# A Grammar of Lushootseed: Phonetics, Phonology, Morphology

Ted Kye

A dissertation

submitted in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

University of Washington

2023

Reading Committee:

Richard Wright, Chair

Sharon Hargus

Myriam Lapierre

Tami Hohn

Program Authorized to Offer Degree:

Department of Linguistics

University of Washington

## Abstract

A Grammar of Lushootseed: Phonetics, Phonology, Morphology

Ted Kye

Chair of the Supervisory Committee:
Richard Wright, Professor and Department Chair
Department of Linguistics

In this dissertation, I document the phonetics, phonology, and morphology of Lushootseed from a corpus of recordings recovered from the archives of the University of Washington's Burke Museum. There are several goals to this dissertation. One goal is to fill in an important gap in the literature on Lushootseed (and Coast Salish) phonetics, where the phonetics of Lushootseed is critically under documented. The goal is to characterize the pattern of speech sounds in Lushootseed by conducting instrumental acoustic analysis of speech sounds from these recordings. Another goal is to address questions concerning the morphology of Lushootseed that has not been previously investigated. Some of these questions concerns the morphological typology of Lushootseed, the position class of verbal affixes, allomorphs, the role of independent pronouns, as well as a descriptive overview of Lushootseed determiners.

I cover several topics on the phonetics and phonology of Lushootseed. For one topic, I compare vowel qualities between the two dialects of Lushootseed, where I test the claim that there are dialectal differences in the realization of /i/ and /u/ (Hess & Hilbert 1976; Zahir 2019) by conducting an acoustic analysis of vowels across Lushootseed dialects. I found that the vowels are acoustically similar between the two dialects. Another topic that I cover is Lushootseed obstruents, where I conduct the first acoustic analysis of obstruents in Lushootseed. A third topic that I address in this dissertation is denasalization, which resulted in a voiced stop series. Although Lushootseed denasalization has been previously documented, an acoustic phonetic analysis of residual nasality in voiced stops has not been conducted. In this dissertation, I conduct the first acoustic phonetic analysis of voiced stops in such a way that can inform us about denasalization in Lushootseed. Another topic that I cover is the prosodic structure of Lushootseed, where I develop the first system of transcribing intonation in Lushootseed. Other topics include the coarticulatory effect of uvular consonants on vowel quality, the analysis and classification of ejectives, as well as an acoustic analysis of laryngealized sonorants in Lushootseed.

In this dissertation, I also cover several topics on Lushootseed morphology. For one topic, I classify the morphological typology of Lushootseed using a quantitative approach. Moreover, I provide the first phonological analysis of the [$g^w$]~[$k^w$] alternation in Lushootseed, where I analyzed this allomorph as coda devoicing. Another topic that I cover is pronominal morphology, where I analyze each pronominal morpheme and how they function syntactically. A third topic that I cover is the set of Tense-Aspect-Mood (TAM) prefixes, where I provide the first analysis of the position class of TAM prefixes. I analyze the position class of TAM prefixes as being due to their unique phonological shapes. A fourth topic that I cover is the set of valency-changing operators, where I analyze not only each valency-changing operator one-by-one, but also the combinations of valency-changing operators in Lushootseed. Finally, I cover determiners and nominal morphology in Lushootseed.

# TABLE OF CONTENTS

# LIST OF ABBREVIATIONS

| | |
|---|---|
| ADD | additive |
| ALTV | allative applicative |
| AUG | augmentative |
| CAUS | causative |
| CLEFT | cleft marker |
| CNN | connective |
| COMP | complementizer |
| CONJ | conjunction |
| CTD | contained |
| DAT | dative applicative |
| DET | determiner |
| DIM | diminutive |
| DIST | distal demonstrative |
| DISTR | distributive |
| EMPH | emphatic |
| F | feminine |
| FUT | future |
| HAB | habitual |
| HYP | hypothetical determiner |
| INCH | inchoative |
| IRR | irrealis |
| LEX | lexical suffix |
| LTR | lack-of-control transitive |
| MD | middle |
| NEG | negation, negative |
| NMLZ | nominalizer |
| OBJ | object |
| OBL | oblique |
| PART | particle |
| PASS | passive |
| PFV | perfective |
| PL | plural |
| POSS | possessive |
| PROG | progressive |
| PROX | proximal demonstrative |
| PST | past |
| PTCL | particle |
| Q | question particle |
| RA | relational applicative |
| RECP | reciprocal |
| REFL | reflexive |
| SBJ | subject |
| SBJV | subjunctive |
| SG | singular |
| SPEC | specific |
| STAT | stative aspect |
| TR | control transitive |

