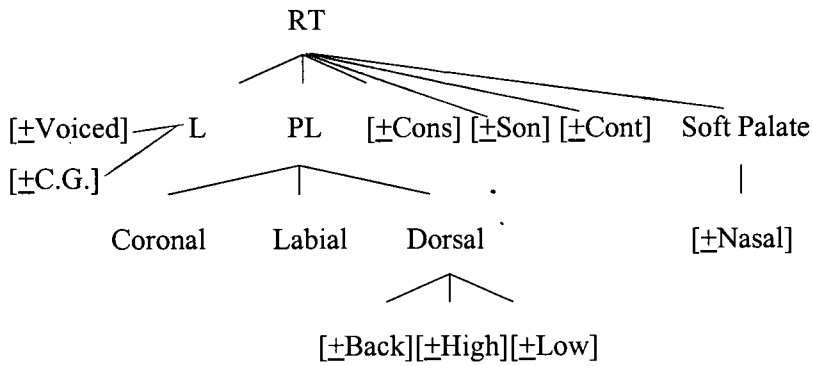
To conclude, a glottalising suffix has a consistent initial part, i.e., a floating feature [+C.G.]+ an initial vowel, in Nuu-chah-nulth.

3.2.1.2.2 Obstruents in glottalisation

The data we have seen show that there are asymmetries between obstruents with respect to the phonemic inventory and glottalisation. Stops/affricates have plain-glottalised pairs, and plain stops/affricates never fail to be glottalised when preceding a glottalising suffix. On the other hand, fricatives do not have glottalised counterparts and there is variation between fricatives in terms of glottalisation: i) only some stem-final fricatives are affected when preceding a lexical glottalising suffix, and ii) no fricative is affected by a grammatical glottalising suffix.

In this section, I will discuss the behaviour of obstruents regarding glottalisation, and how to treat these phonological and morphological asymmetries, implementing features and their combination. As a basic model of the feature geometry, I adopt Sagey (1986) and Halle (1995); (61) is its simplified version showing only features relevant to my discussion, assuming a binary feature system for terminal (non-class node) features:

(61) A model of the feature hierarchy



Because detailed discussion about the adequacy of this feature geometry is beyond the scope of the issue under discussion, I will summarise the implementation of the features here. First, I assume a Root node as an anchor for a set of features, which enables us to distinguish feature(s) linked to an anchor from unlinked floating features. Distinguishing between different suffixes as in (47) is one case where a Root

node is crucial, as we saw above. Another major difference from Halle (1995) lies in the treatment of pharyngeals /ʕ, ḥ/ in terms of Place features. Halle, adopting McCarthy (1994), claims that the two pharyngeals are [-Cons] segments, assigning them under the Tongue Root articulator, not under Place node.[22] He introduces the Guttural node grouping the Larynx, which includes /ʔ, h/, and Tongue Root articulators into a single constituent. However, Nuu-chah-nulth pharyngeals very often group with Dorsal segments rather than with glottals /ʔ, h/. For example, as we will see below, pharyngeals, especially /ḥ/, make a natural class with velars and uvulars in glottalisation. In addition, pharyngeals behave as a Dorsal consonant in the process of vowel lowering, whose triggers are made up of uvulars and pharyngeals (Rose 1976, Stonham 1999, Wilson 2003). Halle (1995) specifies vowel features under the Dorsal node. If velars, uvulars and pharyngeals are grouped under the Dorsal node and only uvulars and phayngeals are specified for [-High], then both glottalisation and vowel lowering may be explained straightforwardly. That is, all Dorsal fricatives have a common surface form in the glottalisation context, which is /ẇ/, and only [-High] Dorsal consonants (uvulars and pharyngeals) affect an adjacent vowel, also specified for Dorsal, in assimilations such as lowering. Although this treatment requires cross-linguistic examination, I group pharyngeals with velars and uvulars under the Dorsal node in Nuu-chah-nulth: the phonological distinction between these three subgroups is created via combination of the dependent features as follows (SPE 1968).

(62) Dorsal consonants

	Velars	Uvulars	Pharyngeals
Back	+	+	+
High	+	-	-
Low	-	-	+

Now, I will discuss how stops/affricates are treated in a glottalisation context and then move onto fricatives.

3.2.1.2.2.1 Stops/affricates

Noted as early as Sapir (1938), a very large number of North American indigenous languages have glottalised stops/affricates (ejectives), whereas glottalised fricatives are very rare (also, see Wang 1968,

[22] Halle suggests a restriction on the choice of designated articulator for [+consonantal]:

"The designated articulator for [+consonantal] phonemes must be one of three Place articulators, Labial, Dorsal, or Coronal" (Halle 1995: 7 (6))

Greenberg 1970, Lindau 1984, Vaux 1998).[23] In addition, glottalisation of a plain stop/affricate triggered by a glottalising suffix is a common phenomenon in this area (Steriade 1997, Caldecott 1999, Howe & Pulleyblank 2001). In this section, I will discuss characteristics of Nuu-chah-nulth glottalised stops/affricates and describe how a plain stop/affricate behaves in a glottalisation context.

In Nuu-chah-nulth, plain stop/affricates have glottalised counterparts. Plain stops/affricates never fail to be glottalised when preceding a glottalising suffix. First of all, an underlying glottalised stop/affricate always maintains its property of glottalic constriction on the surface. The presence of glottalised stops/affricates in Nuu-chah-nulth is guaranteed by ranking Faithfulness constraints MAX[+C.G.], (63a), and DEPRootNode, (63b), over a Markedness constraint *[-Son -Cont +C.G.], (64).[24] [-Cons] is a major class feature that includes both stops and affricates. To distinguish them from other [-Son] consonants such as fricatives, we need [-Cont]. In addition, we need DEPPATH[+C.G.], which does not allow the insertion of association lines. As we will see below, this constraint must be violated to observe higher-ranked constraints. (65) indicates the ranking between the Faithfulness and Markedness constraints, where ⇩ symbolises the ranking between constraints: constraints on the upper side are ranked higher than constraints on the under side.

(63) a. MAX[+C.G.]: [+C.G.] in the input must have a correspondent in the output.

b. DEPRootNode: Any root node in the output must have a correspondent in the input.

c. DEPPATH[+C.G.]: Any output path between [C.G.] and an anchor must have a correspondent path in the input.

(64) *[+Cons -Cont +C.G.]: [+Cons], [-Cont], and [+C.G.] cannot cooccur under the same root node.

(65) Ranking:

MAX[+C.G.]

⇩

DEPRootNode

⇩

DEPPATH[+C.G.], *[+Cons -Cont +C.G.]

[23] Dakota (Shaw 1989) has glottalised fricatives /s', š', x' /, and Mazahua (Spotts 1953) and Huautla Mazatec (Golston & Kehrein 1997) have a glottalised fricative /s'/, which are marked cases cross-linguistically.

[24] MAXPATH[+C.G.] has the same effect as DEPRootNode does, but the former is not relevant when a [+C.G.] feature is not associated in the input. Therefore, I implement DEPRootNode to treat both associated and unassociated [+C.G.] features. Also, DEPRootNode is lower-ranked than MAX[+C.G.], for as we will see in section 3.2.1.5, with a vowel-final stem, the input [+C.G.] always surfaces as a glottal stop.

(66) provides the relevant example and a tableau illustrating the implementation of this ranking:

(66) a. [p̓]usaak 'tired'

b. Tableau

p̓usaak | [+C.G.]	MAX[+C.G.]	DEPRootNode	DEPPATH[+C.G.]	*[+Cons -Cont +C.G.]
☞ a. p̓usaak | [+C.G.]				*
b. pusaak	*!			
c. pʔusaak | [+C.G.]		*!	*	

As shown in the tableau above, the higher-ranked constraints MAX[+C.G.] and DEPRootNode disallow a deletion of the underlying [+C.G.] feature and the insertion of a root node respectively. As a result, a glottalised stop appears on the surface.

Now, consider a derived glottalised stop/affricate. When a plain stop/affricate precedes a glottalising suffix, it always becomes glottalised. As discussed above, a glottalising suffix has a floating feature [+C.G.] in its initial position. The floating [+C.G.] feature never fails to appear on the surface; however, it is realised differently depending on the phonological context: either as glottalisation on an immediately preceding consonant, or as a full glottal stop. With an immediately preceding stop/affricate, [+C.G.] appears as glottalisation on the stop/affricate on the surface, not as a glottal stop. The fact that a stop/affricate never fails to be glottalised before a glottalising suffix can be accounted for by the same ranking status of the constraints introduced in (63) and (64). (67a) is the relevant example with the tableau in (67b).

(67) a. wik-stu/p/-[+C.G.]aqƛ ➔ wikstu[p̓]aqƛ

not-thing-inside 'nothing inside'

b. Tableau

wikstup-[+C.G.]aqƛ	MAX[+C.G.]	DEPRoot Node	DEPPATH [+C.G.]	*[+Cons -Cont +C.G.]
☞ a. wikstup̓aqƛ			*	*
b. wikstupʔaqƛ		*!	*	
c. wikstupaqƛ	*!			

As shown in the tableau, DEPPATH[+C.G.] must be violated when the [+C.G.] feature appears on the surface, in order to obey the higher-ranked constraint MAX[+C.G.]. However, maintaining the feature by inserting a root node leads to a fatal violation. Therefore, when a stop/affricate precedes a glottalising suffix, its glottalised counterpart always surfaces.

The ranking in (65) shows that key Faithfulness constraints, MAX[+C.G.] and DEPRootNode, are higher-ranked than the Markedness constraint, [+Cons -Cont +C.G.], and within Faithfulness, DEPPATH[+C.G.] is outranked by MAX[+C.G.] and DEPRootNode. This implies the following general ranking schema.

(68) Faithfulness
⇩
Markedness

On the other hand, if a language does not allow a floating [+C.G.] feature to link to a stop/ affricate on the surface, but instead requires a full glottal stop, then the ranking would be reversed

as in (69) and the general ranking schema.[25]

[25] Whether a glottal stop is [+Consonantal] is an unsolved issue, but I simply assume that a glottal stop does not violate the markedness constraint *[+Cons][+C.G.] (cf. Chomsky & Halle 1968). We may need a feature to distinguish between a glottal stop and other obstruents, if it is specified for [+Cons]. This needs further study.

(69) a. MAX[+C.G.]
⇩
*[+Cons -Cont +C.G.]
⇩
DEPRootNode, DEPPATH[+C.G.]

(70) Markedness
⇩
Faithfulness

Yowlumne (Steriade 1997) and Coeur d'Alene (Cole 1991) may be relevant cases. In these languages a glottalising suffix only causes a sonorant to become glottalised, but a stop/affricate is not affected, which is the opposite of Nuu-chah-nulth in terms of morphologically-driven glottalisation (see section 3.2.1.2.5 for detailed discussion).

Our final issue, with respect to glottalisation of stops/affricates, is the anchor of the floating [+C.G.] feature. The [+C.G.] feature in a glottalising suffix always links to a stem-final consonant. We need the alignment constraint as defined in (71), in order to obtain this effect, adapting Akinlabi (1996).[26] This constraint is also highly ranked to restrict the anchor to which the floating feature links.

(71) ALIGN-Glo. (Align (Glo. L, Stem, R)): The left edge of a glottalising morpheme must be aligned with the right edge of the stem. A glottalising morpheme is a suffix in stem.

(72) is the ranking of the constraints including (71). The grammar drives an input [+C.G.] to link to an adjacent anchor by the high-ranked MAX[+C.G.] and ALIGN-Glo. Also, DEPRootNode, outranking both DEPPATH[+C.G.] and *[+Cons, +C.G.], leads to glottalisation of an input plain consonant, in particular a stop/affricate, rather than the emergence of a glottal stop. This exactly reflects the case of stops/affricates in the context of glottalisation in Nuu-chah-nulth.

(72) A partial Nuu-chah-nulth grammar
MAX[+C.G.], ALIGN-Glo.
⇩
DEPRootNode
⇩
DEPPATH[+C.G.], *[+Cons -Cont +C.G.]

[26] See Akinlabi (1996) for detailed discussion on affixation of a featural morpheme; also see Kim (2001) for an anchoring restriction of a floating [+C.G.]: it cannot link to a suffix itself which it belongs to.

The following tableaux show how all these constraints interact with each other, causing a plain stop to surface as a glottalised stop: ST stands for stem and WD word. From now on I include morphological structures both in the input and output forms, because as we will see, especially in section 3.2.1.4, the morphological distinction between glottalising suffixes is crucial. However, I do not include two potential candidates in tableaux. One is a candidate which violates a phonotactic constraint which disallows a glottalised consonant in the coda; the other is a candidate where the input floating feature [+C.G.] is still unlinked in the output. The latter case apparently violates no constraints assumed in the tableau, which might lead it to be an output form. To prevent this unwanted result, I would use LINK, which requires all features to be linked to an anchor (cf. 49-51). I will take this for granted in further analyses and not consider such candidates.

(73) a. tup/k/-[+C.G.]aqƛ ➔ tup[k̓]aqƛ

black-inside/consuming '(something) black inside'

b. Tableau

[[tupk-[+C.G.]aqƛ]$_{ST}$]$_{WD}$	MAX[+C.G.]	ALIGN-Glo	DEPRoot Node	DEPPATH [+C.G.]	*[+Cons -Cont +C.G.]
☞a. [[tupk̓aqƛ]$_{ST}$]$_{WD}$				*	
b.[[tupkʔaqƛ]$_{ST}$]$_{WD}$			*!	*	
c. [[tupkaqƛ]$_{ST}$]$_{WD}$	*!				
d. [[t̓upkaqƛ]$_{ST}$]$_{WD}$		*!		*	

In Tableau (73), where a lexical glottalising suffix is attached to a stop, candidate **c** violates the highly-ranked constraint MAX[+C.G.], which prevents the input feature [+C.G.] from being deleted in the output. Candidate **d** is ruled out by the violation of ALIGN-Glo. The glottalising suffix is aligned with the left, not right, edge of the stem. The DEPRootNode constraint determines candidate **a** as an optimal output. Candidate **b** violates the constraint by inserting a root node. Any candidate must violate DEPPATH[+C.G.], if it is to avoid violating the higher-ranked constraint MAX[+C.G.], since the feature [+C.G.] is not linked to any root node in the input. For candidate **a**, it does not violate ALIGN-Glo., since the stem-final /k/, which is the right edge of the stem, is aligned with the left edge of the suffix, which is the [+C.G.] feature.

Tableau (74) shows that when a stop precedes a grammatical glottalising suffix, it becomes a glottalised stop as well. The morphological domain of glottalisation is extended simply from STEM to WORD by attaching a grammatical suffix.[27]

(74) a. k̓uupu/p/-[+C.G.]aƛ → k̓uupu[p̓]aƛ
hanging-SEQ 'to hang (something)'

b. Tableau

[k̓uupup-[+C.G.]aƛ]$_{WD}$	MAX[+C.G.]	ALIGN-Glo.	DEPRoot Node	DEPPATH [+C.G.]	*[+Cons -Cont +C.G.]
☞a. [k̓uupup̓aƛ]$_{WD}$				*	*
b. [k̓uupupʔaƛ]$_{WD}$			*!	*	
d. [k̓uup̓upaƛ]$_{WD}$		*!		*	*
e. [k̓uupupaƛ]$_{WD}$	*!				

In sum, Nuu-chah-nulth grammar requires that when the target consonant in the glottalisation process is a stop or an affricate, it must be glottalised.

3.2.1.2.2.2 Fricatives

Nuu-chah-nulth has a relatively large set of contrasting fricatives with extensive places of articulation: from alveolar to glottal (see the consonant chart (2) in section 3.1). Fricatives are the only set without glottalised counterparts in this language. When a plain fricative precedes a glottalising suffix, it is not glottalised; instead, it surfaces either as a plain fricative followed by a glottal stop or as a glottalised glide, depending upon phonological and morphological contexts.

First, the absence of glottalised fricatives in Nuu-chah-nulth may be due to articulatory mechanisms of sound production, and treated in terms of a phonological constraint, integrating phonetic aspects into phonology. When a fricative is produced, an air tunnel is formed, by which frication of air energy is

[27] See section 3.2.1.4 for the detailed discussion. In the case of stops/affricates, this morphological distinction is not crucial. I, therefore, will postpone the discussion of the morphological aspects in terms of Nuu-chah-nulth glottalisation to section 3.2.1.4, in which I discuss the internal structure of the word, and how the surface form of a fricative preceding a glottalising suffix is morphologically determined.

made. On the other hand, a glottalic consonant is produced by a combination of constriction and rapid vertical movement of the glottis and air compression in a small chamber in the mouth. Consequently, if a fricative is produced accompanied with the constriction of the glottis, there is a lack of enough continuous air frication for a fricative, which makes it difficult to make a glottalised fricative (Wang 1968, Greenberg 1970, Lindau 1984, and Vaux 1998, Gick p.c.). This articulatory difficulty in the production of glottalised fricatives may lead to the fact that glottalised fricatives are very rare cross-linguistically (Maddieson 1984).

The following markedness constraint, which is highly-ranked in Nuu-chah-nulth as well as cross-linguistically in general, disallows a glottalised fricative to surface.[28]

(75) *[+Cons +Cont +C.G.]: [+Cons], [+Cont], and [+C.G.] cannot cooccur under the same root node.

Another unique aspect of Nuu-chah-nulth fricatives with respect to glottalisation is that only some stem-final fricatives are affected by a glottalising suffix; they become a glottalised glide when preceding a lexical glottalising suffix. For convenience, I repeat part of the relevant data in (76), from (33):

(76) a. t̓u/ḥ/-[+C.G.]aqƛ → t̓u[w̓]aqƛ
head-inside/consuming 'eating (fish) head'

b. ƛ̓i/ḥ/-[+C.G.]aqƛ-y̓ak → ƛ̓i[ḥ]ʔaqƛy̓ak
driving-inside-instrument 'shirt'

In (76a) the stem-final fricative becomes a glottalised glide, while the phonetically identical sound in (76b) does not change even though it precedes the same suffix. Therefore, it can be said that this alternation is not determined solely by phonological factors, because a fricative which occupies the final position of only some morphemes is affected.

Two problems present themselves: i) how are two classes of superficially identical fricatives to be distinguished, and ii) how is the fricative/glide alternation to be formally accounted for. I suggest that the alternation between the same sets of fricatives and the phonologically close relationship between fricatives and glides can be accounted for by the principle that features as phonological primitives can be combined freely: i.e. Richness of the Base (Prince & Smolensky 1993, Smolensky 1996, Archangeli & Pulleyblank 1994, Kim & Pulleyblank 2003). Not all feature combinations are realised on the surface, however. They are subject to the Grounding Conditions (Archangeli & Pulleyblank 1994). According

[28] Languages with glottalised fricatives such as Dakota, Mazahua, and Huautla Mazatec may have this markedness constraint lower-ranked in their grammar.

to these two principles, certain well-formed feature combinations from a rich set of feature combinations surface as an output form according to the context. I will discuss the first problem in this section and the second in the next section.

Before explaining the alternation between the same surface fricatives, we need to identify distinctive features which are responsible for the realisation of surface fricatives. The distinctive feature that distinguishes between stops/affricates and fricatives is [±Cont]. [+Cont] is a crucial identifying factor for fricatives; stops/affricates are [-Cont]. Second, we need a feature to distinguish fricatives and glides, which is [±Cons(onantal)], since glides are also specified for [+Cont].[29] Consequently, primary features used to identify fricatives are [+Cons] and [+Cont] and under Richness of the Base, these features can be combined as follows, creating nine possible combinations of the features:

(77) Feature combinations of [±Cons] and [±Cont]

a	b	c	d	e	f	g	h	i
0	-cont	+cont	-cons	+cons	-cont	-cont	+cont	+cont
					-cons	+cons	-cons	+cons

Each combination realises a sound on the surface, which can be a fricative or some other sound. The presence of both features [+Cons] and [+Cont] is essential for a fricative on the surface. If both features are already combined in the input as in (77i), a fricative will surface straightforwardly. In order to realise a fricative from the other combinations, however, we need a phonological mechanism by which either [+Cons] or [+Cont] or both are added to an input feature combination. This process can be done by Have[α] constraints (α is a variable of any feature), which I would call a Construction constraint (See Padgett 2001 for the use of such a constraint).

(78) Have[α]: The feature α must appear in the output.

[29] Clements (1990) uses the feature 'Approximant' to single out liquids and glides from other consonant groups, obstruents and nasals. "[+Approximant] refers to any sound produced with an oral tract stricture open enough so that airflow through it is turbulent only if it is voiceless." Although he agrees with Halle & Clements (1983) on the claim that laterals are [-Cont], he does not specify if glides should be [-Cont] as well. His analysis concentrates on the investigation of sonority theory with an ability to predict valid cross-linguistic generalization; thus, he examines obstruents, nasals, liquids, glides and vowels using only 4 major class features, [Syllabic], [Vocoid], [Approximant], and [Sonorant]. Therefore, we would need more features and finer versions of the sonority scale to accommodate languages which requires further subdivisions. For the problems under discussion in the thesis, we need more features to treat the behaviours of fricatives and glides in the glottalisation context. Unless counterevidence appears, I consider glides [+Cont].

These constraints take effect depending on cross-linguistic or language-specific markedness status of the feature of interest. In this respect, a Construction constraint may be part of Markedness constraints.

If a faithfulness constraint like DEP[α] is higher-ranked than Have[α], then the phonological element α cannot surface as shown in (79) (for relevant discussion, see Keating 1988, which argues that underspecified segments remain underspecified even in surface representations: e.g. intervocalic /h/ in English, Farsi, and Swedish). If the opposite occurs, however, the feature will never fail to appear on the surface, as shown in (80).

(79) Faithfulness >> Construction (Markedness)

∅	DEP[α]	Have[α]
☞a ∅		*
b. α	*!	

(80) Construction (Markedness) >> Faithfulness

∅	Have[α]	DEP[α]
☞ a. α		*
b. ∅	*!	

The markedness status of the features [+Cons] and [+Cont] in Nuu-chah-nulth determine which input representations in (79) are realised as a surface fricative. For [Cons], frequency in the Nuu-chah-nulth lexicon and restrictions on syllable structure lead [+Cons] to be a consonantal default.[30] In Nuu-chah-nulth there are many morphemes that consist only of consonants, while there are no morphemes with only vowels. Also, glides, whether plain or glottalised, have a restriction on their distribution in the lexicon: they do not occur in stem-final or syllable-final position. This means that [+Cons] is unmarked in Nuu-chah-nulth; therefore, Have[+Cons] is higher ranked than DEP[+Cons] as shown in (80).[31]

Compared to Have[+Cons], Have[+Cont] is lower ranked. In terms of frequency cross-linguistically, unmarked [+Cons] consonants are stops/affricates, which are [-Cont] (SPE 1968, Maddieson 1984). In addition, there is no evidence that [+Cont] for obstruents is language-specifically unmarked in Nuu-chah-nulth.

[30] Frequency is one of the criteria when to determine default segments cross-linguistically.

[31] In principle, we must have Have[-Cons] as well, but I do not discuss Have[-F] constraints including it, unless they are of interest to the issue under discussion, to simplify the exposition.

Consequently, when a specific value for the features [Cons] and [Cont] is not specified in the input as in (77a-e), (81) provides relevant features and their value on the surface:

(81) (MAX[+Cons]/[+Cont]) Have[+Cons]

⇩

DEP[+Cons]/[+Cont]

⇩

Have[+Cont]

The constraints and their ranking require that a segment on the surface must be specified for the feature [+Cons] but not always for [+Cont].

Of the possibilities of feature combinations in (77), only (c) and (i) lead to the realisation of a plain fricative; the other feature combinations lead to a stop/affricate or a glide. (See Archangeli & Pulleyblank 1994 for relevant discussion). (82) represents the Nuu-chah-nulth input fricatives.

(82) Nuu-chah-nulth input fricatives:

a.=(77c) /s/ b.=(77i) /S/

$$\begin{bmatrix} +\text{Cons} \\ +\text{Cont} \end{bmatrix} \qquad \begin{bmatrix} \\ +\text{Cont} \end{bmatrix}$$

A plain fricative is derived from both possible input types by the Nuu-chah-nulth grammar in the absence of any affecting factors. Recall that glides are represented as [-Cons, +Cont] and that [+Cont] has no separate phonetic interpretation.

(83) is a Nuu-chah-nulth output fricative: it is derived from either (82a), which obeys MAX, Have and DEP constraints, or from (82b) by the insertion of [+Cons] which is due to (81). (84) illustrates this process by tableaux.

(83) Nuu-chah-nulth output fricatives (e.g. a voiceless alveolar fricative) in a simple case:

/s/

$$\begin{bmatrix} +\text{Cons} \\ +\text{Cont} \end{bmatrix}$$

(84) a. Tableau (with the input 81a)

/s/ [+Cons] [+Cont]	MAX [+Cons]	MAX [+Cont]	Have [+Cons]	DEP [+Cons]	DEP [+Cont]	Have [+Cont]
☞ a. /s/ [+Cons] [+Cont]						
b. /t/ [+Cons]		*!				*
c. /y/ [+Cont]	*!		*			

b. Tableau (with the input 81b)

/S/ [+Cont]	MAX [+Cons]	MAX [+Cont]	Have [+Cons]	DEP [+Cons]	DEP [+Cont]	Have [+Cont]
☞ a. /s/ [+Cons] [+Cont]				*		
b. /t/ [+Cons]		*!		*		*
c. /y/ [+Cont]			*!			

We started this section by raising the question of how to phonologically distinguish a fricative that is affected by a glottalising suffix, as in (86a), from one that is not, as in (85b):

(85) a. t̓u/ḥ/-[+C.G.]aqƛ ➔ t̓u[w̓]aqƛ
head-inside/consuming 'eating (fish) head'

b. ƛ̓i/ḥ/-[+C.G.]aqƛ-y̓ak ➔ ƛ̓i[ḥ]ʔaqƛy̓ak
driving-inside-instrument 'shirt'

The two possible input representations for a surface fricative in (82) solve this problem. That is, the input representation of the stem-final fricative in (85a) corresponds to (82b) and that in (85b) to (82a). Detailed discussion of this issue will be presented in section 3.2.1.2.4.

For glottalised fricatives, [+C.G.] is added to the combinations of [+Cons] and [+Cont]. A set of features which include [+Cons], [+Cont], and [+C.G.] would realise a glottalised fricative as shown in (86).

(86) Glottalised fricatives (e.g. alveolar glottalised fricative)

/s'/

⌈+Cons ⌉
|+C.G. |
⌊+Cont ⌋

However, in Nuu-chah-nulth, the highly-ranked constraint *[+Cons +Cont +C.G.] disallows the combination of these features.

(87) a.. k'ʷi/s/–[+C.G.]ic snow-eating	➔	k'ʷi[y']ic 'eating snow'	(*k'ʷis'ic)
b. ciyapux/s/–[+C.G.]ic hat-eating	➔	ciyapux[s]ʔic 'biting a hat'	(*ciyapuxs'ic)

As seen in tableaux (88-89), the absence of glottalised fricatives is achieved by ranking *[+Cons +Cont +C.G.] above the Faithfulness constraints DEPPATH[+C.G.] and DEP[R-Node]. (88) is the case where the input representation for a fricative has both [+Cons] and [+Cont], and (89) is the case where only [+Cont] is specified in the input. Whether [+Cons] is underlyingly present or not, a plain fricative never becomes a glottalised fricative when preceding a glottalising suffix, as shown in (84b) and (86b). Note that in (88), each candidate is added [+Cons] by the Nuu-chah-nulth grammar (81); hence, the lack of specification of [+Cons] for a fricative in the input does not guarantee avoiding the violation of the Markedness constraint *[+Cons +Cont +C.G.], because the constraint evaluates output forms, not the input.

(88) Tableau: a voiceless alveolar fricative specified for [+Cons]

/s/ | ⌈+Cons⌉ [+C.G.] ⌊+Cont⌋	MAX [+C.G.]	Have [+Cons]	*[+Cons] [+Cont] [+C.G.]	DEPPATH [+C.G.]	DEPRoot Node
a. s ʔ ⌈+Cons⌉ [+C.G.] ⌊+Cont⌋				*	*
b. s' | ⌈+Cons⌉ |+Cont | ⌊+C.G.⌋			*!	*	
c. s | ⌈+Cons⌉ ⌊+Cont ⌋	*!				

(89) Tableau: a voiceless alveolar fricative unspecified

/S/ | [+Cont] [+C.G.]	MAX [+C.G.]	Have [+Cons]	*[+Cons] [+Cont] [+C.G.]	DEPPATH [+C.G.]	DEPRoot Node
a. s ʔ ⌈+Cons⌉ [+C.G.] ⌊+Cont⌋				*	*
b. s' | ⌈+Cons⌉ |+Cont | ⌊+C.G.⌋			*!	*	
c. s | ⌈+Cons⌉ ⌊+Cont⌋	*!				

So far I have discussed how two classes of superficially identical fricatives are formally distinguished, and why a glottalised fricative is not observed in Nuu-chah-nulth. Free combination of features according to Richness of the Base allows the same set of surface segments to be able to have more than one input representations. Also, the Markedness constraint *[+Cons][+Cont][+C.G.] disallows the presence of a glottalised fricative in Nuu-chah-nulth. As seen in (83a) and (85a), however, a plain fricative in a glottalisation context sometimes surfaces as a glottalised glide. In the next section I will discuss the second issue: how the fricative/glide alternation is formally accounted for.

3.2.1.2.3 Glides

Nuu-chah-nulth has four glides: /y/ and /w/, and their glottalised counterparts /ẙ/ and /ẇ/. Plain glides are not available for testing before a glottalising suffix, because Nuu-chah-nulth does not have morpheme-final glides, and glottalisation occurs only between morphemes.[32] However, the phonological differences between plain and glottalised glides need to be discussed since glides interact with fricatives in glottalisation. When some stem-final plain fricatives precede a glottalising suffix, they become glottalised glides. In this section, I provide feature combinations for a plain and glottalised glide, which can help reveal how a fricative and a glide can be phonologically related to each other.

For plain glides, I provide the combinations of [+Son] and [+Cont], whose specific values are realised as a plain glide on the surface. [+Cont] is a feature common in fricatives and glides, while different values of [Son] distinguish them.

(90) Feature combinations of [±Cont] and [±Son]

a	b	c	d	e	f	g	h	i
0	-cont	+cont	-son	+son	-cont	-cont	+cont	+cont
					-son	+son	-son	+son

The presence of both [+Son] and [+Cont] is essential for a glide on the surface. If both features are already combined in the input as in (90i), a glide will surface straightforwardly. As discussed above, the Have[α] constraint is involved in realising glides on the surface from the other combinations. When a specific value for the features [Son] or [Cont] is not specified in the input as in (90a-e), the introduction of the two construction constraints Have[+Son] and Have[+Cont] and their language-specific ranking will be necessary so that a glide can surface. When a feature value for either [+Son] or [+Cont], or for both, is not specified, the Have constraints may drive these features to surface. However, given that the constraint Have [+Cons] is high-ranked in Nuu-chah-nulth (recall the unmarkedness of [+Cons] in Nuu-chah-nulth, which is discussed above), the presence of both the Have[+Cons] and Have [+Son] constraints will cause conflict with the Markedness constraint *[+Son, +Cons]. The conflict between these constraints can be resolved by ranking them. Cross-linguistically, obstruents like stops, affricates and fricatives are more unmarked than sonorants (Jakobson 1943, SPE 1968, Maddison 1984). This leads to ranking Have[+Cons] above Have[+Son]. If, therefore, there is no specification for both [+Cons] and [+Son], then [+Cons] surfaces, obeying both constraints Have[+Cons] and *[+Son, +Cons]. That is, when Have[+Cons] and Have[+Son] are in conflict, the former wins in terms of universal

[32] Of course, we find morpheme-final glides on the surface. These are derived by glottalisation so they are always glottalised. That is, Nuu-chah-nulth does not have any underlying morpheme-final plain or glottalised glides.

markedness principles. The emergence of [+Son] on the surface is suppressed, unless the feature is already specified in the input (whose presence in the output is guaranteed by a higher-ranked faithfulness constraint MAX[+Son]).

Of [+Cons] consonants, unmarked ones are stops/affricates cross-linguistically; in addition, there is no evidence that [+Cont] for obstruents is language-specifically unmarked in Nuu-chah-nulth (SPE 1968, Maddieson 1984). This leads to ranking Have[+Cont] relatively low. All these phonological properties language-specifically as well as cross-linguistically are involved not only in deriving the Nuu-chah-nulth phonemic inventory but also in the patterns of glottalisation. Especially, the relation between a fricative and glide in a glottalisation context will be illustrated below.

(91) is the ranking of the relevant constraints:

(91) A partial Nuu-chah-nulth grammar:

MAX[+Son], MAX[+Cons], MAX[+Cont]

⇩

HAVE[+Cons]

⇩

*[+Cons +Son], [+Cons +Cont]

⇩

DEP[+Cons], DEP[+Son], DEP[+Cont]

⇩

HAVE[+Son], HAVE[+Cont]

Consequently, of the possibilities of feature combinations for a plain glide in (90), only (i) will lead to a glide on the surface. (90a, b, d, and f) will realise a stop, (90c and h) a stop/ affricate, and (90e and g) a nasal. (92) provides an output feature combination for a plain glide.

(92) Nuu-chah-nulth output glides (e.g. a palatal glide):

/y/

[+Son]
[+Cont]

For a glottalised glide, [+C.G.] is added to the combinations of [+Son] and [+Cont]. (93) is an output feature combination for a glottalised glide:

(93) Nuu-chah-nulth glottalised glides (e.g. a palatal glottalised glide)

/ẏ/

[+Son]
|+C.G. |
[+Cont]

3.2.1.2.4 Fricatives in glottalisation

When a fricative precedes a glottalising suffix, it surfaces either as a plain fricative followed by a glottal stop or as a glottalised glide. I suggested above that the alternation between the same set of fricatives in a gottalisation context is due to the two input representations for a single output fricative. In this section, I will discuss in detail how the phonological representations of a single fricative are affected in the context of glottalisation, in terms of the interactions of some relevant Faithfulness and Markedness constraints.

Before going on to this major issue, we need to consider another aspect regarding the surface form of an input fricative. When an input fricative surfaces as a glottalised glide, the input Place feature is maintained in the output. Nuu-chah-nulth has two glottalised glides, /ẏ/ and /ẇ/. If a fricative has a Coronal feature, e.g., /s, ɬ, š/, then glottalisation causes the glottalised coronal glide /ẏ/ to surface (with automatic adjustments of [Strident] and [Anterior] as seen in (94)). If a fricative has a Dorsal feature, e.g., /x, xʷ, x̣, x̣ʷ, ḥ/, then the glottalised dorsal glide /ẇ/ surfaces as seen in (95). In Nuu-chah-nulth, Dorsal fricatives, except /ḥ/, are very rare: I have found 3 morphemes ending with /x/, 8 ending with /xʷ/, 3 ending with /x̣/, and 1 ending with /x̣ʷ/ (see the chart (10)). I have not found any cases where velar, uvular and labio-uvulars become glottalised glides when preceding a glottalising suffix. Because of the lack of enough data, however, I cannot determine if these segment groups are consistently not affected. The examples in (95), therefore, do not include these sound groups.

(94) Coronals

a. k̓ʷi/s/–[+C.G.]ic	→	k̓ʷi[ẏ]ic
snow-eating		'eating snow'
b. hi/š/–[+C.G.]ic	→	hi[ẏ]ic
all-eating		'eating all'
c. hi/ɬ/–[+C.G.]aaʔa	→	hi[ẏ]aaʔa
LOC-on the rock		'on the rock'

(95) Dorsals

a. tu/xʷ/-[+C.G.]aaʔa → tu[w̓]aaʔa
to jump-on the rock 'jumping on the rock'

b. t̓u/ḥ/–[+C.G.]aqƛ → t̓u[w̓]aqƛ
head-inside/consuming 'eating (fish) head'

These patterns are achieved by a high-ranked Faithfulness constraint, MAXPlace, as defined in (96).

(96) MAXPlace: A Place feature, Coronal, Labial, or Dorsal, in the input must have a correspondent in the output. (Lombardi 1997)

Now, consider the following examples:

(97) a. k̓ʷi/s/–[+C.G.]ic → k̓ʷi[y̓]ic
snow-eating 'eating snow'

b. k̓ʷi/s/-ʔi → k̓ʷi[s]ʔi
snow-DEF 'the snow'

(98) a. ciyapux/s/–[+C.G.]ic → ciyapux[s]ʔic
hat-eating 'biting a hat'

b. ciyapux/s/-ʔi → ciyapux[s]ʔi
hat-DEF 'the hat'

In (97), the root-final fricative /s/ in *k̓ʷis-* surfaces as a glottalised glide when preceding a glottalising suffix, as in (96a), and as a plain fricative before a non-glottalising suffix, as in (97b). On the other hand, the root-final fricative /s/ in *ciyapuxs-* consistently surfaces as a plain fricative.

I propose that the fricative in (97) can be represented as (99b) and one in (98) as (99a).

(99) Nuu-chah-nulth input fricatives:

a. /s/ b. /S/

[+Cons] [ ]
[+Cont] [+Cont]

That is, the fricative /s/ in (97) underlyingly has only [+Cont] specified, and the /s/ in (98) has both underlying [+Cons] and [+Cont]. This representational difference causes alternation in (97) but not in (98). Note that whether the feature [+Cons] is specified or not for an input fricative is an important factor leading to the presence/absence of alternation. If [+Cons] is specified in the input, it never fails to appear on the surface, whether it is in a glottalisation or non-glottalisation context. The highly-ranked constraint MAX[+Cons], as defined in (100), in the Nuu-chah-nulth grammar guarantees the consistent presence of [+Cons] in the output,

(100) MAX[+Cons]: [+Cons] in the input must have a correspondent in the output.

On the other hand, when a fricative is not specified for [+Cons], MAX[+Cons] is not relevant. In a non-glottalisation context, a plain fricative surfaces, which is driven by another high-ranked constraint Have[+Cons]. In a glottalisation context, deriving a glottalised glide is the best realisation of an input fricative, which leads to least violation of constraints. (101) shows a partial Nuu-chah-nulth grammar including (100):

(101) A partial Nuu-chah-nulth grammar (revised)[33]

MAX[+C.G.] (63a), MAX[+Cons] (100), ALIGN-Glo. (71), *[+Cons][+Cont][+C.G.] (64)

⇩

DEPRootNode (63b)

⇩

Have[+Cons] (78), MAXPlace (96)

⇩

DEPPATH[+C.G.] (63c)

As seen in tableaux (102-104), the pattern of glottalisation in fricatives is achieved by the grammar (101).

In Tableaux (102-103), where each stem-final fricative /ḥ/ and /s/ is unspecified for [+Cons], every candidate obeys MAX[+Cons] vacuously, since [+Cons] is not relevant here. Each candidate **e** violates the highly-ranked constraint MAX[+C.G.], which requires the [+C.G.] to appear on the output. In candidate **d**, the features [+Cons], [+Cont], and [+C.G.] are linked under the same root node, violating *[+Cons][+Cont][+C.G.]. Candidate **c** violates the constraint ALIGN-Glo., since the [+C.G.] feature, the initial element of the suffix, is not aligned with the right edge of the stem. Candidate **b** violates DEPRootNode by inserting a Root node. MAXPlace determines candidate **a** as an optimal output;

[33] Due to space, I include some constraints crucial for my discussion in the tableaux below.

candidate **f** deletes its input Place value, Dorsal in (102) and Coronal in (103), violating the faithfulness constraint.

(102) t̓u/ḥ/-[+C.G.]aqƛ → t̓u[w̓]aqƛ
head-inside/consuming 'eating (fish) head'

Tableau

[[t̓uḥ+[+C.G.]aqƛ]$_{ST}$]$_{WD}$ [+Cont]	MAX [+Cons]	MAX [+C.G.]	ALIGN-Glo.	*[+Cons] [+Cont] [+C.G.]	DEPRoot Node	Have [+Cons]	MAX Place	DEP PATH [+C.G.]
☞a. [[t̓uw̓aqƛ]$_{ST}$]$_{WD}$ [+Cont]						*		*
b. [[t̓uḥʔaqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]					*!			*
c. [[t̓u'ḥaqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]			*!					*
d. [[t̓uḥ'aqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]				*!				*
e. [[t̓uḥaqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]		*!						
f. [[t̓uy̓aqƛ]$_{ST}$]$_{WD}$ [+Cont]						*	*!	*

(103) k'ʷi/s/-[+C.G.]ic ➔ k'ʷi[y']ic

snow-eating 'eating snow'

Tableau

[[k'ʷis+[+C.G.]ic]$_{ST}$]$_{WD}$ [+Cont]	MAX [+Cons]	MAX [+C.G.]	ALIGN -Glo.	*[+Cons] [+Cont] [+C.G.]	DEPRoot Node	Have [+Cons]	MAX Place	DEP PATH [+C.G.]
☞ a. [[k'ʷiy'ic]$_{ST}$]$_{WD}$ [+Cont]]						*		*
b. [[k'ʷis?ic]$_{ST}$]$_{WD}$ [+Cons] [+Cont]					*!			*
c. [[k'ʷi'sic]$_{ST}$]$_{WD}$ [+Cons] [+Cont]			*!					*
d. [[k'ʷis'ic]$_{ST}$]$_{WD}$ [+Cons] [+Cont]				*!				*
e. [[k'ʷisic]$_{ST}$]$_{WD}$ [+Cons] [+Cont]		*!						
f. [[k'ʷiw'ic]$_{ST}$]$_{WD}$ [+Cont]						*	*!	*

The following example is one in which a fricative is specified for [+Cons], and which results in the absence of glottalisation: a sequence of a fricative and a full glottal stop appears on the surface.

(104) ƛ̓i/ḥ/-[+C.G.]aqƛ-y̓ak ➔ ƛ̓i[ḥ]ʔaqƛy̓ak

driving-inside/consuming-instrument 'shirt'

Tableau

[[ƛ̓iḥ+[+C.G.]aqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]	MAX [+Cons]	MAX [+C.G.]	ALIGN-Glo.	*[+C.G.] [+Cons] [+Cont]	DEP Root Node	Have [+Cons]	MAX Place	DEP PATH [+C.G.]
a. [[ƛ̓iẇaqƛ]$_{ST}$]$_{WD}$ [+Cont]	*!					*		*
☞ b. [[ƛ̓iḥʔaqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]					*			*
c. [[ƛ̓i'ḥaqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]			*!					*
d. [[ƛ̓iḥ'aqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]				*!				*
e. [[ƛ̓iḥaqƛ]$_{ST}$]$_{WD}$ [+Cons] [+Cont]		*!						
f. [[ƛ̓iy̓aqƛ]$_{ST}$]$_{WD}$ [+Cont]	*!					*	*	*

In Tableau (104), candidates **a** and **f** violate MAX[+Cons] by deleting the input [+Cons] feature. The violation of the MAX constraint is fatal. This is the decisive factor in determining why an input fricative specified for [+Cons] cannot surface as a glide, unlike an unspecified one. Candidate **c** violates ALIGN-Glo. Candidate **d** violates the constraint *[+Cons +Cont +C.G.]. Candidate **e** does not obey MAX[+C.G.] because it deletes the input [+C.G.] feature. Consequently, candidate **b** is selected as an optimal output. Note that DEPRootNode does not play a significant role, unlike in tableaux (102) and (103): now that candidate **a** obeys all the high-ranked constraints, the violation of this constraint is not a barrier in it being selected as the optimal output.