# LIST OF FIGURES

# LIST OF TABLES

# ACKNOWLEDGEMENTS

I would like to begin by acknowledging the family members of the speakers, Annie Jack and Martha Lamont, whose recordings I have worked with for the past seven years. I would also like to express my gratitude to them for taking their time to meet with me, as well as granting me permission to work with recordings of their ancestors. Family members of these two speakers include the descendants of Annie Jack, who are Denise Bill (great-granddaughter of Annie Jack), Will Bill Jr. (great-grandson of Annie Jack), Elise Bill-Gerrish (great-great-granddaughter of Annie Jack and daughter of Denise Bill), Justice Bill (great-great-grandson of Annie Jack and son of Will Bill Jr.); and the descendants of Martha Lamont, who are Hank Williams (grandson of Martha Lamont), his daughter, and his descendants. I would also like to express my gratitude to Elise Bill-Gerrish for taking her time to discuss with me about the Muckleshoot language program. Much of the dissertation research would not have been accomplished without their permission and support for the dissertation project.

Much gratitude goes to Kathryn Bunn-Marcuse, curator of the Burke Museum, and Rebecca Andrews, the Burke Museums collections manager, who granted me permission to work with and digitize the recordings for the dissertation research. They were also the ones who encouraged me to reach out to the family members of the speakers in the Metcalf recordings. Much of the dissertation project would not have been established without their guidance and support for this project.

I would also like to acknowledge Laurel Sercombe, archivist for University of Washington's Ethnomusicology Archives, who had these recordings digitized. Much of my research throughout

this program would not have been established without Laurel's support, as well as her digitizing the Metcalf recordings and the recordings from the Thom Hess collection on my behalf.

I would also like to express my gratitude towards Jill *tsisqʷux̌ʷał* LaPointe, granddaughter of the late Vi Hilbert. She has taken her time to meet with me to discuss my dissertation project. She has taught me the importance of being sensitive to these recordings, the elders, and how to approach the family members of the speakers in these recordings. Jill has also taught me the importance of treasuring the words and stories told by the elders.

I would also like to acknowledge and express my gratitude to Michele *dᶻagʷabidic̓aʔ* Balagot, Lushootseed Department Manager, and her colleagues, for reaching out to the descendant of Martha Lamont, Hank Williams, and getting me connected with him to take his time to meet and discuss the dissertation project. Michele has also spent time discussing the Tulalip language program and how language education is being managed in the Marysville School District. Much of Chapter 3 would not have been written without consulting her.

I am very grateful and appreciative of the support from Tami Hohn, Assistant Teaching Professor at the University of Washington and indigenous to the Puyallup Tribe, and who is also a committee member. Tami helped me reach out to Denise Bill and her relatives, who are the living descendants of Annie Jack. If it wasn't for her, I would not have been able to meet with them. Tami has also provided valuable insight and support for the annotation of these recordings. Tami has also taught me the importance of valuing these recordings, as well as understanding how to approach and work with Native American archival recordings that contain culturally sensitive materials. Tami has also provided valuable resources that were significant towards the overall scope of this project. Much of the dissertation project would not have been accomplished without Tami's guidance.

My supervisor, Professor Richard Wright, has been an incredible advisor and supporter. Richard did everything he could to support me and to help me succeed in this program. He has not only supported me throughout this program but has also provided a lot of attention and guidance to my research. I greatly benefited from his guidance and support, so much of my gratitude goes to him.

A great deal of support came from committee member, Professor Sharon Hargus, who provided valuable comments, feedback, and suggestions for each of the dissertation chapters. Sharon has also been an incredible supporter, providing a great deal of attention and guidance towards my dissertation research and academic success in the program. I am greatly appreciative of Sharon's support and guidance.

I am also grateful to committee member Myriam Lapierre, who also provided valuable comments, feedback, and suggestions for each of the dissertation chapters. We had many productive conversations concerning nasality and denasalization in Lushootseed. Myriam has also provided valuable input and resources for Chapter 8 of the dissertation. Much of my work on denasalization in Lushootseed was realized through Myriam's insights, observations, and guidance.

Finally, I would like to acknowledge and express my gratitude to the speakers of this study: Annie Jack and Martha Lamont, renowned story tellers whose legacies will forever be preserved in these recordings. May their legacy never be forgotten and continue to be passed on to future generations.

# DEDICATION

I dedicate this dissertation to the memory of my father, Harry Kye (1957-2022).