In sum, the Nuu-chah-nulth grammar determines whether or not glottalisation occurs in the case of fricatives, depending on the input value of a fricative in terms of [+Cons]. Significantly, the Nuu-chah-

nulth alternation is a consequence of the Richness of the Base, as shown by the fact that identical surface fricatives exhibit alternations, which can only be explained by phonological dynamics.

3.2.1.2.5 Sonorants (nasals) in glottalisation

Glottalisation varies across languages with glottalised consonants. Some Salish languages such as Shuswap, Lushootseed, Saanich, and Spokane have both glottalised obstruents and sonorants, and glottalisation affects both plain stops/affricates and sonorants (Caldecott 1999).[34] On the other hand, Yowlumne (Steriade 1997), Coeur d' Alene (Cole 1991), and Musqueam (Shaw p.c.) also have both glottalised stops/affricates and sonorants, but only a sonorant is glottalised before a glottalising suffix.

In the case of Nuu-chah-nulth, even though both plain obstruents and sonorants have glottalised counterparts, the process of glottalisation rarely affects sonorants, while a stop/affricate is completely affected by a glottalising suffix.[35] (106) summarises this observation:

(105) Comparison between three language groups in glottalisation of consonants

Languages	Glottalised. stops/affricates in inventory	Glottalised Sonorants in inventory	Morphologically-Induced glottalisation of obstruents	Morphologically-induced glottalisation of sonorants
Shuswap, Lushootseed, Saanich, and Spokane	✓	✓	✓	✓
Yowlumne, Coeur d' Alene, Musqueam	✓	✓	None	✓
Nuu-chah-nulth	✓	✓	✓	Very rare; but glottalised glides are the frequent result when the base ends in a fricative.

[34] Pat Shaw (p.c.) pointed out that not all suffixes affect both stem-final obstruents and sonorants. For example, an affixational process like diminutive targets only sonorants, but not obstruents, for glottalisation in some Salish languages such as Musqueam.

[35] As mentioned above, Nuu-chah-nulth does not have morphemes that end with a glide. This makes it impossible to test how the glottalisation affects a plain glide.

This chart shows that typologically there are three groups with respect to morphologically induced glottalisation of consonants: i) languages with across-the-board glottalisation, such as some Salish languages, ii) languages where glottalisation targets only sonorants, such as Yowlumne and Coeur d' Alene, and iii) languages where glottalisation targets only obstruents, such as Nuu-chah-nulth and the other Southern Wakashan languages (See Jacobsen 1996 for Makah, Kim 2001 for Ditidaht).

Within Optimality Theory (McCarthy & Prince 1993, Prince & Smolensky 1993), all constraints are universal and language variation results from different rankings of universal constraints. This means that the variation between the languages in (105) can be accounted for by a portion of universal constraints and their language-specific ranking. I propose that the variation between these three language groups with respect to glottalisation can be explained by the interaction between the Markedness constraints *[+Son +C.G], (106a), and *[-Son +C.G.], (106b), and the Faithfulness constraints MAX[+C.G.], DEPRootNode, and DEPPATH, and the interaction between the Markedness constraints themselves.

(106) Markedness constraints:

a. *[+Son +C.G.]: [+Cons], [+Son] and [+C.G.] cannot cooccur under the same root node.

b. *[-Son +C.G.]: [-Son] and [+C.G.] cannot cooccur under the same root node.

A set of possible rankings of these constraints must be able to derive any attested languages. I will discuss the three language groups, i.e. languages with morphologically-driven glottalisation.

If a language, such as some Salish languages, allows both a stop/affricate and a sonorant to be glottalised, then the language would have the following grammar (R refers to any sonorant; T any stop/affricate, and [+C.G.] is a glottalisation-trigger):[36]

(107) a. MAX[+C.G.],DEPRootNode
⇩
***[-Son][+C.G.],*[+Son][+C.G.]**
⇩
DEPPATH[+C.G.]

b. Faithfulness
⇩
Markedness$_{i,j}$
⇩
Faithfulness

c. Tableau:

R-[+C.G.]	MAX[+C.G.]	DEPRootNode	*[-Son, +C.G.]	*[+Son, +C.G.]	DEPPATH[+C.G.]
☞a. R'				*	*
b. R	*!				
c. R?		*!			*
T-[+C.G.]					
☞a. T'			*		*
b. T	*!				
c. T?		*!			*

In this group of languages, violation of Markedness constraints, by which glottalisation affects both stops/affricates and sonorants, are not crucial,. As seen in the tableau above, this pattern is achieved by ranking both Markedness constraints, *[-Son +C.G.] and *[+Son +C.G.], below the Faithfulness constraints MAX[+C.G.] and DEPRootNode.

If a language, such as Yowlumne, allows glottalisation of a sonorant, but not of a stop/affricate, then the language would have the following grammar:

(108) a.***[-Son+C.G.]**
⇩
MAX[+C.G.],DEPRootNode
⇩
***[+Son+C.G.]**
⇩
DEPPATH[+C.G.][37]

b. **Markedness$_i$**
⇩
Faithfulness
⇩
Markedness$_j$
⇩
Faithfulness

[36] I concentrate on derived glottalised consonants, providing relevant constraints only.

[37] However, Yowlumne allows an underlying glottalised obstruent; therefore, we would need another constraint MAXPATH[+C.G.], which outranks the markedness constraint *[-Son +C.G.]. This faithfulness constraint also plays a crucial role in treating the distribution of glottalised sonorants for some languages which underlyingly have glottalised sonorants, but no derived glottalised ones, as with Nuu-chah-nulth.

c. Tableau

R-[+C.G.]	*[-Son +C.G.]	MAX[+C.G.]	DEPRootNode	*[+Son +C.G.]	DEPPATH[+C.G.]
☞a. R'				*	*
b. R		*!			
c. R?			*!		*
T-[+C.G.]					
a. T'	*!				*
☞b. T		*			
☞c. T?			*		*

In this group of languages, to violate the Markedness constraint *[-Son +C.G.] is fatal, while to violate another Markedness constraint *[+Son +C.G.] is not. Hence, sonorants are allowed to be glottalised, but stops/affricates are not. When it comes to the surface form of a stop/affricate in a glottalisation context, language-specific ranking of the relevant Faithfulness constraints will determine an optimal output form: if MAX[+C.G.] is higher-ranked than DEPRootNode, then a stop/affricate followed by a glottal stop will surface as in candidate **c**; if vice versa, then a plain stop/affricate will surface as in candidate b, deleting the input [+C.G.].

Finally, if a language, such as Nuu-chah-nulth, allows glottalisation of a stop/affricate, but not of a sonorant, the language would have the following grammar:

(109) a. *[+Son +C.G.]
⇩
MAX[+C.G.], DEPRootNode
⇩
***[-Son, +C.G.]**
⇩
DEPPATH[+C.G.]

b. **Markedness$_j$**
⇩
Faithfulness
⇩
Markedness$_i$
⇩
Faithfulness

c. Tableau

R-[+C.G.]	*[+Son,+C.G.]	MAX[+C.G.]	DEPRoot Node	*[-Son +C.G.]	DEPPATH[+C.G.]
a. R'	*!				*
☞b. R		*			
☞c. R?			*		*
T-[+C.G.]					
☞a. T'				*	*
b. T		*!			
c. T?			*!		*

In this group of languages, violating the Markedness constraint *[+Son +C.G.] is fatal, while violating another Markedness constraint *[-Son +C.G.] is not. Therefore, when a sonorant is in a glottalisation context, a glottalised sonorant as shown in candidate **a** is disallowed. On the other hand, a stop/affricate is glottalised, obeying the two Faithfulness constraints MAX[+C.G.] and DEPRootNode. For the surface form of a sonorant when preceding a glottalising suffix, an optimal output form will be selected depending upon the relative ranking status of the Faithfulness constraints. This case is exactly opposite to (108).

Now, consider real cases from Nuu-chah-nulth glottalised sonorants and glottalisation of sonorants. Nuu-chah-nulth has underlying glottalised sonorants, while a plain sonorant is rarely glottalised in a glottalisation context. These properties can be accounted for by the interaction between the Markedness constraint *[+Son, +C.G.] and the Faithfulness constraint MAXPATH[+C.G.] with the ranking in (110).

(110) a. MAXPATH[+C.G.]
⇩
*[+Son +C.G.]

b. Faithfulness
⇩
Markedness

The Markedness constraint *[+Son +C.G.] disallows a glottalised sonorant to surface. On the other hand, MAXPATH[+C.G.] does not allow a [+C.G.] feature linked to an underlying glottalised sonorant to change its anchor to another or to be deleted (by which the input path also disappears in the output). The conflict between these two constraints is settled by a portion of Nuu-chah-nulth grammar, (109), ranking MAXPATH[+C.G.] above *[+Son +C.G.]. This renders trivial the violation of *[+Son +C.G.] to obey

MAXPATH[+C.G.], which enables an underlying glottalised sonorant to surface. As seen in tableau (111), this process is achieved by the ranking in (110).

(111) m̓aa 'to bite'

Tableau

m̓aa [+C.G.]	MAXPATH [+C.G.]	*[+Son +C.G.]	MAX[+C.G.]	DEPRoot Node	DEPPATH [+C.G.]
☞ a. m̓aa [+Cons +Son +C.G.]		*			
b. m ʔaa [+Cons] [+C.G.] [+Son]	*!			*	*
c. maa [+Cons] [+Son]	*!		*		

Candidate **a** obeys the higher-ranked constraint MAXPATH[+C.G.], although violating *[+Son +C.G.], whereas candidates **b** and **c** violate this Faithfulness constraint. This leads candidate **a** to be selected as an optimal output. As a result, underlying glottalised nasals in Nuu-chah-nulth never fail to surface as such.

While the ranking Faithfulness >> Markedness in Nuu-chah-nulth allows glottalised nasals on the surface, if a language disallows glottalised nasals, then the ranking will be reversed: Markedness >> Faithfulness, which is cross-linguistically frequently observed.

Another issue with respect to glottalisation in sonorants is that a plain sonorant rarely becomes glottalised when preceding a glottalising suffix, whether lexical, as in (112), or grammatical, as in (113).

(112) haʔu/m/-[+C.G.]aqƛ → haʔu[m]ʔaqƛ
food-inside 'food inside (of something)

(113) waa-cu/m/-[+C.G.]aƛ-sa → waacu[m]ʔaƛsa
say-would-SEQ-1sg/NEU 'I would say…'

The general absence of derived glottalised sonorants is due to a relatively high-ranked Markedness constraint *[+Son, +C.G.]. Tableaux (114) and (115) show the interaction of *[+Son, +C.G.] with other

constraints, leading to no glottalisation in a nasal (here MAXPATH[+C.G.] is not relevant since the input [+C.G.] does not link to any anchor):

(114) Tableau for (112)

[[haʔum+[+C.G.]aqƛ]$_{ST}$]$_{WD}$	MAX PATH [+C.G.]	*[+Son +C.G.]	MAX [+C.G.]	ALIGN-Glo.	DEPRoot Node	DEPPATH [+C.G.]
☞ a. [[haʔumʔaqƛ]$_{ST}$]$_{WD}$					*	*
b. [[haʔum̓aqƛ]$_{ST}$]$_{WD}$		*!				*
c. [[haʔumaqƛ]$_{ST}$]$_{WD}$			*!			
d. [[haʔu'maqƛ]$_{ST}$]$_{WD}$				*!		*

(115) Tableau for (113)

[cum+[+C.G.]]$_{WD}$	MAX PATH [+C.G.]	*[+Son +C.G.]	MAX [+C.G.]	ALIGN-Glo.	DEPRoot Node	DEPPATH [+C.G.]
☞ a. [cumʔaƛ]$_{WD}$					*	*
b. [cum̓aƛ]$_{WD}$		*!				*
c. [cumaƛ]$_{WD}$			*!			
d. [cu'maƛ]$_{WD}$				*!		*

As seen in the tableaux above, the process of glottalisation does not affect the stem-final nasal /m/ in *haʔum* in (114) and *cum* in (115), creating a sequence of a plain nasal and a glottal stop on the surface. Candidate **b** violates the highly-ranked constraint *[+Cons, +Son, +C.G.]. Candidate **c** is ruled out by violating another highly ranked constraint MAX[+C.G.]. Candidate **d** violates ALIGN-Glo. by linking [+C.G.] to a segment preceding the stem-final consonant /m/. As a result, candidate **a** is selected as an optimal output form. Even though the optimal output violates the two low-ranked constraints DEPRootNode and DEPPATH[+C.G.], their violations are not crucial now that it obeys all the highly ranked constraints.

In sum, the lack of derived glottalised sonorants (nasals) in Nuu-chah-nulth, despite the presence of phonemic glottalised ones, is mainly due to the relatively high-ranked Markedness constraint, [+Cons,

+Son, +C.G.]. The constraint affects part of Nuu-chah-nulth phonology rather than its whole phonology, creating the effect of emergence of the unmarked with respect to glottalisation.

3.2.1.3 Stops/affricates and sonorants in Richness of the Base

In previous sections, I discussed how the alternation between the same set of fricatives in glottalisation is treated in terms of the principle of Richness of the Base. According to Richness of the Base, features as phonological primitives can be combined freely: there is no constraint on the form of the input. In the case of fricatives, two combinations of the features [+Cons] and [+Cont] can be realised as a fricative. These two different input representations of a single surface fricative lead to two different output forms in a glottalisation context, while they consistently surface as a plain fricative in a simple context.

One might ask how the principle works with stops/affricates and sonorants. Isn't it the case that there can be alternation between the same set of stops/affricates or between the same set of sonorants as in fricatives, if features can be combined freely? On first thought, it seems to be possible, but the interaction between Markedness and Faithfulness constraints in Nuu-chah-nulth grammar shows that it is not the case. The following subsections discuss feature combinations for stops/affricates and for sonorants, with their behaviours in a glottalisation context, in sections 3.2.1.3.1 and 3.2.1.3.2, respectively.

3.2.1.3.1 Stops/affricates

Combinations of possible values for a single feature [Cons] are needed in order to derive a surface stop/affricate. There are three possible representations of this feature in the input as in (116).

(116)	a	b	c
	0	+Cons	-Cons

When a feature is not specified in the input, as in (116a), language-specific or cross-linguistic markedness with respect to the feature of interest determines the feature value. In Nuu-chah-nulth, [+Cons] is an unmarked feature as discussed in section 2.4, and thus a portion of relevant constraints with the following ranking, (117), assigns [+Cons] to the representation in (116a):

(117) Have[+Cons]
⇩
DEP[+Cons], DEP[+Cont]
⇩
Have[+Cont]

In sum, there are two possible ways to derive a surface stop/affricate, (116a) and (b). The question is how these two different input representations for a single stop/affricate are realised on the surface when the stop/affricate precedes a glottalising suffix. As seen in the following two tableaux, when an input stop/affricate precedes a glottalising suffix, it always surfaces as a glottalised stop/affricate, whether [+Cons] is specified or not, unlike fricatives. As is the case of fricatives, this results from the interaction between Faithfulness and Markedness constraints. Also, note that when [+Cons] is underlyingly specified, MAX[+Cons] prevents a glottalised glide from appearing on surface as in fricatives; when it is not specified, Have[+Cons] disallows a glottalised glide to surface. (In fact, the Faithfulness constraint DEP[+Cont] will also prevent a glottalised glide from appearing on the surface). Recall that in the case of fricatives, it is not crucial to violate Have[+Cons] (cf. (102-104)).

(118) tup/k/-[+C.G.]aqƛ ➔ tup[k̓]aqƛ
black-inside/consuming '(something) black inside'

Tableau A: [Cons] specified (/k/)

[[tupk[+C.G.]aqƛ]$_{ST}$]$_{WD}$ | [+Cons]	MAX [+Cons]	MAX [+C.G.]	ALIGN-Glo.	DEP Root Node	HAVE [+Cons]	DEPPATH [+C.G.]	*[+Cons] [+C.G.]
☞ a. [[tupk̓aqƛ]$_{ST}$]$_{WD}$ | [+Cons]						*	*
b. [[tupkʔaqƛ]$_{ST}$]$_{WD}$ | [+Cons]				*!		*	
c. [[tup̓kaqƛ]$_{ST}$]$_{WD}$ | [+Cons]			*!			*	*
d. [[tupkaqƛ]$_{ST}$]$_{WD}$ | [+Cons]		*!					
e. [[tupw̓aqƛ]$_{ST}$]$_{WD}$	*!				*		

Tableau B: [+Cons] unspecified (/K/)

[[tupK[+C.G.]aqƛ]$_{ST}$]$_{WD}$	MAX [+Cons]	MAX [+C.G.]	ALIGN-Glo.	DEP Root Node	HAVE [+Cons]	DEPPATH [+C.G.]	*[+Cons] [+C.G.]
☞ a. [[tupk̓aqƛ]$_{ST}$]$_{WD}$ | [+Cons]						*	*
b. [[tupkʔaqƛ]$_{ST}$]$_{WD}$ | [+Cons]				*!		*	
c. [[tup̓kaqƛ]$_{ST}$]$_{WD}$ | [+Cons]			*!			*	*
d. [[tupkaqƛ]$_{ST}$]$_{WD}$ | [+Cons]		*!					
e. [[tupẇaqƛ]$_{ST}$]$_{WD}$					*!		

3.2.1.3.2 Nasals

Nuu-chah-nulth has both glides and nasals, each of which has plain and glottalised pairs. I will discuss nasals in this section (see section 3.2.1.2.3 for glides).

For a plain nasal to surface, both [+Cons] and [+Son] will be needed. The possible combinations of both values of the features are as follows:

(119) Feature combinations of [±Cons] and [±Son]

a	b	c	d	e	f	g	h	i
0	-cons	+cons	-son	+son	-cons	-cons	+cons	+cons
					-son	+son	-son	+son

If the two features are already combined in the input as in (119i), a nasal will surface straightforwardly. As discussed above, Nuu-chah-nulth grammar implementing Have[α] constraints is involved to realise a nasal from the other combinations. When a specific value for the features [Cons] and [Son] is not specified in the input as in (119a-e), a portion of Nuu-chah-nulth grammar, (120) (repeated from (91), determines the value of the unfilled feature(s)).

(120) MAX[+Son], MAX[+Cons], MAX[+Cont]

⇩

HAVE[+Cons]

⇩

*[+Cons +Son], [+Cons +Cont]

⇩

DEP[+Cons], DEP[+Son], DEP[+Cont]

⇩

HAVE[+Son], HAVE[+Cont]

First of all, if [+Son] is filled in (119c), where [+Cons] is underlyingly specified, then it violates the Markedness constraint *[+Son, +Cons], although it satisfies the lower-ranked Construction constraint Have[+Son]. On the other hand, if [-Son] is filled in (119c), then it itself derives a stop/affricate, without violating *[+Son, +Cons]. (119c), therefore, is an input representation which is realised not as a nasal but as a stop/affricate. This is compatible with cross-linguistic markedness, where a stop/affricate is less marked than a nasal. For (119e), [+Cons] can be filled by obeying the higher-ranked constraint Have[+Cons], although violating *[+Son, +Cons]. This enables (119e) to surface as a nasal. Finally, (119a) will surface as a stop or affricate, since the high-ranked constraint Have[+Cons] will lead to the presence of the feature on the surface, whereas *[+Son, +Cons] will suppress the addition of [+Son]. As a result, only (119e) and (119i) can be realised as a nasal on the surface.

The question arises again how these two different input representations for a single nasal are realised on the surface, when the nasal precedes a glottalising suffix. We see in the following two tableaux that an input nasal in a glottalising context, whether [+Cons] is specified or not, does not become glottalised: it surfaces as a plain nasal followed by a glottal stop. Note that when [+Cons] is underlyingly specified, MAX[+Cons] (and DEP[+Cont]) prevents a glottalised glide from appearing on the surface as in stops/affricates and fricatives; when it is not specified, DEP[+Cont] prevents a glottalised glide from appearing on the surface.

(121) haʔu/m/-[+C.G.]aqƛ ➔ haʔu[m]ʔaqƛ

food-inside 'food inside (of something)

Tableau A: [+Cons] specified (/m/)

[[haʔum+[+C.G.]aqƛ]$_{ST}$]$_{WD}$	*[+Son +C.G.]	MAX [+Cons]	MAX [+C.G.]	ALIGN-Glo.	DEP [+Cont]	DEPRoot Node	DEPPATH [+C.G.]
☞ a. [[haʔumʔaqƛ]$_{ST}$]$_{WD}$ [+Cons]						*	*
b. [[haʔumaqƛ]$_{ST}$]$_{WD}$ [+Cons]	*!						*
c. [[haʔumaqƛ]$_{ST}$]$_{WD}$ [+Cons]			*!				
d. [[haʔu'maqƛ]$_{ST}$]$_{WD}$ [+Cons]				*!			*
e. [[haʔuwaqƛ]$_{ST}$]$_{WD}$		*!			*		*

Tableau B: [+Cons] unspecified (/M/)

[[haʔum+[+C.G.]aqƛ]$_{ST}$]$_{WD}$	*[+Son +C.G.]	MAX [+Cons]	MAX [+C.G.]	ALIGN-Glo.	DEP [+Cont]	DEP[R-Node]	DEPPATH [+C.G.]
☞ a. [[haʔumʔaqƛ]$_{ST}$]$_{WD}$ [+Cons]						*	*
b. [[haʔumaqƛ]$_{ST}$]$_{WD}$ [+Cons]	*!						*
c. [[haʔumaqƛ]$_{ST}$]$_{WD}$ [+Cons]			*!				
d. [[haʔu'maqƛ]$_{ST}$]$_{WD}$ [+Cons]				*!			*
e. [[haʔuwaqƛ]$_{ST}$]$_{WD}$					*!		*

3.2.1.4 Morphological variation: lexical vs. grammatical

The Nuu-chah-nulth suffixes must be classified into lexical or grammatical morphemes. Rose (1976) and Stonham (1999) provide the following distinction between these two kinds of suffixes. Lexical suffixes provide an independent part of the word's meaning or a dependent meaning which is completed only in conjunction with the total meaning of the root-suffix combination. Linearly, they are ordered between a root and any grammatical suffixes. On the other hand, grammatical suffixes consist of elements which provide Tense, Mode, Modal, and Person information. A schematic sequence of morphemes in Nuu-chah-nulth word is as follows.

(122) Internal structure of Nuu-chah-nulth word

[Prefix(Red)-Root - Lexical suffixes - Grammatical suffixes]$_{Word}$

This morphological distinction needs to be considered, for a single fricative exhibits alternation on the surface depending upon the suffixes attached to the fricative-final stem.

When a fricative precedes a lexical glottalising suffix, it surfaces as either a glottalised glide or a plain fricative followed by a glottal stop, depending upon the lexical item. I dealt with this kind of alternation by providing a phonological distinction in the input for the same set of fricatives. Interestingly, this kind of alternation does not occur with a fricative followed by a grammatical glottalising suffix: when a fricative precedes a grammatical glottalising suffix, it is never affected. That is, glottalisation in Nuu-chah-nulth exhibits different results in the case of fricatives depending upon the morphological category of a glottalising suffix, whether lexical or grammatical. Recall that in the case of stops/affricates, they are always glottalised before any glottalising suffix. The following data exemplify each case, with a lexical glottalising suffix as in (123), and with a grammatical suffix as in (124).

(123) k̓ʷi/s/-[+C.G.]ic → k̓ʷi[y̓]ic
snow-eating 'eating snow'

(124) k̓ʷi/s/-[+C.G.]aƛ-uk-ʔick → k̓ʷi[s]ʔaƛukʔick
snow-SEQ-POSS-2sg 'You have snow.'

In (123) the stem-final /s/ in k̓ʷis- 'snow' becomes a glottalised glide when preceding the lexical glottalising suffix '-[+C.G.]ic'. On the other hand, if the same fricative precedes the grammatical glottalising suffix '-[+C.G.]aƛ', then it is not affected, surfacing as a plain fricative followed by a glottal stop as in (124).

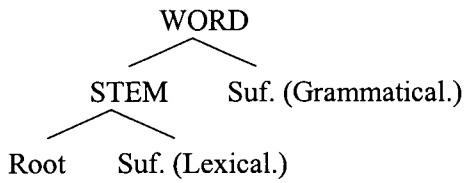
These data raise a question: how do we account for the difference in triggering power between a lexical glottalising suffix and a grammatical one? I suggest that this morphological variation between the same segments with respect to glottalisation should be treated by distinguishing the morphological domains where a constraint takes effect. The constraint DEPRootNode prevents a root node from being inserted, and it plays a role in determining an optimal output form, as we saw above. I propose that this faithfulness constraint should be divided into two subconstraints according to morphological domains: DEPRootNode]$_{STEM}$ and DEPRootNode]$_{WORD}$.

(125) a. DEPRootNode]$_{STEM}$: Any root node within a stem domain in the output must have a correspondent in the input.

b. DEPRootNode]$_{WORD}$: Any root node within a word domain in the output must have a correspondent in the input.

It is controversial whether grammatical suffixes in Nuu-chah-nulth are really suffixes or clitics (see Sapir & Swadesh 1939, Swadesh 1939, Haas 1969, Davis & Sawai 2001, Davidson 2002 for detailed discussion). Also, it has not yet been conclusively determined what a stem is and what a word is in this language. For the purpose of assigning a domain where glottalisation occurs, I assume that STEM is a morphological unit which is created by attaching lexical suffixes, while WORD is a morphological unit which is created by attaching grammatical suffixes as shown in (126) (cf. Selkirk 1986, where depending upon classes of attaching affixes, lexical items are classified into root or word).

(126) A schematic internal structure of word



Nuu-chah-nulth allows multiple lexical and grammatical affixation. The schematic structure (126) does not reflect this characteristic, focusing on the morphological categories projected by suffixation, which is relevant to my discussion. Whenever any lexical suffix attaches to a root or stem, it projects STEM, and whenever any grammatical suffix attaches to a stem, it projects WORD. In addition, only a grammatical suffix can attach to a word, projecting WORD.

The two subsets of the DEP[RootNode] constraint have the following ranking, (127), with respect to the Markedness constraint *[+Son, +Cont, +C.G.], which prevents a glottalised glide from appearing on the surface.[38]

(127) DEP[RootNode]$_{STEM}$

⇩

*[+Son, +Cont, +C.G.]

⇩

DEP[RootNode]$_{WORD}$

The interaction of the Faithfulness and Markedness constraints determines the output forms of both a target consonant and the trigger, as we will see in tableaux below.

(128) is the final version of the portion of the Nuu-chah-nulth grammar relevant for the particular processes under discussion here:

(128) A partial Nuu-chah-nulth grammar (the final version)

*[+Cons +Cont +C.G.][39]

⇩

MAXPATH[+C.G.]

⇩

*[+Son -Cont +C.G.]

⇩

MAX[+C.G.], MAX[+Cons], CONTIGUITY

⇩

DEPRootNode]$_{STEM}$

⇩

*[+Son +Cont +C.G.], MAXPlace

⇩

DEPRootNode]$_{WORD}$

⇩

DEPPATH[C.G.], *[+Cons -Cont +C.G.]

[38] This is not the only possible approach within OT (cf. Bermudez-Otero (2003), Kiparsky (2003), Stonham (2003): these studies argue for a multi-stratal approach within OT, allowing more than one grammar in a single language). However, I do not discuss which approach works better, since it is beyond the scope of my thesis.

[39] I ranked this constraint the same as MAX[+C.G.] in section 2.1.3.4. Given that a glottalised fricative is more marked than a glottalised sonorant cross-linguistically, and that *[+Son +C.G.] is higher-ranked than MAX[+C.G.], I rank *[+Cons +Cont +C.G.] higher than this faithfulness constraint. Moreover, given that there is no glottalised fricative, whether underlyingly or in derived contexts, unlike with nasals, I rank *[+Cons +Cont +C.G.] higher than all faithfulness constraints inclduing MAXPATH[+C.G.].

Note that the relative ranking of the four markedness constraints is *[+Cons +Cont, +C.G.] >> *[+Son -Cont +C.G.] >> *[+Son, +Cont, +C.G.] >> *[+Cons -Cont +C.G.]. This reflects their degrees of markedness cross-linguistically (Sapir 1938, Maddieson 1984). That is, glottalised stops/affricates (ejectives) are less marked than glottalised sonorants, which are less marked than glottalised fricatives. Within sonorants, I haven't found any evidence yet whether glottalised glides are less marked than glottalised nasals crosslinguistically, although the Nuu-chah-nulth grammar in (128) tells us that glottalised nasals are more marked than glottalised glides in the language.

The morphological variation in glottalisation of fricatives is treated as follows. First, (129) is a case where a stem-final fricative precedes a grammatical suffix (note that the stem-final /s/ in (129) is not specified for [+Cons]; hence, MAX[+Cons] is not relevant here: cf. (103)).

(129) a. k̓ʷi/s/-[+C.G.]aƛ-uk-ʔick → k̓ʷi[s]ʔaƛukʔick
snow-SEQ-POSS-2sg 'You have snow.

b. Tableau: A fricative preceding a grammatical suffix

[[k̓ʷis]$_{ST}$ -[+C.G.]aƛ]$_{WD}$ | [+Cont]	*[+Cons +Cont +C.G.]	MAX [+C.G.]	ALIGN -Glo.	DEPRoot Node STEM	*[+Son +Cont +C.G.]	MAX Place	DEPRoot Node WORD	DEP PATH [+C.G.]
a. [[k̓ʷiẏ]$_{ST}$ aƛ]$_{WD}$					*!			*
☞ b.[[k̓ʷis]$_{ST}$ʔaƛ]$_{WD}$							*	*
c. [[k̓ʷi'ˢ]$_{ST}$ aƛ]$_{WD}$			*!					*
d. [[k̓ʷis]$_{ST}$ aƛ]$_{WD}$		*!						
e. [[k̓ʷis']$_{ST}$ aƛ]$_{WD}$	*!							*
f. [[k̓ʷiẇ]$_{ST}$ aƛ]$_{WD}$					*!	*		*

In tableau (129) (I focus only on the issue of relevance), DEPRootNode]$_{STEM}$ is not relevant here since the domain where the root node is inserted is not STEM, but WORD. To insert a root node in a word domain is trivial compared to inserting one in a stem domain. Consequently, the Markedness constraint *[+Son, +Cont, +C.G.] plays a crucial role, selecting candidate **b** as an optimal output form. Candidate **b**

obeys both MAX[+C.G.] and *[+Son, +Cont, +C.G.] by avoiding linking the three features in the same root node, at the same time realising [+C.G.] on the surface as a full glottal stop.

Consider the following example, where a lexical glottalising suffix follows a fricative.

(130) a. k̓ʷi/s/-[+C.G.]ic → k̓ʷi[y̓]ic
snow-eating 'eating snow'

b. Tableau: A fricative preceding a lexical suffix

[[k̓ʷis+[+C.G.]ic]$_{ST}$]$_{WD}$ [+Cont]	*[+Cons +Cont +C.G.]	MAX [+C.G.]	ALIGN -Glo.	DEPRoot Node STEM	*[+Son +Cont +C.G.]	MAX Place	DEPRoot Node WORD	DEP PATH [+C.G.]
☞ a. [[k̓ʷiy̓ic]$_{ST}$]$_{WD}$					*			*
b. [[k̓ʷisʔic]$_{ST}$]$_{WD}$				*!			*	*
c. [[k̓ʷi'sic]$_{ST}$]$_{WD}$			*!					*
d. [[k̓ʷisic]$_{ST}$]$_{WD}$		*!						
e. [[k̓ʷis'ic]$_{ST}$]$_{WD}$	*!							*
f. [[k̓ʷiw̓ic]$_{ST}$]$_{WD}$					*	*!		*

Here, the constraint DEP[R-Node]$_{STEM}$ plays a decisive role in determining the surface form of an input fricative. Candidate **b** is ruled out by inserting a root node in a stem domain, and thus fatally violating DEP[R-Node]$_{STEM}$. The violation of DEP[R-Node]$_{WORD}$ constraint is not fatal since it is lower-ranked.

In sum, fricatives surface differently depending upon the morphological categories of glottalising suffixes: a fricative, when preceding a lexical suffix, surfaces as a glottalised glide; the same fricative, when preceding a grammatical suffix, surfaces as a plain fricative followed by a glottal stop.

On the other hand, stops/affricates are not affected by those morphological factors. Consider the following examples.

(131) a. tup/k/-[+C.G.]aqƛ ➔ tup[k̓]aqƛ

black-inside/consuming '(something) black inside'

b. Tableau: A stop preceding a lexical suffix

[[tupk-[+C.G.]aqƛ]$_{ST}$]$_{WD}$	MAX [+C.G.]	CONTI-GUITY	DEPR Node] STEM	*[+Son +Cont +C.G.]	MAX Place	DEPR Node] WORD	DEP PATH [+C.G.]	*[-Cons -Cont +C.G.]
☞ a. [[tupk̓aqƛ]$_{ST}$]$_{WD}$							*	*
b. [[tupkʔaqƛ]$_{ST}$]$_{WD}$			*!			*	*	

(132) a. k̓uupu/p/-[+C.G.]aƛ ➔ k̓uupu[p̓]aƛ

hanging-SEQ 'to hang (something)'

b. Tableau: A stop preceding a grammatical suffix

[k̓uupup-[+C.G.]aƛ]$_{WD}$	MAX [+C.G.]	CONTI-GUITY	DEP[R-Node] STEM	*[+Son +Cont +C.G.]	MAX Place	DEPR Node] WORD	DEP PATH [+C.G.]	*[+Cons -Cont +C.G.]
☞a. [k̓uupup̓aƛ]$_{WD}$							*	*
b. [k̓uupupʔaƛ]$_{WD}$						*!	*	

Stops/affricates, whether they are in the domain of STEM or WORD, are always glottalised before glottaliseding suffixes. It is basically possible, since the markedness constraint *[-Son +C.G.] is lower-ranked than DEPRootNode$_{STEM}$ and –$_{WORD}$. Note that the crucial difference between stops/affricates and fricatives: in (129-130), [+Son +Cont +C.G.] plays a crucial role in determining the optimal output form, while in (131-132), it is irrelevant.

3.2.1.5 A vowel-final stem in glottalisation

So far, I have discussed cases of a stem with a final consonant. In this section, I will show how glottalisation affects stems that end with a vowel. As seen in (133-4), when a glottalising suffix follows a vowel-final stem, a glottal stop appears on the surface, whether the suffix is lexical or grammatical.

I. With lexical suffixes

(133) a. cixčuu-[+C.G.]aḥs → cixčuu[ʔ]aḥs
fried-container 's.t. fried in a container (bowl)'

b. m̓aa-[+C.G.]iḥta → m̓aa[ʔ]iḥta
to bite-at the end 'to bite s.t. at the end'

II. With grammatical suffixes

(134) a. ʔu-cḥi-[+C.G]aƛ-ʔiš → ʔucḥi[ʔ]aƛʔiš
it-to marry-SEQ-3sg/IND 'S/he is now married.'

b. ʔu-ca-[+C.G.]ap → ʔuca[ʔ]ap
it-to go-CAUS 'to bring s.t./s.o. to s.w.'

Nuu-chah-nulth does not allow a glottalised vowel and furthermore, cross-linguistically glottalised vowels are very rare (Maddieson 1984). This property can be instantiated via the following Markedness constraint, which is highly-ranked in the language.

(135) *[-Cons, +Syllabic, +C.G.]: [-Cons], [+Syllabic], and [+C.G.] cannot cooccur under the same root node.[40]

Consider the following examples and tableaux, where the process of how a vowel-final stem preceding a lexical glottalising suffix, (136), or a grammatical glottalising suffix, (137), surfaces is shown.

(136) a. cixčuu-[+C.G.]aḥs → cixčuu[ʔ]aḥs
fried-container 's.t. fried in a container (bowl)'

[40] Following Clements (1990), I make use of [+Syllabic] to single out vowels from [-Cons] segments: vowels and glides.

b. Tableau: A vowel before a lexical suffix

[[cixčuu+[+C.G.]aḥs]$_{ST}$]$_{WD}$	*[-Cons +Syll. +C.G.]	MAX [+C.G.]	ALIGN-Glo.	DEPRoot Node STEM	DEPRoot Node WORD	DEPPATH [+C.G.]
☞a. [[cixčuuʔaḥs]$_{ST}$]$_{WD}$				*	*	*
b. [[cixčuuaḥs]$_{ST}$]$_{WD}$		*!				
c. [[cixčuu'aḥs]$_{ST}$]$_{WD}$	*!					*
d. [[cixč'uuaḥs]$_{ST}$]$_{WD}$			*!			*

(137) a. ʔu-ca-[+C.G.]ap ➔ ʔuca[ʔ]ap

it-to go-CAUS 'to bring s.t./s.o. to s.w.'

b. Tableau: A vowel before a grammatical suffix

[ʔuca+[+C.G.]ap]$_{WD}$	*[-Cons +Syll. +C.G.]	MAX [+C.G.]	ALIGN-Glo.	DEPRoot Node STEM	DEPRoot Node WORD	DEPPATH [+C.G.]
☞a. [ʔucaʔap]$_{WD}$					*	*
b. [ʔucaap]$_{WD}$		*!				
c. [ʔuca'ap]$_{WD}$	*!					*
d. [ʔučaap]$_{WD}$			*!			*

In the tableaux, the high-ranked constraints, MAX[+C.G.], *[-Cons][+Syllabic][+C.G.] and ALIGN-Glo. rule out the candidates **b, c, and d**, respectively. Each candidate **a** violates DEP constraint(s), but the violation is not crucial since this candidate obeys all the highly-ranked constraints. In sum, in Nuu-chah-nulth, a vowel is not glottalised in the context of glottalisation and the trigger [+C.G.] is realised as a glottal stop on the surface.

3.2.1.6 A remaining issue

To understand glottalisation in Nuu-chah-nulth, we need to consider phonetic, phonological, and morphological factors of both the target and the trigger. As seen above, in particular, the presence or absence of glottalisation in fricatives is associated with morphological and phonetic/phonological aspects. Also, the general absence of glottalisation in nasals is accounted for by phonological dynamics based on Faithfulness and Markedness. However, there is a case that appears to be inconsistent to the analysis provided here. As the table in (32) shows, the ratios of consistent glottalisation and non-glottalisation in fricatives are almost symmetrical. I provided an analysis of the presence/absence of glottalisation in fricatives according to their phonetic and phonological properties. I divided fricatives into two classes, one subclass specified for the feature [+Cons] and one unspecified. With these representations for fricatives, the constraints *[+Cons, +Cont, +C.G.] and MAX[+Cons] play an important role in determining the surface form of an input fricative. However, consider the following examples:

(138) Suffix-dependent glottalisation: c̓aawumɬ 'one left'

a. c̓aawum<u>ɬ</u>–[+C.G.]aaʔa	➔	c̓aawum<u>y̓</u>aʔa
one left-on the rock		'One (person) left on the rock'
b. c̓aawum<u>ɬ</u>-[+C.G.]akƛi	➔	c̓aawum<u>ɬ</u>ʔakƛi
-rear		'One left at the rear (of a boat)'
c. c̓aawum<u>ɬ</u>-[+C.G.]iḥta	➔	c̓aawum<u>y̓</u>iḥta
-at the end		'One person left at the end (of a wharf)'

Suffix-dependent glottalisation in fricatives raises the following question: how can we treat the cases where a stem-final fricative in a lexical item becomes a glottalised glide with some suffixes, but does not with other suffixes? Is a fricative with this kind of alternation specified for [+Cons] or not?

One assumption may be that some morphemes have two variants for its final fricative, one specified for the feature [+Cons] and one unspecified. This leads to the presence of two kinds of output forms for some morphemes: a fricative unspecified for [+Cons] is realised as a glottalised glide on the surface when preceding a glottalising suffix as in, e.g., (105a and c) and one specified for [+Cons] is not affected by a glottalising suffix and thus a sequence of a fricative and a full glottal stop surfaces as an output form as in, e.g., (136b). This requires further study.

3.2.1.7 Conclusion

The distribution of glottalised consonants and patterns of glottalisation in Nuu-chah-nulth raise many interesting theoretical issues. In particular, the main goal of this study is how to treat the asymmetry between obstruents and sonorants, and the alternation between the same sets of fricatives within a unified system. I discussed the problems raised using two principles under Optimality Theory: Markedness and Richness of the Base. This approach provides a straightforward answer to the question of why the process of glottalisation in Nuu-chah-nulth exhibits such unique properties.

I summarise the main characteristics of Nuu-chah-nulth glottalisation and key issues as follows:

i. Glottalising suffixes: only some suffixes cause glottalisation and the initial part of a glottalising suffix is regulated, the floating [+C.G.] feature followed by a vowel.

ii. Morphological variation: a glottalising suffix exhibits different effects with fricatives depending on whether it is lexical or grammatical.

iii. Richness of the Base: rich combinations of features, along with the interaction between Markedness and Faithfulness constraints, lead to alternation between the same set of surface consonants in terms of glottalisation in Nuu-chah-nulth.

iv. Nuu-chah-nulth grammar: a simple set of universal constraints and their language-specific ranking, along with phonetic and phonological properties of a consonant, determine the surface form.

   a. stops/affricates: they never fail to be glottalised; Nuu-chah-nulth has plain-glottalised series in the phonemic inventory.

   b.fricatives: they never become glottalised; Nuu-chah-nulth does not have glottalised fricatives.

   c. nasals: they are rarely glottalised; Nuu-chah-nulth has phonemic glottalised nasals.

v. Suppression of the marked: whenever a fricative is affected by a glottalising suffix, a glottalised glide appears on the surface rather than a glottalised fricative, which is cross-linguistically marked.

vi. Markedness among glottalised sonorants: Although there is no cross-linguistic evidence that glottalised glides are less marked than glottalised nasals, or vice versa, the patterns and characteristics of Nuu-chah-nulth glottalisation reveal that glottalised nasals are more marked than glottalised glides

vii. Module interaction: universal constraints occupy one of the key parts in a constraint-based theory like Optimality Theory, and some of them that are introduced in this study are grounded on phonetic and morphological aspects. Nuu-chah-nulth glottalisation is one of the cases where phonetics, phonology and morphology interact with each other.

3.2.2 Lenition

We saw, in the previous section, that only some suffixes trigger glottalisation, and that there is variation between the target consonants depending upon phonetic/phonological and morphological contexts. Nuu-chah-nulth has another morphologically-driven phonological process, lenition, where some suffixes cause an immediately preceding fricative to become a glide: e.g. /s/ ➔ [y]. According to Kirchner (1998: 1), the term 'lenition' is used to refer to phonological phenomena of "some reduction in constriction degree or duration" such as degemination, flapping, spirantization, reduction to approximants, debuccalization and elision. In Nuu-chah-nulth, lenition only reduces consonants to approximants, i.e. glides.

The process exhibits variation between the target consonants and alternation in the same surface consonants, as observed in glottalisation of fricatives, but the phonological characteristics are significantly different from glottalisation. In addition, leniting suffixes are all lexical, whereas glottalising suffixes are either lexical or grammatical. The following chart summarises the patterns of lenition.

(139) The patterns of lenition in Nuu-chah-nulth

	Stops/affricates	Fricatives	Nasals
Lenition	NO	YES/NO	NO
Emergence of /y/	NO	YES/NO	YES

3.2.2.1 Description

As in glottalisation, Nuu-chah-nulth consonants exhibit a consistent asymmetry in the process of lenition, although in a different way. Stops and affricates are not affected by a leniting suffix. (140) shows that a stem-final stop, (140a-c), or affricate, (140d-f), is not lenited, nor is there any segment added, when preceding the leniting suffix *-is* 'at the beach' or *-iɬ* 'inside (the house), on the floor'.

(140) Stops/affricates: not lenited

a. hiš-ʔiq-stu/p/-iɬ-uk-ʔiš ➔ hiyiqstu[p]iɬukʔiš
all-ʔ-thing-inside-POSS-3sg/IND 'S/he has everything inside her/his house'

b. hap/t/-iɬ ➔ hap[t]iɬ
to hide-inside 'hiding s.t. in a house.'

c. tup/k/-is → tup[k]is
black-beach '(s.t.) black on the beach'

d. ya/c/-iɬ → ya[c]iɬ
to step-on the floor 'stepping on the floor'

e. ma/ƛ/-is → ma[ƛ]is
tied-beach 'tied at the beach'

f. ʔuk/č/-iɬ → ʔuk[č]iɬ
along with-inside '(s.o.) accompanying in a house'

On the other hand, fricatives preceding a leniting suffix exhibit an alternation that is related to the pattern they exhibit when they precede a glottalising suffix. A stem-final fricative in some lexical items consistently becomes a plain glide, and the same fricative in other lexical items is consistently not affected before a leniting suffix, surfacing as a plain fricative. (141-142) exemplify these cases: note that the fricatives /ɬ/ and /s/ in (142) are changed into /y/, while the same fricatives in (142) are not affected, surfacing as such. In the latter case, no segment is added. Note that each compared form shows that the underlying morpheme does not include /y/ as a final segment.

(141) Fricatives I: lenited

a. hi/ɬ/-is → hi[y]is
Loc-at the beach 'there is {s.t.} at the beach'

Cf. hiɬʔiš 'there is something…'

b. ḥuu/ɬ/-is → ḥuu[y]is
LOC-at the beach 's.o. over there (far away) at the beach'

Cf. ḥuuɬʔišʔaɬ 'there are some people over there…'

c. ʕuyaa/s/-is → ʕuyaa[y]is
to move-at the beach 'moving one position to another at the beach'

Cf. ʕuyaasaa 'moving'

d. nawaa/s/–is → nawaa[y]is
to sit-at the beach 'sitting on the beach'

Cf. nawaasaa 'sitting'

e. hi/ɬ/-iɬ → hi[y]iɬ
LOC-inside 'someone is inside (the building/house).'

f. ḥuu/ɬ/-iɬ → ḥuu[y]iɬ
LOC-inside 's.o. is inside (the building) over there (far away) '

g. ʕuyaa/s/-iɬ → ʕuyaa[y]iɬ
to move-inside 'moving one position to another inside (the building).

h. nawaa/s/-iɬ → nawaa[y]iɬ
to sit-inside 'sitting inside'

(142) Fricatives II: not lenited

a. ƛu/ɬ/-is → ƛu[ɬ]is
nice-at the beach 's.t. nice at the beach'

b. ma/ɬ/-is → ma[ɬ]is
cold-at the beach 'it's cold at the beach'

c. tim/s/-is → tim[s]is
garbage-at the beach 'garbage on the beach'

d. ḥismi/s/-is → ḥismi[s]is
blood-at the beach 'blood on a beach'

e. ƛu/ɬ/-iɬ → ƛu[ɬ]iɬ
nice-on the floor 's.t. nice on the floor'

f. ma/ɬ/-iɬ → ma[ɬ]iɬ
cold-on the floor 'the floor is cold.'

g. tim/s/-iɬ → tim[s]iɬ
garbage-inside 'garbage on the floor/inside (the house)'

h. ḥismi/s/-iɬ → ḥismi[s]iɬ
blood-on the floor 'blood on the floor'

On the other hand, when post-alveolar (i.e. alveo-palatal, velar, labio-velar, uvular, labio-uvular, and pharyngeal) fricatives precede a leniting suffix, they are consistently not affected, irrespective of their input form. Consider the following examples.

(143) a. čʼu/š/-iɬ → čʼu[š]iɬ
new-on the floor 's.t. new on the floor (e.g. mat, rug, etc.)

b. ƛʼu/š/-iɬ → ƛʼu[š]iɬ
dry-on the floor 'the floor is dried up.

c. ƛʼu/š/-is → ƛʼu[š]is[40]
dry-at the beach '(the sand) on the beach is dry.'

d. quu/x/-iɬ → quu[x]iɬ
to freeze-on the floor 's.t. frozen on the floor (e.g. water)'

e. taa/xʷ/-iɬ → taa[xʷ]iɬ
to spit-on the floor 'spitting on the floor'

f. čiš/x̣/-iɬ → čiš[x̣]iɬ
dirty-inside 'dirty inside (the house)'

g. čap/x̣ʷ/-iɬ → čap[x̣ʷ]iɬ
man-inside 'men in a house'

[40] Rose (1976:15) shows that the Tseshaht counterpart of this is lenited: ƛʼu[š]-is → ƛʼu[y]is 'dried on the beach'. However, the Ahousaht form is consistently not lenited. This is an interesting dialect variation that requires further research.

h. č'i/ḥ/-iɬ → č'i[ḥ]iɬ

s.t. negative-on the floor 's.t. scary on the floor

The following chart summarises the frequency of lenition in fricatives, which are classified into alveolar and post-alveolar: I tested this with the 118 fricative-final stems which I used for the glottalisation test. For semantic reasons, many combinations of the stems with either of the two leniting suffixes are not possible. I obtained the following results from 57 fricative-final stems. Of 21 stem-final alveolar fricatives, 11 are consistently lenited, while 10 are not. There are no inconsistent cases such as found in glottalisation (cf. section 3.2.1 (36)).

(144) Lenition of fricatives

Alveolar fricatives	Stems	%	Post-alveolar fricatives	Stems	%
Consistent lenition	11	55	Consistent lenition	0	0
No lenition	10	45	No lenition	36	100
TOTAL	21	100	TOTAL	36	100

Interestingly, a sonorant preceding a leniting suffix generally appears as a plain sonorant followed by a glide /y/, as shown in (145-148). However, with some stems, a glottal stop appears on the surface instead of a glide, as in (149-151); or either a glottal stop or a glide appears depending on suffixes, as in (152-153). (Recall that Nuu-chah-nulth does not have any morphemes ending with a glide, so only stem-final nasals are tested.)

I. Presence of /y/

(145) a. hayu/m/-iɬ → hayu[my]iɬ

Not knowing-inside 'getting lost in a house'

b. hayu/m/-is → hayu[my]is

Not knowing-beach 'lost in a beach'

(146) a. ƛ̓iƛ̓u/m/-iɬ → ƛ̓iƛ̓u[my]iɬ
To shoot-inside 'shooting inside the house'

b. ƛ̓iƛ̓u/m/-is → ƛ̓iƛ̓u[my]is
To shoot-at the beach 'throwing arrows/shooting at the beach'

(147) a. siicmi/n/-iɬ → siicmi[ny]iɬ
maggot-on the floor 'maggots on the floor'

b. siicmi/n/-is → siicmi[ny]is
maggot-at the beach 'maggots at the beach'

(148) a. ɬa-ɬak̓ʷi/n/-iɬ → ɬaɬak̓ʷi[ny]iɬ
RED-to beseech-inside 's/he beseeches s.o. inside the house.'

b. ɬa-ɬak̓ʷi/n/-is → ɬaɬak̓ʷi[ny]is
RED-to beseech-at the beach 's/he beseeches s.o. at the beach.'

II. Presence of /ʔ/

(149) a. huupukʷaṅum-iɬ → huupukʷaṅum[ʔ]iɬ (*huupukʷaṅumyiɬ)
storage box-on the floor 'storage box (basket) on the floor'

b. huupukʷaṅum-is → huupukʷaṅum[ʔ]is (*huupukʷaṅumyis)
storage box-at the beach 'storage box (basket) on the beach'

(150) a. husmin-iɬ → husmin[ʔ]iɬ (*husminyiɬ)
kelp-on the floor 'kelp on the floor'

b. husmin-is → husmin[ʔ]is (*husminyis)
kelp-at the beach 'kelp at the beach'

(151) a. cikimin-iɬ → cikimin[ʔ]iɬ (*cikiminyiɬ)
iron-on the floor 'iron on the floor'

b. cikimin-is → cikimin[ʔ]is (*cikiminyis)
iron-at the beach 'iron at the beach'

III. Presence of either /y/ or /ʔ/

(152) a. maamaak̓in-iɬ → maamaak̓in[y]iɬ
to play-inside 's.o. playing inside the house (e.g. with toys)

b. maamaak̓in-is → maamaak̓in[ʔ]is
to play-at the beach 's.o. playing at the beach'

(153) a. k̓ʷasitum-iɬ → k̓ʷasitum[ʔ]iɬ
branch-on the floor 'branches on the floor'

b. k̓ʷasitum-is → k̓ʷasitum[y]is
branch-at the beach 'branches at the beach'

Note that in (152-153) a glide and a glottal stop alternates according to the triggering suffix, but the surface form of the suffix is not predictable with the relevant suffix. The suffix *-iɬ* appears as *-yiɬ* in (152a) and *-ʔiɬ* in (153a); the suffix -is appears as *-ʔs* in (152b) and in *-yis* (153b).

The following chart shows the variation of nasals with respect to the presence of a glide and a glottal stop; a glide surfaces more regularly compared to a glottal stop.

(154) Frequency of a glide and a glottal stop in the context of nasal lenition

Cases	No. of stems	%
Always /y/	17	71
Always /ʔ/	5	21
Either /y/ or /ʔ/	2	8
TOTAL	24	100

3.2.2.2 Analysis

As in glottalisation, lenition shows very complex properties phonologically and morphologically. I have found only two triggering suffixes and they are both lexical suffixes: *-iɬ* 'on the floor/inside (the house)' and *-is* 'at the beach'.[41] First, these suffixes only affect fricatives, while they cause no change of the target stop/affricate and nasal. Second, as in glottalisation, fricatives preceding a leniting suffix exhibit alternation: some stem-final fricatives are affected, but not some others with the same phonetic

[41] Rose (1976: 14) provides another suffix -ačiƛ 'inceptive, get to, become', but there is only one example (ʔiḥ^{w}-ačiƛ ➔ ʔiwačiƛ 'get to be big'). The Ahousaht counterpart shows the same form, (iia), but there is no systematic process with respect to lenition with the suffix as seen below.

i)	a. čamas-ačiƛ sweet-become	➔	čam[iičiƛ] 'becoming sweet'
	b. quuʔas-ačiƛ man-become	➔	quʔ[iičiƛ] 'becoming an adult'
ii)	a. ʔiiḥ-ačiƛ big-become	➔	ʔii[wačiƛ] 'becoming big
	b. nisaak-ačiƛ full-become	➔	nis[wačiƛ] 'becoming full'
iii)	a. ɬatx̣-ačiƛ soft-become	➔	ɬatx̣[k^{w}ačiƛ] 'becoming soft'
	b. šux̣-ačiƛ rusyt-become	➔	šux̣[k^{w}ačiƛ] 'becoming rusty
	c. ʔuuktis-ačiƛ to copy-become	➔	ʔuuktis[k^{w}ačiƛ] 'according to (s.o./s.t.)'
iv)	čaaḥ-ačiƛ hard/firm-become	➔	čaaḥ[ačiƛ] 'becoming hard'

It seems that there are four allomorphs for the suffix. In i), part of each root morpheme is truncated and -iičiƛ is attached; in ii), the form -wačiƛ is used and iia) seems to undergo lenition and in iib) part of the stem {aak} is deleted but there is no lenition; in iii) the form -k^{w}ačiƛ is used; finally in iv) -ačiƛ is used. Due to this variation, and the rare cases of lenition with the suffix, I will not include this suffix as a leniting suffix for now.

characteristics. Third, lenition is more restricted, applying to alveolars, but not to post-alveolars. Finally, when preceding a leniting suffix, a nasal has a glide inserted on the surface, though with some stems, a glottal stop can appear on the surface instead of a glide. These generalisations raise the following questions:

1. How is the form of a leniting suffix explained?

2. How do we explain the consistent lack of lenition of stops/affricates, the alternation of fricatives, and the presence of /y/ or /ʔ/ with nasals?

3. How do we account for the fact that post-alveolar fricatives are consistently not lenited?

I will discuss the first two issues in section 3.2.2.2.1, the third in section 3.2.2.2.2. In addition, I will discuss the implications of the systematic phonological properties of Nuu-chah-nulth consonants in terms of glottalisation and lenition in 3.2.2.2.3. Finally, in section 3.2.2.3, I will examine how to treat vowel-final stems preceding a leniting suffix.

3.2.2.2.1 A floating feature [+Voiced], faithfulness, and markedness

Rose (1976) suggests that all the leniting suffixes begin with /h/, which is the lenition-causing factor. To explain the patterns of lenition (mainly of Tseshaht), her analysis requires four rules: an /h/ to /ʔ/ shift rule, an /h/ deletion rule, a /ʔ/ deletion rule, and a fricative-glide shift rule (Rose 1976: 27-28). The analysis seems only to describe the phenomenon, not explaining why some variation and apparently irregular patterns occur. In addition, there is no phonological motivation for the presence of /h/: in particular, it never surfaces (see Rose 1976 for the detailed discussion). In sum, the argument for /h/ as an initial element of a leniting suffix raises two problems: the adequacy of explanation as well as 'abstractness' (Kiparsky 1982b).

Alternatively, following Howe 1996, I assume that a leniting suffix has a floating [+Voiced] feature in its initial position, which links to an available preceding consonant (also see Kim & Pulleyblank 2003. for more detailed discussion).[42] Interestingly, Oowekyala, a Northern Wakashan, also has lenition, where stem-final voiceless obstruents become voiced before some suffixes (Howe 2000: 34-38). Howe argues that the [+Voiced] feature is the factor for the alternation and that [+Voiced] and [+C.G.] are active in Oowekyala phonology. I suppose that although Nuu-chah-nulth does not have a voicing contrast in obstruents, [+Voiced] is active in some phonological processes such as lenition under discussion in the language as well. That is, the phonological property of [+Voiced] in terms of lenition might be a

[42] Howe (1996) proposes the same representation for a leniting suffix for Nuu-chah-nulth.

common characteristic through Wakashan languages. This requires further research, though. (155) schematises the form of a leniting suffix:

(155) Leniting Suffix: [+Voiced]VX

```
[            RT. . .]Len.Suffix
              |
  [+Voiced]   |
              V
```

One might suggest the possibility that the underlying form of leniting suffixes includes a glide as an initial element rather than a floating [+Voiced]. This hypothesis, however, does not work in two respects for Nuu-chah-nulth. The first problem is related to a morphological issue. If the first element of leniting suffixes were a glide, then we could not provide a straightforward answer to the question of why some suffixes with an initial /y/ trigger lenition, but not others (see section 3.2.1. for the same line of discussion for glottalisation). The second is related to a phonological issue. If a leniting suffix started as a glide, then how could we explain the fact that a stop or affricate preceding a glide always causes the deletion of the glide, since it is either a fricative or a glide that IS deleted in the same context? There are no phonological cues we can use to predict their distribution. Therefore, the presence of a glide on the surface seems to be guaranteed only when following a nasal or a vowel. On the other hand, non-leniting suffixes never fail to
appear on the surface as shown in (156), whether it follows a stop (156), fricative (157), or nasal (158).[43]

(156) Stop

ʕičaak-/y/aq	➔	ʕičaak[y]aq
rotten-Existential		'something rotten'
(something/someone)		

(157) Fricative

ċistup-iiɬ-/y/aq	➔	ċistupiiɬ[y]aq
Rope-to make-Exis.		'someone making a rope'

(158) Nasal

huupakʷaṅum-/y/aq	➔	huupakʷaṅum[y]aq
storage box-Exis.		'A storage box'

[43] Zoll (1996) claims that a segment with the same phonetic contents should have different underlying representation, if some always appears on the surface, while some others are often deleted. She names the latter "latent" segments and represents them as a floating feature or feature groups.

In conclusion, the representation of a leniting suffix, (157), encodes both aspects of the target (no lenition or lenition), and the surface alternations of the trigger ([+Voiced] on a preceding consonant and [+Voiced] in an independent segment).

As seen in the previous section, a leniting suffix surfaces in different ways when following a consonant, and the target consonant also exhibits variation. I repeat some relevant examples from (141-144) for convenience. First, compare a stop and a nasal. Neither consonant group is affected by a leniting suffix. However, the floating [+Voiced] feature of a leniting suffix does not surface when following a stop as seen in (160), while is appears as a glide on the surface, when following a nasal as seen in (160).

(159) tup/k/-[+Voiced]is → tup[k]is
black-beach '(s.t.) black on the beach'

(160) hayu/m/-[+Voiced]is → hayu[my]is
Not knowing-at the beach 'getting lost at the beach'

Interestingly, the nasal itself is not affected by a leniting suffix, like stops/affricates, but it exhibits the same effect as fricatives in that a glide appears on the surface. However, the mechanism by which /y/ appears seems different. There is a notable difference regarding lenition of nasals: the glide is not an output correspondent of an input nasal as in fricatives; the input nasal surfaces faithfully without any featural changes (cf. (141). Then questions arise: i) why does a nasal only allow the "insertion" of a glide, but not a stop/affricate, and ii) why isn't a nasal replaced as a glide on the surface, as in fricatives?

I suggest that the asymmetry between the three sound groups in terms of lenition is due to the interaction between a constraint on syllable structure, and some faithfulness constraints. Cross-linguistically, there is a tendency that the sonority of a syllable-final consonant must exceed that of a following syllable-initial consonant. Murray & Vennemann (1983) names this principle the Syllable Contact Law, and Clements (1990) defines it as below: $ indicates a syllable boundary.

(161) The Syllable Contact Law (Clements 1990: 287 (4))

In any sequence C_a \$ C_b there is a preference for C_a to exceed C_b in sonority.

(162) is the sonority scale for sounds (see Hooper 1976, Basbøll 1977, Lekach 1979, Kiparsky 1979, Steriade 1982, Selkirk 1984 among others).

(162) least sonorous most sonorous

← ---------- →

Obstruents	Nasals	Liquids	Glides	Vowels
1	2	3	4	5

I implement the principle (161) as a universal constraint, (163).

(163) Syllable Contact Condition (SCC)

In any sequence $C_a]_{\sigma\,\sigma}[C_b$, if Cb is [+Son], then Ca must not be [-Son].

When a coda obstruent precedes an onset glide, it does not create an optimal syllable contact, violating (163), while a sonorant coda preceding an onset glide would not violate it. The effect of (163) in Nuu-chah-nulth appears by the interaction with the following faithfulness, DEPRootNode and MAX[+Voiced] (164), and markedness constraint, (165), as expressed as the ranking in (166).

(164) Faithfulness

MAX[+Voiced]: [+Voiced] in the input must have a correspondent in the output.

(165) Markedness

*[-Son +Voiced]: [-Son] and [+Voiced] cannot cooccur within the same root node.

*C: No coalescence of the two tokens of [+Voiced] to a single anchor is allowed.
(=NoMultipleLink[+Voiced]:NML[+Vd])

[+Vd][+Vd]

(166) Ranking

SCC, *[-Son, +Voiced], NML[+Vd]

⇩

MAX[+Voiced]

⇩

DEPRootNode

The implication of the ranking of these constraints is illustrated in tableau (167) with a stop, and in (168) with a nasal; recall that the initial part of a leniting suffix is a floating [+Voiced].

(167) tupk-[+Voiced]is ➔ tupkis

black-the beach '(s.t.) black on the beach'

Tableau[44]

tupk-[+Voiced]is	SCC	*[-Son, +Vd]	NML[+Vd]	MAX [+Voiced]	DEPRoot Node
a. tupk . yis[45] | [+Voiced]	*!				*
☞b. tup . kis				*	
c. tup . gis | [+Voiced]		*!			

Candidate **a** violates both SCC and DEPRootNode by inserting a root node and thus creating a bad syllable contact. It is, thereby, possible to avoid violating MAX[+Voiced], but the fatal violation of the higher-ranked constraint SCC leads this candidate to be ruled out. Candidate **c** violates *[-Son, +Voiced] by linking the floating feature to the voiceless obstruent target /k/. Consequently, candidate **b** is selected as an optimal output form. It violates MAX[+Voiced] by deleting the input feature, but the violation is not crucial since the constraint is lower ranked.

(168) hayu/m/-[+Voiced]is ➔ hayu[my]is
Not knowing-at the beach 'getting lost at the beach'

Tableau

[hayum+[+Vd]is	SCC	*[-Son, +Vd]	NML[+Vd]	MAX [+Voiced]	DEPRoot Node
☞ a. hayum. yis | [+Voiced]					*
b. hayu . mis				*!	
c. hayu . mis | [+Voiced]			*!		

Candidate **b** is ruled out by violating the relatively high-ranked constraint MAX[+Voiced]. In candidate **c**, the [+Voiced] nasal is linked to the input floating [+Voiced], leading to multiple association of the

[44] A potential candidate is the stem-final stop surfaces as a glide as in the case of fricatives. Such a candidate would violate MAX[-Cont], which must be high-ranked in Nuu-chah-nulth.

[45] This and following relevant candidates must violate DEPPlaceNode and some other features as well, in order to realise the floating [+Voiced]. However, I do not include discussion of this constraint in order to simplify the exposition.

feature. This causes a fatal violation of NM[+Vd]. Consequently, candidate **a** is selected as an optimal output form. The optimal form violates DEPRootNode, which is low-ranked and thus whose violation is not crucial. Note that the sequence of a nasal and a glide does not violate SCC; their sonority is close to each other, compared to that of an obstruent and a glide.

Finally, a stem-final fricative is affected, exhibiting alternation. Some stem-final fricatives surface as glides when preceding a leniting suffix, while others are not affected.

(169) hiɬ-[+Voiced]is → hi[y]is.
LOC-at the beach 'there is (s.o./s.t.) at the beach

(170) ƛuɬ-[+Voiced]is → ƛu[ɬ]is
nice-at the beach (s.t.) nice at the beach'

In (169) the stem-final /ɬ/ becomes a glide /y/ before the leniting suffix -[+Voiced]*is*, but in (170) the same fricative from another lexical item surfaces faithfully. As in the case of glottalisation, this kind of alternation between the same set of fricatives can be dealt with using two different input representations of a single surface fricative. I repeat from (99) the representations below:

(171) Nuu-chah-nulth input fricatives

a. /s/ b. /S/

$$\begin{bmatrix} +\text{Cons} \\ +\text{Cont} \end{bmatrix} \qquad \begin{bmatrix} \\ +\text{Cont} \end{bmatrix}$$

Recall that when a morpheme with a fricative in its final position is on its own, these different input representations are realised as the same fricative. The alternation appears when a leniting suffix is attached. To treat fricative cases, we need MAX[+Cons], (172), and their language-specific ranking, (173), which is a revised version of (166).

(172) MAX[+Cons]: [+Cons] in the input must have a correspondent in the output.

(173) Ranking

SCC, *[-Son, +Voiced], NML[+Vd], MAX[+Cons]

⇩

MAX[+Voiced]

⇩

DEPRootNode

The following tableaux illustrate this effect: (174) includes a fricative unspecified for [+Cons] and (175) a fricative specified for [+Cons].

(174) hiɬ-[+Voiced]is ➔ hi[y]is

LOC-at the beach 'there is s.o. at the beach

Tableau: No specification of [+Cons]

hiɬ+[+Voiced]is	SCC	*[-Son, +Vd]	MAX [+Cons]	MAX [+Voiced]	DEPRoot Node
☞a. hi . yis | [+Voiced]					*
b. hi . ɬis				*!	
c. hiɬ . yis | [+Voiced]	*!				*
d. hi . ɮis | [+Voiced]		*!			

In (174) the input fricative /ɬ/ is not specified for [+Cons] and thus the constraint MAX[+Cons] is not relevant. Candidate **b** violates MAX[+Voiced] by deleting the input [+Voiced] feature. Candidate c is ruled out by a bad syllable contact: a violation of SCC. Candidate d violates the markedness costraint *[-Son +Voiced], which is caused by linking the [+Voiced] feature to [-Son] consonant. In candidate **a**, the floating feature [+Voiced] links to the immediately preceding anchor, as in candidate d, but the target surfaces as a glide /y/, which is not [-Son]. Consequently, a fricative unspecified for [+Cons] can easily become lenited as shown in the tableau.

(175) is a case of a fricative specified for [+Cons].

(175) ƛuɬ-[+Voiced]is ➔ ƛu[ɬ]is

nice-at the beach 's.t. nice at the beach'

Tableau: Specification of [+Cons]

[ƛuɬ+[+Voiced]is | [+Cons]	SCC	+[-Son, +Vd]	MAX [+Cons]	MAX [+Voiced]	DEPRoot Node
☞ a. ƛuɬis | [+Cons]				*	
b. ƛuɬyis | [+Cons]	*!				*
c. ƛuɣis | [+Voiced] [+Cons]		*!			
d. ƛuyis			*!		

As shown in the tableau, MAX[+Cons], as well as the two markedness constraints, plays a crucial role in determining the optimal output. The input fricative is specified for [+Cons]; thus its disappearance in the output causes a fatal violation of the faithfulness constraint as seen in candidate **d**. Candidates **b and c** also fatally violate the high-ranked markedness constraint. Therefore, candidate **a** is selected as an optimal output form where the input fricative surfaces as such.

3.2.2.2.2 No lenition with post-alveolar fricatives

All stem-fricatives, when preceding a glottalising suffix, consistently exhibit alternation, whether they are alveolar, velar, uvular, or pharyngeal. We found the same kind of alternation with some fricatives in the previous section. However, if stem-final fricatives in the context of lenition are post-alveolar, then they are consistently not affected. As we saw in (143), they always surface as a plain fricative, not a glide. All unaffected fricatives constitute a phonological class, [-Anterior], and exhibit immunity to the floating [+Voiced], whether [+Cons] is specified or not in the input, unlike [+Anterior]. I repeat the relevant examples from (143).

(176) a. ċu/š/-iɬ → ċu[š]iɬ

new-on the floor 's.t. new on the floor (e.g. mat, rug, etc.)

b. ƛ̓u/š/-iɬ → ƛ̓u[š]iɬ
dry-on the floor 'the floor is dried up.

c. ƛ̓u/š/-is → ƛ̓u[š]is
dry-at the beach '(the sand) on the beach is dry.'

d. quu/x/-iɬ → quu[x]iɬ
to freeze-on the floor 's.t. frozen on the floor (e.g. water)'

e. taa/x^w/-iɬ → taa[x^w]iɬ
to spit-on the floor 'spitting on the floor'

f. čiš/x̣/-iɬ → čiš[x̣]iɬ
dirty-inside 'dirty inside (the house)'

g. čap/x̣^{w}/-iɬ → čap[x̣^{w}]iɬ
man-inside 'men in a house'

h. č̓i/ḥ/-iɬ → č̓i[ḥ]iɬ
s.t. negative-on the floor 's.t. scary on the floor

Howe (2000) notices that "... Oowekyala normally excludes consonants that are specified [-anterior] (e.g. š, č, , , ʎ).... [in some phonological processes (?)]...". I suggest that the feature [Anterior] plays a crucial role in determining the availability of alternation in lenition in Nuu-chah-nulth as well. Unmarked segments are more easily a target for phonological processes than marked segments cross-linguistically, and [+Anterior] consonants are less marked than [-Anterior] (Chomsky & Halle 1968, Morelli 1999, Roca & Johnson 1999, Lombardi 2000).[46] I suggest that the lack of lenition with post-alveolar ([-Anterior]) fricatives is related to this universal property. That is, [-Anterior] fricatives, which is more marked than [+Anterior] fricatives, are excluded in lenition. Given that glottalisation applies to all fricatives in Nuu-chah-nulth, Nuu-chah-nulth provides an example that the markedness principle is imposed only to one or part of phonological processes with the same potential targets in a single language.

[46] Following Chomsky & Halle (1968:304), I make use of [Anterior] to distinguish anterior consonants (labials, dentals, and alveolars) from nonanterior ones (palato-alveolar, velar, uvular, and pharyngeal).

While [±Anterior] provides a phonological domain where a fricative is affected or not, the relevant feature for this issue is [+Strident]. That is, [-Anterior]-[+Strident] is not subject to lenition, but [+Anterior]-[+Strident] is. This restriction is expressed by the following two faithfulness constraints and their ranking with respect to other faithfulness and markedness constraints.

(177) Constraints:

a. MAX[+Strident]: The input [-Anterior]-[+Strident] must have its correspondent in the output.

|

[-Anterior]

b. MAX[+Strident]: The input [+Anterior]-[+Strident] must have its correspondent in the output.

|

[+Anterior]

(178) Ranking:

MAX[+C.G.], *[+Cons, +Cont, +C.G.], [-Son, +Voiced]

⇩

MAX[+Strident]

|

[-Anterior]

⇩

MAX[+Voiced]

⇩

MAX[+Strident]

|

[+Anterior]

The implication of the ranking is illustrated in the following tableaux with relevant examples, where we will see how differently [-Anterior] fricatives behave depending on whether they are in the context of glottalisation or lenition.

(179) [+Anterior]: e.g. /s/

a. Glottalisation

ʕuyaa/s/-[+C.G.]aḥs → ʕuyaa[ỷ]aḥs

to move-at the beach 'moving one position in a boat to another'

b. Lenition

ʕuyaa/s/-[+Voiced]is ➔ ʕuyaa[y]is

to move-at the beach 'moving one position to another at the beach'

(180) a. Tableau: Glottalisation

ʕuyaas-[+C.G.]iic | [+Cont] [+Ant] [+Strident]	*[+Cons] [+Cont] [+C.G.]	MAX [+C.G.]	DEPRoot Node	MAX[+Str] | [-Ant]	MAX[+Str] | [+Ant]
☞ a. ʕuyaaʔyiic | +Cont -Ant -Strident +C.G.					*
b. ʕuyaasʔiic | +Cont +Ant +Strident			*!		
c. ʕuyaas'iic | +Cont +Ant +Strident +C.G.	*!				
d. ʕuyaasiic | +Cont +Ant +Strident		*!			

b. Tableau: Lenition

ʕuyaas+[+Vd]is | [+Cont] [+Ant] [+Strident]	*[-Son +Voiced]	DEPRoot Node	MAX[+Str] | [-Ant]	MAX [+Voiced]	MAX[+Str] | [+Ant]
☞a. ʕuyaayis | [+Cont] [-Ant] [+Voiced]					*
b. ʕuyaasyis | [+Cont] [+Ant] [+Strident]		*!			
c. ʕuyaazis | [+Cont] [+Ant] [+Strident] [+Voiced]	*!				
d. ʕuyaasis | [+Cont] [+Ant] [+Strident]				*!	

With [+Anterior] stem-final fricatives preceding each trigger [+C.G.] and [+Voiced], respectively, all the faithfulness and markedness constraints outranking MAX[+Str] cause the input fricative to surface as a glottalised or plain glide, if they are unspecified for [+Cons].

On the other hand, if the target fricative is [-Anterior], MAX[+Strident] in the domain of [-Anterior] plays a crucial role in maintaining its input [+Strident] in the context of lenition (but not in the context of glottalisation). This MAX constraint is still lower-ranked than MAX[+C.G.], but outranks MAX[+Voiced]. This makes it possible to maintain the input [-Anterior] fricative on the surface in the context of lenition, scarifying the input [+Voiced], as illustrated in (182).

(181) [-Anterior]: e.g. /š/

a. Glottalisation

hiš-[+C.G.]iic → hi[ỷ]iic

all-to take 'to take all'

b. Lenition

hiš-[+Voiced]is ➔ hi[š]is

all-at the beach 'all (the people) at the beach'

(182) a. Tableau: Glottalisation

hiš-[+C.G.]iic | [+Cont] [-Ant] [+Strident]	*[+Cons] [+Cont] [+C.G.]	MAX [+C.G.]	DEPRoot Node	MAX[+Str] | [-Ant]	MAX[+Str] | [+Ant]
☞ a. hiʔiic | [+Cont] [-Ant] [-Strident] [+C.G.]				*	*
b. hišʔiic | [+Cont] [-Ant] [+Strident]			*!		
c. hiš'iic | [+Cont] [-Ant] [+Strident] [+C.G.]	*!				
d. hišiic | [+Cont] [-Ant] [+Strident]		*!			

b. Tableau: Lenition

hiš+[+Vd]is | [+Cont] [-Ant] [+Strident]	*[-Son +Voiced]	DEPRoot Node	MAX[+Str] | [-Ant]	MAX [+Voiced]	MAX[+Str] | [+Ant]
a. hiyis | [+Cont] [-Ant] [+Voiced]			*!		*
b. hišyis | [+Cont] [-Ant] [+Strident]		*!			
c. hiʒis | [+Cont] [-Ant] [+Strident] [+Voiced]	*!				
☞d. hišis | [+Cont] [-Ant] [+Strident]				*	

3.2.2.2.3 'Richness of the Base'

I treated alternation of fricatives observed both in glottalisation and lenition in terms of the principle 'Richness of the base'. The two different representations for a single input fricative cause different output forms in the contexts of both processes. If, however, there is no systematic treatment of input fricatives in the representation, then the analysis would be just an ad hoc solution. In this section, I will compare the relevant data from glottalisation and lenition and examine whether they exhibit consistency in their input representations. This will support the analysis.

(183) Fricatives: Type 1 ("glottalised")

a. hi/ɬ/-[+C.G.]aḥs → hi[ỷ]aḥs
Loc-vessel 'there is (s.t.) in a boat'

b. ʕuyaa/s/-[+C.G.]aḥs → ʕuyaa[ỷ]aḥs
to move-vessel 'moving one position to another in a boat'

c. nawaa/s/-[+C.G.]aḥs ➔ nawaa[ỷ]aḥs
to sit (leisurely)-vessel 'leisurely sitting in a boat'

d. ḥuu/ɬ/-[+C.G.]aḥs ➔ ḥuu[ỷ]aḥs
over there (far away)-vessel '(someone) over there far away in a car'

(184) Fricatives: Type 2 (not glottalised)

a. ƛu/ɬ/-[+C.G.]aḥs ➔ ƛu[ɬ]ʔaḥs
nice-vessel '(s.t.) nice in a boat'

b.tim/s/-[+C.G.]aḥs ➔ tim[s]ʔaḥs
garbage-vessel 'garbage in a boat'

c. m̓a/ɬ/-[+C.G.]aḥs ➔ m̓aɬ[ʔ]aḥs
cold-vessel 'cold liquid'

d. ḥismi/s/-[+C.G.]aḥs ➔ ḥismis[ʔ]aḥs
blood-vessel 'blood in a bowl'

I suggested that a fricative affected by a glottalising suffix is underlyingly unspecified for [+Cons] and one unaffected is specified for the feature. Therefore, each fricative in (183a-b) must not be specified for the feature and each fricative in (184a-b) must be specified. Then, we would expect the same alternation in lenition. That is, a fricative unspecified for [+Cons] is affected by a leniting suffix and one specified for [+Cons] is not. The following examples show that this is the case.

(185) Fricatives: Type 1 (lenited)

a. hi/ɬ/-[+Voiced]is ➔ hi[y]is
Loc-at the beach 'there is (s.o./s.t.) at the beach'

b. ʕuyaa/s/-[+Voiced]is ➔ ʕuyaa[y]is
to move-at the beach 'moving one postion to another at the beach'

c. nawaa/s/-[+Voiced]iɬ ➔ nawaa[y]iɬ
to sit (leisurely)-inside/ 'sitting inside leisurely'
on the floor

d. ḥuu/ɬ/-[+Voiced]is → ḥuu[y]is
over there-at the beach '(someone) over there far away on the beach'
(far away)

(186) Type 2 (not lenited)

a. ƛu/ɬ/-[+Voiced]is → ƛu[ɬ]is
nice-at the beach '(s.t.) nice at the beach'

b. tim/s/-[+Voiced]is → tim[s]is
garbage-at the beach 'garbage at the beach'

c. m̓a/ɬ/-[+Voiced]iɬ → m̓aɬiɬ
cold-inside/on the floor 'the floor is cold.'

d. ḥismi/s/-[+Voiced]is → ḥismisis
blood-at the beach 'Blood on a beach'

These examples show that a fricative consistently maintains its input form through both phonological processes: glottalisation and lenition.

To conclude, all the fricatives that undergo glottalisation also undergo lenition; those that do not undergo glottalisation also do not undergo lenition. (See Kim & Pulleyblank 2003 for detailed discussion). The free combination of features in inputs predicts the possibility of two distinct types of fricatives (Archangeli & Pulleyblank 1994), and the consistent behaviour of fricatives in the two phonological processes in Nuu-chah-nulth provide empirical evidence for the principle "Richness of the Base" (Prince & Smolensky 1993). One might suggest that an alternate approach, Lexicon Optimization with motivated underspecification where underspecification is implemented only when phonological alternations appear on the surface (Inkelas 1995), can treat the same problems. However, as we saw in section 3.2.1 and this section, [-Anterior] fricatives, as well as [+Anterior] ones, exhibit alternation in the context of glottalisation, but not in the context of lenition. If we adopt Lexicon Optimization, then how could we determine the input form of each [-Anterior] fricative? When a set of segments does not exhibit consistent alternation over all phonological or morphological contexts, we could simply not depend on Lexicon Optimization. On the other hand, 'Richness of the Base" does not cause the same dilemma, since it never requires such a condition on input forms.

3.2.2.3 Vowel-final stems in lenition

Vowel-final stems in the context of lenition exhibit the same properties in the context of glottalisation. Just as a stem-final vowel preceding a glottalising suffix is not affected, a stem-final vowel is not affected when it is followed by a leniting suffix. Before a glottalising suffix, a glottal stop appears; before a leniting suffix, a glide appears as seen in (187).

(187) a. ʔu-ca-(i)iɬ-ʔiš ḥuu → ʔuca[y]iɬʔiš
it-to go-inside-3sg/IND that 'S/he is lying the other way.'

b. ciq-ḥsii-(i)iɬ → ciqḥsii[y]iɬ
to speak-?-inside 'a speaker in a house'

c. ḥaṁa-(i)iɬ → ḥama[y]iɬ
to stay-inside 'to stay s.w. in a house'

d. čii-is-aƛ-uk-či → čii[y]isʔaƛukči
to pull-at the beach-SEQ-POSS-2sg/IMP 'go and pull your canoe up (to the beach)!'

e. kaačuu-is → kaačuu[y]is
to measure-at the each 'to measure s.t. at the beach'

f. sayaa-is → sayaa[y]is
far-at the beach 'far at the beach'

When a leniting suffix follows a vowel-final stem, the vowel is not affected and a glide [y] appears on the surface between the stem and the suffix.[47] The presence of /y/ with a vowel-final stem is basically due

[47] However, there is an exception as follows: instead of /y/, a nasal /m/ appears on the surface.

i) ṁaɬ-(i)iɬ → ṁaɬ[m]iiɬ
cold-inside 'cold inside'

Interestingly, the stem-final fricative is not glottalised, surfacing followed by a glottal stop, when preceding glottalising suffixes.

ii) ṁaɬ-[+C.G.]aḥs → ṁaɬ[ʔ]aḥs 'Cold liquid in a bowl'
-vessel/bowl

to the interaction between the two faithfulness constraints MAX[+Voiced] and DEPRootNode. I do not include constraints which are not crucial and whose effects are discussed in the previous sections.

As shown in the following tableau, the high-ranked constraint MAX[+Voiced] drives the presence of /y/ when a vowel-final stem precedes a leniting suffix.

(188) a. sayaa-[+Voiced]is → sayaa[y]is
far-at the beach 'far at the beach'

b. Tableau

[sayaa+[+Vd]is	MAX[+Voiced]	DEPRootNode
☞ a. sayaa . yis | [+Vd]		*
b. sayaa . is	*!	

Before leaving this section, we need to discuss exceptional cases with nasals in the context of lenition. I suggested above that the presence of /y/ on the surface in the context of lenition is due to a floating feature [+Voiced]. When lenition is not an option for the target consonant, the [+Voiced] feature is deleted when following a stop/affricate. On the other hand, it is realised as a glide with a fricative or nasal target, albeit with a different mechanism. There are some exceptions with nasals as shown in (189-193).

(189) a. huupukʷaṅum-iɬ → huupukʷaṅum[ʔ]iɬ/ (*huupukʷaṅumyiɬ)
storage box-on the floor 'storage box (basket) on the floor'

b. huupukʷaṅum-is → huupukʷaṅum[ʔ]iɬ/ (*huupukʷaṅumyis)
storage box-at the beach 'storage box (basket) on the beach'

ṁaɬ-[+C.G.]aqχ → ṁaɬ[ʔ]aqχ 'Cold inside'
-inside

ṁaɬ-[+C.G.]iḥta → ṁaɬ[ʔ]iḥta 'Cold at the end'
-at the end

ṁaɬ-[+C.G.]aap → ṁaɬ[ʔ]aap 'To buy s.t. cold (e.g. ice cream)'
-to buy

(190) a. husmin-iɬ → husmin[ʔ]iɬ (*husminyiɬ)
kelp-on the floor 'kelp on the floor'

b. husmin-is → husmin[ʔ]is (*husminyis)
kelp-at the beach 'kelp at the beach'

(191) a. cikimin-iɬ → cikimin[ʔ]iɬ (*cikiminyiɬ)
iron-on the floor 'iron on the floor'

b. cikimin-is → cikimin[ʔ]is (*cikiminyis)
iron-at the beach 'iron at the beach'

(192) a. maamaak̓in-iɬ → maamaak̓in[y]iɬ
to play-inside 's.o. playing inside the house (e.g. with toys)

b. maamaak̓in-is → maamaak̓in[ʔ]is
to play-at the beach 's.o. playing at the beach'

(193) a. k̓ʷasitum-iɬ → k̓ʷasitum[ʔ]iɬ
branch-on the floor 'branches on the floor'

b. k̓ʷasitum-is → k̓ʷasitum[y]is
branch-at the beach 'branches at the beach'

These exceptions do not seem to be associated with differences in input representations. First, unlike alternation observed in fricatives, this is a marginal phenomenon: 17 of 24 stem-final nasals tested are followed consistently by a glide in the lenition context. Second, the issue is not whether a target segment is affected or not, but rather, the presence of an extra form only with a certain set of consonants. Third, the presence of a glottal stop with some lexical items does not seem to be related with the phonological input, the floating [+Voiced] feature.[48] I suspect that this type of exception is not phonologically, but rather, morphologically, motivated. Recall that as seen in (154), 71 % of the tested nasal-final stems consistently exhibit /y/ on the surface. Therefore, the presence of a glottal stop may be due to a kind of

[48] In fact, a glottal stop has [+C.G.]. Nuu-chah-nulth makes phonological use of only [+C.G.] and [+Voiced] as laryngeal features. Therefore, their complementary distribution makes sense, although we need to investigate what kind of mechanism drives such alternation from an underlying [+Voiced]. Thanks to Pat Shaw for this point.

allomorph, which uses a Nuu-chah-nulth default consonant /ʔ/ as part of an allomorph of a morpheme in question. That is, in the lenition context with a nasal, some nasal-final morphemes may lexical-specifically drive such insertion. This requires further research.

3.2.3 Labialisation

Ahousaht Nuu-chah-nulth does not have labialisation, while it is claimed that another dialect, Tseshaht, does (see Sapir & Swadesh 1939, Stonham 1999). I will start with a brief discussion of labialisation, because it is closely related to the topic of delabialisation, treated in the next section, and for comparison between dialects.

Stonham (1999) describes velar or uvular consonants in Tseshaht being labialised between a preceding high back rounded vowel /u/ and a following non-round vowel, as expressed in the rule in (194):

(194) Labialisation rule: C → [+rnd] / u __ V
[-rnd]

(Stonham 1999: 86)

The Tseshaht examples in (196) are taken from Stonham (1999:86)

(195) labialisation data[49]

a. haʔuk-qatḥ-(ya)atu k -'e:ʔita → haʔukqatḥʔatu kʷ e:ʔit
eat-pretendedly-make noise-3.PURP 'he made the noise of eating'

b. č'ičm̓u q i:ɬ-ʔaaqƛ-qa → č'iičm̓u qʷ i:ɬʔaaqƛqa
scapegoat-make…-FUT.INTENT-SUB 'they will make him a scapegoat'

c. ʔu-ʔu::štaqyu q -aɬš-y̓ak-uk → ʔuʔu: štaqyu qʷ aɬšy̓akukʔi
PL-doctor-?-…song-POSS 'his doctoring songs'

However, as Stonham himself mentions, we cannot see if the target consonant is really underlyingly a plain velar/uvular or a labio-velar/uvular. A labio-velar/uvular loses its labial property before a consonant or word-finally, while it maintains that property before a vowel in Nuu-chah-nulth in general.

> …The difficulty in providing convincing examples of this process is not that there are few examples available, but rather that of the large number of examples, the majority are difficult to establish as not involving underlying labialised consonants…

[49] In previous studies including Stonham (1999), a glottalising suffix is indicated by an apostrophe mark as the initial element as seen in (195a) -'e:ʔita.

Consider the following examples, which are from Ahousaht:

(196) The presence of labiality before a vowel

a. cap/x̣^{w}/-atuk → cap[x̣^{w}]atuk
to boil-sound 'boiling noise

b. ci/x^{w}/-aa → ci[x^{w}]aa
to fry-DUR 'frying'

c. c̓u/q^{w}/-aa → c̓u[q^{w}]aa
to stab-DUR 'stabbing'

d. ḥiik^{w}-ḥii/k^{w}/-a → ḥiikḥii[k^{w}]a
RED-to wind-CONT 'winding, curved'

e. nuu/k^{w}/-iiɬ → nuu[k^{w}]iiɬ
song-to make 'to make a song'

(197) The absence of labiality before a consonant or word-finally

a. cap/x̣^{w}/-saap → cap[x̣]saap
to boil-MOM.CAUS 'to boil'

b. ci/x^{w}/-čuu → ci[x]čuu
to fry-in a state of 'fried'

c. c̓u/q^{w}/-šiƛ → c̓u[q]šiƛ
to stab-MOM 'to stab'

d. ḥii/k^{w}/-ḥiik^{w}-(y)a → ḥii[k]ḥiik^{w}a
RED-to wind-CONT 'winding, curved'

e. nuu/k^{w}/ → nuu[k]
song 'song'

In (196), each labio-velar/uvular consonant maintains its labiality when preceding a vowel, while in (197), it becomes its non-labial counterpart before a consonant or word-finally. Another account for the

alternation observed in (195), therefore, may be that the target consonant maintains its underlying labial property when preceding a vowel, rather than it being a derived property in the proposed context.

Note that the following examples from Ahousaht show that this dialect does not exhibit a process of labialisation.

(198) No-labialisation in Ahousaht

a. ċikyuu-/q/aača Crooked-1sg/DUB	➔	ċikyuu[q]aača	(*ċikyuuq^{w}aača)
b. ċikyuu-/q/aq Crooked-very much	➔	ċikyuu[q]aq	(*ċikyuuq^{w}aq)
c. ċišx̣ċuu-/q/aača Dusty inside-1sg/DUB	➔	ċišx̣ċuu[q]aaċa	(*ċisx̣ċuuq^{w}aaċa)
d. ċišx̣ċuu-/q/aq Dusty inside-very much	➔	ċišx̣ċuu[q]aq	(*ċišx̣ċuuq^{w}aq)

Each target consonant is underlyingly non-labial and does not undergo labialisation in the proposed context: between /u/ and a non-round vowel. It is difficult to provide more data, since there are not many morphemes ending with /u/, and since not many combinations of morphemes ending with /u/ and morphemes beginning with a velar or uvular can be obtained for semantic reasons.

In conclusion, it seems that we need to test more data to confirm if Tseshaht really has labialisation. Moreover, it is necessary to examine other Nuu-chah-nulth dialects to see if the lack of labialisation in Ahousaht is a special case or a general tendency through all the dialects.

3.2.4 Delabialisation

We saw in (197) that a labio-velar/uvular consonant becomes delabialised before a consonant and word-finally. This distributional restriction can be dealt with by the following constraints, (199a-b), and their language-specific ranking, (200).

(199) a. NoRoundCoda: No [+Round] consonant is in coda.[50]

[50] It seems that it is a general property of Nuu-chah-nulth to disallow marked features such as [+C.G.] (all glottal consonants), [-Cons] (glides), and [+Round] (velar-labial and uvular-labial consonants). Therefore, we might need

b. MAX[+Round]: [+Round] in the input must have a correspondent in the output.

(200) Ranking: NoRoundCoda >> MAX[+Round]

(201) is the relevant example and the effect of the ranking (200) is shown in tableau (202).

(201) cap/x̣^{w}/-saap ➔ cap[x̣]saap
to boil-MOM.CAUS 'to boil'

cf. cap/x̣^{w}/-atuk ➔ cap[x̣^{w}]atuk
to boil-sound 'boiling noise

(202) Tableau

/capx̣^{w}-saap/ [+R]	NoRoundCoda	MAX[+Round]
☞ a. capx̣.saap		*
b. capx̣^{w}.saap [+R]	*!	

As seen in the tableaux, the deletion of underlying labiality is due to the constraint NoRoundCoda, which disallows a labial consonant in a coda, outranking MAX[+Round], which requires an underlying [+Round] to appear on the surface. Candidate b is ruled out by fatally violating NoRoundCoda, although it obeys MAX[+Round] by maintaining the phonological element in question on the surface.

3.2.4.1 Description: delabialisation before /u/

Nuu-chah-nulth has another context where the labial property is deleted. Labio-velar and uvular consonants, /x^{w}, k^{w}, x̣^{w}, q^{w}/, become delabialised when preceding a [+Round] vowel, /u/.[51] (Also see Sapir & Swadesh 1939 and Stonham 1999). The following examples illustrate the process:

a general coda condition such as NoMarkedCoda. However, I simply make use of (199) for the problem under discussion. Thanks to Joe Stemberger for this point.

(203) a. ċa/x^{w}/-uuɬ ➔ ċa[x]uuɬ
to stab/spear-face 'wrinkles'

cf. ċa[x^{w}]iɬ 'to stab s.t. to the floor'

b. hawi/k^{w}/-uk ➔ hawi[k]uk
to eat-doer 'a big eater'

cf. haʔu[k^{w}]iɬʔiš 's.o. eats s.t. inside'

c. ċu/q^{w}/-umɬ ➔ ċu[q]umɬ
to pierce-round 'to pierce some round stuff like a drum'

cf. ċu[q^{w}]iɬ 'to be pierced into the floor'

Interestingly, in Ditidaht (Klokeid 1977a) and Makah (Jacobsen 1969), labiovelars are consistently round both word-finally and before /u/. According to Klokeid, in a variety of Ditidaht, a vowel assimilates in rounding to a preceding labial consonant.

On the other hand, in Ahousaht Nuu-chah-nulth a preceding /u/ does not affect the roundness of a labio-velar or –uvular as shown in (204), as well as in the compared examples in (203):

(204) a. haʔu/k^{w}/-iɬ-ʔiš ➔ haʔu[k^{w}]iɬʔiš (*haʔukiɬʔiš)
to eat-inside-3sg/IND 'S/he eats inside (the house)'

b. tu/x^{w}/-iɬ ➔ tu[x^{w}]iɬ (*tuxiɬ)
to jump-on the floor 'jumping to the floor'

The following data shows that the process of delabialisation is pervasive. Also, note that native speakers apply glottalisation to the final stop of novel loan words before a glottalising suffix as well, as in (205b) and (206b).[52]

(205) The labial property maintained before a non-round vowel
a. ku/k^{w}/a-ap-(m)it-siš ➔ ku[k^{w}]aʔapitsiš
Korean bread-to buy-PAST-1sg/IND 'I bought Korean bread (one kind)'

[51] Stonham (1999) provides examples of velar and uvular stops only in Tseshaht.
[52] I made up the words to test if delabialisation is applied to loan words too.

*kukaʔapitsiš

b. ɬu/xʷ/ap-ap-(m)it-siš ➔ ɬu[xʷ]apʔapitsiš

Korean apple-to buy-PAST-1sg/IND 'I bought Korean apples (one kind)'

*ɬuxapʔapitsiš

(206) The labial property lost before a round vowel

a. ka/kʷ/u-ap-(m)it-siš ➔ ka[k]uʔapitsiš

Korean bread-to buy-PAST-1sg/IND 'I bought Korean bread (another kind)'

*kakʷuʔapitsiš

b. ɬa/xʷ/up-ap-(m)it-siš ➔ ɬa[x]upʔapitsiš

Korean apple-to buy-PAST-1sg/IND 'I bought Korean apples (another kind)'

*ɬaxʷupʔapitsiš

The unique properties of Nuu-chah-nulth delabialisation are summarised as follows: i) the trigger is a round vowel, /u/, which is the only round vowel in Nuu-chah-nulth, ii) the target is labio-velar and labio-uvular consonants, and iii) there is a directional restriction: only a following, not preceding, vowel causes delabialisation.

3.2.4.2 Analysis

Delabialisation occurs in order to avoid the clash of [+Round] ([+R]) features, which are immediately adjacent. There might be more than one way to resolve the feature clash cross-linguistically: deletion of one of the feature occurrences, insertion of another segment, and so on.

Nuu-chah-nulth implements deletion to avoid the feature clash. There are two ways to delete the [+Round] feature: deleting [+Round] linked to a consonant, or to a vowel. Considering feature values of vowels in (207), if [+Round] of a consonant is deleted, then (208a) will surface; if [+Round] of a vowel is deleted, then (208b) will surface. I indicate relevant features only in (208). Note that /u/ is the only [+Round] high vowel in Nuu-chah-nulth, and thus if the feature value is lost, then the feature [+Back] is also lost, maintaining its height.

(207) Feature values of Nuu-chah-nulth vowels

	/i/	/u/	/a/	/e/	/o/
HIGH	+	+	-	-	-
LOW	-	-	+	-	-
BACK	-	(+)	+	-	(+)
ROUND	-	+	-	-	+

(208) a. /-k^{w}u-/ ➔ [-k u-]

```
 | |        | |
[+R][+R]   [-R][+R]
    |+H|       |+H|
    [+B]       [+B]
```

b. /-k^{w}u-/ ➔ [-k^{w} i-]

```
 | |        |   |
[+R][+R]   [+R][-R]
    |+H|       |+H|
    [+B]       [-B]
```

As we will see below, Nuu-chah-nulth does not allow any change in backness. That is, maintaining input backness of a segment is more significant than maintaining input roundness of a segment. This is guaranteed by the interaction of the faithfulness constraints (209-210), and two markedness constraints NoMultipleLink (211) and OCP$_{\sigma}$[+Round] (212) (OCP is subject to syllable structure for this case), and their language-specific ranking in (213). MAX constraints require an input feature in question, [+Back] and [+Round], to appear on the surface. MAXPATH[+Round] disallows the input path between a feature in question and an anchor to be deleted. NoMultipleLink prevents a single feature from associating to two anchors. Another aspect of delabialisation in Nuu-chah-nulth is that the trigger must follow, not precede, the target. OCP$_{\sigma}$[+Round] drives this directional restriction.

(209) a. MAX[+Back]: [+Back] in the input must have a correspondent in the output.

b. MAX[+Round]: [+Round] in the input must have a correspondent in the output.

(210) MAXPATH[+Round]: Any input path between [+Round] and an anchor must have a correspondent path in the output.

(211) NoMultipleLink[+Round](NML[+Round]: No coalescence of a single [+Round] to two anchors is allowed.

(212) OCP_{σ}[+Round]: Adjacent [+Round] features within a syllable are banned.

(213) Ranking: OCP_{σ}[+Round], MAX[+Back], NML[+Round]

⇩

MAX[+Round], MAXPATH[+Round]

Now, examine, in the following tableaux, how the constraints and their ranking work.

(214) ya/x^w/-umɬ ➔ ya[x]umɬ (cf. ya[x^w]iɬ 'to brush s.t. on a bed')
to brush-round/surface 'to brush off (e.g. sweater)'

(215) Tableau

yax^w-umɬ | | [+R] [+R,+B]	OCP_{σ} [+Round]	MAX [+Back]	NML [+Round]	MAX [+Round]	MAXPATH [+Round]
☞ a. ya.xumɬ | [+R,+B]				*	*
b. ya.x^w umɬ \╱| [+R][+B]			*!	*	
c. ya.x^w imɬ | | [+R][-B]		*!		*	
d. ya.x^{w}umɬ | | [+R][+R]	*!				

In tableau (215), candidate b is ruled out by violating NML[+Round]: the [+Round] feature is linked to two anchors. Candidate c violates MAX[+Back] by deleting the input feature. Candidate d is ruled out by violating OCP, which is due to a sequence of two [+Round] features on adjacent segments within a syllable. Consequently, candidate a is selected as an optimal output. Note that especially between faithfulness constraints, a lower-ranking status of MAX[+Round] and MAXPATH[+Round] than MAX[+Back] and NML[+Round] results in this form.

In sum, the Nuu-chah-nulth grammar represented in (213) causes a consonant to lose its labiality when a triggering vowel follows the target consonant.

Consider the following example, where /u/ precedes the target consonant /x^w/.

(216) tu/x^{w}/-iɬ ➔ tu[x^{w}]iɬ (*tuxiɬ)

to jump-on the floor 'to jump to the floor'

(217) Tableau

t u x^{w}-iɬ | | [+R,+B][+R]	OCP$_{\sigma}$ [+Round]	MAX [+Back]	NML [+Round]	MAX [+Round]	MAXPATH [+Round]
a. tu. xiɬ | | [+R,+B][-R]				*!	*
b. tu. x^{w}iɬ \/ [+R]			*!	*	
c. ti. x^{w}iɬ | | [-R,-B][+R]		*!		*	
☞d. tu. x^{w}iɬ | | [+R][+R]					

In (217), where the potential triggering vowel precedes a labio-velar consonant, the input labiality surfaces as such. This results basically from the OCP constraint which is sensitive to syllable structure. That is, while in (215), candidate **d** violates this constraint by having two [+Round] features in the same syllable, candidate **d** in (217) does not, since they belong to different syllables. Therefore, MAX[+Round] (or MAXPATH[+Round] since ranking between them is not crucial) plays a decisive role in determining the optimal output. Candidate **a** violates the constraint by deleting the input [+Round]. Consequently, candidate **d** is selected as an optimal output form, which maintains both [+Round] features in the input. In sum, a triggering vowel /u/ does not affect a following target consonant. The asymmetry between the same vowels with respect to delabialisation can be treated by the domain specified OCP constraint.

3.2.4.3 Phonetic aspects

In the previous section, I treat delabialisation as deletion of a [+Round] feature. However, one might suggest that the phenomenon in fact is not a deletion, but a coalescence of two [+Round] features. In this section, I discuss phonetic properties of the relevant consonants, thereby providing a piece of evidence for the deletion approach.

Interestingly, while Nuu-chah-nulth (Ahousaht) has no morpheme starting with /w/ followed by /u/, I have found two tokens of the sequence word-internally as shown in (218).

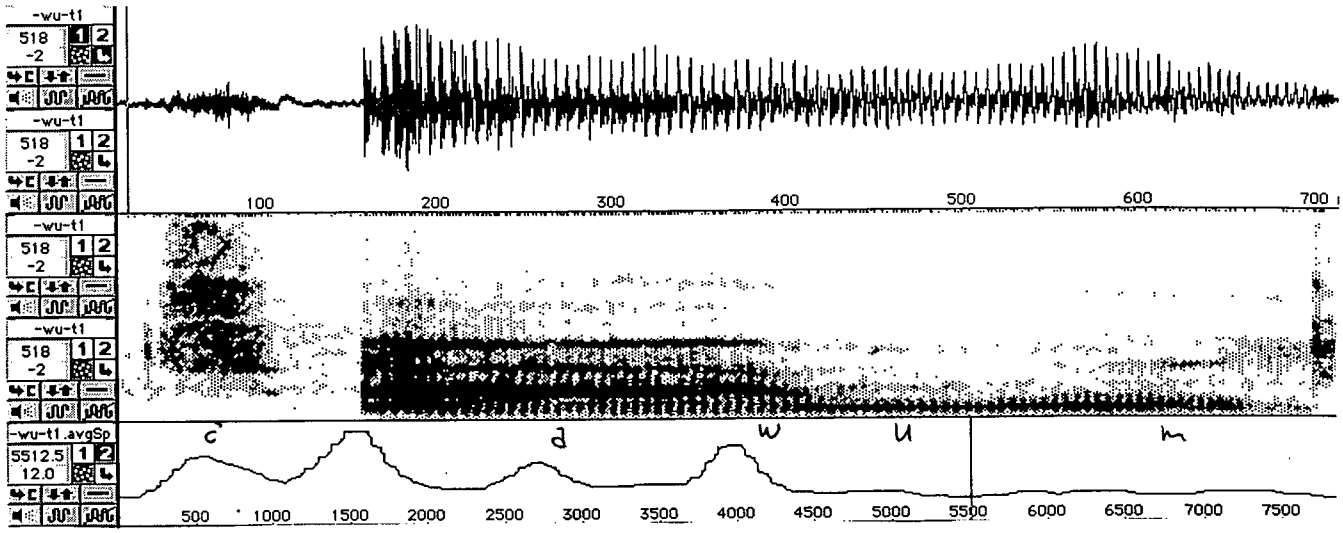
(218) a. c̓aa[wu]mɬ 'one left'

b. na[wu]qumɬ 'tardy'

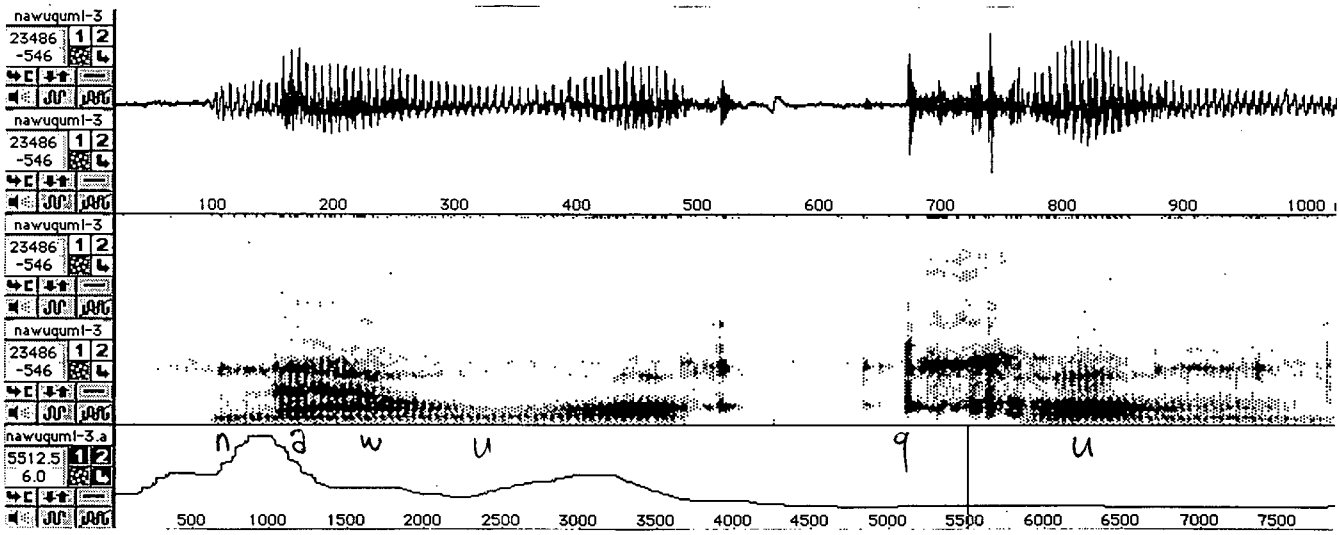
It is impossible to obtain the sequence over morpheme boundaries: recall that the language does not have morphemes ending with a glide. These two morphemes, therefore, will provide very important phonetic cues for potential /C^{w}u/ sequences. That is, these examples show what kind of acoustic picture a labial sound followed /u/ has. (219a-b) is the spectrogram of (218a-b), respectively.

(219) Spectrograms of the /wu/ sequence

a. čaa[wu]mɬ



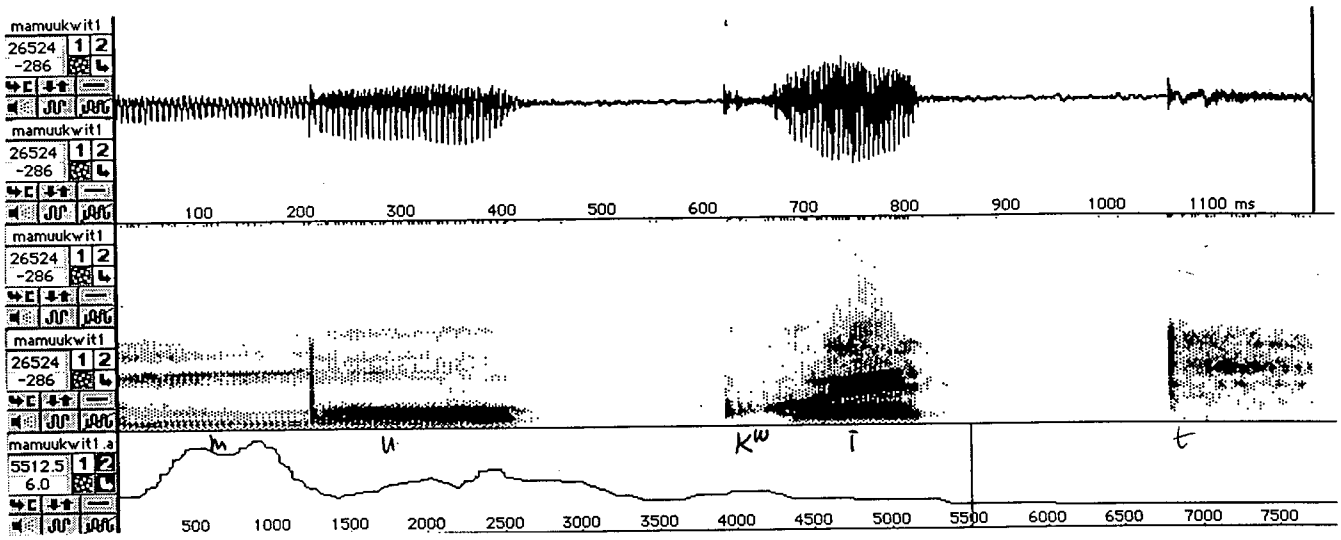
b. na[wu]qumɬ



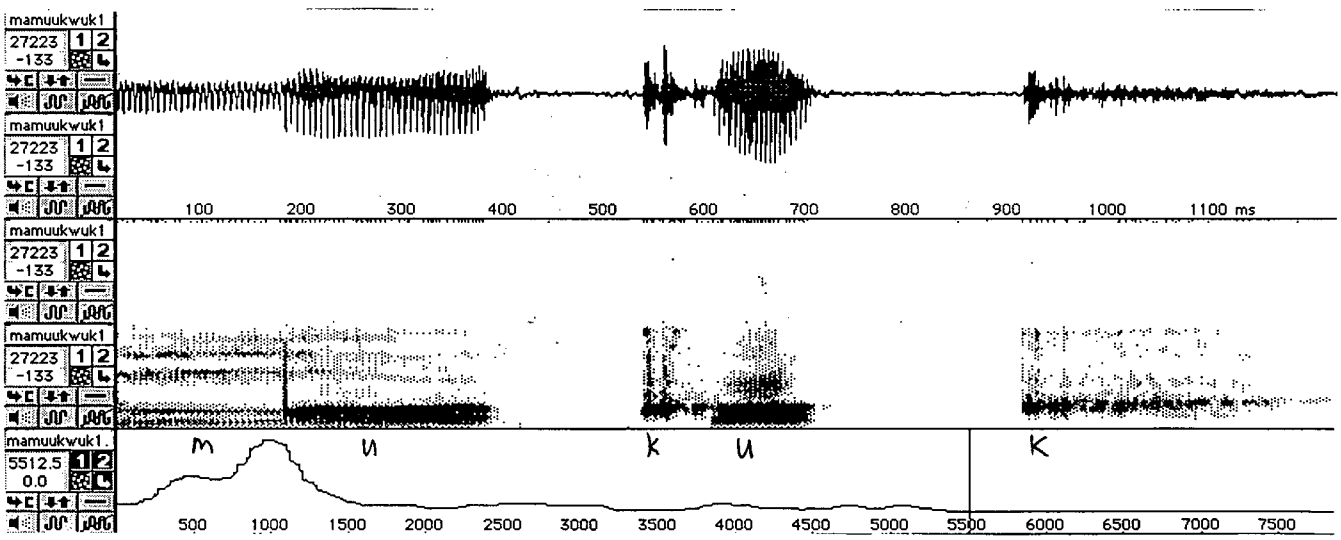
In the spectrogram, the transition between the glide and the vowel is clearly shown. If an underlying /k^{w}u/ sequence exhibits a similar formant transition of this, and different aspects from an underlying /ku/ sequence in terms of spectrograms and duration, then we should say that this might be coalescence, not deletion.

For this test, I recorded the same token for each case 10 times, since it was hard to obtain enough minimal pairs. The task was to compare the duration of the vowel which follows each relevant consonant. I chose only stops for this test, since it is easier to measure the duration of the vowel after stop release than after frication for fricatives is over. (220) and (221) are the spectrograms of an underlying /k^{w}/ before /i/ and /u/, respectively. (222) and (223) are the spectrograms of an underlying /k/ before /i/ and /u/, respectively.

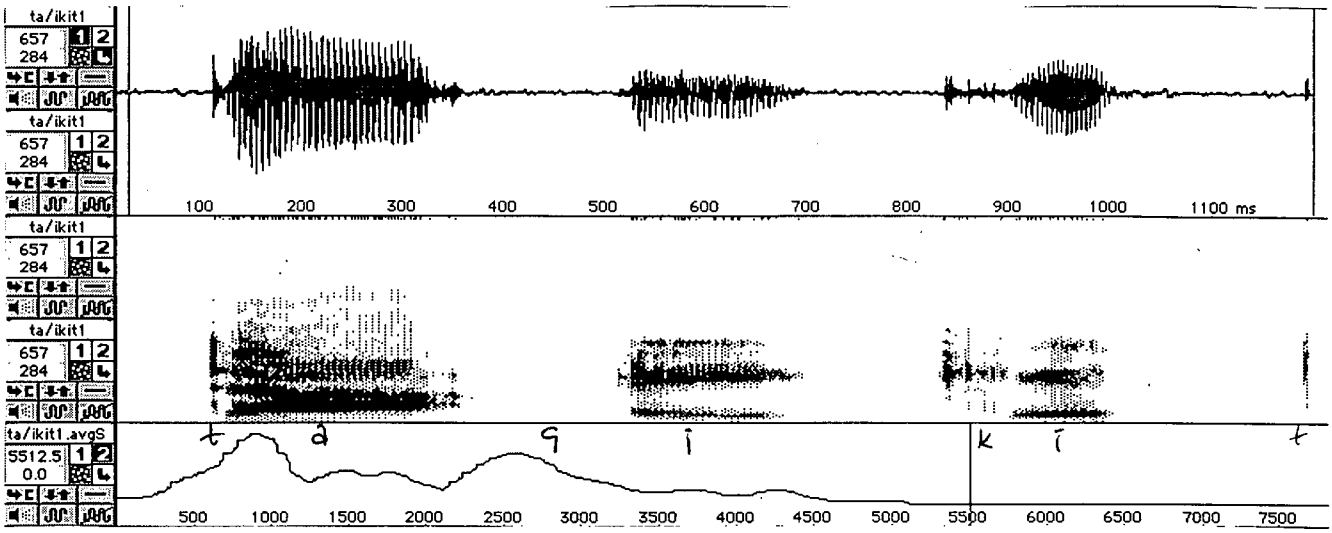
(220) Spectrograms of /mamuuk^{w}it/



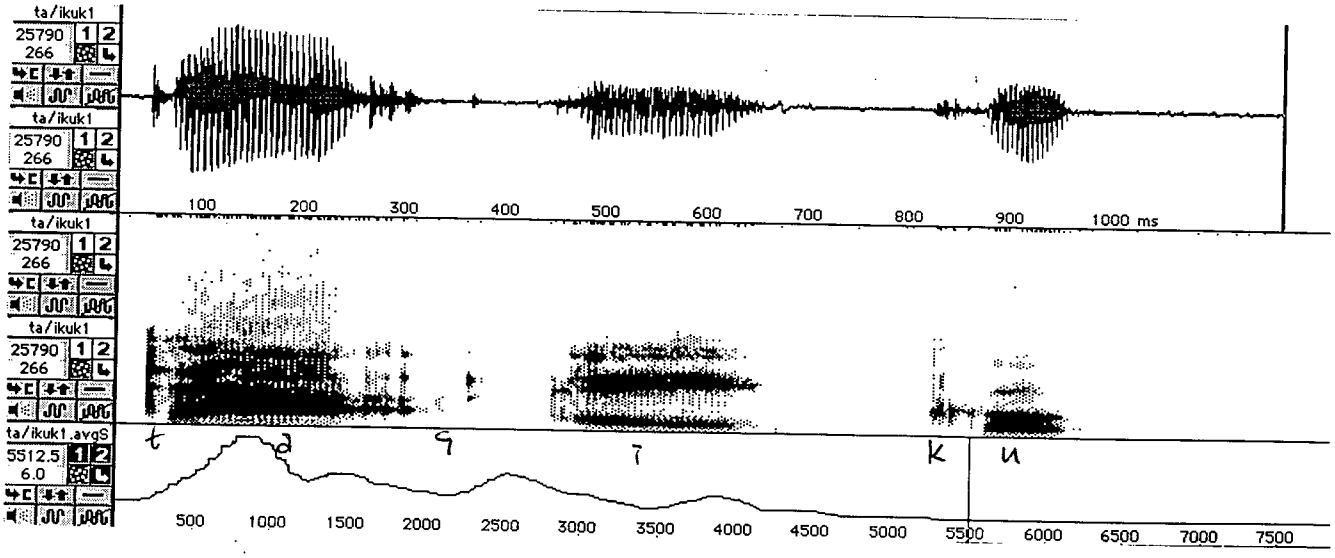
(221) Spectrograms of /mamuuk^{w}uk/



(222) Spectrogram of /taʃikit/



(223) Spectrogram of /taʃikuk/



The argument that the labiality of an underlying labio-velar or –uvular consonant is deleted when preceding a round vowel /u/, not coarticulated with the vowel, is supported by these acoustic results. First, a typical formant transition shown in the sequence –wV-, as in (219) and (220), is not observed in the sequence –k^{w}u-. (221) and (223) show that whether the velar stop is underlyingly /k^{w}/ or /k/, the surface forms exhibit identical acoustic properties when preceding /u/, the lack of formant transition. Second, for a labial-velar stop followed by /i/, its voicing duration is longer than a vowel following a velar stop as seen in (224) below: 142.38 ms vs. 114.74 ms. On the other hand, if the vowel in question is /u/, its duration is almost identical, whether the underlying preceding stop is labio-velar or velar as seen in (225): 112.29 ms vs. 111.55 ms. The reason that a vowel following a labio-velar is longer than a vowel following a plain velar seems to be due to the phase of labiality which is phonetically realised as a glide /w/. Given labiality is deleted before /u/, no difference in duration between a vowel following an underlying labio-velar and another token of the same vowel following a plain velar is straightforwardly accounted for.

(224) Duration of /^{w}i/ vs. /i/

Token	mamuuk^{w}it	taʕikit
#1	131.72 ms	102.31 ms
#2	146.17	112.34
#3	144.81	112.02
#4	142.72	106.35
#5	152.34	117.01
#6	132.97	114.69
#7	143.90	126.26
#8	146.44	128.12
#9	140.77	120.07
#10	142.04	108.30
Average	142.38 ms	114.74 ms

(225) Duration of /ʷu/ vs. /u/

Token	mamuukʷuk	taʕikuk
#1	98.14 ms	104.22 ms
#2	107.55	116.78
#3	111.97	114.33
#4	127.01	116.15
#5	123.27	104.58
#6	101.36	117.37
#7	116.37	108.25
#8	118.28	99.73
#9	100.73	112.47
#10	118.23	121.63
Average	112.29 ms	111.55 ms

3.2.5 Vowel alternation

In Nuu-chah-nulth, vowels can exhibit alternation in length, which is triggered by suffixes (see Sapir & Swadesh 1939 for Tseshaht). In this section, I will discuss such alternation: vowel lengthening/shortening in § 3.2.5.1 and variable vowels in § 3.2.5.2.

3.2.5.1 Vowel lengthening/shortening

Some suffixes in Nuu-chah-nulth cause alternation in vowels in terms of length, as they do with consonants. With the presence of some suffixes, underlying vowel(s) of a root or stem are either lengthened or shortened on the surface. Superficially, these appear to be independent processes, but I will treat them under a unified system in terms of metrical requirements specified for suffixes attached to the root/stem morpheme. I will start with vowel lengthening.

3.2.5.1.1 Description I: vowel lengthening

Some suffixes trigger lengthening of the vowel of a stem-initial syllable. The second syllable of the stem may also be affected. For suffixes that trigger lengthening of the initial syllable, there are two patterns for the effect, considering changes to the second syllable. With some suffixes, if the second syllable of the stem is long, then it is shortened; with some other suffixes, only the first syllable of the stem is affected. In both cases, the second syllable does not have to be part of a root morpheme. In the case that the triggering suffix itself occupies the second syllable, it is not affected (except -ḥwaaɬ). (226) summarises the observation.

(226) Patterns of Nuu-chah-nulth lengthening

Type	Triggering suffixes	Root/stem	
		1st syllable	2nd syllable
Type I	-(q)iiɬ, -ḥwaaɬ, -ʔiƛ, -, -ʔinḥi -p̓a(a), -p̓ičḥ	Lengthened	Shortened
Type II	-iṅak̓uuḥ, -awiɬ, -panač,	Lengthened	No change

I have found 21 lengthening suffixes, but only 9 of them are confirmed regarding type. This is due to the fact that bisyllabic root morphemes are rare in Nuu-chah-nulth, and many combinations of a bisyllabic

root/stem and the suffixes in question are not allowed for semantic reasons.[53] Therefore, I could not check whether the stem-second long vowel is shortened or unaffected by the other 12 suffixes. What is significant, though, is that all 21 suffixes cause the stem-initial vowel to be lengthened, and at least two patterns are observed. I will discuss the two confirmed patterns of vowel lengthening in this section, which raises interesting theoretical issues.

Consider the following examples, which are type I. Note that if the 1st syllable is underlyingly long, it is not affected by the lengthening suffix as shown in (228e). Also, note that each compared example shows that with "neutral" suffixes, there is no vowel alternation.

A. Type I:

(227) -(q)iiɬ 'to make'[54]

a. ʔ/i/nkʷ-iiɬ → ʔ[ii]nkʷiiɬ
fire-to make 'making fire'

cf. ʔinkʷ-uẇiɬ → ʔinkuẇiɬ
fire-place 'smoke house'

b. č'/a/pac-iiɬ → č'[aa]paciiɬ
canoe-to make 'making a canoe'

cf. č'apac-ʔi → č'apacʔi
canoe-Def 'the canoe'

c. s/a/pn/ii/-qiiɬ → s[aa]pn[i]qiiɬ
bread-to make' 'making bread'

cf. sapnii-q-naq → sapniiqnaq
bread-EXIS-choice of 'to specially like to eat bread'

d. m/a/ḥt/ii/-qiiɬ → m[aa]ḥt[i]qiiɬ
house-to make 'building a house'

[53] Sapir & Swadesh 1939 provides a larger number of lengthening suffixes of Tseshaht, but Ahousaht speakers do not recognize many of them and also some of Ahousaht lengthening suffixes do not have counterparts in Tseshaht. Interestingly, all cognate suffixes behave in the same way in both dialects.

cf. maḥtii-ʔap → maḥtiiʔap
house-to buy 'to buy a house'

e. n/uu/k^{w}-iiɬ → n[uu]k^{w}iiɬ
song-to make 'composing songs'

(228) -ʔiƛ 'to take'

a. č'/u/š-ʔiƛ → č'[uu]šʔiƛ
new-to take 'taking s.t. new'

cf. č'uš-uk → č'ušuk
new-DUR 'new'

b. č'/a/ʔ/uu/š-ʔiƛ → č'[aa]ʔ[u]y̓iƛ
raw-to take 'taking s.t. raw'

cf. č'aʔuuš-ʔak-ʔick → č'aʔuušʔakʔick
raw-POSS-2sg/IND 'you have s.t. raw.'

c. s/a/pn/ii/-q-ʔiƛ → s[aa]pn[i]ʕiƛ[55]
bread-EXIS-to take 'taking bread'

cf. sapnii-ʔi → sapniiʔi
'bread-DEF' 'the bread'

(229) -ḥwaaɬ 'to use'

a. k/u/m̓/aa/-ḥwaaɬ → k[uu]m̓[a]ḥw̓aaɬ
Scarcely/hardly any-to use 'using hardly any'

cf. kum̓aa-c̓as → kum̓aac̓as
Scarcely-to bet 'betting a little bit'

---

[54] The suffix initial /q/ disappears on the surface, when it follows a consonant-final stem.

[55] The suffix -ʔiƛ is also a glottalising suffix, and when it is attached a stem ending with /q/, the uvular stop becomes a pharyngeal stop (see section 3.2.1 for the detailed discussion of glottalisation).

b. t̓/u/n/aa/x-ḥwaaɬ → t̓[uu]n[a]xḥwaaɬ
Tulle-to use 'using a tulle'

cf. t̓unaax-ʔata → t̓unaaxʔata
Tulle-to need 'to need a tulle'

c. t/aa/n/aa/-q-ḥẇaaɬ → t[aa]n[a]qḥwaaɬ
money-EXIS-to use 'using money'

cf. taanaa-quẇas → taanaaquẇas
money-place 'bank'

d. č̓/i/šx̣-ḥẇ/aa/ɬ → č̓[ii]šx̣ḥẇ[a]ɬ
dirty-to use 'using s.t. dirty'

cf. č̓išx̣-uuɬ → č̓išx̣uuɬ
dirty-face 'dirty face'

e. ʔ/u/-ḥẇ/aa/ɬ → ʔ[uu]ḥẇ[a]ɬ
it-to use 'to use'

cf. ʔu-ʔiiš → ʔuḥʔiiš
it-3sg/IND 'it is…'

f. s/uu/-ḥw/aa/ɬ → s[uu]ḥẇ[a]ɬ
to hold-to use 'using (your) hand/fingers'

cf. suu-ʔiš → suuʔiš
to hold-3sg/IND 'S/he is holding (s.t.)'

The vowel of the suffix *-ḥwaaɬ* 'to use' is shortened, as seen in (229d-f), when it is attached to a monosyllabic stem, which is the only case of shortening within the lengthening suffix itself that I have found so far.[56] Despite its peculiarity, it still seems to fit into the prosodic format of type I: the first syllable is long and the second is short, although the second is not part of a stem but the suffix itself.

[56] Most of lengthening suffixes consist of short syllables in the initial two syllables except *–qiiɬ* 'to make' and *-ḥwaaɬ* 'to use', so it is not possible to test whether other lengthening suffixes are affected, i.e. shortened.

When a suffix of this type is attached to a root/stem, the first syllable of the root/stem is lengthened and the second syllable, if long, is shortened. This is the case even when the first syllable of the root is underlyingly long, in which case there is no overt lengthening process.

When a suffix of type II is attached to a stem, then the first syllable of the stem is lengthened as seen in (230-231)). Unlike type I, the second syllable of the stem is not affected; therefore, if it is long, then it surfaces faithfully as seen in (230b-c) and (231c-d).

B. Type II

(230) -panač 'moving around'

a. ʔ/a/ya-panač → ʔ[aa]yapanač
many-moving around 'Many people moving around'

cf. ʔaya-qs → ʔayaqs
many-vessel 'There are many (people) in a vessel.'

b. n/a/qč/uu/-panač → n[aa]qč[uu]panač
drunk-moving around '(s.o.) moving around drunk (from place to place)'

cf. naqčuu-ʔiš → naqčuuʔiš
drunk-3sg/IND 'S/he is drunk.'

c. n/a/ʔ/uu/k-panač → n[aa]ʔ[uu]kpanač
to accompany-moving.. '(s.o.) accompanies (s.o.)

cf. naʔuuk-ʔiš John → naʔuukʔiš John.
To accompany-3sg/IND 'S/he accompanied John.'

(231) -iṅak̓uuḥ 'to observe'

a. w/i/k-iṅak̓uuḥ-siš → w[ii]kiṅak̓uuḥsis
NEG-to observe-1sg/IND 'I am watching nothing'

cf. wik-ata → wikata
NEG-EXIS 'nobody'

b. q/a/ḥ-iṅak̓uuḥ → q[aa]ḥiṅak̓uuḥ
to die-to observe 'dreaming of dead people'

cf. qaḥ-saap → qaḥsaap
to die-MOM.CAUS 'to kill'

c. ḥ/aa/cḥ/uu/ɬa-(i)ṅak̓uuḥ → ḥ[aa]cḥ[uu]ɬaṅak̓uuḥ
chief showing chief's status- observing a chief doing his status (e.g. singing, dancing)

d. k/aa/c/aa/-(i)ṅak̓uuḥ → k[aa]c[aa]ṅak̓uuḥ
hailing-to observe 'observing hailing'

3.2.5.1.2 Description II: vowel shortening

One suffix causes the syllable(s) of a root or stem to shorten, which is the opposite of the lengthening process shown above. So far, I have found only one suffix triggering vowel shortening, -(q)aq 'very, too'.[57] Sapir & Swadesh (1939) also documented this suffix in Tseshaht.

(232) a. t/uu/ḥukʷ-(q)aq-mit-siš → t[u]ḥukʷaqitsiš
scared-very-PAST-1sg/IND 'I was very scared.'

cf. tuuḥukʷitsiš waɬšiƛ 'I was scared to go home.'

b. h/ii/xʷatḥi-(q)aq-ʔiš → h[i]xʷatḥiqaqʔiš
angry-very-3sg/IND 'S/he is very angry.'

cf. hiixʷatḥiʔiš ʔumʔiiq 'Mom is angry.'

c. y/aa/qƛ-(q)aq-ʔiš → y[a]qƛaqʔiš
to dislike-very-3sg/IND 'S/he dislikes s.o. very much.'

cf. yaaqƛsiš cakupʔi 'I dislike the man.'

(233) shows that if the stem is bisyllabic, whether the second syllable is part of a root or not, then all long vowels are affected.

(233) a. ċ/ii/q/aa/-qaq → ċ[i]q[a]qaqʔiš naʔaat
a spiritual song-very 'S/he is singing a spiritual song very loudly.

cf. ċiiqaa-ʔiš naʔaat → ċiiqaaʔiš naʔaat
a spiritual song-3sg/IND 'S/he is singing a spiritual song.'

b. n/a/q-č/uu/-qaq-ʔiš → n[a]qč[u]qaqʔiš
to drink-PERF-very-3sg/IND 'S/he is much drunk.'

cf. naq-čuu-ʔiš → naqčuuʔiš.
To drink-PERF-3sg/IND 'S/he is drunk.'

c. ḥ/aa/cḥ/uu/ɬa-qaq-ʔiš → ḥ[a]cḥ[u]ɬaqaqʔiš
chief showing chief's status 'He is really overdoing his status as a chief.'

cf. ḥaacḥuuɬa-ʔiš → ḥaacḥuuɬaʔiš
chief showing chief's status-3sg/IND 'He is doing his status as a chief.'

In sum, all the data above show that vowel alternations in the language cannot be due to the automatic effect of metrical structure based on phonological principles. They are imposed idiosyncratically by the suffix (cf. Sapir & Swadesh 1939).

3.2.5.2 Analysis

Nuu-chah-nulth lengthening and shortening phenomena do not result from metrical requirements which are phonologically motivated, although the internal structures by the processes are phonologically based, as we will see below. That is, they are not due to the creation of a single unmarked foot structure, a frequent pattern cross-linguistically. Nuu-chah-nulth has various foot structures derived from these processes. This poses a problem with the emergence of the unmarked approach (cf. McCarthy & Prince 1994a), for it would predict unmarked foot structures in determining surface forms. In addition, these phenomena occur with only some suffixes, and thus they cannot be treated as a general phonological process which affects the initial syllable(s) of all roots/stems. As we will see below, each foot structure is determined by a morphologically supplied template. Also, the initial syllables of the affected roots/stems can be long or short depending upon the triggering suffixes. These properties tell us that such alternations are not completely phonologically determined.

[57] The suffix initial consonant /q/ disappears on the surface when it follows a consonant-final stem.

I propose that both lengthening and shortening processes are lexically-determined, as in reduplication, which is discussed in section 5.1. (cf. Sapir & Swadesh 1939, Rose 1981, Davidson 2002, Wojdak 2003) Extending the ideas developed in Marantz (1982), McCarthy & Prince (1986), and Pulleyblank (to appear), I suggest that each lengthening/shortening-triggering suffix manifests metrical requirements to be satisfied on the surface. I assume that all triggering suffixes are specified for a foot form to be realised on the surface. We need to consider metrical structures in general, and then foot forms in Nuu-chah-nulth in order to treat the issue under discussion.

According to previous treatments of metrical structures, the basic foot structures are moraic trochees, syllabic trochees, and iambs (see Hayes 1985, 1987, 1994, 1995, McCarthy & Prince 1986, among others). Hayes (1994:63 (3)) defines them as follows (I replace his symbol ' - ' for a light syllable with L and ' - ' for a heavy syllable with H, respectively, in terms of syllable weight). In Nuu-chah-nulth, coda consonants do not contribute to the weight of syllable.[58] Therefore, a light syllable refers to a syllable with a short vowel and a heavy syllable refers to a syllable with a long vowel.

(234) a. Moraic trochee:

two light syllables, first strong (x .) or one strong heavy: (x)

L L H

b. Syllabic trochee:

two syllables of any weight, first strong: (x .)

σ σ

c. Iamb:

two syllables with first light and second strong: (. x) or one strong heavy : (x)

L σ H

Hayes claims that these templates are grounded on an extralinguistic principle as follows (1994: 63 (4) for more detailed discussion).

(235) Iambic/Trochaic Law

i. Elements contrasting in intensity naturally from groupings with initial prominence.

ii. Elements contrasting in duration naturally form groupings with final prominence.

[58] I do not have strong evidence that Ahousaht sonorants in the coda are moraic and there seems no clear way of testing it, although there are claims in previous work that they are moraic (see Wilson 1985, Stonham 1990, 1994, 1999 for Tseshaht).

According to Sapir and Swadesh (1939), Wilson (1985), Howe (1996), and Stonham (1999), Nuu-chah-nulth assigns stress on either of the first two syllables of the word, i.e., the first foot, and the weight of the syllable is a crucial factor in determining the position for stress in the foot. Stress falls on the 1st syllable of the word, unless it is light and the 2nd is heavy, in which case stress falls on the 2nd syllable. Then each prosodic word (PW) consists of a single foot, which stands in the initial position of the word. This is derived by the following constraints, (236), and their language-specific ranking as in (237) (Howe 1996). According to ALIGN-L, every foot except the initial foot of a prosodic word must violate it. Violations of ALIGN-L are counted in terms of syllables. FT-BIN requires that each foot have either two syllables or two moras. PARSE-SYLL disallows any syllable unlinked to foot.

(236) a. ALIGN-L=Align(Ft, L, PrWd, L): The left edge of each foot must align with the left edge of a prosodic word (Violations assessed in terms of syllables).

b. FT-BIN: Feet must be binary under syllabic or moraic analysis.

c. PARSE-SYLL: All σ must be parsed into feet.

(237) Ranking: ALIGN-L, FT-BIN
⇩
PARSE-SYLL

(238) illustrates the implication of the ranking.

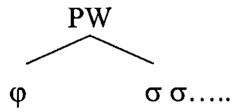
(238) Tableau (σ stands for syllable; φ foot; PW prosodic word)

σ σ σ σ	ALIGN-L	FT-BIN	PARSE-SYLL
☞ a. $\{(\sigma\ \sigma)_{\varphi}\sigma\ \sigma\}_{PW}$			**
b. $\{(\sigma\ \sigma)_{\varphi}\ (\sigma\ \sigma)\varphi\}_{PW}$	*!*		
c. σ σ σ σ			***!*
d. $\{(\sigma\ )_{\varphi}\sigma\ \sigma\ \sigma\}_{PW}$		*!	***
e. $\{(\sigma\sigma\sigma\sigma)_{\varphi}\}_{PW}$		*!	
f. $\{\sigma(\sigma\sigma)_{\varphi}\sigma\}_{PW}$	*!		**

The prosodic restriction can lead a foot form to be trochaic or iambic. That is, (237) requires a prosodic word to have a single foot, which is bisyllabic, but as seen in (238), the optimal foot can be trochaic or iambic depending on the weight of the syllables within the foot. Unstressed syllables link

directly to PW as shown in (239; 238a), rather than to φ, which leads to a violation of FT-BIN (as in 238e).

(239) Internal structure of the Nuu-chah-nulth Prosodic Word

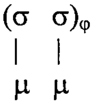


To conclude, Nuu-chah-nulth has a single foot in the initial position of each prosodic word as shown in (239)

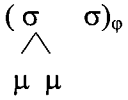
As far as vowel lengthening and shortening are concerned, the alternation is associated with trochaic foot patterns. Following Crowhurst (1991)'s treatment of foot structures, I suggest that Nuu-chah-nulth vowel alternation triggered by suffixes must be dealt with in terms of either of the three possible trochaic structures, that is, templates.[59],[60]

(240) Trochaic foot

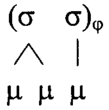
a. FootForm I: two light syllables



b. FootForm II: two syllables with 1st heavey



c. FootForm III: two syllables with one heavy



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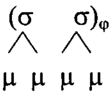
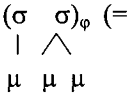
[59] Given that vowel lengthening/shortening is associated with trochaic foot structures, we can expect another trochaic foot, which consists of two heavy syllables as seen below. (See Hammond 1990, Crowhurst 1991 for cross-linguistic evidence for this foot structure.)



(=(240b)

I have not found any cases of the type in the processes of vowel alternation. However, this type is observed in the patterns of reduplication, which will be discussed in section 5.1. In the section, I will also discuss how an iambic foot as defined in (234c) and represented as below, is used to generalise metrical structures triggered by suffixes.

Iambic foot: two syllables with second heavy:



(=(234c)

[60] See section 5.1 for detailed discussion of possible foot structures in Nuu-chah-nulth, and Crowhurst (1991) as a comprehensive study of templatic approach for morphologically-determined metrical structure.

FootForm I specifies that the foot consists of two light syllables and the first is prominent. This foot form is specified for Class III suffixes (the shortening case). That is, in the lexicon relevant suffixes include not only melodic but metrical information and the metrical requirement is realized on the surface. This raises an interesting issue: the metrical element of the suffix has priority over that of the stem in terms of foot structure (cf. McCarthy & Prince 1995, Alderete 1999; I will leave this as further research). Foot Form II specifies that the foot consists of two syllables and the first should be heavy, but the second has no specification. This foot form is specified for Class II suffixes (=Type II of lengthening cases). Foot Form III specifies that the foot consists of two syllables and the first should be heavy and the second is light. This foot form is specified for Class I suffixes (Type I of lengthening cases).

Now, I will show how these templates are associated with each lengthening-/shortening-triggering suffix. First, the lengthening suffixes of type I, which cause the first syllable of the stem to be lengthened but the second, if any, to be shortened, are specified for Foot Form III, (240c), to be realised on the surface. Second, lengthening suffixes of type II, which affect only the first syllable of the stem, are specified for Foot Form II, (240b). Finally, shortening suffixes, which cause the first two syllables of the stem to shortened, are specified for Foot Form I, (240a). From the perspective of OT, the realisation of each foot form specified for each triggering suffix can be explained by the following constraints, as shown in (241), and their language-specific ranking, as indicated in (242). (I provide constraints only which are significant to my discussion.)

(241) Constraints:

a. MAXFootForm: A foot in the input must have a correspondent in the output.

b. MAXμ: Moras in the input must have a correspondent in the output.

c. DEPμ: Moras in the output must have a correspondent in the input.

(242) Ranking (237+241):

ALIGN-L, FT-BIN

⇩

PARSE-SYLL

⇩

MAXFootForm

⇩

MAXμ, DEPμ

The grammar requires that any prosodic requirements for surface forms should always be obeyed, even at the cost of the input forms' change, specifically in terms of moras.

The effect of the grammar is illustrated in tableau (244) with the relevant example (243). I take for granted that there is only a single foot in the left edge of a prosodic work as, I discussed above, and thus, I provide candidates only which observe the relevant constraints in the following tableaux (see (238)).

(243) sapnii-qiiɬ ➔ saapniqiiɬ

bread-to make' 'making bread'

(244) Tableau

sapnii-qiiɬ $(\sigma \quad \sigma)_\varphi$ $\wedge \quad \vert$ $\mu \ \mu \ \mu$	MAXFootForm	MAXμ	DEPμ
☞ a. $(\text{saapni})_\varphi$ qiiɬ		*	
b. $(\text{sapnii})_\varphi$qiiɬ	*!		
c. $(\text{sapni})_\varphi$qiiɬ	*!	*	

As shown in the tableau, the suffix requires that the foot must be of FFIII on the surface (see (240)). Candidate **a** obeys the constraint MAXFootForm by realising the foot structure specified for class III suffixes on the surface, which is a long vowel on the 1st syllable and a short vowel on the 2nd syllable of the stem. Candidate **b** obeys both MAXμ and DEPμ constraints by maintaining the input moras, but fatally violates MAXFootForm. Candidate **c** also violates this constraint by failing to realise the input foot of the suffix on the surface. The language-specific ranking, MAXFootForm >> MAX/DEPμ, determines the optimal output form, which is candidate **a**.

On the other hand, if the suffix vowel itself constitutes the 2nd syllable, then it is not shortened as shown in (247).

(245) a. ʔink^w-iiɬ ➔ ʔiink^{w}iiɬ

fire-to make 'making fire'

To treat this restriction, we need an alignment constraint for the suffix -*iiɬ* as in (246) (See McCarthy & Prince 1993 for relevant discussion).

(246) ALIGN-*iiɬ*=Align(μ, R, *iiɬ*, L)

We need to restrict this constraint to *iiɬ*, since other suffixes are not subject to this kind of restriction (cf. -*ḥẃaaɬ*).

In addition, we need WSP, which prevents a light syllable from being prominent in a trochaic foot.

(247) Weight-to-Stress Principle (WSP) (Prince & Smolensky 1992:53)

Heavy syllables are prominent in foot structure.

(248) illustrates the implication of these constraints.

(248) Tableau for (245)

ʔink^{w}-iiɬ(σ σ)$_{\varphi}$ ∧ | μ μ μ	FT-BIN	WSP	ALIGN-*iiɬ*	MAXFootForm	MAXμ	DEPμ
☞ a. (ʔiin)$_{\varphi}$k^{w}iiɬ				*		*
b. (ʔiink^{w}iɬ)$_{\varphi}$			*!		*	*
c. (ʔink^{w}iɬ)$_{\varphi}$			*!	*	*	
d. (ʔink^{w}iiɬ)$_{\varphi}$		*!	*	*		
e. (ʔin)$_{\varphi}$k^{w}iiɬ	*!			*		
f. (ʔiink^{w}iiɬ)$_{\varphi}$			*!	*		*

In tableau (248), candidates **b, c** and **f** are ruled out by aligning the suffix inside of the foot, a fatal violation of ALIGN-*iiɬ*. The alignment constraint requires the suffix to be outside the foot. Candidates **d** and **e** violate either of the metrical constraints: candidate **d** has a trochaic foot structure with a light prominent syllable, a violation of WSP, and candidate **e** has a monomoraic foot. In Nuu-chah-nulth, the coda is not moraic, as I will discuss in Chapter 4; therefore, the stem-final sonorant /n/ in candidate **e** does not count, which leads to a violation of FT-BIN. Consequently, candidate **a** is selected as an optimal output form. It does not have a foot template which suffixes of type I require, but surfaces without violating any high-ranked constraints.

With suffixes of type II, only the first syllable of the stem is affected.

(249) a. q/a/ḥ-iṅak̓uuḥ → q[aa]ḥiṅak̓uuḥ
to die-to observe 'dreaming of dead people'

b. n/a/qč/uu/-panač → n[aa]qč[uu]panač
drunk-moving around '(s.o.) moving around drunk (from place to place)'

FFII is specified for this type of suffixes as a prosodic requirement: for convenience, I repeat it in (250).

(250) FootFormII: $(\underset{\mu\ \mu}{\underset{\wedge}{\sigma\ \ \sigma}})_{\varphi}$

This foot form does not impose any requirements on the second syllable. The template will be satisfied if the first syllable of the stem has a bimoraic trochee, whether the second syllable is long or not.

The following tableaux illustrates the process for (249a-b).

(251) Tableau for (249a)

qaḥ-iṅak̓uuḥ$(\underset{\mu\ \mu}{\underset{\wedge}{\sigma\ \ \sigma}})_{\varphi}$	MaxFootForm	MAXμ	DEPμ
☞ a. (qaahi)$_{\varphi}$ṅak̓uuḥ			*
b. (qaḥi)$_{\varphi}$ṅak̓uuḥ	*!		
c. (qaḥii)$_{\varphi}$ṅak̓uuḥ	*!		*

In (251), candidates **b** and **c** are ruled out by violating MaxFootForm by failing to realise the input foot on the surface. Candidate **a** is selected as an optimal output, where the first syllable of the stem is lengthened.

(252) Tableau for (249b)

naqčuu-panač(σ σ)$_\varphi$ μ μ	MAXFootForm	MAXμ	DEPμ
☞ a. (naaqčuu)$_\varphi$panač			*
b. (naqču)$_\varphi$panač	*!	*	
c. (naqčuu)$_\varphi$panač	*!		
d. (naaqču)$_\varphi$panač	*!	*	*

In (252), candidates **b, c and d** all violate MAXFootForm by not having the input foot realised on the surface. Candidate **a** is selected as an optimal output form, where the first syllable of the stem is lengthened, but both the second syllable and the suffix are not affected.

Finally, the process of vowel shortening is associated with the foot form I, which is repeated in (253).

(253) (σ σ)$_\varphi$
| |
μ μ

(254) is the relevant example and (255) illustrates the selection process.

(254) a. t/uu/ḥuk^w-(q)aq-mit-siš ➔ t[u]ḥuk^{w}aqitsiš
scared-very-PAST-1sg/IND 'I was very scared.'

(255) Tableau

tuuḥuk^w-aq(σ σ)$_\varphi$ | | μ μ	MAXFootForm	MAXμ	DEPμ
☞ a. (tuḥu)$_\varphi$k^{w}aq		*	
b. (tuuḥu)$_\varphi$k^{w}aq	*!		
c. (tuuḥuu)$_\varphi$k^{w}aq	*!		*
d. (tuḥuu)$_\varphi$k^{w}aq	*!	*	*

In (255), candidates **b, c, and d** violate MAXFootForm by failing to have the input foot on the surface. Candidate **a** obeys the high-ranked constraint, selected as an optimal output.

The following example shows that when the stem consists of two long syllables, both are shortened, which is expected from the template in (253).

(256) a. ḥaacḥuuɬa-qaq-ʔiš → ḥacḥuɬaqaqʔiš

chief showing chief's status 'He is really overdoing his status as a chief.'

(257) Tableau

ḥaacḥuuɬa-qaq$(\sigma\ \sigma)_\varphi$ | | μ μ	MAXFootForm	MAXμ	DEPμ
☞a. (ḥacḥu)$_\varphi$ɬaqaq		**	
b. (ḥaacḥuu)$_\varphi$ɬaqaq	*!		
c. (ḥacḥuu)$_\varphi$laqaq	*!	*	
d. (ḥaacḥu)$_\varphi$ɬaqaq	*!	*	

In sum, both the lengthening and shortening of vowels in the same context, albeit with different triggers, tells us that these phenomena are not purely phonologically motivated. That is, the domain of the process is the same, the foot of a stem morpheme, but the motivation for each phenomenon is not to meet general metrical requirements. Recall that long vowels are shortened with some suffixes, but short vowels are lengthened with some other suffixes, and also many suffixes have no effect on length. Lengthening and shortening of a vowel is dependent on metrical requirements of specific suffixes, not of the general grammar of Nuu-chah-nulth. The treatment of the processes in terms of adequate foot forms underlyingly manifested on the suffix in question provide a clear account with respect to vowel alternation. Moreover, a superficially complex array of apparently separate processes, including reduplication as we will see in section 5.1, may be treated under a unified system.

3.2.5.2 Variable vowels

Nuu-chah-nulth has three types of vowels in terms of length: always long, always short, and a context-dependent long/short, which is called "the variable vowel" in previous work (see Sapir & Swadesh 1939, Rose 1976, 1981).

(258-260) shows examples of vowels that are always long, irrespective of where they are positioned: i.e. irrespective of how many syllables precede it. (261-263) are cases of vowels that are always short.

(258) a. naq-ʔ/ii/k → naaʕ[ii]k
to drink-Habitual 's.o. who always drinks a lot'

b. waʔič-ʔ/ii/k → waaʔič'[ii]k
to sleep-Habitual 's.o. who always sleeps'

(259) a. wik-s/uu/k → wiks[uu]k
NEG-2sg/NEU '....that you are not...'

b. kʷi-kʷis-čik-(m)it-s/uu/k → kiʷkʷisčikits[uu]k
RED-different-?-PAST-2sg/NEU 'You're saying (words) differently.'

(260) a. kʷis-w/aa/qḥ-ƛa → kʷisw[aa]qḥƛa
different-to mean-again 'different meaning'

b. ʔi-ʔiqḥ-w/aa/qḥ-ƛa → ʔiʔiqḥw[aa]qḥƛa
RED-same-to mean-again 'the same meaning'

(261) a. taʔ/i/ɬ-(m)it-siš → taʔ[i]ɬitʔiš
sick-PAST-1sg/IND 'I was sick.'

b. ta-taʔ/i/ɬ-ʔaɬuk → tataʔ[i]ɬʔaɬuk
RED-sick-to look after 'looking after s.o. sick'

(262) a. ʔus/u/m → ʔus[u]m
to want 'to need'

b. ʔu-ʔus/u/m → ʔuʔus[u]m
RED-to want 'to want'

(263) a. hiɬ-ʔ/a/ƛ-ʔiš → hiɬʔ[a]ƛʔiš
LOC-SEQ-3sg/IND 'S/he was there.'

b. haʔum-ʔ/a/ƛ-ʔiš → haʔumʔ[a]ƛʔiš
food/tasty-SEQ-3sg/IND 'it is tasty.'

Some vowels are variable in length: if they are in the first or second syllable, then they are long, but if not, they are short, as shown in (264-267). This process is independent of the presence of a lengthening suffix. Moreover, the number of following syllables, (265) vs. (266), and their heaviness, (264) vs. (267), do not matter. Variable vowels can appear either on a root morpheme as in (264-265) or on a suffix as in (266-267). In the case of roots, the alternation occurs only by reduplication, which is the only way to position a root vowel outside the first two syllables.

(264) a. naʔ/u(u)/k-ʔiš → naʔ[uu]kʔiš
going along-3sg/IND 'S/he went (along with s.o.)'

b. na-naʔ/u(u)/k-ʔiik → nanaʔ[u]k̓iik
RED-going along-Habitual 's.o. who goes always along (with another)'

(265) a. t̓ic/a(a)/siɬ-(m)it-ʔiš → t̓ic[aa]siɬitʔiš
cheating at a game-3sg/IND 'S/he is cheating at the hanaa game.'

b. t̓ii-t̓ic/a(a)/siɬ-ʔiik → t̓iit̓ic[a]siɬʔiikʔiš
Red-cheating at a game-Habitual 's.o. who always cheats at the hanaa game'

(266) a. čuš-ʔ/a(a)/p-ʔiš → čušʔ[aa]pʔiš[61]
new-to buy-3sg/IND 'S/he bought s.t. new'

b. šuwis-ʔ/a(a)/p-skʷii-ʔiš → šuwiy̓[a]pskʷiʔiš
shoes-to buy-must be-3sg/IND 'it must be that s/he bought shoes.'

(267) a. suḥaa-ʔ/i(i)/c-ʔiš → suw̓[ii]cʔiš
salmon-to eat-3sg/IND 'S/he ate salmon.'

b. čamas-ʔ/i(i)/c-ʔiš → čamay̓[i]cʔiš
sweet-to eat-3sg/IND 'S/he ate s.t. sweet.'

[61] -ʔaap and -ʔiic are glottalising suffixes, which cause a plain consonant to become its glottalised counterpart. I simply show them with an initial glottal stop in the underlying form, to simplify exposition.

As with other phonological phenomena in Nuu-chah-nulth, this is not a general property of vowels; this kind of vowel alternation is a property of some morphemes only. Two major questions arise with these data: why is the domain of the alternation the first two syllables and what is the underlying form of the vowels; in particular, how are they distinguished from vowels that are consistently long or short?

The first issue may be closely related to the scope of foot in Nuu-chah-nulth. Recall that the domain of vowel alternation is the foot, which can include at most the first two syllables. Variable vowels are metrically "strong" in the domain of foot, while they are "weak" outside the foot. This treatment has the consequence that all vowel length alternation in Nuu-chah-nulth consistently occurs in the domain of the foot.

For the second issue, I propose that Nuu-chah-nulth vowels are distinguished in terms of the number of moras and their linking status to feature matrices (cf. Harris 1985).[62] They are represented as follows: here each vowel stands for a set of relevant features.

	Long	Short	Variable
(268)	a. μ μ \ / i	b. μ | i	c. μ μ | i
(269)	a. μ μ \ / u	b. μ | u	c. μ μ | u
(270)	a. μ μ \ / a	b. μ | a	c. μ μ | a

Each (a) vowel is always long, each (b) vowel is always short, but the length of each (c) vowel alternates depending on the context. These representations satisfy a requirement that underlying representations among vowels with different phonological properties be distinct from each other. In particular, if variable (long) vowels have an input representation distinct from non-variable long vowels in terms of association, it can straightforwardly account for why only variable vowels exhibit such an alternation. The lack of a second link reflects the fact that the vowel is not always linked to that mora. Recall that variable vowels are long only within the first two syllables in the word.

[62] Harris (1985:34) proposes a similar analysis for an analogous set of facts involving diphthongs in Spanish. He suggests that non-alternating diphthongs have two underlying moras linked to the vowel, and alternating diphthongs underlyingly have two moras, but only one is linked to the vowel. A second link surfaces only if they occupy a stressed syllable.

Within OT, I propose the following constraints to treat this issue.

(271) a. MAXμ: Mora in the input must have a correspondent in the output.

b. MAXμ]$_{\varphi}$: Within a foot, mora in the input must have a correspondent in the output.

(272) a. MAXPATHRtNode: Any input path between mora and a root node must have a correspondent path in the output.

b. DEPPATHRtNode: Any output path between mora and a root node must have a correspondent path in the input.

(273) HaveRtNode: A mora must be specified (by linking to a root node).

MAX constraints require input phonological elements to appear on the surface. However, we need a domain-specified MAXμ as in (273b) as well as a general version (273a). As we will see below, their relative ranking status must be MAXμ]$_{\varphi}$ >> MAXμ. To maintain an input mora in the output in the domain of foot is more important than a general domain. MAXPATHRtNode and DEPPATHRtNode prevent differences in terms of association between a root node and mora. Finally, observance/violation of all these faithfulness constraints is driven by another constraint, HaveRtNode, (273).

These constraints and their ranking, (274) drive the observed effects in terms of vowel length.

(274) MAXμ]$_{\varphi}$, MAXPATHRtNode, HaveRtNode

⇩

DEPPATHRtNode

⇩

MAXμ

The following tableaux with the relevant examples illustrate the implication of (274). I start with long vowels.

(275) Long vowels: e.g. /i:/

a. naq-ʔiik ➔ naaʕiik

to drink-Habitual 's.o. who always drinks a lot'

b. waʔič-ʔiik ➔ waaʔič'iik

to sleep-Habitual 's.o. who always sleeps'

(276) Tableau for (275a)

μ μ naq- ʔ i k	MAXμ]$_{\varphi}$,	MAXPATHRt Node	HaveRtNode	DEPPATHRt Node	MAXμ
☞ μ μ a. (naʕ i k)φ					
μ b. (naʕ i k)φ	*!	*			*
μ μ c. (naʕ i k)φ		*!	*		

(277) Tableau for (275b)

μ μ waʔič- ʔ i k	MAXμ]$_{\varphi}$,	MAXPATHRt Node	HaveRtNode	DEPPATHRt Node	MAXμ
☞ μ μ a. (waʔi)φ č' i k					
μ b. (waʔi)φ č' i k		*!			*
μ μ c. (waʔi)φ č' i k		*!	*		

In tableaux (276-7), an underlyingly long vowel must surface faithfully, in whichever context it appears. If, therefore, one of the underlying moras is deleted as in each b candidate, it leads to fatal violations of MAX constraints: MAXμ and/or MAXPATHRtNode. Here, the domain is not crucial, since all non-optimal candidates violate one or both of the MAXμ constraints. In the case of each candidate c, although it maintains the input mora, it fatally violates HaveRtNode$_{\varphi}$ and MAXPATHRtNode.

(278) is an example of underlying short vowels.

(278) Short vowels

a. taʔiɨ-(m)it-siš ➔ taʔiɨitʔiš

sick-PAST-1sg/IND 'I was sick.'

b. ta-taʔiɬ-ʔaɬuk ➔ tataʔiɬʔaɬuk

RED-sick-to look after 'looking after s.o. sick'

(279) Tableau for (278a)

μ | taʔi ɬ-(m)it	MAXμ]$_{\varphi}$,	MAXPATHRt Node	HaveRtNode	DEPPATHRt Node	MAXμ
☞ μ | a. (taʔi)φ ɬit					
μ μ \ / b. (taʔi)φ ɬit				*!	
μ μ | c. (taʔi)φ ɬit			*!		

(280) Tableau for (278b)

μ | ta-taʔi ɬ-ʔaɬuk	MAXμ]$_{\varphi}$	MAXPATHRt Node	HaveRtNode	DEPPATHRt Node	MAXμ
☞ μ | a.(tata)φʔ iɬʔaɬuk					
μ μ \ / b.(tata)φʔiɬʔaɬuk				*!	
μ μ | c.(tata)φʔ iɬʔaɬuk			*!		

In tableaux (279-280), each candidate b is ruled out by inserting a path (in fact, a mora as well, but the main issue is more related to DEPPATH; thus I do not include DEPμ), which leads to fatal violations of DEPPATHRtNode. Each candidate c violates HaveRtNode by having a more unlinked on the surface. As in (276-277), a distinction of domain is not crucial.

Finally, in the case of variable vowels, the interaction of the MAX constraints and DEPPATHRtNode leads to an alternation, which is why we call this type of vowel 'variable'.

(281) Variable vowels

a. suḥ(aa)-ʔ ii c-ʔiš ➔ suẇ ii cʔiš (*suẇicʔiš)

salmon-to eat-3sg/IND 'S/he ate salmon.'

b. čamas-ʔ ii c-ʔiš ➔ čamaẏ i cʔiš (čamaẏiicʔiš)

sweet-to eat-3sg/IND 'S/he ate s.t. sweet.'

(282) Tableau for (281a)

μ μ | suḥ(aa)-ʔ i c	MAXμ]$_{\varphi}$	MAXPATHRt Node	HaveRtNode	DEPPATHRt Node	MAXμ
μ μ \ / ☞a. (suẇ i c)φ				*	
μ | b. (suẇ i c)φ	*!				*
μ μ | c. (suẇ i c)φ			*!		

(283) Tableaus for (281b)

μ μ | čamas-ʔ i c	MAXμ]$_{\varphi}$	MAXPATHRt Node	HaveRtNode	DEPPATHRt Node	MAXμ
☞ μ | a. (čamas)φʔ i c					*
μ μ \ / b. (čamas)φʔ i c				*!	
μ μ | c. (čamas)φʔ i c			*!		

As seen in the tableaux, the vowel /i/ in question appears as short or long depending on the context. The relevant context is the foot. When it stands within the foot, it surfaces as long, while when it is outside foot, it surfaces as short. In (282), candidate **b** is ruled out, since it fatally violates the constraint MAXμ]$_{\varphi}$. It deletes an underlying mora in the domain of foot. Although candidate a has an inserted path, allowing its vowel to appear as a long vowel on the surface, it maintains an underlying mora. An insertion of path within the domain of foot to realise the input mora is not a fatal violation, given that the candidate obeys the higher three constraints. Candidate c is ruled out by having one of the input mora unlinked on the surface. On the other hand, in tableau (283), candidate **a**, which has a short vowel, is selected as an optimal output. The determining factor is the high-ranked HaveRtNode, and DEPPATHRtNode and low-ranked MAXμ. Now that the domain in question is not the foot, the domain-specified MAX constraint MAXμ]$_{\varphi}$ is not relevant. Candidate **b** violates the DEPPATHRtNode constraint,

by inserting a path. Deleting an underlying mora outside the foot is not a fatal violation, which leads candidate a to win. Candidate **c** has a mora unlinked to an anchor, which is a violation of HaveRtNode. Note that candidates **a and c** have the same phonetic realisations and thus it seems that the ranking between HaveRtNode and MAXμ is not crucial. This raises the following questions: how much we should consider phonological aspects for surface forms, or whether we need to consider phonetic properties only for them. I leave these questions for further research, ranking them as such for now: HaveRtNode >> MAXμ.

Consequently, the alternating length of vowels result from domain-specified faithfulness constraints and their interaction with other faithfulness constraints.

Chapter 4 PROSODIC PHONOLOGY

In this chapter, additional properties of Nuu-chah-nulth prosody will be discussed. Some Nuu-chah-nulth prosodic structures and constituents exhibit properties which are not commonly observed cross-linguistically. Therefore, this study will provide significant opportunities to consider linguistic properties from a different perspective in terms of universalities and typological issues.

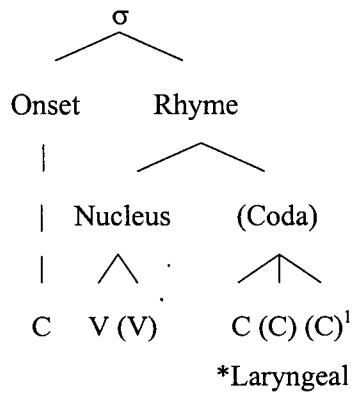
4.1 Syllable Structure

Nuu-chah-nulth allows one and only one consonant in the onset position and a maximum of three consonants in the coda position. Every syllable must have an onset, but codaless syllables are possible. While many North-West American indigenous languages allow consonant clusters in onset, it seems rare to allow complex codas, but disallow complex onsets. Although cross-linguistic preference for open syllables (the Maximal Onset Principle: complex onset is preferred over complex coda) and the Syllable Contact Law (in a sequence of two consonants belonging to different syllables, the first must outrank the second in sonority: Murray & Vennemann 1983) apply to many languages (Clements & Keyser 1983, Murray & Vennemann 1983, Laeufer 1985, Clements 1990), Nuu-chah-nulth syllable structure is not restricted by these principles (see section 3, where concrete examples are provided).

Moreover, while any consonant can be an onset, none of the glottal consonants can appear in the coda position: glottalised obstruents /p̓, t̓, k̓, k̓ʷ, c̓, č̓, x̓/, glottalised sonorants /m̓, n̓, y̓, w̓/, glottal consonants /ʔ, h/, and a pharyngeal stop /ʕ/ are all impermissible as codas (see Sapir & Swadesh 1939, Stonham 1999 among others). This is an interesting variation between related languages. The two sister languages Ditidaht and Makah allow glottalised consonants in coda.

Nuu-chah-nulth has only three vowel phonemes cross-cut by a length contrast and their distribution is not restricted, as we saw in chapter 2. The properties of the syllable structure in Nuu-chah-nulth can be schematised as in (1), with some examples in (2), repeated from (53) and (54) in section 3.2.1.

(1) The Nuu-chah-nulth syllable structure (cf. Stonham 1994: 76)



(2) Examples

a. CV	:	ha . ʔum	'food'
b. CVC	:	ha . ʔum	'food'
c. CVCC	:	m̓uks . ʔi	'the rocks'
d. CVCCC	:	c̓u . c̓umɬḥ . ta	'to wash feet'
c. CVV	:	m̓aa	'to bite'
d. CVVC	:	wiiq . siɬ	'stormy'
f. CVVCC	:	yaack	'to kick'
g. CVVCCC	:	yaaqƛs	'to despise someone'

The prosodic information provides a piece of evidence for the argument that Nuu-chah-nulth glottalised consonants are a single consonant, not a sequence of a plain consonant and a glottal stop. (See section 3.1. more detailed discussion.)

4.2 Prosodic constituents

I discussed in chapter 3 (and chapter 5) that prosodic constituents such as mora, syllable, foot, prosodic word, among which the following hierarchy is assumed to exist (McCarthy and Prince 1986, 1988, 1990, 1991a, b, 1993, van der Hulst 1984, Hyman 1985, Hayes 1989, Zec 1988, Ito 1989 among others), play a crucial role in the phonology and morphology of Nuu-chah-nulth.

[1] The parentheses mean that coda consonants are optional. It does not seem right to say that one consonant is in the coda and the others are appendices, since there is no restriction on consonant clusters regarding their location, i.e. word-internal or at word-edge.

(3) Prosodic Hierarchy

Prosodic Word	PrWd
	|
Foot	Ft
	|
Syllable	σ
	|
Mora	μ

In particular, the number of moras for vowels and their linking status provide phonological distinction between vowels. The Nuu-chah-nulth foot seems to be both syllable-counted and mora-counted. There is no phonological evidence that the language allows moras on coda consonants. Syllable weight, irrespective of where a syllable has coda or not, depends only on vowels. If coda consonants did have moras, then we would expect that there could not be syllables with long vowels before codas. However, Nuu-chah-nulth has many cases of syllables with long vowels before codas, even 3 three coda consonants (see (2g)). Syllable weight does not play many significant roles in Nuu-chah-nulth. It seems that it is involved only in stress assignment: stress is assigned on the initial syllable in a foot except when the second syllable is heavy i.e. includes a long vowel.

4.3 Consonant clusters

Nuu-chah-nulth allows consonant clusters in codas: CC or CCC. A sequence of three consonants is not very common in the middle of a morpheme, but is frequently observed in morpheme edges or between morphemes. Also, a sequence of two identical consonants is possible only between morphemes, as in (6), and there are no true geminates (i.e. within a single morpheme). Very interestingly, the first one of the stop-stop or affricate-affricate sequence produces a release typical for such consonants, even in the coda position. In addition, the sequence sounds longer than a single token of the same segment. This phonetic property, not only the morphological aspects, tells us that they are not a geminate.

(4) a. huḥta[kk]
huḥtak-k
To know-2sg/INT
'Do you know....?'

b. ʕiiḥaḵ̓a[ƛƛ]a

ʕiiḥ-ak-ʔaƛ-ƛa

to cry-DUR-SEQ-again/also

'S/he is crying again.'

c. ʔacšiƛwiṭ̓a[ss]iš

ʔac-šiƛ-wiṭ̓as-siš

fishing-MOM-is going to-1sg/IND

'I am going to go fishing.'

Another interesting property of Nuu-chah-nulth prosody is that consonant clusters of obstruents do not require a strict version of the Sonority Sequence Principle, which is defined in (5).

(5) Sonority Sequencing Principle (Clements 1990: 2)

Between any member of a syllable and the syllable peak, only sounds of higher sonority rank are permitted.

The general sonority hierarchy is as follows, although there can be more subdivision depending on individual languages, repeated from (162) in section 3.2.2 (see Hooper 1976, Basbøll 1977, Lekach 1979, Kiparsky 1979, Steriade 1982, Selkirk 1984, Clements 1990, Kenstowicz 1994).

(6) least sonorous most sonorous

← ---------- →

Obstruents Nasals Liquids Glides Vowels

Within Nuu-chah-nulth codas, there is no case where a sonorant follows an obstruent, while it is common that a sonorant precedes an obstruent as seen in (7). (As mentioned above, because a glide cannot occur in a coda, there is no example of a consonant cluster including a glide.) This property regarding syllable structure is cross-linguistically common, applying to Nuu-chah-nulth as well. However, as seen in (8-11), there seems to be no strict requirement between obstruents, with a fricative-fricative sequence, (8), a stop/affrcate-stop/affricate sequence, (9), a fricative preceding a stop/affricate, (10), and a stop/affricate preceding a fricative, (11). Interestingly, fricatives preceding stops/affricates are not common in Nuu-chah-nulth, compared to other combinations of obstruents as shown in (10), which seem to be more natural cross-linguistically.

In addition, there seems to be no restriction on order of coda consonants in terms of place. For example, compare (8c)-(8d) and (9b)-(9c): both the coronal-dorsal sequence and the dorsal-coronal sequence are possible, unlike in English, where only the coronal-dorsal sequence is possible.

I. Sonorant+obstruent

(7) a. k̓iɬanuy̓inɬʔanitniš (k̓iɬanus-inɬ-ʔat-mit-niš) 'We were served sea lion meat' /nɬ/

b. ʔuušḥyums 'friend/relative' /ms/

c. λ̓intyaʕa (λ̓int-yaq-ʔaaʔa) 'ashes on the rock' /nt/

d. λ̓uɬʔakλinλ (λ̓uɬ-akλi-inλ) 'touching s.o.'s buttocks' /nλ/

e. mučxumɬyaʕiḥta (mučxumɬ-yaq-iḥta) 's.o. curled up at the end' /mɬ/

f. mamakʷink 'trying to sell' /nk/

g. hiiɬinksta (hiɬ-(w)inksta) 's.t. in between' /nks/

h. k̓imxʷʔiš (k̓imx̣-ʔiš) 'S/he breathes a type of breathing.' /mxʷ/

II. Fricative+fricative

(8) a. waɬwaɬš (waɬ-waɬ-š) 'going home once in a while' /ɬš/

b. ʔuušḥ̓umsukʔi (ʔuušḥ̓ums-uk-ʔi) 'my friend' /šḥ/

c. tuxšiλ̓aḥsʔiš (tux-šiλ-aḥs-ʔiš) 'S/he is jumping in a boat' /ḥs/

d. čišx̣ʔakλi (čišx̣-akλi) 'dirty buttocks' /šx̣/

e. ciyapux̣sʔi (ciyapux̣s-ʔi) 'the hat' /x̣s/

f. ʔuʔuššyukʷap̓aλ̓i (ʔu-ʔuuš-š-yukʷ-ap̓aλ-i) 'Make her cry for something!' /šš/

g. čičišx̣ḥta (či-čišx̣-ḥta) 'dirty feet' /x̣ḥ/

III. Stop/affricate+stop/affricate

(9) a. huḥtakk (huḥtak-k) 'Do you know…?' /kk/

b. λuɬʔaqλ (λuɬ-aqλ) 'nice/clean inside (e.g. an oven)' /qλ/

c. λ̓iλqλ̓iλqš (λ̓iλq-λ̓iλq-š) 's.t. keeps sparkling' /λq/

d. hupčkumɬ 'curled up' /pč/

e. yackʔiš (yack-ʔiš) 'S/he kicked (s.t.)' /ck/

f. tupkʔiš (tupk-ʔiš) 'It is black.' /pk/

g. čuuḥcmapṭhwaaɬ (čuuḥcmapt-ḥwaaɬ) 'to use alder tree' /pt/

h. wiiwiitqk̓uk (wii-witq-k̓uk) 'to appear not good' /tq/

i. čitkčitkš (čitk-čitk-š) 'to twist repeatedly' /tk/

j. sikt?iš (sikt-?iš) 'It is an egg of head lice.' /kt/

III. Fricative+stop/affricate

(10) a. ?ustʕaa?a (?ust-q-?aa?a) 's.t. moved from one place to another on the rock' /st/

b. čuuhcmaptḥwaaɬ (čuuḥcmapt-ḥwaaɬ) 'to use alder tree' /ḥc/

c. wiškwiškš?iš (wišk-wišk-š-?iš) 'S/he keeps scolding.' /šk/

d. ḥuuḥuustqʕinyaʕa (ḥuu-ḥuustqʕin-yaq-?aa?a) 'sound of splashing water in a canoe' /stq/

IV. Stop/affricate+fricative

(11) a. kaakkamatqs p̓inʕaaɬ?iš?aɬ (kaa-kamatq-sp̓inʕaaɬ-?iš-?aɬ) 'They compete with each other in running' /tqs/

b. šuwisukqs (šuwis-uk-qs) 'my shoes' /kqs/

c. na?uuqs (na?uu-qs) 's.o. going along (with another) in a vessel' /qs/

d. čačapx̣?aɬuk (ča-čapx̣-aɬuk) 'looking after a man' /px̣/

e. ɬicx?aa?a (ɬicx-aa?a) 's.t. spread out on the rock' /cx/

f. ƛatx̣?aḥs 'plate' /tx̣/

g. ?iiqh?iƛ (?iqḥ-iƛ) 'taking the same' /qḥ/

h. ɬaaɬakhɬi?iikk̓uk (ɬaa-ɬaakḥɬi-?iik-k̓uk) 'someone seems to always tell a tale' /kḥ/

i. miitxmiitx^{w}ak̓uk (miitx-mitx^{w}-a-k̓uk) 'to keep turning continuously' /tx/

j. ƛaḥ?iicithsuu (ƛaḥ-iic-mit-ḥsuu) 'Did you finish eating?' /tḥ/

4.4 Vowel hiatus

4.4.1 Description

As mentioned above, Nuu-chah-nulth does not allow onsetless syllables. If a vowel hiatus arises when combining two morphemes (V_1+V_2), there are three ways to avoid it: i) insertion of a glottal stop /?/, ii) insertion of a glide /y/ (both of these providing an onset for the second vowel, as shown in (12) and (13)), and iii) deletion of one of the vowels as in (14).[2]

[2] The insertion of /?/ is not associated with glottalisation. If a morpheme, e.g. -uuƛ had a floating [+C.G.] feature as an initial element, as we discussed in section 3.2.1, then it would cause a stem-final stop/affricate to be glottalised. However, as seen in the example c̓ikuuƛ (< c̓ik-uuƛ), the stem-final /k/ is not affected.

(12) a. ċi-uuƛ → ċi[ʔ]uuƛ

to throw-become 'to throw s.t. to fire/fire place'

Cf. ċik-uuƛ → ċikuuƛ (*ċik̓uuƛ)

Crooked-become 'to become crooked'

b. qii-uk → qii[ʔ]uk

Long time-DUR 'To take a long time'

Cf. witq-uk → witquk

Awful-DUR 'awful'

c. saa-uk → saaʔuk

To crawl-DUR 'Crawling'

(13) a. ḥayu-ista → ḥayu[y]ista

Ten-in a vessel 'There are ten in a boat.'

Cf. wik-ist → wikist

NEG-in a vessel 'no one in a boat'

b. muu-ista → muu[y]ista

Four- 'There are four in a boat.'

c. ṅupu-ista → ṅupu[y]ista

Six 'There are six in a boat.'

d. ƛa-um-ḥsa → ƛa[y]umḥsa

another-thing-to want 'To want some other.'

Cf. ti-ʕaqƛ-um → tiʕaqƛum

To wipe-buttock-thing 'toilet paper'

e. muu-umɬ → muu[y]umɬ

Four-s.t. left 'Four left'

(14) a. ʔu-ʔu-ataḥ → ʔuʔ[u]taḥ
It-trying to get/aim at 'Whaling'

Cf. hi-hin-ataḥ-ʔiš ťaṅaak → hihinataḥʔiš

b. ʔaƛa-ista → ʔaƛ[i]sta
Two- 'There are two in a boat.'

c. qacča-ista → qacč[i]sta
three- 'There are three in a boat.'

d. kuṁaa-ista → kuṁ[ii]sta
Few- 'There is few in a boat.'

e. ʔu-ii c → ʔ[uu]c
It-to belong to 'To belong to'

Cf. wik-iic → wikiic
NEG-to belong to 'not to belong to'

f. ʔaya-(a)as → ʔay[aa]s
Many-on the surface 'lots of (s.t.) on the table'

Cf. wik-(a)as → wikaas
NEG-on the surface 'nothing on the table'

g. kuṁaa-(a)as → kuṁ[aa]s
Few- 'Few on the table.'

h. kuṁaa-umɬ → kuuṁ[u]mɬ
Few-s.t. left 'Few left'

i. ṅupu-umɬ → ṅup[u]mɬ
Six- 'Six left'

j. qacc̓a-umɬ → qaacc̓[u]mɬ
three- 'Three left'

k. ʔaƛa-umɬ → ʔaaƛ[u]mɬ
Two- 'Two left'

l. ʔaya-ista → ʔay[i]sta
Many-in a vessel (people) 'There many people in a boat'

In Nuu-chah-nulth, there are not many morphemes that begin or end with a vowel, which makes it hard to establish the frequency of each case in the vowel-hiatus context. Also, for morphological or semantic reasons it was simply easier to elicit data with some specific morphemes such as -umɬ and -ista. Therefore, at the current stage, I cannot tell which method is most productive in Nuu-chah-nulth. It seems that the three ways to avoid vowel hiatus occur with almost the same frequency. Consider the following chart, which shows potential and observed distribution: shaded cells indicate cases where there is no occurrence among the three options; in the vowel-deletion column, the deleted vowel is indicated in the parenthesis; a long vowel includes variable vowels, since that distinction does not seem to be crucial; finally, when the vowels in the sequence are the same, I do not indicate which one is deleted.

(15) The frequency of /ʔ / or /y/ insertion and vowel deletion

Contexts	/ʔ/ insertion	/y/ insertion	Vowel deletion
/i/__/i/			
/i:/__/i/			
/i/__/i:/			
/i:/__/i:/			
/i/__/u/			
/i:/__/u/	2		
/i/__/u:/	3		
/i:/__/u:/			
/i/__/a/			

Contexts	/ʔ/ insertion	/y/ insertion	Vowel deletion
/i:/__/a/			
/i/__/a:/			
/i:/__/a:/			
/u/__/u/			1
/u:/__/u/		2	
/u/__/u:/			
/u:/__/u:/	1		
/u/__/i/		3	
/u:/__/i/		1	
/u/__/i:/			1(i:)
/u:/__/i:/			
/u/__/a/			1 (u) 1 (a)
/u:/__/a/			
/u/__/a:/			
/u:/__/a:/			
/a/__/a/	3		
/a:/__/a/			
/a/__/a:/	1		
/a:/__/a:/			1
/a/__/i/			3 (a)
/a:/__/i/			1 (a:)

Contexts	/ʔ/ insertion	/y/ insertion	Vowel deletion
/a/__/i:/			
/a:/__/i:/			
/a/__/u/	2	1	2 (a)
/a:/__/u/	2		1 (a:)
/a/__/u:/			
/a:/__/u:/	1		
TOTAL	15	7	12

As shown in the chart (15), there are many gaps, presumably accidental, in the cells. Except for the contexts of the /a(:)-u/ sequence, either /ʔ/, /y/ insertion or deletion is used, exhibiting complementary distribution. In the case of deletion, /a/ is predominantly deleted, whether it is short or long. Interestingly, sometimes the length of the deleted vowel is maintained on the surviving vowel as in (14d-e) and sometimes not as in (14h): note that in (14d) and (14h), the stem is the same, *kumaa*. Therefore, it cannot be said that this kind of process is completely based on phonological aspects.

4.4.2 Analysis

The distribution of the three processes raises the following questions: i) how to characterise the contexts: i.e., is there any phonetic, phonological, or lexical motivation for each case, and ii) why is /a/ more subject to deletion than other vowels?

For the first question, although in some cases the contexts exhibit complementary distribution, there seems to be no phonological significance. Although only /ʔ/ insertion is used when V1 is /i/, and all cases of V1=/i/ take /ʔ/, all three alternatives can be used when V1 is /u/ or /a/. Further, it does not seem that V2 is the determining factor, for the three ways can be used whether V2 is /i/, /u/, or /a/. The number of syllables does not work, either: whether the stem morpheme is mono- or bisyllabic, all three alternatives are observed. Also, it is not likely that the distribution is lexical. As seen (12-14), the same morphemes appear in each case. For example, with -ista and -umɨ both /y/-insertion and vowel deletion are found. Furthermore, the morpheme ʔu- 'it' loses its vowel sometimes as in (14e) and maintains it sometimes as in (14a).

The best way of treating these apparently unpredictable phenomena would be to consider each inserted /ʔ/ or /y/ as the underlyingly last segment of each morpheme in question. Recall that Nuu-chah-nulth does not allow glides or glottalised segments in coda position. If they are a stem-final segment underlyingly, their surface alternation is straightforwardly accounted for: the presence of them before a vowel on the surface, as in (16a) and (17a), respectively, but the absence before a consonant, as seen in (16b) and (17b), respectively.

(16) a. saaʔ-uk	➔	saa[ʔ]uk
To crawl-DUR		'Crawling'
b. saaʔ-mis-inƛ	➔	saamisinƛ (*saaʔmisinƛ)
to crawl-thing-?		'to crawl up on something'
(17) a. muuy-umɬ	➔	muu[y]umɬ
Four-thing (left)		'Four left'
b. muuy-čiiɬ	➔	muučiiɬ (*muuyčiiɬ)
Four-day long		'Thursday'

This approach would resolve both the alternation and unpredictability problems. As mentioned above, Nuu-chah-nulth implements the three ways to resolve "vowel-hiatus" problems. However, we could not predict when and where each one of them is used.

One problem still might remain: with *ńupu* 'six' we have both /y/ and null surface forms as below, which repeated from (13c) and (14i).

(18) a. =(13c)		
ńupu-ista	➔	ńupu[y]ista
Six		'There six in a boat.'
b. =(14i)		
ńupu-umɬ	➔	ńup[u]mɬ
Six-s.t. left		'Six left'

This would be a counter-example to the proposed solution. I will leave this for further research.

Supposing that the 'insertion' case is not insertion, but (consonant) deletion, we would have only one type of vowel-hiatus solution, which is vowel deletion as seen in (14). Interestingly, it is /a/ that is

consistently deleted. The question is why is /a/ more subject to deletion than other vowels. /a/ is the most sonorous vowel, and also it seems that the vowel is most frequent in the language.[3] There are three possible solutions for this problem, which still need to be thoroughly examined: two phonological and one morphological. One of the phonological solutions is that /a/ may be a default vowel in terms of frequency in Nuu-chah-nulth and that a default vowel is deleted in the context of vowel hiatus.[4] If it is true that /a/ is a default in the language, this would be a straightforward solution. The other phonological solution is that V1 is always deleted unless it is the only vowel in the morpheme.[5],[6] (See Casali 1996, 1997, Rosenthall 1994, Lamontagne 1996, Lamontagne & Rosenthall 1996, Bakovic 2002, Michael & Crowhurst 2002 for relevant discussion, which investigate how vowel hiatus across morpheme boundaries is resolved by deletion of the leftmost or rightmost vowel.) This seems to work in all the cases in (14). The only problem is that when two vowels meet, the first vowel is all /a/ or the two vowels are the same. At the current stage, it is not clear whether the first vowel is deleted since it is /a/, or since it occupies the first position in the sequence. The morphological solution is that the stem vowel is deleted unless it constitutes the only syllable of the stem. As shown in (14), it is the stem vowel that is deleted in the vowel-hiatus context, if it is not the only vowel of the stem. Again, each deleted stem-vowel is either /a/ or has the same phonetic quality as the surviving vowel. Consequently, it is not clear yet whether the factor is morphological or phonological. The vowel hiatus problem seems to require a long-term project, obtaining enough data, to provide a complete solution.

[3] I have got such impression via many elicitation sessions, although I have not collected statistics.

[4] Thanks to Joe Stemberger for this point. (Also see Pulleyblank 1988, Stemberger 1992 for relevant discussion.).

[5] If the only vowel is deleted, then there might be an identity problem raised.

[6] Thanks to Pat Shaw for this point.

Chapter 5 MORPHOLOGY

All the phonological processes discussed so far are sensitive to morphological or lexical information. The phenomena to be treated in this chapter also result from the interaction between phonology and morphology. However, I deal with them here in a separate chapter, because their morphological aspects are more significant, compared to other morpho-phonological phenomena, especially with respect to word formation. That is, the two issues of this chapter, reduplication and allomorphy, are related to morphemes, rather than phonemes, as a target unit in the relevant processes. I start with reduplication, which is a pervasive phenomenon in Nuu-chah-nulth.

5.1 Reduplication

Reduplication is a phenomenon that has attracted much attention from linguists, due to developments in phonological and morphological theory (McCarthy 1979a,b; Marantz 1982; Kiparsky 1986; McCarthy & Prince 1986, 1994a,b, 1995, 1999; Steriade 1988; Urbanczyk 1995, 1996, 1999; Spaelti 1997; Gafos 1998; Downing 1998, 2000, 2001; Alderete et.al 1999; Inkelas & Zoll 2000; Struijke 1998, 2000; Kim to appear; Pulleyblank to appear among others). Nuu-chah-nulth has very unique patterns of reduplication, which raise many interesting questions both analytically and theoretically.

Nuu-chah-nulth has two types of reduplication processes: reduplication without triggers, and reduplication triggered by suffixes. I will start with the former in the following section.

5.1.1 Description

5.1.1.1 Reduplication without a triggering suffix

When reduplication occurs without a triggering suffix, the reduplicated form leads to another word either with or without additional meaning. When an additional meaning is added, the reduplicated form refers to plurality or repetition of the thing/act/status in question in most cases. On the other hand, for the cases where an additional meaning is not given, there seem to be no non-reduplicated counterparts, i.e. the reduplicated words are frozen forms. The following examples illustrate each case: in the morpheme-by-morpheme gloss, RED(uplicant), a reduplicative prefix, indicates the copied part of the stem morpheme.

Reduplication can refer to repetition as in (1a-b) or plurality as in (1c-f).

(1) a.naaqnaaqʔiš[1]

RED-naq-ʔiš

RED-to drink-3sg/IND

'S/he keeps drinking.'

cf. naqšiƛʔiš 'S/he drinks (water).'

b. t'it'icašiƛ[2]

RED-t'icaa-šiƛ

RED-to switch-MOM

'switching more than once'

cf. t'icaašiƛ 'switching once'

c. mamaḥti[3]

RED-maḥtii

RED-house

'houses'

cf. maḥtiiʔi 'the house'

d. tutupkʔič

RED-tupk-ʔič

RED-black-to wear

'more than one person wearing black'

cf. tupkʔič 'one person wearing black

[1] In addition to reduplication, the vowels of the reduplicant and the root morpheme are lengthened in this case.

[2] In the root morpheme t'icaa- 'to switch', the second vowel is a 'variable vowel'; therefore, in the surface form the vowel is shortened since it stands outside the foot.

[3] The second vowel of the morpheme maḥtii- 'house' is also a variable vowel.

e. t̓ut̓uc̓iiḥ[4]

RED-t̓uc̓(up)-ʔiiḥ

RED-sea urchin-to gather/fish

'gathering more than one sea urchin'

cf. t̓uc̓up̓iiḥ 'gathering one sea urchin'

f. nuuknuuk

RED-nuuk^{w}

RED-song

'songs'

cf. nuukʔi 'the song'

Reduplication can add new meaning other than repetition/plurality as follows.

(2) a. nanaʔa

RED-naʔa

RED-to hear

'to understand/to be educated'

cf. naʔamits... 'I heard that...'

c. nunuuk

RED-nuuk

RED-song

'to sing'

cf. nuukʔi 'the song'

[4] *-ʔiiḥ* is a reduplication-triggering suffix. This example is a case where there are two motivators for reduplication in a word, but a coping process happens only once. This provides another piece of evidence that Ahousaht Nuu-chah-nulth does not have double reduplication, although it is not clear which is the trigger for reduplication. Also, I suppose that no reduplication in t̓uc̓up̓iiḥ in the compared example might be due to maximisation of lexical contrast (see section 5.1.3 for detailed discussion).

d. maamaati

RED-mat-i

RED-to fly-?

'bird'

cf. mataa 'flying'

Some words do not have non-reduplicative forms. In this circumstance, reduplication is used just for creating a word: many animal names seem to be loan words from Chinook Jargon, e.g. muusmuus 'cow'.[5]

(3) a. kakaẃin 'killer whale' (*kaẃin)

b. ʕaʕaaƛiʕiḥta (ʕaʕaaƛiq-ʔiḥta) 'mouse' (*ʕaaƛiʕiḥta)

c. piišpiš 'cat' (*piš/*piiš)

d. muusmuus 'cow (*muus)

e. maamaati 'bird'[6]

f. p̓ap̓ac̓aqƛ (<p̓ap̓ac-ʔaqƛ) 'yeast bread' (*p̓ac)

g. čičiči 'teeth' (*či)

These forms are made by repeating a sequence of sounds which consist of a single syllable, with sometimes different vowel length as in (3b and c). Because they are frozen forms, we cannot know whether the word *kakaẃin*, for example, is from either ka-ka-ẃin or ka-kaẃin.

An interesting issue is whether they really result from the process of '(inherent) reduplication' or they just happen to have the same sequence of sounds. One possible answer is from a property of Nuu-chah-nulth reduplication. Ahousaht Nuu-chah-nulth does not have double reduplication, i.e. repeating a sequence of sounds more than once. Therefore, if a word is made by reduplication, there is no more reduplication, even when a reduplication-triggering suffix such as -k̓uk is added as in (4). *nanaʔa* is already created by reduplicating the morpheme *naʔa*, so there is no more reduplication. The lack of double-reduplication seem to be related to morphological haplology, where two suffixes happen to have

[5] Mary Jane Dick and Pat Shaw (p.c.).

[6] For (3e), Nuu-chah-nulth has a base morpheme mat- 'to fly', although –i is not confirmed about its origin.

the same phonological content, one of them is not realised on the surface. (See Stemberger 1981 for detailed discussion.). As a result, the cases in (3) can be called 'inherent reduplication' (see Buckley 1996, Rose 1996 for relevant discussion).

(4) nanaʔak̓ukʔiš (*nananaʔak̓ukʔiš)
nanaʔa-k̓uk-ʔiš (nanaʔa < RED-naʔa)
to understand-to resemble-3sg/IND
'S/he seems to be knowledgeable'

cf. mimiɬk̓ukʔicuuš (*miɬmiɬk̓ukʔicuuš)
RED-miɬ-k̓uk-ʔičuuš
RED-same-to resemble-2pl/IND
'Both of you look alike.'

In the same spirit, if the forms in (3) were made by reduplication, we would expect that reduplication would not occur with any form in (3). Consider the following examples.

(5) a. kakaẃink̓ukʔiš (*kakakaẃink̓ukʔiš)
kakaẃin-k̓uk-ʔiš
a killer whale-to resemble-3sg/IND
'It looks like a killer whale.'

b. piišpišk̓ukʔiš (*piišpiišpišk̓ukʔiš)
piišpiš-k̓uk-ʔiš
cat-to resemble-3sg/IND
'It looks like a cat.'

c. maamaatik̓ukʔiš (*maamaamaatik̓ukʔiš)
maamaati-k̓uk-ʔiš
bird-to resemble-3sg/IND
'It looks like a bird.'

These examples support an analysis that the words are made by 'inherently' reduplicating some part (or a whole) of a sequence of sounds.

The following examples are cases where reduplication contributes no clear additional meanings to the root morpheme, but there exist non-reduplicated root forms without meaning changes. For example, the

root morpheme *čʼu-* can be used with its own meaning 'to wash' but without reduplication, as in *čʼumiiɬ* 'to wash the floor'. However, as seen in (6a), with the suffix –qs 'dish', the root morpheme must be reduplicated and there is no additional meaning but 'to wash'..

(6) a. čʼučʼuqs
RED-čʼu-qs
RED-to wash-dish
'to wash dishes'

cf. čʼumiiɬ 'to wash the floor' (<čʼu 'to wash'-miiɬ 'floor')

b. ɬaɬakʼʷinyaʕaḥs
RED-ɬakʼʷin-yaq-ʔaḥs
RED-to console-EXIS-vessel
'S/he is consoling s.o. in a boat/car.'

cf. ɬakʼʷinitʔiš . . . 'S/he consoled s.o.....' (<ɬakʼʷin 'to console'-(m)it 'PAST'-ʔiš '3sg/IND')

c. kʼukʼuupsumʔiḥta
RED-kʼupsum-ʔiḥta
RED-ring-at the end
'a ring at the end of a nose

cf. kʼupsumʔi 'the ring' (<kʼupsum 'ring' -ʔi 'Def.')

d. kiƛkiiƛuksumʔap
RED-kiiƛuksum-ʔap
RED-glasses-to buy
'to buy glasses'

cf. kiiƛuksum 'glasses'

Reduplication without a triggering suffix as shown in (1)-(6) can be classified into two processes in terms of word formation: one is a systematic, so predictable, process such as the case of plurality/repetition, (1), and the other is an exceptional, so unpredictable, process such as the cases of addition of unpredictable meaning, (2), inherent reduplication, (3), and no additional meaning, (6). The unpredictable cases would be processed in the lexicon as a lexical-internal process. For the predictable cases, we might provide a

formal analysis illustrated as the tableau in (8) with the relevant example in (7). I do not discuss the prosodic identity of the reduplicant, the constraints, and their ranking here, because they will be examined in detail when I discuss reduplication triggered by suffixes in the next section.[7]

(7)=(1c) mamaḥti

RED-maḥti(i)[8]

RED-house

'houses'

(8) Tableau:

σ]rep.- maḥti	INTEGRITY (σ)	NOCODA	MAX_{BR}
☞ a. $_{\sigma}$[ma]maḥti		*	*** (ḥti)
b. $_{\sigma}$[maḥ]maḥti		**!	** (ti)
c. $_{\sigma}$[maḥ]timaḥti		**!	
d. $_{\sigma}$[ ]maḥti		*	****!* (maḥti)
e. $_{\sigma}$[ma]$_{\sigma}$[ḥi]timaḥti	*!	*	

The 'repetition' reduplicant manifested as a syllable in the input surfaces by copying the first syllable of the root morpheme. In particular, candidate **b and c** are ruled out by having a coda in the reduplicant. This is crucial, sacrificing complete identity between the base and the reduplicant: cf. candidate **a.** Candidate e violates INTEGRITY(σ) by having multiple copying of syllables. Candidate **a** is selected as an optimal output. This kind of mechanism will be investigated in more detail below.

[7] Definition of the constraints used in tableau (8); we would need INTEGRITY(seg.) to prevent multiple correspondents of an input segment from appearing on the surface, but see 5.1.2.3 for detailed discussion.

a. NOCODA: Syllables may not have codas.

b. MAX_{BR}: Every element of the base must have a correspondent in the reduplicant.

c. INTEGRITY(σ): The input syllable must not have multiple correspondents in the output.

[8] Tableau (7b) illustrates reduplication only, ignoring vowel length change of /i/ in maḥti(i): see section 3.2.5 for relevant discussion.

5.1.1.2 Reduplication triggered by a suffix

Reduplication triggered by suffixes exhibits relatively more systematic aspects morphologically and semantically, although there are some complicated characteristics.

The characteristics of reduplication triggered by suffixes in Nuu-chah-nulth are as follows. First, when reduplication is triggered by a suffix, the meaning of the suffix is added to the reduplicated form. However, given that the meaning of the suffix cannot be distinguished from the overall meaning of the suffix plus reduplicant, it would be right to say that the added meaning is associated to reduplicant and the triggering suffix as a whole, rather than the suffix on its own. This raises an interesting question regarding the morphological identity of reduplicant+suffix: are they two independent morphemes, i.e. suffix and concomitant prefix, or a single morpheme whose constituents are just discontinuous. (I will discuss this in section 1.2.) Second, when a triggering suffix is attached to a stem, the reduplicative properties of triggered reduplication are comparable to reduplication without a trigger. Interestingly, the form of the reduplicant, the copied part, is not fixed for all the suffix-triggering reduplication, but it is systematic. Depending upon the attached suffix, the form of the reduplicant ranges from CV to CVVCCC. The reduplicant, at most one syllable, either has a coda or not, and its vowel is either long or short depending upon the triggering suffix. In total, there are 14 patterns which I analyse as following into 7 main types in Nuu-chah-nulth reduplication. I do not include a sub-classification depending on whether a reduplicant copies the coda of the base or not in the chart (in which case we would expect 14 types in total) to simplify the exposition. This is because I focus on vowel length variation, and coda variation is not related to the vowel-alternation issue. I will return to the coda issue in the next section. (9) summarises the patterns in terms of vowel length:

(9) Patterns of Nuu-chah-nulth reduplication

TYPE	Vowel length in		RED-BASE
	Reduplicant	Base	
Class I	Short/long	Unaffected; so maintaining its length on the surface.	CV(V)(C)-CV(V)(C)
Class II	Long	Unaffected; so maintaining its length on the surface	CVV-CV(V)(C)
Class III	Short	Unaffected; so maintaining its length on the surface	CV-CV(V)(C)
Class IV	Long	Affected; lengthened, if underlyingly short	CVV(C)-CVV(C)
Class V[9]	Short	Affected; shortened, if underlyingly long	CV-CV(C)
Class VI	Long	Affected; shortened, if underlyingly long	CVV-CV(C)
Class VII	Short	Affected; lengthened, if underlyingly short	CV(C)-CVV(C)

Very interestingly, exhibiting the full range of possible interactions, each two of the 7 patterns constitutes a pair within the system, in terms of the interaction between the base and the reduplicant in vowel length: except for Class I, for which, logically, constituting a pair is not possible. In each pair, classes II and III, classes IV and V, and classes VI and VII, one of every pair has a reduplicant with a long vowel and the other a reduplicant with a short vowel. Also, with the pairs of classes IV and V, and of classes VI and VII, the interaction between the base and the reduplicant exhibit different properties. In the pair of classes IV and V, the base and the reduplicant have the same vowel length, while in the pair of classes VI and VII, the base and the reduplicant exhibit different vowel length.

The following sections illustrate each case of the 7 patterns.

5.1.1.2.1 Class I: Red=σμ(μ); Base unaffected

Four suffixes belong to this type: *-ƛa* 'again, also' *-š* 'once in a while/continually', *-ʔaɬuk* 'to look after' and *-ḥta* 'foot'. Of these, *-ʔaɬuk*, and *-ḥta* do not allow a coda in the reduplicant, while *-ƛa* and *-š* do. The reduplicant has a long or short vowel depending upon the base, the root of the stem the reduplicant attaches to, and there is no change in the base.[10] I exemplify each suffix in (10-13), respectively:

[9] The same patterns are attested in Tseshaht except the 5th pattern (Sapir and Swadesh 1939). I am not sure whether they did not find the pattern or whether the Tseshaht dialect just does not have the pattern.

(10) -ƛa 'again, also'

a. yacyacmiɬʔaƛʔisƛa (*yayacmiɬʔaƛʔisƛa)

RED-yac-miɬ-ʔaƛ-ʔiš-ƛa

RED-to walk-on the floor-SEQ-3sg/IND-again

'She is walking around again now.'

b. ʕaaqʕaaʕaƛʔišƛa[11] (*ʕaaʕaaʕaƛʔišƛa)

RED-ʕaaq-ʔaƛ-ʔiš-ƛa

RED-to shout-SEQ-3sg/IND-again

'She is yelling again.'

c. tatamis-ƛa (*tamtamisƛa)

RED-tamis-ƛa

RED-to drift-again

'To keep drifting'

(11) -š 'continually'

a. tuuḥtuuḥšʔišʔaɬ ťatṅaʔis (*tuutuuḥšʔišʔaɬ)

RED-tuuḥ-š-ʔišʔaɬ ťatṅa-ʔis

RED-to get frightened-continually-3pl/IND children-DIM

'The children get frightened continually (e.g. by thunder)

b. watqwatqšʔiš ʔiščiip Kyle. (*wawatqšʔiš)

RED-watq-š-ʔiš ʔiščiip Kyle

RED-to swallow-continually-3sg/IND gum

'Kyle keeps swallowing gum.'

---

[10] As seen in the examples, the triggering suffix is not always adjacent to the base, which is why I need to define the base as the root of the stem the suffix attaches to.

[11] The suffix -ʔaƛ is a glottalising suffix, which causes the preceding uvular stop to become a pharyngeal stop (see section 3.2.1). This example will raise a problem with my analysis in terms of parallel syllable structure and the feature identity between the base and the reduplicant. For with this suffix, the coda of the base must be copied, but the base coda is not a coda any more and some of its featural properties are changed. I will leave this issue for further research.

c. kakamatqščiʔaƛukʔiš ṭaṅaʔis. (*kamkamatqščiʔaƛukʔiš)

RED-kamatq-š-čiƛ-ʔaƛ-uk-ʔiš ṭaṅa-ʔis

RED-to run-continually-MOM-SEQ-POSS-3sg/IND child-DIM

'Her/His child keeps running.'

(12) -ʔaɬuk 'to look after'

a. tataʔiɬʔaɬuk (*taʔtaʔiɬʔaɬuk)

RED-taʔiɬ-ʔaɬuk

RED-sick-to look after

'to look after s.o. sick'

b. čačapx̣ʔaɬuk (*čapx̣čapx̣ʔaɬuk)

RED-čapx̣-ʔaɬuk

RED-man-to look after

'to look after a man/husband'

c. nuunuuk̓ʷaɬuk[12] (*nuuknuuk̓ʷaɬuk)

RED-nuukʷ-ʔaɬuk

RED-song-to look after

'to look after songs (in a sense as a care-taker)'

(13) -ḥta 'foot'

a. m̓am̓aɬḥta (*m̓aɬm̓aɬḥta)

RED-m̓aɬ-ḥta

RED-cold-foot

'cold feet'

b. tatakinisḥta (*taktakinisḥta)

RED-takinis-ḥta

RED-socks-foot

'to wear socks'

c. ʔuuʔuušḥtačipʔiš Lois šuwis. (*ʔuušʔuušḥtačipʔiš)

RED-ʔuuš-ḥta-čip-ʔiš Lois šuwis

RED-some-foot-?-3sg/IND Lois shoes

'Lois is wearing someone else's shoes.'

5.1.1.2.2 Class II: Red=σμμ; Base unaffected

One suffix is found for this type: -ʔiik 'someone who is always doing something (habitually)'. The reduplicant is always long, whether the base vowel is long or short; there is no change in the base, but coda is not allowed in the reduplicant with the suffix. However, we would expect cases that allow codas to appear with some other suffixes, but I have not found such cases.

(14) -ʔiik 'some who always does something'

a. naanaʔataḥʔiik (*naaʔnaʔataḥʔiik)

RED-naʔataḥ-ʔiik

RED-to listen-s.o. who always does s.t.

's.o. who always listens a lot'

b. ʔuuʔuuwaʔiik (*ʔuuwʔuuwaʔiik)

RED-ʔuuwa-ʔiik (ʔuuwa < ʔu(u)-wa)

it-to say

RED-to complain- s.o. who always does s.t.

's.o. who always complains a lot'

c. yaayaqƛsƛ'aɬʔiik (*yaaqƛyaqƛsƛ'aɬkʔiik)

RED-yaqƛ-sƛ'aɬ-ʔiik

RED-disliking-each other- s.o. who always does s.t.

's.o. who always dislikes another'

5.1.1.2.3 Class III: Red=σμ; Base unaffected

Two suffixes belong to this class: -yuk^{w} 'to cry', and -ʔiiḥ 'to hunt for, fish'. The reduplicant is always short, whether the base vowel is long or short; there is no change in the base, but coda is consistently not

[12] -*ʔaɬuk* triggers glottalisation as well.

found in the reduplicant in all cases. I exemplify each suffix in (15-16), respectively.

(15) -yuk^{w} 'To cry'

a. ʔaʔaqiyukḥ (*ʔaqʔaqiyukḥ)
RED-ʔaqi-yuk^{w}-ḥ
RED-what-to cry-3sg/INT
'What is she crying for?'

b. wiwikyukʔiš (*wikwikyukʔiš)
RED-wik-yuk^{w}-ʔiš
RED-NEG-to cry-3sg/IND
'S/he is crying for nothing'

c. ʔuʔuušyuk^{w}apʌʔi (*ʔušʔuušyuk^{w}apʌʔi)
RED-ʔuuš-yuk^{w}-ʔap-ʔaʌ-ʔi
RED-some-to cry-CAUS-SEQ-3sg/IMP
'Make her cry for something!'

d. tataanaqayukʔiš (*tantaanaqyukʔiš)
RED-taana-qa-yuk-ʔiš
RED-money-for-to cry-3sg/IND
'S/he is pouting for money.'

(16) -ʔiiḥ 'to hunt for/try to get/collect/fish'

a. ḳiḳiɬatʔiiḥ (*ḳiɬḳiɬanustʔiiḥ)
RED-ḳiɬanus-t-ʔiiḥ
RED-sea lion-PL-to hunt for
'hunting for seals'

b. ʔuʔuuskaʔiiḥ (*ʔusʔuuskaʔiiḥ)
RED-ʔuuska-ʔiiḥ
RED-?-to hunt for
'taking a chance'

c. sisikt̓iiḥ[13] (*siktsikt̓iiḥ)

RED-sikt-ʔiiḥ

RED-egg of head lice-collect

'picking eggs of head lice'

5.1.1.2.4 Class IV: Red=σμμ; Base=$_1$σμμ

Two suffixes belong to this class: -ya 'continuously', -šiƛ 'to start'. The reduplicant is always long, and the base (or the first syllable of the base, if it consists of more than one syllable) is also long. If, therefore, the vowel of the base is short, then it is lengthened. Reduplication of this type forces the coda of the base to be copied. (17-18) illustrate each suffix (the glide /y/ of -ya is deleted after a consonant, which is another process beyond my discussion here):

(17) -(y)a 'continuously'

a. w̓aaw̓aasaqaʔiš (*w̓aasw̓aasaqaʔiš)

RED-w̓asaq-(y)a-ʔiš

RED-to cough-continuously-3sg/IND

'She is continuously coughing.'

cf. w̓asaqitʔiš 'S/he coughed'

b. cuuccuucaʔiš (*cuucuucaʔiš)

RED-cuc-(y)a-ʔiš

RED-to scratch-continuously-3sg/IND

'S/he is continuously scratching.'

cf. cucaa 'scratching'

c. miitxmiitxaʔiš (*miimiitxaʔiš)

RED-mitx-(y)a-ʔiš

RED-to spin-continuously-3sg/IND

'S/he spins continuously.'

cf. mitxaa 'spining'

[13] -*ʔiiḥ* is a glottalising suffix as well.

d. t̓iickt̓iicka (*t̓iit̓iicka)

RED-t̓iick-(y)a

RED-the sound of thunder-continuously

'thunder'

(18) -šiƛ 'to start to ..'

a.tuuxtuuxšiƛ (*tuutuuxšiƛ)

RED-tux-šiƛ

RED-to jump-to start to..

'starting to jump'

cf. tuxmitsiš 'I jumped'

b. w̓aaw̓aasaqšiƛ (*w̓aasw̓aasaqšiƛ)

RED-w̓asaq-šiƛ

RED-to cough-to start to..

'starting to cough'

cf. w̓asaqitsiš 'I coughed.'

c. c̓uusc̓uusšiƛ (*c̓uuc̓uusšiƛ)

RED-c̓us-šiƛ

RED-to dig-to start to..

'starting to dig (a hole)'

cf. c̓usaa 'digging'

d. ʕiiḥʕiiḥši?aƛuk?iš nay̓aqak (*ʕiiʕiiḥši?aƛuk?iš)

RED-ʕiiḥ-šiƛ-?aƛ-uk-?iš nay̓aqak

RED-to cry-to start to-SEQ-POSS-3sg/IND baby

'Her baby starts to cry.'

5.1.1.2.5 Class V: Red=σμ; Base=$_1$σμ

Two suffixes belong to this type: -k̓uk^w 'to resemble', and -(č)ink 'together, side by side'. The

reduplicant has short vowel and (the first syllable of) the base is also short. If, therefore, the vowel of the base is long, then it is shortened. The coda of the base is not copied with this class of suffix. (19-20) exemplify each suffix.

(19) -k̓ukʷ 'to resemble'[14]

a. ʔuʔusumk̓ukʔiš (*ʔusʔusumk̓ukʔiš)
RED-ʔusum-k̓ukʷ-ʔiš
RED-to need/want-to resemble-3sg/IND
'S/he appears to need (s.t.)'

b. mimiɬk̓ukʔicuuš (*miɬmiɬk̓ukʔicuuš)
RED-miɬ-k̓ukʷ-ʔičuuš
RED-same-to resemble-2pl/IND
'Both of you look alike.'

c. ƛ̓iƛ̓ixʷak̓uk (*ƛ̓ixƛ̓ixʷak̓uk)
RED-ƛ̓iixʷ-(a)a-k̓ukʷ
RED-to smile/laugh-DUR-to resemble
'Smirk'

cf. ƛ̓iixʷaa 'smiling'

d. qʷiqʷiqk̓ukʷii
RED-qʷii-q-k̓ukʷ-ii
RED-what-EXIS-to resemble-3sg/REL
'What appears to be (pl), s.t. unusual'

cf. qʷiiċumʔakii ʔaaʔaaʔiša ʔumʔi ʔuuċumʔak
'(I wonder) what is the purpose, your mom is in a hurry.'

[14] The labiality of the suffix is deleted when preceding a consonant.

(20) -(č)ink 'to converse with/together/side by side'

a. čačačink
RED-čaa-čink
RED-swiftly moving water-side by side
'going against the tide of swift current'

cf. čaanitʔiš ňačiqs '(The ocean) is flowing rapidly at Tofino.'

b. huhuʔačinksapʔiš muna (*huʔhuuʔačinksapʔiš)
RED-huʔa-čink-sap-ʔiš muna
RED-to put together-side by side-MOMCAUS-3sg/IND engine
'He puts engine back together.'

c. ciciqinkʔiš (*ciqciqinkʔiš)
RED-ciq-(č)ink-ʔiš
RED-to speak-to converse
'S/he is praying.'

5.1.1.2.6 Class VI[15]: Red=σμμ; Base=$_1$σμ

Two suffixes belong to this type: -itỷak 'afraid/fear', and -(k)časči 'to play on someone's side'. The reduplicant is always long, but (the first syllable of) the base is short. If, therefore, the vowel of the base is long, then it is shortened. The coda of the base is not copied with this class of suffix. (21-22) exemplify each suffix.

(21) -itỷak 'afraid/fear'

a. wiiwikitỷak (*wiikwikitỷak)
RED-wik-itỷak
RED-NEG-afraid/fear
'Not afraid of anything'

[15] Thanks to Rachel Wojdak for calling my attention to this and Type VII.

b. siisicitʸaksiš (*siicsicitʸaksiš)

RED-siic-itʸak-siš

RED-maggot-afraid/fear

'I am afraid of maggots.'

cf. siičʔiš 'it is a maggot.'

c. čiičišxitʸak

RED-čišx-itʸak

RED-dirty-afraid/fear

'afraid of s.t. dirty'

d. ḥiiḥiyitʸak

RED-ḥiyi-itʸak

RED-snake-afraid/fear

'Fearing snakes'

(22) -(k)časči 'to play on someone's side'

a. wiiwikčasči (*wiikwikčasči)

RED-wik-(k)časči

RED-NEG-to play (on someone's side)

'Not participating..'

b. ʔuuʔuščasči (*ʔuušʔuščasči)

RED-ʔuuš-(k)časči

RED-some-to play (on someone's side)

'S/he is on s.o.'s side in a team.'

cf. ʔuušnaak 'to appreciate something'

c. ʔaaʔayasči

RED-ʔaya-(kča)sči

RED-many-to play (on someone's side)

'Many on someone's side'

5.1.1.2.7 Class VII: Red=σμ; Base=$_1$σμμ

Three suffixes belong to this class: -sapi 'to depend on', -ṅuk 'on the hand', and -suɬ 'on the eyes'.[16] The process is exactly opposite to Class VI reduplication: the reduplicant is always short, but if (the first syllable of) the base is underlyingly short, then it is lengthened as in (23). Of these three suffixes, -sapi does not allow coda reduplication.

(23) -sapi 'to depend on'

a. wiwiiksapiʔiš (*wikwiiksapiʔiš)
RED-wik̇-sapi-ʔiš
RED-NEG-to depend on-3sg/IND
'S/he is depending on nothing.'

cf. wikʔiš .. 'it is not...'

b. ʔuʔuušsapiʔiš (*ʔušʔuušsapiʔiš)
RED-ʔuuš-sapi-ʔiš
RED-some-to depend on-3sg/IND
'S/he is depending on someone.'

c. ʔaʔaaqisapiḥsuu waaɬak mituuni
RED-ʔaqi-sapi-ḥsuu waɬ-ak mituuni
RED-what-to depend-2pl/INT to go-DUR Victoria
'What are you depending on to go to Victoria?'

cf. ʔaqiḥ 'What is it?'

[16] -suɬ 'on the eyes' raises another interesting issue: fixed segmentism. I will provide the relevant data and the issue in sections 5.1.1.2.7-8, to avoid repetition.

(24) -ṅuk 'on the hand'

a. ḥicḥiicṅuk (*ḥiḥiicṅuk)

RED-ḥic-ṅuk

RED-feces-on the hand

'Feces on the hand'

cf. ḥicmis 'feces'

b. tupktuupkṅuk (*tutuupkṅuk)

RED-tupk-ṅuk

RED-black-on the hand

'Black hand (e.g. from grease)'

cf. tupkʔiš 'It is black.'

c. č'isx̣č'iisx̣ṅuk (*č'ič'iisx̣ṅuk)

RED-č'isx̣-ṅuk

RED-dirty-on the hand

'Dirty hands'

cf. č'isx̣ʔiš 'It is dirty'

d. ƛ'aqƛ'aaqṅuk

RED-ƛ'aaq-ṅuk

RED-grease/lard-on the hand

'lard on the hand'

e. nanaawinkṅuk

RED-naawink-ṅuk

RED-slow-on the hand

'(working) slow using hands'

5.1.2 Analysis

Since McCarthy (1979), Marantz (1982), Kiparsky (1986) and McCarthy & Prince (1986), much theoretical attention has been given to partial reduplication. Under the Templatic Prosodic Morphology, partial reduplication is performed to satisfy templatic requirements which are specified for a reduplicative morpheme. Recently, Downing (2000, 2001) has claimed that reduplication-specific prosodic constraints determine reduplicant size.

On the other hand, Generalized Template Theory (McCarthy & Prince 1994, Urbanczyk 1995) implements general phonological constraints which derive the shape of the reduplicant through indirect reference to morphological categories such as 'Affix'. Further, the A-templatic approach, favored in recent work, assumes systems where various patterns of reduplication cover cross-linguistic possible range, and argues for the Emergence of the Unmarked (TETU) effect, without reduplication-specific templates (Urbanczyk 1996, 1999; Spaelti 1997; Gafos 1998; McCarthy & Prince 1999). Apparently, the patterns of reduplication in Nuu-chah-nulth might be treated under any mechanisms. However, as we will see when we discuss fixed segmentism in reduplication, the approach taken in the thesis has more advantages.

Nuu-chah-nulth reduplication can be summarized as follows. Both the reduplicant and the base exhibit multiple patterns in terms of vowel length. Moreover, the reduplicants with some class of triggering suffixes are codaless, while those with some others have codas. I provide the schematic representations of Nuu-chah-nulth reduplication below, including both vowel and coda variation, for convenience:

(25) Patterns of Nuu-chah-nulth reduplication

TYPE	RED-(1st σ of)BASE	Coda (Reduplicant)
Class I-1	CV(V)(C)-CV(V)(C)	**Yes**
Class I-2	CV(V)-CV(V)(C)	No
Class II	CVV-CV(V)(C)	No
Class III	CV-CV(V)(C)	No
Class IV	CVV(C)-CVV(C)[17]	**Yes**
Class V	CV-CV	No
Class VI	CVV-CV	No
Class VII-1	CV-CVV	No
Class VII-2	CV(C)-CVV(C)	**Yes**

We would expect that the possible full range of reduplication patterns would be 14 types: each class has either coda or not, although TETU would predict fewer cases with coda reduplication. However, Nuu-chah-nulth reduplication creates 9 patterns only: coda reduplication has been observed with classes I, IV & VII only; classes II, III, V, and VI do not have coda reduplicaton; class IV allows reduplication including the coda of the base only.

In sum, for Nuu-chah-nulth reduplication triggered by suffixes, the size of the reduplicant is consistently one syllable, but the exact shape of the reduplicant varies depending upon triggering suffixes. Also, the underlying stem is subject to change depending upon the attached suffix. These observations raise the following questions:

I. How to define the identity of the reduplicant?

II. How to treat the systematic size of the reduplicant?

III. How to treat variation in reduplicant forms in terms of vowel length and coda?

IV. How to treat modification of base forms in terms of vowel length?

V. How to treat the 9 reduplicative types within a unitary system

[17] With one of class IV suffixes, -(y)a, a coda is obligatory and fixed, /ƛ/, if it is monosyllabic and codaless. The chart does not reflect this property, but I will discuss the issue in section 5.1.1.2.7 and also see Wojdak (2002) for more comprehensive discussion.

I propose that in Nuu-chah-nulth the reduplicant shape emerges from prosodic requirements manifested in some suffixes (for the first and second problems) and that the surface shapes of both reduplicant and base are determined by metrical requirements, which are also specified for each triggering suffix (for the third and fourth problems). In addition, I suggest that lexically indexed faithfulness constraints cause variation between the 9 types in terms of the presence/absence of reduplicant coda and modification of the base vowel length (for the third, fourth, and fifth problems). The following three sections discuss each argument.

5.1.2.1 Prosodic characterisation of reduplicants

Adapting Marantz (1982), McCarthy & Prince (1986), Downing (2000, 2001), and Pulleyblank (*to appear*), I suggest that each reduplication-triggering suffix manifests prosodic requirements to be satisfied on the surface as seen in (25).

(26) σ…ƛa (for example)

They could be called circumfixes, where the prefix part consists only of a prosodic element and the suffix consists of both prosodic and melodic elements. It is still controversial whether this kind of affixation should be named as circumfixation, i.e. a single morpheme whose constituents are discontinuous, or whether it consists simply of a suffix and a concomitant prefix. The typical counter-example against the 'circumfix' approach is the German past participle, ge…t as in *gewandert* 'wandered', which has a phonetically identical form to the past tense, /t/. However, in the Nuu-chah-nulth case, the suffixes in question are not used as an independent morpheme unlike the German past participle (see Spencer 1991 for more discussion). To discuss the morphological aspects of circumfixation is beyond the scope of the thesis; hence, I do not develop more arguments for circumfixation.

Such prosodic requirements on each suffix cause a reduplicative prefix on the surface in a way to be examined shortly. This templatic approach is the same as, in particular, Downing (2000, 2001). However, Downing treats the issue of the reduplicant size grammatically, i.e., using a constraint which defines the size of the reduplicant, while my approach tries to solve the problem lexically, i.e. with lexically-specified prosodic requirements. These two approaches apparently achieve the same goal, but I will show later that the lexical approach has an advantage in dealing with the issue of reduplicant shape, at least in Nuu-chah-nulth (see sections 5.1.1.2.7-8).

Prosodic requirements manifested as a cooccurring monosyllabic prefix define the identity of the reduplicant, both prosodically and morphologically, and its size. However, as we saw above, the reduplicant and the base vary in vowel length. Vowels in reduplicative prefixes surface as long with class I, II, IV and VI suffixes, while surfacing as short with class I, III, V, and VII suffixes. Moreover,

the base form is modified with class IV-VII suffixes. To treat these problems, I propose that variation of reduplicant forms and modification of base forms are due to metrical requirements specified for each triggering suffix and to the interaction between domain-specified faithfulness constraints and a constraint regulating foot-structures.

5.1.2.2 Metrical requirements of the foot

In section 3.2.5, I discussed metrical structures, in particular trochaic foot forms in Nuu-cha-nulth. Metrical requirements manifested in some suffixes, i.e. vowel-lengthening and –shortening suffixes, cause modification to morphemes in terms of vowel length, when they combined with a stem. Although trochaic foot forms are only required in vowel alternation via the two processes, both iambic and trochaic foot forms are found in reduplication. Crowhurst (1991) suggests that the inventory of primitive foot structures provided by Universal Grammar is as follows:

(27) Inventory of primitive foot structures: Crowhurst (1991:54)

Name	Prosodic Shape	#[18]
Disyllabic	[σ σ]	1
Bimoraic	[μ μ]	2
Left-heavy	[μμ μ]	3
Right-heavy	[μ μμ]	4
Heavy	[σμμ σμμ]	5

According to Crowhurst, all these foot structures are observed cross-linguistically, citing Hayes (1987, 1991), Prince (1991), Prince & Smolensky (1991), McCarthy & Prince (1986, 1990), Hammond (1990), Ishihara (1990), Crowhurst (1990), Dresher & Lahiri (1991), and Rice (1991).

Very interestingly, when it comes to Nuu-chah-nulth reduplication, the following foot structures are found; they all belong to the primitive foot structures in (27). However, Nuu-chah-nulth foot structures need to be more finely specified: for example, two syllables + 'they must be light' in (28a), two moras linked a single syllable + another syllable with no specification of mora in (28b), two syllables + 'the first syllable must be light' in (28e).

[18] I replaced the original column with this column to simplify the exposition.

(28) Possible foot structures in Nuu-chah-nulth

a. F(oot)F(orm)I: two light syllables (σ σ)φ = (27-1)

```
(σ σ)φ
 | |
 μ μ
```

b. F(oot)F(orm)II: two syllables with 1st heavy (σ σ)φ = (27-1)

```
( σ σ )φ
  ^
  μ μ
```

c. F(oot)F(orm)III: two syllables with 1st heavy, 2nd light (σ σ)φ = (27-3)

```
(σ σ)φ
 ^ |
 μ μ μ
```

d. F(oot)F(orm)IV: two heavy syllables (σ σ)φ = (27-5)

```
(σ σ)φ
 ^ ^
 μ μ μ μ
```

e. F(oot)F(orm)V: two syllables with first light: (σ σ)φ = (27-1)

```
(σ σ)φ
 |
 μ
```

f. F(oot)F(orm)VI: two syllables with first light; second heavy: (σ σ)φ = (27-4)

```
(σ σ)φ
 | ^
 μ μ μ
```

As metrical requirements manifested in some suffixes, expressed as foot structures, are related to modification of some roots/stems in vowel length, so multiple forms of the reduplicant and modification of the base in vowel length can be due to the same requirements. Hence, I suggest that each suffix (except for class I) is specified for one of these foot forms as in (30-35). This is summarised in (29). Note that with class I suffixes, RED forms an independent foot, while with class II-VII suffixes, RED forms either a trochaic or iambic foot with the base.

(29) Surface foot structure of each class

TYPE	RED-BASE	Foot form
Class I	CV(V)-CV(V)	No specification
Class II	CVV-CV(V)	(30): FFII
Class III	CV-CV(V)	(31): FFV
Class IV	CVV-CVV	(32): FFIV
Class V	CV-CV	(33): FFI
Class VI	CVV-CV	(34): FFIII
Class VII	CV-CVV	(35): FFVI

(30) Class II: FFII: two syllables with 1st heavy $(\sigma \quad \sigma)\varphi$
$\wedge$
$\mu\ \mu$

(31) Class III: FFV: two syllables with 1st light: $(\sigma \quad \sigma)\varphi$
$|$
μ

(32) Class IV: FFIV: two heavy syllables $(\sigma \quad \sigma)\varphi$
$\wedge\ \wedge$
$\mu\ \mu\ \mu\ \mu$

(33) Class V: FFI: two light syllables $(\sigma \quad \sigma)\varphi$
$|\quad |$
$\mu\ \ \mu$

(34) Class VI: FFIII: two syllables with 1st heavy, 2nd light $(\sigma \quad \sigma)\varphi$
$\wedge\ |$
$\mu\ \mu\ \mu$

(35) Classes VI: FFVI: two syllables with 1st light, 2nd heavy: $(\sigma \quad \sigma)\varphi$
$|\ \wedge$
$\mu\ \mu\ \mu$

Recall that with vowel lengthening or shortening suffixes, either only the first syllable of the root morpheme is lengthened (in vowel lengthening) or the first two syllables of the stem are shortened (in vowel shortening). Cases with only the second syllable of the stem lengthened or shortened or cases with only the first syllable of the stem is shortened are not attested in Nuu-chah-nulth. These prosodic

characteristics in Nuu-chah-nulth can only be compatible with trochaic foot structures, while multiple patterns observed in reduplication cannot result from only one type of foot forms. Therefore, we can find both trochaic and iambic foot forms in the reduplication patterns. Note also that with class II suffixes, either foot form II or VI can be used, which are of the same structure.

Such different specifications of foot structure above drive the multiple patterns both in the reduplicant and the base, with the interaction of the constraints below, some of which I make use of for vowel lengthening and shortening processes as well (see section 3.2.5: (241a)).

(36) MAXFootForm: A foot must agree with the metrical requirement specified on suffixes, if any.

5.1.2.3 Indexation of faithfulness constraints

Patterns of reduplication in Nuu-chah-nulth exhibit variation between reduplicant forms in terms of the presence/absence of coda as well as variation in vowel length as we discussed above. To treat the problem, I adopt the proposal of Itô & Mester (1999). Lexical/stratal variation is due to the ranking of faithfulness constraints.[19] The reduplicants of class II, III and V-VI, and some of class I and VII suffixes are codaless, while the base consistently maintains its coda. I propose that this is due to different ranking status between indexed faithfulness constraints with respect to the markedness constraint NOCODA.

First, the following input-output faithfulness constraints, which are domain-specified, ensure the identity between the input and output correspondents.

(37) Input-Output faithfulness: δ=all classes

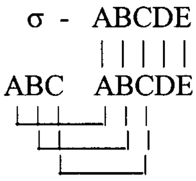
a. MAXIO$_\delta$: Every segment of the input in the domain of δ has a correspondent in the output.

b. DEPIO$_\delta$: Every element in the output in the domain of δ has a correspondent in the input.

Second, following Spaelti (1997) and Pulleyblank (to appear), I interpret the identity relationship between the reduplicative prefix and the base by transitivity as seen in (38). The input-reduplicant correspondence is indirectly related via the base; thus, a constraint is needed which requires the prosodic prefix to have featural content, rather than a constraint which requires the input-output faithfulness relationship such as DEPIO. The relevant constraint is INTEGRITY (39) (see McCarthy & Prince 1995).

[19] Also see Buckley 1996, Smith 1997, 1998a,b, 1999, 2000, 2001, Odden 1998, Kim 2001 for discussion of constraints subject to morphological/lexical domains.

(38) Input:



(39) INTEGRITY: No segment of the input has multiple correspondents in the output.

(38) violates (39), because ABC of the input each have the two identical output elements on the surface. However, this constraint is violable, when higher-ranked constraints are at stake. That is, the violations of INTEGRITY result in order to satisfy the requirement that the base have a correspondent in the reduplicant and vice versa. The relevant constraints are MAXBR and DEPBR as defined in (40), which are morphological domain-specified. Moreover, they play a crucial role in determining the shape of the reduplicant in terms of the presence/absence of coda, as we will see below.[20]

(40) Base-Reduplicant Faithfulness: δ=all classes

a. MAXBR$_\delta$: Every element of the base in the domain δ of has a correspondent in the reduplicant.

b. DEPBR$_\delta$: Every element of the reduplicant in the domain of δ has a correspondent in the base.

Lexically domain-specified MAX/DEPIO$_\delta$, in (37), and MAX/DEPBR$_\delta$ constraints, which, as will be clear throughout the discussion, are also phonologically domain-specified.

As will be clearer when I discuss the relevant cases, the identity between the reduplicant and the base in the domain of class I-1, IV and VII-1 is crucial with respect to the coda, forcing a violation of NOCODA, while one in the domain of class I-2, II, III, V, VI, and VII-2 can be suppressed to obey the higher-ranked NOCODA. Also, the interaction between the MAX/DEPIO and MAX/DEPBR constraints, subject to both phonological and lexical domains which are indicated on them, and one between FootForm and the faithfulness constraints lead to variation in both bases and reduplicants.

(41) shows language-specific ranking status of all the constraints to be used in the process under discussion.

---

[20] While Pulleyblank (to appear) claims that reduplication-specific constraints such as FAITHBR constraints are not necessary in the case of Yoruba reduplication, my analysis must make use of the constraints to treat modification of the base forms in Nuu-chah-nulth, which will be made explicit throughout discussion.

(41) MAX/DEPIO(SEG), MAXIO(μ)$_{[I\text{-}IV,VII]}$, DEPIO(μ)$_{[I\text{-}III,\ V\text{-}VI]}$

⇩

MAXFootForm

⇩

MAXIO(μ)$_{[V,VI]}$, DEPIO(μ)$_{[IV,VII]}$

⇩

MAX/DEPBR $_{[I\text{-}1,IV,\ VII\text{-}1]}$

⇩

NOCODA

⇩

MAX/DEPBR $_{[I\text{-}2,II,III,V,\ VI,\ VII\text{-}2]}$

⇩

INTEGRITY

Now, we will see how these constraints and their language-specific ranking work to create the surface forms in the reduplication context. In the following tableaux, I indicate the base via underlining. It seems that there is no generally agreed formal definition of the base, sometimes referring to it (and the reduplicant as well) in an arbitrary way for the purpose of analysis (see Spaelti 1997; cf. Urbanczyk 1995). For present purposes, I simply consider the base as the root morpheme of the stem to which the reduplicant affixes, following general practice (McCarthy & Prince 1993, Spaelti 1997). I do not count each triggering-suffix as part of the base. As seen in many cases, a triggering suffix does not have to be immediately adjacent to a root morpheme. It is possible that there are one or more other suffixes intervening between the root and a triggering suffix. The suffix just causes (part of) a root morpheme to be reduplicated, but does not include itself as part of the base.

I will start with Class I-1 suffixes, with which the reduplicant is completely identical with the base in vowel length: the reduplicant is short/long if the base is short/long and also the coda is copied.

(42) Class I-1

yacyacmiɬʔaƛʔisƛa

RED-yac-miɬ-ʔaƛ-ʔiš-ƛa

RED-to walk-on the floor-SEQ-3sg/IND-again

'She is walking around again now.'

(43) Tableau

/σ-yac...-ƛa/	MAXIO	DEPIO	**MAXBR I-1**	**DEPBR I-1**	NO CODA	INTEGRITY[21]
☞a. $_{\sigma}$[yac]yac					**	*** (yac)
b. $_{\sigma}$[ya]ya	*! (c)					** (ya)
c. $_{\sigma}$[ya]yac			*!(c)		*	** (ya)
d. $_{\sigma}$[yac]ya	*! (c)				*	** (ya)
e. $_{\sigma}$[yac]yaac		*!(μ)	*(μ)		**	*** (yac)
f. $_{\sigma}$[ ]yac			*!**		*	

Candidates **b and e** are ruled out by violating the high-ranked constraints MAXIO and DEPIO, respectively: the input stem-final consonant /c/ does not surface in **b** and a mora is added on the surface in **e**. Recall that the reduplicant does not cause a DEPIO violation, but rather an INTEGRITY violation. It must be violated to satisfy MAXBR, which outranks INTEGRITY. Candidates **c, d, and f** violate MAXBR and DEPBR, respectively, which is higher-ranked than NOCODA in the domain of class I-1. The reduplicant does not copy the base-final consonant /c/ in c, and /c/ in the reduplicant does not have a correspondent in the base in **d**. Candidate **a**, which obeys all these high-ranked constraints, is selected as an optimal output. MAXFootForm is not relevant in reduplication triggered by class I suffixes, because the suffixes do not impose a metrical structure to be realised on the surface. Note that reduplication is limited to a single syllable. As suggested above, it is due to the underlying single-syllabic prefix (without featural content).

Consider the following example, which has a bisyllabic base.

(44) The case of a bisyllabic base

tatamis-ƛa (*tamtamisƛa or *tamistamisƛa)

RED-tamis-ƛa

RED-to drift-again

'To keep drifting'

This case can have candidates such as (45g and i), in addition to candidates of the types found in (43b-f).

[21] I simply count the number of INTEGRITY violations as melodic doubling, ignoring moraic doubling.

(45) Tableau

/σ-tamis-λa/	MAXIO	DEPIO	INTEGRITY (σ)	MAXBRσ-STRUC	**MAXBR I-1**	**DEPBR I-1**	NO CODA	INTEGRITY
☞ a. $_{\sigma}$[ta]tamis					***		*	**
:								
g. $_{\sigma}$[ta] $_{\sigma}$[mis]tamis			*!				**	*****
i. $_{\sigma}$[tam]tamis				*!	**		**	***

To prevent these candidates from appearing as surface forms, we need the following two constraints.

(46) a. INTEGRITY(σ): The input syllable must not have multiple correspondents in the output.

b. MAXBRσ-STRUC: The constituents of the reduplicant must match with the counterparts in the base in terms of syllabic structure.

Violation of INTEGRITY(σ) is fatal, while having multiple correspondents of the input segments is tolerated as the ranking shows. Therefore, candidate **g** is ruled out, with the consequence that reduplication is limited only to a single syllable. To observe (46b), the reduplicant has the same syllabic structure as the counterpart of the base. (See parallel syllable structure conditions in work on language production such as Nooteboom 1969, Stemberger 1985a: ch. 6). In candidate **i**, the coda of the monosyllabic reduplicant /m/ is an onset of the second syllable of the base, violating MAXBRσ-STRUC. Although the reduplicant must copy the base maximally to observe MAXBR, a requirement to maintain a faithful relationship between the base and reduplicant in terms of syllable structure has priority over the constraint. In sum, with class I-1 suffixes, the reduplicant can have a coda, but only if (the first syllable of) the base must have a coda as well.

Class I-2 suffixes have the same pattern as I-1 suffixes except for the fact that the coda of the base is not copied. This difference is due to different ranking status among domain-specified MAXBR constraints. To obtain the no-coda effect in the reduplicant, the ranking of MAXBRI-2 with respect to NOCODA must be NOCODA >> MAXBR, which is reflected in tableau (48) with the relevant example (47).

(47) Class I-2

čačapx̣ʔaɬuk

RED-čapx̣-ʔaɬuk

RED-man-to look after

'to look after a man/husband'

(48) Tableau

/Rσ-čapx̣-ʔaɬuk/	MAXIO	DEPIO	NO CODA	**MAXBR I-2**	**DEPBR I-2**	INTEGRITY
☞ a. $_{\sigma}$[ča]čapx̣			*	**(px̣)		**
b. $_{\sigma}$[čapx̣]čapx̣			**!			****
c. $_{\sigma}$[ča]ča	*!*					**
d. $_{\sigma}$[ča]čaapx̣		*!(μ)	*	** (px̣) * (μ)		**
e. $_{\sigma}$[ ]čapx̣			*	***!* (čapx̣)		

As shown in tableau (48), candidates **c and d** are ruled out by violating the high-ranked constraints MAXIO and DEPIO, respectively, by deleting the coda consonants in **c** and by inserting a mora in **d**. Candidates **a and b** tie in these constraints. Note that the MAX/DEPBR constraint in the domain of class I-2 is lower-ranked than NOCODA. Consequently, candidate **a** is selected as an optimal form.

With class II suffixes, the reduplicant always has a long vowel but the base is not affected.[22] Recall that class II suffixes are specified for the following metrical requirement.

(49) Class II: FFII-two syllables with 1st heavy $(\underset{\mu\ \mu}{\underset{\wedge}{\sigma\quad\sigma}})_{\varphi}$

(50) Class II

yaayaqƛsťaɬʔiik

RED-yaqƛ-sťaɬ-ʔiik

RED-disliking-each other- s.o. who always does s.t.

's.o. who always dislikes another'

[22] From now on, I do not include candidates relevant to HAVESPEC for space reasons.

(51) Tableau

/Rσ-yaqƛ...ʔiik(σ σ)$_{\varphi}$/ ∧ μ μ	MAXIO	DEPIO	MAX Foot Form	NO CODA	**MAXBR II**	**DEPBR II**	INTEGRITY
☞ a. {$_{\sigma}$[yaa]<u>yaqƛ</u>}$_{\varphi}$				*	**(qƛ)	*(μ)	**
b. {$_{\sigma}$[ya]<u>yaqƛ</u>}$_{\varphi}$			*!	*	**(qƛ)		**
[23]c. {$_{\sigma}$[yaqƛ]<u>yaqƛ</u>}$_{\varphi}$			*!	**			****
d. {$_{\sigma}$[yaaqƛ]<u>yaaqƛ</u>}$_{\varphi}$		*! (μ)		**			****
e. {$_{\sigma}$[yaa]<u>yaaqƛ</u>}$_{\varphi}$		*! (μ)		*	**(qƛ)		**
f. {$_{\sigma}$[yaa]<u>ya</u>}$_{\varphi}$	*!*(qƛ)					*(μ)	**
g. {$_{\sigma}$[yaaqƛ]<u>yaqƛ</u>}$_{\varphi}$				**!		*(μ)	****

In tableau (51), candidates **d, e, and f** fail to maintain the correspondence between the input and the output by deleting the input consonants in **f**, and by inserting a mora on the stem (i.e. base) in **d and e**. Note that the identity relationship between reduplicant and input element is transitive. Whether the reduplicant is long or short, this does not cause MAX/DEPIO violation, although it may cause MAX/DEPBR violation. Candidates **b and c** do not obey the metrical requirement that is specified for the suffix: a foot with two moras on the 1st syllable. This leads to a fatal violation of MAXFootForm. Candidate **g** is ruled out by fatally violating NOCODA. Candidate **a**, which is the only candidate obeying or incurring fewer violations of the high-ranked constraints, is chosen as an optimal output.

With class III suffixes, the reduplicant is always short, and the base is unaffected. (52) is the metrical requirement specified for the suffixes and (53) is one of the relevant examples with tableau (54).

(52) Class III: FFV: two syllables with first light: (σ σ)$_{\varphi}$
|
μ

(53) Class III

ʔuʔuušyukʷapaƛ̓i

RED-ʔuuš-yukʷ-ʔap-ʔaƛ-ʔi

RED-some-to cry-CAUS-SEQ-3sg/IMP

'Make her cry for something!'

[23] To compare candidate **b and c**, they violate MAXFootForm in the same way, whether the surface has coda in the reduplicant or not. Recall that Nuu-chah-nulth consonants cannot be moraic.

(54) Tableau

/Rσ-ʔuuš-yukʷ(σ σ)$_\varphi$/ μ	MAXIO	DEPIO	MAX Foot Form	NO CODA	**MAXBR III**	**DEPBR III**	INTEGRITY
☞ a. {$_\sigma$[ʔu]ʔuuš}$_\varphi$				*	*(š) *(μ)		**
b. {$_\sigma$[ʔuu]ʔuuš}$_\varphi$			*!	*	*(š)		**
c. {$_\sigma$[ʔuuš]ʔuuš}$_\varphi$			*!	**			***
d. {$_\sigma$[ʔuš]ʔuuš}$_\varphi$				**!	*(μ)		***
e. {$_\sigma$[ʔuš]ʔuš}$_\varphi$	*!(μ)			**			***
f. {$_\sigma$[ʔu]ʔuu}$_\varphi$	*!(š)				*(μ)		**

As with class II suffixes, the identity between the base and the reduplicant is not crucial regarding the vowel length and coda. The only difference from class II is that reduplication-triggering suffixes from class III require the first syllable of the foot to be monomoraic on the surface. Candidates **b and c** do not obey this requirement, which leads to a violation of MAXFootForm. Candidates **e, and f** also violate the high-ranked constraint: one of the input stem moras is deleted in **e**, and the stem-final consonant does not surface in **f**. Candidate **d** is ruled out by violating NOCODA, which is higher-ranked than MAX/DEPBR in the domain of class III. This results in the selection of candidate **a** as an optimal output, which trivially violates the latter.

With class IV suffixes, both the reduplicant and the base must be long, which sometimes leads to modification of the base in terms of vowel length. This is due to the following metrical requirement specified for the suffixes.

(55) Class IV: FFIV: two heavy syllables (σ σ)$_\varphi$
μ μ μ μ

Before we see the tableau, recall that I mentioned that two IO Faithfulness constraints, MAXIO and DEPIO need to be ranked depending on phonological and morphological classes. Until now, the ranking was not crucial and thus I did not provide the detailed ranking status in the previous tableaux. However, we need to consider their ranking status subject to phonological morphological classes at this point. In the domain of class IV (in fact, class VII as well), DEPIO is lower-ranked than MAXFootForm, which leads to lengthening of the base vowel.

(56) DEPIO$_{[I\text{-}III,\ V\text{-}VI]}$ >> FootForm >> DEPIO$_{[IV,\ VII]}$

(57) Class IV

cuuccuuca?iš

RED-cuc-(y)a-?iš

RED-to scratch-continuously-3sg/IND

'S/he is continuously scratching.'

(58) Tableau

/Rσ-cuc-(y)a (σ σ)$_\varphi$/ ∧ ∧ μ μ μ μ	MAXIO	MAXFoot Form	DEPIO IV	**MAXBR IV**	**DEPBR IV**	NO CODA	INTEGRITY
☞a. {$_\sigma$[cuuc]<u>cuu</u>}$_\varphi$<u>c</u>a			* (μ)			*	***
b. {$_\sigma$[cuc]<u>cuu</u>}$_\varphi$<u>c</u>a		*!	* (μ)	*(μ)		*	***
c. {$_\sigma$[cuc]<u>cu</u>}$_\varphi$<u>c</u>a		*!				*	***
d. {$_\sigma$[cuuc]<u>cu</u>}$_\varphi$<u>c</u>a		*!			*(μ)	*	***
e. {$_\sigma$[cuu]<u>cuu</u>}$_\varphi$<u>ca</u>			* (μ)	*!(c)			**
f. {$_\sigma$[cuu]<u>cuu</u>}$_\varphi$ya	*!(c)		* (μ)				**

As seen in the tableau, candidate **f** is ruled out by deleting an input consonant /c/, a violation of MAXIO. Candidates **b-d** do not obey MAXFootForm. The identity between the base and the reduplicant is crucial in the domain of class IV, which forces trivial violation of NOCODA. Candidate **e** obeys NOCODA but thereby violates MAXBR fatally. Consequently, candidate **a** is chosen as an optimal output.

With class V suffixes, the reduplicant is always short and the base vowel is shortened, if it is underlyingly long. This means that MAXIO[μ] in the domain of class V is not crucially high-ranked. The MAXIO constraint is high-ranked in the domain of class I-IV & VII, whether the element of interest is moras or segments. On the other hand, in the domain of class V (in fact, also in the domain of VI), MAXIO[Seg.] and MAXIO[μ] are ranked differently. An input segment must surface, while an input mora can be suppressed when some other phonological requirements are at stake. In sum, the apparently complicated aspects regarding reduplication can be simplified as seen in the following ranking in (59).

(59) $\text{MAXIO}_{\text{I-IV,VII}}$, $\text{MAXIO[seg]}_{\text{V-VI}}$ >> $\text{MAXIO[}\mu\text{]}_{\text{V-VI}}$

(60) is the metrical structure required for class V suffixes.

(60) Class V: FFI: two light syllables (σ σ)$_\varphi$
| |
μ μ

Now, consider the relevant example, (61), with tableau, (62).

(61) Class V
ƛ̓iƛ̓ixʷak̓uk
RED-ƛ̓iixʷ-(a)a-k̓uk
RED-to smile/laugh-DUR-to resemble
'Smirk'

(62) Tableau

/Rσ-ƛ̓iixʷ...k̓uk / (σ σ)$_\varphi$ | | μ μ	MAXIO [Seg.]$_V$	DEPIO	MAX Foot Form	MAXIO [μ]$_V$	NO CODA	**MAXBR V**	**DEPBR V**	INTEGRITY
☞a. {$_\sigma$[ƛ̓i]ƛ̓i}$_\varphi$xʷa				*		*(xʷ)		**
b. {$_\sigma$[ƛ̓ii]ƛ̓ii}$_\varphi$xʷa			*!			*(xʷ)		**
c. {$_\sigma$[ƛ̓i]ƛ̓ii}$_\varphi$xʷa			*!			*(xʷ) *(μ)		**
d. {$_\sigma$[ƛ̓ixʷ]ƛ̓i}$_\varphi$xʷa				*	*!			***
e. {$_\sigma$[ƛ̓i]ƛ̓i}$_\varphi$a	*! (xʷ)			*				**
f. {$_\sigma$[ƛ̓ii]ƛ̓i}$_\varphi$xʷa			*!	*		*(xʷ) *(μ)		**

Candidate **e** violates MAXIO[Seg], because the input stem-final consonant [xʷ] is deleted. Candidates **b, c, and f** are ruled out by violating the high-ranked MAXFootForm constraint. Candidate **d** has a coda in the reduplicant, which causes a fatal violation of NOCODA. Candidate **a** does not achieve complete identity between the base and the reduplicant, in order to less violate the markedness constraint.

The final pair, classes VI and VII, exhibits an opposite property from class IV and V, showing moraic polarity. First, consider the following example from Class VI suffixes with which the reduplicant has a long vowel, but the base vowel is shortened, if it is underlyingly long. (63) is the metrical structure required for this class.

(63) Class VI: FFIII: two syllables with one heavy (σ σ)$_\varphi$
/\ |
μ μ μ

(64) is the relevant example with tableau (65).

(64) Class VI

a. siisicityʼaksiš

sii-siic-ityʼak-siš

RED-maggot-afraid/fear

'I am afraid of maggots.'

(65) Tableau

/Rσ-siic-ityʼak/ $(\sigma\ \ \sigma)_\varphi$ ∧ | μ μ μ	MAXIO [Seg.]$_{VI}$	DEPIO	MAX Foot Form	MAXIO [μ]$_{VI}$	NO CODA	**MAXBR VI**	**DEPBR VI**	INTEGRITY
☞a. $\{_\sigma$[sii]<u>si</u>$\}_\varphi$<u>c</u>i				*		*(c)	*(μ)	**
b. $\{_\sigma$[sii]<u>sii</u>$\}_\varphi$<u>c</u>i			*!			*		**
c. $\{_\sigma$[si]<u>si</u>$\}_\varphi$<u>c</u>i			*!	*		*		**
d.$\{_\sigma$[siic]<u>sii</u>$\}_\varphi$<u>c</u>i			*!		*			***
e. $\{_\sigma$[sii]<u>si</u>$\}_\varphi$	*! (c)			*			*(μ)	**
f. $\{_\sigma$[sii]<u>sii</u>$\}_\varphi$	*! (c)		*					**
g. $\{_\sigma$[si]<u>sii</u>$\}_\varphi$<u>c</u>i			*!			*(c) *(μ)		**
h. $\{_\sigma$[siic]<u>si</u>$\}_\varphi$<u>c</u>i				*	*!		*(μ)	***

In tableau (65), what is notable are candidates **b, c, d, and g**. They are all ruled out by violating MAXFootForm. With class VI suffixes, the first syllable of the foot must be heavy and the second light. Candidates **a and h** tie on these high-ranked constraints. NOCODA determines the optimal output, which is candidate **a**.

Finally, consider the final class, VII, which can be classified into VII-1 and -2 according to whether the coda of the base is copied or not. Both subsets exhibit moraic polarity as in class VI, but in an opposite way, which is due to the following metrical structure required for the class.

(66) Classes VII: FFVII: two syllables with second heavy: $(\sigma\ \ \sigma)_\varphi$
∧ \|
μ μ μ

(67) is the relevant example and (68) illustrates the implication of the template and the constraints.

(67) Class VII-1

a. ḥicḥiicn̓uk

RED-ḥic-n̓uk

RED-feces-on the hand

'Feces on the hand'

(68) Tableau

/σ-ḥic-n̓uk(σ σ)$_{\varphi}$/ | ∧ μ μ μ	MAXIO	MAX Foot Form	DEPIO $(\mu)_{VII}$	**MAXBR VII-1**	**DEPBR VII-1**	NO CODA	INTEGRITY
☞ a. $\{_{\sigma}$[ḥic]<u>ḥiic</u>$\}_{\varphi}$			*	*(μ)		**	***
b. $\{_{\sigma}$[ḥii]<u>ḥiic</u>$\}_{\varphi}$		*!	*	*(c)		*	**
c. $\{_{\sigma}$[ḥi]<u>ḥic</u>$\}_{\varphi}$		*!		*(c)		*	**
d. $\{_{\sigma}$[ḥic]<u>ḥic</u>$\}_{\varphi}$		*!				**	***
e. $\{_{\sigma}$[ḥii]<u>ḥi</u>$\}_{\varphi}$	*!(c)	*			*(μ)		**
f. $\{_{\sigma}$[ḥii]<u>ḥii</u>$\}_{\varphi}$	*!(c)	*	*				**
g. $\{_{\sigma}$[ḥi]<u>ḥiic</u>$\}_{\varphi}$			*	*(c) *!(μ)		*	**
h. $\{_{\sigma}$[ḥii]<u>ḥic</u>$\}_{\varphi}$		*!		*(c)	*(μ)	*	**

As seen in the tableau (68), **candidates b, c, d, f, and h** are ruled out by violating MAXFootForm. With class VII suffixes, the foot structure must have the first syllable light and the second heavy, but these candidates have different foot structure from the input form. **Candidates a and g** tie on these all high-ranked constraints and DEPIO. MAXBR determines the final winner, which is candidate **a**. Note that NOCODA is lower ranked than MAXBR in the domain of class VII-1.

(69) is the case where the reduplicant does not have a coda, which is due to NOCODA outranking MAX/DEPBR in the domain of VII-2 as illustrated in (70). The selection process is the same as VII-1.

(69) Class VII-2

a. wiwiiksapiʔiš

RED-wik-sapi-ʔiš

RED-NEG-to depend on-3sg/IND

'S/he is depending on nothing.'

(70) Tableau

/Rσ-wik-sapi(σ σ)$_\varphi$/ | ∧ μ μ μ	MAXIO	MAX Foot Form	DEPIO (μ)$_{VII}$	NO CODA	**MAXBR VII-2**	**DEPBR VII-2**	INTEGRITY
☞ a. {$_\sigma$[wi]<u>wiik</u>}$_\varphi$			*	*	*(k) *(μ)		**
b. {$_\sigma$[wii]<u>wiik</u>}$_\varphi$		*!	*	*	*(k)		**
c. {$_\sigma$[wi]<u>wik</u>}$_\varphi$		*!		*	*(k)		**
d. {$_\sigma$[wik]<u>wik</u>}$_\varphi$		*!		**			***
e. {$_\sigma$[wii]<u>wi</u>}$_\varphi$	*! (k)	*				*(μ)	**
f. {$_\sigma$[wii]<u>wii</u>}$_\varphi$	*! (k)	*	*				**
g. {$_\sigma$[wik]<u>wiik</u>}$_\varphi$			*	**!	*(μ)		***
h. {$_\sigma$[wii]<u>wik</u>}$_\varphi$		*!		*	*(k)	*(μ)	**

In sum, although patterns of Nuu-chah-nulth reduplication exhibit complicated properties, they can be treated with only a simple set of constraints. The constraints used are universal in that they play a role in determining surface forms in other languages as well, such as NOCODA, while some of them still have language-specific properties: for example, morphological-domain-specified faithfulness constraints. The reduplicative morpheme is specified as a prosodic element, which is σ. This circumfixation leads to the combination of a monosyllabic prefix and a suffix. Moreover, metrical requirements specified for suffix determine the surface reduplicant form, sometimes leading to modification of the base. On the other hand, because, whether the base is mono- or bi-syllabic, the reduplicant is always monosyllabic, one might suggest that the size of the reduplicant results from the emergence of the unmarked effect (for an A-templatic approach) or from a constraint which defines the size of the reduplicant: e.g. RED=σ, (for a templatic approach). The presence of underlying prosodic elements leading to reduplication, however, is supported by fixed segmentism in Nuu-chah-nulth, which will be discussed in the next section.

In conclusion, the interaction of prosodic/metrical requirements and domain-specified faithfulness constraints, and one of faithfulness and markedness constraints cause variation in both reduplicant and

base forms. This treatment straightforwardly explains the complicated properties of Nuu-chah-nulth reduplication.

5.1.3 Exceptional cases

Reduplication triggered by suffixes consistently exhibits the patterns described above, but there are several exceptional cases with some suffixes.

(71) with –k̓uk

a. siisiick̓uk (*sisick̓uk)
RED-siic-k̓uk
RED-maggot-to resemble
'rice'

b. ʔuuʔuušk̓ukʔiš (*ʔuʔušk̓ukʔiš)
RED-ʔuuš-k̓uk-ʔiš
RED-some-to resemble-3sg/IND
'S/he looks like someone.'

c. tiitiičk̓ukʔiš (*titičk̓uk)
RED-tiič-k̓uk-ʔiš
RED-alive-to resemble-3sg/IND
'S/he looks healthy.'

In (71), we would expect both the base and the reduplicant vowels to be short, according to the pattern with the suffix (cf. (28): class V). However, the underlying long vowel appears as such in the reduplicant as well as the base. I assume that this exceptional case can be treated as lexicalisation. For example, the meaning of the word in (71a) is not '(it) looks like a maggot' but 'rice'.[24] The preservation of the vowel length may be related to the lexicalised meaning. In (71b), the underlying long vowel appears on the surface and the shortened form is not allowed. I suggest that this exception is to maximise lexical contrast (Czaykowska-Higgins & Urbanczyk 2001). Consider the following example.

[24] If we add a pronominal suffix *-ʔiš*, as follows, then it can mean either 'it is rice' or 'it looks like maggots.' Interestingly, the sentence still exhibits the same length with the both meanings.

i) siisiick̓ukʔiš

(72) ʔuʔukʷukʔiš

ʔu-ʔuukʷuk-ʔiš

RED-to resemble-3sg/IND

'S/he looks like some specific person.'

(71b) means 'S/he looks like someone (the speaker does not have any specific person in mind), while in (72), the speaker thinks about a certain person s/he knows. I suppose that no shortening in (71b) results from the purpose of clear distinction between phonologically similar sequences of words. The most mysterious case is (71c), which is really an exceptional case for no morphological or semantic reasons.

(73) shows that both the presence of the reduplicant and its absence does not affect the meaning as a whole. This kind of optionality only occurs when the base is followed by the morpheme –waaqḥ 'to mean'; therefore, it can be said that it is not really an exception for the pattern of -ƛa.

(73) Optionality with -ƛa

a. ʔiʔiqḥwaaqḥƛa

ʔi-ʔiqḥ-waaqḥ-ƛa

RED-same-to mean-again

'the same meaning

cf. ʔiqḥwaaqḥƛa 'the same meaning'

b. kʷiskʷiswaaqḥƛa

kʷis-kʷis-waaqḥ-ƛa

RED-different-to mean-again

'different meaning'

cf. kʷiswaaqḥƛa 'different meaning'

5.1.4 Fixed segments in reduplication

As seen above, reduplicants generally obtain their phonological constituents from the base morphemes. However, there are two types of fixed segments which appear with reduplication-triggering suffixes.

5.1.4.1 Presence of /ƛ/ with 'Repetitive' suffixes[25]

With the suffixes -(y)a 'continuously' and -š/č 'continually', the reduplicant has a coda /ƛ/ on the surface.[26] It appears only when the base is monosyllabic and ends with a vowel, as seen in (74)-(75), (compare a case where (the first syllable of) the base has a coda). However, if the base starts with /ƛ/ or /ƛ̓/, then the alveolar affricate /c/ is inserted instead, as in (74c-d) and (75d).

(74) with –(y)a 'continously'

a. ċuuƛċuuyaʔiš
RED-ƛ-ċu-ya-ʔiš
RED-to wash-continuously-3sg/IND
'S/he does laundry continuously'

cf. ċu-kʷiƛ-it-ʔiš John ṁučičtupukʔi. 'John washed his clothes.'

cf. cuuccuucaʔiš (*cuuƛcuucaʔiš)
RED-cuc-(y)a-ʔiš
RED-to scratch-continuously-3sg/IND
'S/he is continuously scratching.'

b. kʷaaƛkʷaayaʔiš
RED-ƛ-kʷaa-ya-ʔiš
RED-to back up-continuously-3sg/IND
'S/he keeps backing up.'

cf. kʷaačiƛkʷačiƛʔiš John niʔuuƛ. 'John is backing up and ending (up to the rocks).'

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[25] Wojdak (2002) also investigates the same issue.

[26] The initial /y/ in -ya is deleted after a consonant as in (i) (see (16) for more examples); -š and -č are allomorphs of the {CONTINUALLY} suffix: the former appears after a consonant, or a low vowel /a/, and the latter after a high vowel, /i/ or /u/ (see (69)). Also see Rose (1981).

i) cuuccuucaʔiš
cuuc-cuc-(y)a-ʔiš
RED-to scratch-continuously-3sg/IND
'S/he is continuously scratching.'

c. ƛaacƛaayaʔiš

RED-c-ƛa-ya-ʔiš

RED-to split wood-continuously-3sg/IND

'S/he keeps splitting wood.'

cf. ƛačitamitʔiš naniiqsakʔi. 'John is splitting wood for his granpa.'

d. ƛ̓iicƛ̓iiyaʔišʔaɬ

RED-c-ƛ̓i-ya-ʔišʔaɬ

RED-to shoot-continuously-3pl/IND

'They keep shooting.'

cf. ƛ̓ičiƛitwaʔiš John piišpiš. 'It is said that John shot a cat.'

(75) with -š 'continually'

a. t̓iƛt̓ičʔiš

RED-ƛ-t̓i-č-ʔiš

RED-to throw-continually-3sg/IND

'S/he keeps throwing (s.t.).'

cf. t̓ičiƛitʔiš John kʷaacsac̓um. 'John threw chairs.'

cf. watqwatqšʔiš ʔišc̓iip Kyle. (*waƛwatqšʔiš)

RED-watq-š-ʔiš ʔišc̓iip Kyle

RED-to swallow-continually-3sg/IND gum

'Kyle keeps swallowing gum.'

b. suƛsukšʔiš

RED-ƛ-su(kʷiƛ)-š-ʔiš

RED-to grab-continually-3sg/IND

'S/he keeps taking s.t.'

cf. sukʷiƛ̓asʔiš y̓ukʷiiqsakʔi. 'S/he wants to get his younger sibling.'

c. kuuƛkuučʔiš

RED-ƛ-kuu-č-ʔiš

RED-to filet-continually-3sg/IND

'S/he keeps mending a mat.'

cf. kuučiƛitʔiš John. 'John was filleting (e.g. salmon for smoking).'

d. ƛacƛašʔiš.

ƛa-c-ƛa-š-ʔiš

RED-to split wood-continually-3sg/IND

'S/he is splitting wood continually'

5.1.4.2 Presence of /c/

Nuu-chah-nulth reduplication creates another kind of fixed segmentism. /c/ appears with one of the class VII suffixes *-suɬ* (also see Sapir & Swadesh 1939). As seen in (76), whether the base has a coda or not, and is monosyllabic or bisyllabic, unlike /ƛ/ insertion, it is always present. If, therefore, the base has a coda, /c/ replaces it.[27]

(76) a. k̓uck̓uuχsuɬ

RED-c-k̓uχ-suɬ

RED-residue-on the eyes

'Dirt on the eyes'

cf. k̓uχkʷačyu 'matted with dirt'

b. wicwiiksuɬ

RED-c-wik-suɬ

RED-NEG-on the eyes

'Nothing on your eyes (e.g. glasses)'

cf. wikʔiš 'It is not…'

[27] For the lengthening process of the base vowel, see 5.1.2.

c. kickiiƛuksuɬ

RED-c-kiƛ-uk-suɬ

RED-?-POSS-on the eyes

'Wearing glasses'

cf. kiƛuuk 'glasses'

d. ṁucṁuuqsuɬ

RED-c-ṁuq-suɬ

RED-burnt-on the eyes

'A burnt-color eyeball'

cf. ṁuqumɬ 'burnt around (e.g. a canoe)'

e. ʔucʔuuksuɬ

RED-c-ʔuk-suɬ

RED-another-on the eyes

'Wearing another's (glasses)'

cf. ʔukčiq 'two vessels traveling side by side'

f. ṅucṅuuqsuɬ

RED-c-ṅuq^{w}(ii)-suɬ

RED-stye-on the eyes

'stye on the eyes'

cf. ṅuq^{w}ii 'boil'

g. kickiiṅucsuɬʔiš

RED-c-kiṅuc-suɬ-ʔiš

RED-blue-on the eys-3sg/IND

'S/he has black eyes.'

cf. kiṅucakʔiš 'It is blue.'

5.1.4.3 Analysis

The examples above lead to the interesting issue of fixed segmentism. Alderete et. al (1999) distinguish two types of reduplication with fixed segmentism. They claim that fixed segments can be treated as cases of emergence of the unmarked if they are phonological defaults, but fixed segments can also be due to a process of affixation in which case they should be treated as morphologically-driven fixed segmentism (cf. Wojdak 2002).

The fixed segments in Nuu-chah-nulth reduplication, /ƛ/ and /c/, appear only with some suffixes and can be the unmarked segments neither language-internally nor cross-linguistically. It seems that their presences are morphologically motivated. Following Kim & Picanço (2003), I suggest that the fixed segments should be underlyingly specified. (Also see Wojdak 2002 for another argument in the same line). Moreover, since Nuu-chah-nulth reduplicants result from prosodic requirements, i.e. prosodic templates, manifested on some suffixes, the fixed segments are specified on the prosodic element. As I claimed above, some suffixes are specified for a prosodic element, σ, and thus the fixed segments would be specified within the underlying syllable. Recall that the fixed segments always appear as coda: the base always starts with a consonant. This means that fixed segments should be specified in the input for both phonological forms and prosodic positions. Therefore, their underlying representations would be as follows, where the position of the fixed segments within the underlyingly specified syllable is determined.

(77) σ …ya
|
Coda
|
ƛ

(78) σ …suɬ
|
Coda
|
c

There are two other problems: the context of their appearance and allomorphy. While the segment /c/ with *-suɬ* appears invariably on the surface, /ƛ/ appears only when the base morpheme ends with a vowel and is monosyllabic. In addition, the latter has an allomorph /c/, which appears when the base morpheme starts with /ƛ/ or /ƛ̓/ as in (79).

(79) a. ƛacƛašʔiš

ƛa-c-ƛa-š-ʔiš

RED-to split wood-continually-3sg/IND

'S/he is splitting wood continually'

b. ƛ̓iicƛ̓iiyaʔišʔaɬ

ƛ̓ii-c-ƛ̓i-ya-ʔišʔaɬ

RED-to shoot-continuously-3pl/IND

'They keep shooting.'

For the first problem: the contexts of the fixed segments, I propose that their distribution results from the interaction of faithfulness constraints, (80), and a constraint which prevents the presence of complex coda in a prefix, (81a), and an alignment constraint, (81b). Note that (80c) is domain-specified: this constraint is ranked differently depending on classes of triggering suffixes, as we will see in tableaux below (cf. Wojdak 2002).

(80) a. MAXIO: An input element must have a correspondent in the output.

b. MAXBR: Every element of the base has a correspondent in the reduplicant.

c. MAXBRCodaFs]δ: Every feature of the base coda has a correspondent in the reduplicant in the domain of δ (δ= a morphological class: class I.....or VII).

(81) a. NoComplexCoda]$_{Prefix}$: There is no complex coda in the domain of prefix.

b. ALIGN-/ƛ/: Align /ƛ/ with a monosyllabic root.

(80a) drives an effect by which a fixed segment appears on the surface. (80b-c) require a counterpart of the base elements in the reduplicant. (81a) disallows more than one coda consonant in the reduplicant. (81b) prevents /ƛ/ from appearing on the surface, if the root morpheme the prefixal reduplicant attaches to (i.e. the base) consists of more than on syllable.

(82) shows language-specific ranking status of these constraints: the ranking drives underlyingly specified coda segments in the reduplicant to surface.

(82) NoComplexCoda]$_{prefix}$, ALIGN-/ʔ/

⇓

MAXBRCodaFs$_{IV}$

⇓

MAXIO

⇓

MAXBRCodaFs$_{VII}$

⇓

MAXBR

First, consider the /c/ case in (83): as illustrated in (84). This is a simpler case: it does not exhibit alternation unlike /ʔ/. The fixed consonant appears as a coda of the reduplicant on the surface, instead of the base coda /k/.

(83) ʔucʔuksuɬ

ʔuc-ʔuk-suɬ

RED-another-on the eyes

'Wearing another's (glasses)'

(84) Tableau[28]

/σ-ʔuk-suɬ | coda | /c/	NoComplex Coda]$_{Prefix}$	MAXIO	MAXBR CodaFs VII	MAXBR
☞ a. {$_{\sigma}$[ʔuc]ʔuuk}$_{\varphi}$			*	*
b. {$_{\sigma}$[ʔuk]ʔuuk}$_{\varphi}$		*!		
c. {$_{\sigma}$[ʔukc]ʔuuk}$_{\varphi}$	*!			
d. {$_{\sigma}$[ʔu]ʔuuk}$_{\varphi}$		*!	*	*

In tableau (84), candidate a violates MAXBRCodaFs in the domain of class VII. The base coda is /k/, while the reduplicant coda is the underlyingly specified /c/. The relevant features can be [-Strident], [Dorsal] and so on. However, candidates **b, c, and d** do not obey one of the higher-ranked constraints NoComplexCoda]$_{Prefix}$ and MAXIO. Candidate **b** has the reduplicant which almost completely copies the

[28] The suffix is specified for FootForm VII, where the first syllable is short and the second long. Our issue under discussion is fixed segmentism, so I do not include constraints regarding metrical requirements.

base, but by doing that, violates MAXIO. Note that the input coda /c/ does not surface. Candidate **c** has another coda as well as the fixed coda consonant in the reduplicant, which is not allowed by NoComplexCoda]$_{Prefix}$. Consequently, candidate **a** is selected as an optimal output, only realising the fixed coda.

Second, the restriction that /ƛ/ appears only when the base morpheme is monosyllabic AND ends with a vowel as in (85a), but does not when the root is bisyllabic as in (85b), can be treated by the grammar in (82) in the same way.

(85) a. ċuuƛċuuyaʔiš (*ċuuċuuyaʔiš)
RED-ƛ-ċu-ya-ʔiš
RED-to wash-continuously-3sg/IND
'S/he does laundry continuously'

b. haahaaʕicx̣aʔiš (*haaƛhaaʕicx̣aʔiš)
RED-haʕicx̣-(y)a-ʔiš
RED-to sneeze-continuously-3sg/IND
'S/he continuously sneezes.'.

Compare the following tableaux.

(86) Tableau for (85a)

/σ-ċu-ya | coda | /ƛ/	NoComplexCoda]$_{Prefix}$	MAXBR CodaFs$_{IV}$	MAXIO	MAXBR
☞ a. $_{\sigma}$[ċuuƛ]ċuu				
b. $_{\sigma}$[ċuu]ċuu			*!	

(87) Tableau for the case of a monosyllabic base with coda

/σ-cuc-ya | coda | /ƛ/	NoComplexCoda]$_{Prefix}$	MAXBR CodaFs$_{IV}$	MAXIO	MAXBR
☞ a. $_{\sigma}$[cuuc]cuuc			*	
b. $_{\sigma}$[cuuƛ]cuuc		*!		
c. $_{\sigma}$[cuu]cuuc		*!	*	*
d. $_{\sigma}$[cuucƛ]cuuc	*!			

(88) Tableau for (85b)

/σ- haʕicx̣-ya | coda | /ƛ/	NoComplexCoda]$_{Prefix}$	ALIGN-/ƛ/	MAXBR CodaFs$_{IV}$	MAXIO	MAXBR
☞ a. $_{\sigma}$[haa]haaʕicx̣			*	*	****
b. $_{\sigma}$[haaƛ]haaʕicx̣		*!	*		****

As seen in the tableau above, the underlyingly specified coda /ƛ/ can surface only if the base has a specific phonological structure: i.e. a single open syllable. Note that while MAXBRCodaFs outranks MAXIO in the domain of class IV, it is lower-ranked than MAXIO in the domain of class VII-1. This drives different effects in terms of the distribution of each fixed segment. That is, /c/, with a class VII-1 suffix, must surface whether the base has coda or not, whereas /ƛ/, with a class IV suffix, can only surface when the base does not coda.

Finally, following Wojdak (2002), which treats the problem as an OCP effect, where the sequence of two [+Lateral] features is disallowed as defined in (89a), I show that the appearance /c/, instead of /ƛ/, can be dealt with the following constraints.

(89) a. *[+LAT][+LAT]: A sequence of two [+Lateral] features is not allowed.

b. MAXIO[+Lateral]: An input [+Lateral] feature must have a correspondent in the output.

c. MAXIO[+Strident]: An input [+Strident] feature must have a correspondent in the output.

These constraints and their language-specific ranking (as illustrated in tableau (91)) cause the underlying /ƛ/ to appear as /c/ on the surface: both have identical features except for [Lateral]. (see Wojdak 2002 for a detailed discussion). (90) is the relevant example.

(90) ƛaacƛaayaʔiš (*ƛaaƛƛaayaʔiš)

ƛaa-c-ƛa-ya-ʔiš

RED-to split wood-continuously-3sg/IND

'S/he keeps splitting wood.'

(91) Tableau

/σ-ƛaa-ya (FFIV) | coda | /ƛ/	*[+LAT][+LAT]	MAXIO(seg)	MAXIO [+Lateral]	MAXIO [+Strident]
☞ a. σ[ƛaac]ƛaa			*	
b. σ[ƛaaƛ]ƛaa	*!			
c. σ[ƛaa]ƛaa		*!	*	*
d. σ[ƛaat]ƛaa			*	*!

In the tableau, candidate **b** is ruled out, a case of the OCP violation, *[+Lat][+Lat]. Candidate **c** deletes the input /ƛ/, violating MAXIO(seg), which count a segment itself. Candidates **a and d** both violates MAXIO [+Lateral]. MAXIO[+Strident] determines candidate **a** as the optimal output.

5.2 Allomorphy

Nuu-chah-nulth has many interesting processes of allomorphy. We need to look at these morpho-phonological phenomena, since such morphological information often helps to better understand phonological processes such as glottalisation, lenition and reduplication; otherwise, some aspects of the phonological phenomena could be considered exceptions. In many cases, their distribution is predictable in terms of phonological factors, while in some cases, there seem to be no phonological clues for each allomorph of a morpheme in question. I will start with the predictable cases.

5.2.1 Predictable allomorphy

The following morphemes are cases where the distribution of their allomorphs is predictable. The predictability comes from phonological aspects.

5.2.1.1 -šiƛ/čiƛ/kʷiƛ 'momentaneous'

The morpheme -šiƛ/čiƛ/kʷiƛ 'momentaneous' is an aspectual suffix. It can denote either perfective or inceptive aspect depending on semantic properties of the stem morpheme (see Swadesh & Swadesh 1933, Sapir & Swadesh 1939, Rose 1981, Davidson 2002 for the detailed discussion: I concentrate on the phonological aspect of the morpheme-initial segment). The distribution of each allomorph of the suffix is as follows

(92) The distribution of the allomorphs of {šiƛ}

Allomorphs	Contexts	Examples
[š]iƛ	After a consonant-final stem	(93)
[č]iƛ	After a [-round] vowel-final stem	(94)
[kʷ]iƛ	After a [+round] vowel-final stem	(95)

When the suffix is attached to a consonant-final stem, it surfaces as *–šiƛ* as shown in (93).

(93) a. tuẇaḥ-[š]iƛ 'jumping into a vessel'

b. kaapap-[š]iʔaƛ̓atʔiš John. 'John is loved by someone'

c. kamatq-[š]iƛʔiš 'S/he starts to run.'

d. tux-[š]iƛʔiš 'S/he starts to jump.'

e. suut-[š]iƛʔiš 'S/he starts to drill.'

f. tupk-[š]iƛʔiš 'It becomes black.'

g. capx̣-[š]iƛʔiš 'It starts to boil.'

h. m̓aɬ-[š]iƛʔiš 'it is getting cold.'

i. his-[š]iƛʔiš capx̣ʔi 'She hit the man.'

j. tuxtuxš-[š]iʔaƛukʔiš 'S/he now starts to keep jumping.'

k. hac-[š]iʔaƛʔiš waʔičuƛ 'S/he completely fell asleep.'

l. ʕič-[š]iƛʔiš 'it is getting rotten.'

When the suffix follows a vowel-final stem and the vowel is [-round], the suffix surfaces as *-čiƛ* as shown in (94).

(94) a. naatsii-[č]iƛitʔiš John ʔuušḥy̓umsukʔi. 'John saw his friend.'

b. ƛ̓i-[č]iƛʔiš maamaatiʔi. 'He shot the bird.'

c. saa-[č]iƛʔiš 'S/he starts to crawling.'

d. waasca-[č]iƛḥ ṅuw̓i 'Where does your dad go?'

When the suffix is preceded by a vowel-final stem, and the vowel is [+round], the suffix surfaces as *–kʷiƛ* as shown in (95).

(95) a. su-[kʷ]iƛitʔišʔaɬ taana 'they took the money'

b. c̓u-[kʷ]iƛʔiš 'S/he starts to wash s.t.'

c. tu-[kʷ]iƛʔiš 'it starts to scatter.'

d. ʔuu-[kʷ]iƛ̓asʔiš c̓ukuu ' '

In sum, the momentaneous suffix surfaces as *-šiƛ* after a consonant, and as either *-čiƛ* or *-kʷiƛ* after a vowel.

This generalisation raises two questions: i) what is the underlying form, and ii) after the underlying form is determined, how to treat the distribution of the allomorphs within OT.

For the first question, I suppose that *-šiƛ* is the underlying form. While each context for *-čiƛ* and *-kʷiƛ* provides a predictable clue for those allomorphs; [-round] and [+round], respectively, it seems that there is no close phonological relation between *-šiƛ* and its distribution. Therefore, this morphological process can be generalised as follows: the momentaneous suffix *–šiƛ* surfaces as *-čiƛ* and *-kʷiƛ* after vowels.

For the second question, given it is proposed that *-šiƛ* is the underlying form, how can we account for the distribution of each allomorph? I suggest that the complementary distribution of the allomorphs can

be treated in terms of sequence restriction and assimilation. For the sequence restriction, we would need the following constraint which prevents [+Cont] from appearing after [-Cons]: because this restriction applies only to the momentaneous suffix, we would need to specify a morpheme-specific domain.

(96) Sequence constraint: { is a morpheme boundary.

*[-Cons] $_{Mom}${[+Cont]: A sequence of [-Cons] and [+Cont] is not allowed.

The assimilation aspect is associated with two allomorphs, -*čiƛ* and -*k*^{w}*iƛ*, which appears only after a vowel-final stem. Their distribution is predictable: the former appears after a [-Round], and the latter after [+Round]. The presence of -*čiƛ* is a simple case: its featural content is identical to that of -*šiƛ* except for [Cont]. To obey (96), the underlying [+Cont] is changed to [-Cont]. To obtain this effect, we would have the following ranking of the relevant constraints.

(97) *[-Cons]$_{Mom}${[+Cont], MAX[Cons]

⇩

MAX[+Cont]

The surface presence of –*k*^{w}*iƛ* can be a case of true assimilation case. It appears after a [+round] vowel. In Nuu-chah-nulth [+round] vowels are always [+back]. I choose [round] as a relevant feature instead of [back], since the initial roundness, rather than backness, property of the allomorph -*k*^{w}*iƛ* seems to be activated for the process in question Now that the surface form of the allomorph is -*k*^{w}*iƛ*, not kiƛ, as a contrast form against -*čiƛ*, backness does not seem to be crucial.

To treat the assimilation aspect, we need the following alignment constraint (98), which outranks the two faithfulness constraints (99).

(98) ALIGN-[+R]=Align([+Round], R, *Momentaneous*, L): The right edge of the feature [+Round] should coincided with the left edge of the momentaneous suffix.

(99) a. DEP[+Round] : The feature [+Round] in the output must have a correspondent in the input.

b. DEPPATH[+Round]: Any output path between [+Round] and an anchor must have a correspondent path in the input.

In the following tableaux we see how the constraints work for the proper allomorphs of the suffix to surface. To simplify the exposition, I exclude all other phonological aspects which are not relevant to my discussion.

(100) a. tuẃaḥ-šiƛ ➔ tuẃaḥšiƛ 'jumping into a vessel'

(101) Tableau

tuẃaḥ- šiƛ | | [+Cons][+Cont]	*[-Cons]$_{Mom}$\{[+Cont]	MAX[Cons]	MAX[+Cont]
☞ a. tuẃaḥ-[š]iƛ | | [+Cons][+Cont]			
b. tuẃaḥ-[č]iƛ | | [+Cons][-Cont]			*!
c. tuẃaḥ-[k^w]iƛ | | [+Cons][-Cont]			*!

In the context where a stem-final element is [+Cons], the momentaneous suffix surfaces faithfully as shown in (101). The higher-ranked two constraints are not relevant.

(102) is a case of *–čiƛ* with the tableau (103). The underlying *-šiƛ* surfaces as *–čiƛ.* to avoid a fatal violation of *[-Cons]$_{Mom}$\{[+Cont], and MAX[-Cons].

(102) naatsii-/š/iƛitʔiš John ʔuušḥẏumsukʔi. ➔ naatsii[č]iƛ 'John saw his friend.'

(103) Tableau

naatsii- šiƛ | | [-Cons][+Cont]	*[-Cons]$_{Mom}$\{[+Cont]	MAX[Cons]	ALIGN[+R]	DEP[+R]	MAX[+Cont]
☞ a. naatsii-[č]iƛ | | [-Cons][-Cont] [-Round][-Round]					*
b. naatsii-[š]iƛ | | [-Cons][+Cont]	*!				
c. naatsii-[k^w]iƛ | | [-Cons][-Cont] [+Round]				*!	
d. naats-[š]iƛ | [+Cont]		*!			

When a stem-final element is [-Cons], the constraint *[-Cons]$_{Mom}${[+Cont] prevents the input -*šiƛ* from surfacing. Moreover, -*k^{w}iƛ* is not allowed, either: it would cause a DEP[+R] violation as seen with candidate **c**. The deletion of the input [-Cons] in candidate **d** leads to a fatal violation of MAX[Cons]. Therefore, the momentaneous suffix surfaces with /č/ in its initial position as seen with candidate **a**.

Finally, -*k^{w}iƛ* surfaces if the stem ends with /u/ as illustrated in tableau (105), with the relevant example (104).

(104) tu-šiƛʔiš ➔ tuk^{w}iƛʔiš 'it starts to scatter.'

(105) Tableau

tu- šiƛ | | [-Cons][+Cont]	*[-Cons]$_{Mom}${[+Cont]	MAX[Cons]	ALIGN[+R]	DEP[+R]	MAX[+Cont]
☞ a. tu-[k^{w}]iƛ [+Round]					*
b. tu-[č]iƛ | | [-Cons][-Cont] [+Round]			*!		
c. tu-[š]iƛ | | [-Cons][+Cont]	*!				
d. tu-[k^{w}]iƛ | | [+Round][+Round]				*!	

In (105), candidate **b** is ruled out by violating the alignment constraint. The feature [+Round] is not aligned with the left edge of the momentaneous suffix. Candidate **c** has a sequence of [-Cons] and [+Cont], a fatal violation of *[-Cons]$_{Mom}${[+Cont]. Candidate **d** violates DEP[+R] by inserting [+Round] feature. Candidate **a** violates MAX[+Cont], but trivially; therefore, it is selected as an optimal output. In addition, it violates DEPPATH[+Cont], which I did not include in the tableau for reasons of space. However, in the spirit of OT, it must be lower-ranked than the four high-ranked constraints.

The approach provides a simple account regarding the distribution of the allomorphs of the suffix. However, I have found the following exceptional cases.

(106) Exceptions

a. him-[č]iƛ himʔasʔanitsiš. 'S/he brought s.t. to show me.' (*himšiƛ...)

b. ʔiiḥ-[k^{w}]iƛʔasitʔiš muksʔi. 'S/he was going to throw big stones.' (*ʔiiḥšiƛʔasitʔiš...)

These examples apparently raise a problem with my analysis above. In the two examples, we expect *-šiƛ* on the surface for each case. Besides, there are no common phonological properties between these stem-final consonants. This requires further research.

5.2.1.2 Consonant deletion: -(C)V....

Some suffixes such as -(k)łaa, -(q)umł, (q)iił, and -(y)a have their initial consonant deleted when following a consonant-final stem.

(107) -(k)łaa 'to be called..'

a. ʔu-kłaa-siš Eun-Sook . → ʔukłaasiš Eun-Sook
it-to be called-1sg/IND 'My name is Eun-Sook'

b. kʷis-kłaa-k̓uk-ʔiš → kʷisłaak̓ukʔiš
different-to be called-to seem-3sg/IND 'it seems like he has a different name.'

(108) -(q)umł 'round'

a. ʔaƛa-qumł → ʔaƛaqumł
two-round 'two dollars'

b. ƛ̓is-qumł → ƛ̓isumł
white-round 's.t. white and round'

(109) -(q)iił

a. sapnii-qiił → sapniiqiił
bread-to make 'to make bread'

b. mamuukʷ-qiił → mamuukʷiił
basket-to make 'to make baskets'

(110) -(y)a[29]

a. c̓u-ya-ʔiš → c̓uuƛc̓uuyaʔiš
to wash-continuously-3sg/IND 'S/he does laundry continuously'

[29] *-ya* is a reduplication-triggering suffix (see section 5.1)

b. cuc-ya-ʔiš → cuuccuucaʔiš

to scratch-continuously-3sg/IND 'S/he is scratching continuously.'

This kind of deletion is not related to a restriction forbidding consonant clusters. As we saw in section 4.3, in Nuu-chah-nulth a sequence of three consonants is allowed, even in the middle of a word. In fact, all the morphemes except *-kɬaa* have only one initial consonant. Moreover, the relevant sequences do not violate the Sonority Sequence Principle (see section 4.3.). Interestingly, although some suffixes start with a consonant cluster, such as *-swi* 'to overdo s.t., *-qʔičḥ* 'year', and *-ḥs* '1sg/Interogative', they do not allow their initial consonant to be deleted as seen below.

(111) waʔič-swi-ʔiš → waʔičswiʔiš (*waʔičwiʔiš)

to sleep-beyond normality-3sg/IND 'S/he slept in.'

(112) nup-qʔičḥ → nupqʔičḥ (*nupʔičḥ)

one-year(s) 'one year'

(113) siy̓a-(a)s-ḥs → siy̓asḥs (*siy̓as)

I-belong to-3sg/INT 'Does it belong to me?'

Although the distribution of allomorphs of each morpheme in (107)-(110) is predictable, it seems that we could not find any context from neighbouring sounds, given that consonant clusters are frequently observed in the language and that there are no other phonological factors for deletion in Nuu-chah-nulth.

Nevertheless, one possible solution for this problem is that segments which are deleted in the relevant context do not have a root node underlyingly. Zoll (1996) proposes that when only part of segments with the same phonological contents are deleted in certain contexts, they should be distinguished from full segments, which are never deleted. Zoll names the former as 'latent segments' and suggest that they consist of a floating feature or a set of floating features, i.e. subsegments. They link to an epenthetic root node inserted only in certain phonological contexts, while conventional floating features link to an existing root node. While I claimed in section 3.2.1 that a distinction between floating features and latent segments is not necessary, a distinction between full segments and latent segments is necessary in order to treat this kind of asymmetry in terms of deletion. Therefore, following Zoll, I propose that the segments in question in (107)-(110) consist of a set of floating features and that they appear on the surface by inserting a root node, when they follow a vowel. However, if they follow a consonant, they do not appear on the surface. This process can be treated by the interaction of DEPRootNode, which is domain-specified, and MAX[Subseg.] (114).

(114) MAX[Subseg.]: every subsegment in the input must have a correspondent in the output.

As seen in the ranking (115), to insert a root node is tolerated only if they following a vowel.

(115) DEPRootNode(C__) >> MAX[Subseg.] >> DEPRootNode(V__)

(117) and (119) illustrate the implication of the ranking, with the relevant examples (115) and (117), respectively.[30]

(116)=(107a)

ʔu-kɬaa-siš Eun-Sook . ➔ ʔukɬaasiš Eun-Sook

it-to be called-1sg/IND 'My name is Eun-Sook'

(117) Tableau

ʔu-[Subseg.]ɬaa	DEPRootNode(C__)	MAX[Subseg.]	DEPRootNode(V__)
☞ a. ʔukɬaa			*
b. ʔuɬaa		*!	

Candidate b is ruled out by deleting the input subsegment. Candidate a, which is selected as an optimal output, violates DEPRootNode(V__), but trivially.

(118)=(107b)

kʷis-kɬaa-k̓uk-ʔiš ➔ kʷisɬaak̓ukʔiš

different-to be called-to seem-3sg/IND 'it seems like he has a different name.'

(119) Tableau

kʷis-[Subseg.]ɬaa	DEPRootNode(C__)	MAX[Subseg.]	DEPRootNode(V__)
a. kʷiskɬaa	*!		
☞ b. kʷisɬaa		*	

To insert a root node after a consonant leads to a fatal violation as seen with candidate **a**. Hence, candidate **b** is selected as an optimal output form, which has the input subsegment deleted on the surface.

[30] I do not provide a set of features for /k/ in the input form for reasons of space, specifying just as 'Subseg.'

5.2.1.3 -š/č/kʷi(ƛ) 'momentaneous'

The suffix-final consonant, /ƛ/, is deleted before some grammatical suffixes such as –(ʔ)aƛ 'sequential', -(ʔ)at 'passive', -(ʔ)i '2sg/IMP(erative), and -ʔaqƛ 'future tense' (Stonham 1999). The first three suffixes are glottalising suffixes and the last isn't, but commonly they all start with a glottal stop on the surface. (Recall that the initial glottal stop of the glottalising suffixes is just one case of surface realisations of such suffixes: when following a stop/affricate, there is no glottal stop in the surface form of the relevant suffix). Interestingly, the suffix-final consonant is not deleted but glottalised before lexical glottalising suffixes such as -(ʔ)as and -(ʔ)aḥs. Consider the following examples: the suffix is followed by a grammatical suffix in (120) and by a lexical suffix in (121).

(120) Grammatical glottalising suffixes

a. naatsii-či ƛ -[+C.G.]aƛ-ʔat-ʔiš ẏukʷi ➔ naatsiičiʔaƛ'atʔiš ẏukʷi
to see-MOM-SEQ-PASS-3sg/IND 'S/he saw (your) younger sibling then.'

cf. naatsiičiƛsiš ẏukʷi 'I saw (your) younger sibling.'

b. ƛ'uḥ-ši ƛ [+C.G.]at-ʔiš ➔ ƛ'uḥšiʔatʔiš
to slap-MOM-PASS-3sg/Ind 'S/he was slapped (by someone)'

cf. ƛ'uḥšiƛsiš John. 'I slapped John.'

(121) Lexical glottalising suffixes

a. tux-ši ƛ -[+C.G.]as-ʔiš ➔ tuxši ƛ' asʔiš
to jump-MOM-going s.w.-3sg/IND 'S/he is going s.w. to jump.'

b. tux-ši ƛ -[+C.G.]aḥs-ʔiš ➔ tuxši ƛ' aḥsʔiš
to jump-vessel-3sg/IND 'S/he starts to jump in the boat.'

As I discussed in section 5.2.1.1, the momentaneous suffix, although only its initial segment is involved, exhibits a no-faithfulness property. This kind of deletion which occurs with the suffix tells us that the suffix in general is susceptible to change. Another interesting aspect about this suffix is that the alternation of the momentaneous suffix provides a significant clue to the morphological distinction of suffixes. It is sometimes difficult to identify the morphological status of Nuu-chah-nulth suffixes using

only semantic or lexical properties. This phonological information helps to understand the morphological properties of some suffixes. The examples in (120) and (121) provide a phonological way to distinguish between lexical and grammatical suffixes.

On the other hand, deletion of the suffix-final consonant before a grammatical glottalising suffix poses an interesting problem. An affricate such as /ƛ/ is supposed to be glottalised by the initial floating [+C.G.], and the feature surfaces as a glottal stop when a vowel-initial stem precedes it. The triggering factor for the deletion of /ƛ/ seems to be a glottal stop, while a glottal stop can surface with a glottalising suffix only if it follows a vowel. This situation creates a paradox. That is, the consonant is deleted before a glottal stop, but the glottal stop from a glottalising suffix can surface only after the affricate is deleted, thereby the stem to which a glottalising suffix attaches becomes vowel-final. I will leave this problem for further research.

5.2.1.4 quuʔas/quuʔac 'First Nation person'

The root morpheme-final consonant surfaces as /s/ before a consonant-initial suffix, as in (122), and as /c/ before a vowel-initial suffix, as in (123).

(122) a. quuʔa s -ʔi 'the man/First Nations person'
First Nations person-Definite

b. quuʔa s -ʔiš 'S/he is a First Nations person'
F.N. person-3sg/IND

c. quuʔa s -maḥsaʔiš 'S/he wants to be a First Nations person.'
F.N. person-to want-3sg/IND

(123) a. quuʔa c -aq-ʔiš 'a big First Nations guy'
F.N.person-very, much-3sg/IND

b. quuʔa c -iic 'belongings to F.N. e.g. land, house, etc.'
F.N.person-to belong to

The alternation exhibits a property similar to the alternation of momentatneous suffix -*šiƛ*, in that the context is consonant vs. vowel. A more interesting issue, however, is related with glottalisation. The alternation of the suffix gives clear clues to apparently exceptional cases of glottalisation and supports my argument regarding the representation of a glottalising suffix.

Consider the following examples.

(124) a.	quuʔas/c-aqƛ	➔	quuʔaċaqƛ
	F.N. –inside		'seagull eggs.'
b.	quuʔas/c-aḥs	➔	quuʔaċaḥs
	F.N. –vessel		'a F.N. person in a boat'
c.	quuʔas/c-aqƛ̓as	➔	quuʔaċaqƛ̓as
	F.N. –in a house		'F.N. people living in a house'

With a glottalising suffix, a fricative becomes either a glottalised glide or a plain fricative followed by a glottal stop, depending on stem morphemes the suffix attaches to. Given that the root morpheme has two allomorphs, *quuʔas* and *quuʔac*, the surface glottalised affricate [ċ] is obviously not an exceptional case. Moreover, the alternation provides support to the argument that the initial element of a glottalising suffix is not a glottal stop, a consonant (cf. Sapir and Swadesh 1939, Rose 1976). The morpheme-final /s/ appears only before a consonant-initial suffix, as shown in (123). Therefore, my analysis that a glottalising suffix has a floating [+C.G] feature, not a full glottal stop (thus the initial element of the suffix is a vowel), is borne out (see section 3.2.1 for the detailed discussion).

5.2.2 Unpredictable cases

Allomorphs of the following morphemes are unpredictable in terms of their distribution. Although they do not seem phonologically interesting and also allomophy of this kind is purely morpheme-specific alternation, I include them in the thesis for the purpose of documentation, and also in the hopes that others would be inspired to find and investigate new issues in greater detail.

5.2.2.1 -yaq/-q 'Existential'

Either -yaq or -q can be used with the same meaning, but their use is not predictable. Moreover, as seen in the ungrammatical forms, it seems not be related to free variation. That is, their distribution is determined according to what the stem morpheme is, lexical idiosyncrasy.

(125) a. supicyaʕas (*supicʕas)

supic-yaq-[+C.G.]as[31]

sand-EXIS-on the ground

'There is sand on the ground'

b. ʔučknaḥʕas (*ʔučknaḥyaʕas)

ʔučknaḥ-q-[+C.G.]as

small-EXIS-on the ground

'There is something small on the ground'

5.2.2.2 pronominal suffixes: siš/s

Both forms of the 1st singular indicative pronominal suffix, *-siš* and *-s*, can be used alternatively without change of meaning. Unlike the –yaq/-q alternation, this morpheme exhibits free variation.

(126) a. yaaʔakuksiš suẇa.

yaaʔak-uk-siš suẇa

love-CAUS-1sg/IND you

'I love you'

b. yaaʔakuks suẇa.

yaaʔak-uk-s suẇa

love-CAUS-1sg/IND you

'I love you'

[31] *-as* is a glottalising suffix and when it follows a uvular stop /q/, it causes the stop to be a pharyngeal stop /ʕ/ (see section 3.2.1).

Chapter 6 CONCLUSION

In the previous chapters, I have described various phonological and morphological phenomena in Ahousaht Nuu-chah-nulth, and investigated the theoretical implications of these phenomena in terms of universality, markedness, variation, and typology, in the framework of Optimality Theory (OT).

Chapter 2 discusses the internal structure of Nuu-chah-nulth words and morphological properties that are related to phonological phenomena. Nuu-chah-nulth words consist of a root followed by suffixes, which must be classified into lexical and grammatical categories. It is important to understand the mechanism of combining morphemes and the characteristics of morphemes in order to find out how and/or to what extent morphology is involved in phonological alternations. Morphological, as well as phonological, aspects provide important clues to the questions raised by the phonological phenomena discussed in chapter 3 and 4.

Chapter 3 treats the properties of intra- and inter-segmental phonology and their consequences for linguistic theory. Section 3.1 and 3.2 looked at how free combination of features drives surface alternations, in particular consonant alternation. How to encode patterns where instances of the same surface segments exhibit different behaviour depending on the morpheme in which they are found has been a controversial issue. The approach taken in this thesis to solving this problem provides a solution consistent with a core idea of OT, 'Richness of the Base'. Nuu-chah-nulth fricatives show a surface alternation in the context of glottalisation and lenition. Moreover, they exhibit consistent behaviour in both contexts. Fricatives with a surface alternation before a glottalising suffix also show the same pattern of alternation in the context of lenition. Also, if a fricative is consistently not affected in the context of glottalisation, it is not affected in the context of lenition. These systematic patterns of fricatives in both phonological processes are straightforwardly treated under 'Richness of the Base'. Very interestingly, post-alveolar fricatives are consistently not affected in both processes, however. This problem can be dealt with by the same mechanism, using a faithfulness constraint which requires [-Anterior] fricatives to maintain its feature value in question on the surface. Ironically, this asymmetry between [+Anterior] and [-Anterior] fricatives in terms of presence/absence of alternation according to different phonological processes supports the approach of 'Richness of the Base". As discussed in section 3.2.2, an alternative approach, Lexicon Optimization, would have a problem in determining an input form of fricatives in these specific cases. Another interesting question is how to treat markedness of glottalised consonants cross-linguistically. I discuss how to treat this problem in terms of factorial typology by universal constraints and their language-specific ranking.

Section 3.3 and 3.4 discuss labialisation and delabialisation, respectively. Ahousaht Nuu-chah-nulth does not have labialisation, while delabialisation raises interesting questions regarding its phonetic properties. Nuu-chah-nulth labio-velar and labio-uvular consonants lose their labiality when preceding a consonant or a high-back vowel /u/. What is especially interesting is whether the loss of labiality before

/u/ should be interpreted as co-articulation or pure deletion. Acoustic treatments of the issue support a deletion approach. Nevertheless, it seems necessary to conduct more research to investigate both phonetic and phonological characteristics of co-articulation and deletion more clearly.

Section 3.5 deals with vowel alternation. Nuu-chah-nulth has two types of vowel alternation: one is morphologically-based and the other is phonologically-based. Vowel alternation can be triggered by some suffixes. There are three patterns depending on the triggering suffixes: lengthening of the first root vowel, lengthening of the first stem vowel and shortening of the second stem vowel, and shortening of the first two vowels of a stem. I treat the various patterns in terms of metrical templates. Each pattern results from foot structures specified for triggering suffixes. This section (with section 5.1) gives an opportunity to examine the scope of possible foot structures both in Nuu-chah-nulth and cross-linguistically. On the other hand, vowel alternation can be phonologically motivated. Some vowels are either long or short depending on their position in the word. The prosodic unit 'foot' plays an important role in determining the length of vowels in question. When such vowels, i.e. variable vowels, stand in a foot, they are long, while when they stand outside a foot, they are short. I treat this problem in terms of different representations of vowels and faithfulness constraints. This issue reveals that even within OT, we still need to implement phonological representations.

Chapter 4 provides additional characteristics of Nuu-chah-nulth prosody such as syllable structure, prosodic units, vowel hiatus and consonant clusters. Prosodic structures in Nuu-chah-nulth pose many interesting typological issues. I discussed basic properties of prosodic structures and their relationship with some phonological processes.

Finally, chapter 5 investigates morphological processes such as reduplication and allomorphy. Nuu-chah-nulth has multiple patterns of reduplicant and base, which is not common cross-linguistically. The treatment of 9 patterns of reduplication is conducted in terms of both prosodic and metrical templates. This is an approach consistent with the treatment for vowel alternation. The vowel alternation found in reduplication is due to prosodic and metrical requirements specified for triggering suffixes. Such treatment provides a unified system for all kinds of vowel alternation observed in the language. Moreover, reduplication with fixed segmentism raise a controversial question concerning whether reduplicant forms result from grammars or lexical specification. I claim that the shape of the reduplicant and modification of the base forms are determined by both prosodic and metrical templates, although their surface realisation is achieved by grammar. The consequence of my anlaysis is that patterns of reduplication in Nuu-chah-nulth can't be dealt with a-templatically. Another morphological process discussed in the thesis is allomorphy. Allomorphs of some morphemes are phonologically predictable, while others are not. Whether they are predictable or not, they make linguistically important challenges. The thesis discusses to what extent phonology can be involved in the formation of allomorphs and defines how the interaction between phonology and morphology can be interpreted within OT.

This thesis covers a broad range of the phonological and morphological phenomena in Nuu-chah-nulth. However, for reasons of time and space, some interesting and important issues could not be treated completely. It seems that the stress system and vowel deletion in the context of vowel hiatus will require a bigger data set for a proper treatment. These issues are discussed, but to establish systematic patterns of their distribution, we need additional relevant data by which we can obtain a generalisation.

Finally, I hope that this work contributes to the revitalisation of the language and will stimulate further documentation of the other Nuu-chah-nulth dialects.

ƛ̓eekoo!

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Appendix: List of triggering suffixes (page numbers refer to pages where each suffix is discussed with relevant examples)

Suffixes	Gloss	Glottalis-ing	Leniting	Vowel Length-ening	Vowel Short-ening	Redupli-cation	Page No.
-akƛi	At the rear	✓					34
-(a)aɬuk	To look after	✓				✓	34, 185
-aḥi	Thing	✓					34
-aḥs	Vessel/container	✓					34
-aƛ	NOW/Sequential	✓					40
-(a)ap	To buy	✓					34
-aq	Very				✓		142
-aqa	Happening/result of s.t.	✓					34
-aqƛ	Inside	✓					34
-aqƛ'as	In woods, in the house	✓					34
-as	To go s.w., to do s.t.	✓					34
-as	Outside, on the ground (status)	✓					34
-awiɬ	To expect			✓			137
-a(a)ʔa	On the rock	✓					34
-(č)ink	To converse with, together, side by side					✓	189
-ḥta	Foot					✓	184
-ḥwaɬ	To use			✓			137
-iic	To eat	✓					34
-iiḥ	To hunt/fish, to try to get	✓				✓	34, 185
-iḥta	At the end	✓					34
-iɬ	Inside the house, on the floor		✓				93
-iik	A person who is always doing s.t.	✓				✓	34, 185
-(q)iiɬ	To make			✓			136
-is	At the beach		✓				93

Suffixes	Gloss	Glottal-ising	Leniting	Vowel Length-ening	Vowel Short-ening	Redupli-cation	Page No.
-iƛ	To take/get	✓		✓			34
-iiƛ	On the ground (process)	✓					34
-inɬ	To serve	✓					34
-iṅak̓uuḥ	To watch			✓			137
-itẏak	Fear					✓	190
-k̓uk	To resemble					✓	189
-(k)časči	To play on someone's side					✓	190
-ƛa	Again, also					✓	183
-ṅuk	On the hand					✓	192
-panač	To move about			✓			137
-p̓(a)a	Not to like			✓			137
-p̓ičḥ	Doing s.t. while doing some other.			✓			137
-sapi	To depend on					✓	192
-suɬ	At the eye					✓	217
-š	Continually					✓	183
-šiƛ	To start to					✓	187
-uup	Vehicles (all kinds)	✓					34
-(y)a	Continuously					✓	187
-ʔinḥi	To wait for			✓			34
-yuk^{w}	To cry					✓	185