# PART 1. BACKGROUND & INTRODUCTION

# Chapter 1. BACKGROUND ON LUSHOOTSEED

## 1.1 LANGUAGE FAMILY

Lushootseed belongs to the Salish language family. According to Kroeber (1999), the Salish language family constitutes the largest accepted linguistic family in the Pacific Northwest. The earliest known written record of Salish dates to 1793, where Sir Alexander Mackenzie recorded a short vocabulary list of Shuswap and Bella Coola during his journey to the Pacific (Mackenzie 1970). Systematic data collection began around the 1830's, when missionaries and ethnographers began classifying North American languages. Data collectors during this time included Myron Eells, George Gibbs, Horatio Hale, and William F. Tolmie. Salish was well recognized as a language family in the northwest during the 19$^{th}$-century, where it figured famously in Powell's (1891) classification of North American languages. However, some of the earliest genealogical classifications of Salish dates to the mid-19$^{th}$-century in the ethnographic and philological works of Horatio Hale (1846), where Hale classified the language family as "Tsihaili-Selish Family".

The Salish language family consists of twenty-three languages. These languages are spoken (or formerly spoken) in Washington State, near-by states such as Oregon, Idaho, and Montana, as well as various parts of British Columbia. The Salish language family can be subdivided into three branches: Central Salish, Interior Salish, and Tsamosan. Boas & Haeberlin (1927) were the first to provide evidence of divisions among Salish languages, where they divided Salish languages into Coast and Interior branches. Today, it is widely accepted that Salish can be divided into the three branches named above (Czaykowska-Higgins & Kinkade 1998). There is no specification for the languages Bella Coola (also known as Nuxalk) and Tillamook with respect to these branches (in other words, Bella Coola or Tillamook may belong to independent branches[1]). This subgrouping of Salish languages is based on the work of Czaykowska-Higgins & Kinkade (1998:1-5), which is summarized in Table 1.1 (note that the label "Central Salish" is equivalent to Kroeber's (1999) "Coast Salish"). Lushootseed belongs to the Central Salish branch of the Salish family.

**Table 1.1** Subdivisions of Salish based on Czaykowska-Higgins & Kinkade (1998).

| Branch | Division | Languages |
|---|---|---|
| | | Bella Coola (Nuxalk)<br>Tillamook |
| Central Salish | Straits | Northern Straits<br>Clallam |
| | Others | Comox<br>Pentlatch<br>Sechelt<br>Squamish<br>Halkomelem<br>Nooksack<br>Twana<br>Lushootseed |
| Interior Salish | Northern | Lillooet<br>Thompson<br>Shuswap |
| | Southern | Columbian<br>Colville-Okanagan<br>Spokane-Kalispel-Flathead<br>Coeur d'Alene |
| Tsamosan | Inland | Upper Chehalis<br>Cowlitz |
| | Maritime | Quinault<br>Lower Chehalis |

According to Czaykowska-Higgins & Kinkade (1998), the Central Salish branch consists of a long chain of languages, which are characterized "by no one distinguishing set of independent innovations, but in which each language shares properties with its immediate neighbors" (1998:4).

[1] Thompson (1979) considered Bella Coola to be a split from all the other Salish languages, making it a part of the highest-level branching within the Salish family. Moreover, Thompson considered Tillamook to be a Central Salish language, though the evidence for this is unclear.

There is only one known division to occur in Central Salish: Straits, which includes Northern Straits and Clallam (Montler 2012, 2018). Northern Straits and Clallam share many features together, such as phonological, morphological, and lexical properties. Interior languages fall into Northern (Lillooet, Thompson, and Shuswap) and Southern (Columbian, Colville-Okanagan, Spokane-Kalispel-Flathead, and Coeur d'Alene) divisions. According to Thompson & Kinkade (1990), the basis of these two divisions is due to structural and lexical properties of the languages. These divisions exhibit less diversity than languages of Central Salish. The Tsamosan languages are based on their geographic distribution. The Maritime division (Quinault and Lower Chehalis) are closest to the sea, whereas the Inland division (Upper Chehalis and Cowlitz) fall inland just east from the Maritime languages. According to Czaykowska-Higgins & Kinkade (1998), Tsamosan languages differ phonologically, morphologically, lexically, and syntactically from the other languages, and "most likely should be considered a dialect chain" (1998:4).

The Salish family provides important implications on the linguistic history of Pacific Northwest languages. The geographical distribution of Salish languages has brought itself into contact with other diverse languages (such as Sahaptin or Wakashan languages). As Kroeber (1999) puts it:

> Salish is thus potentially a source of information on the diffusion of linguistic properties within a large portion of the famous Northwest linguistic area; when a feature is shared by a non-Salish language and a Salish language, there is a relatively good chance of being able to determine whether the feature was found in Proto Salish – a valuable clue as to whether the feature diffused into or out of Salish. The study of Salish comparative grammar thus has implications beyond the family itself (p. 1).

The geographic distribution of the Salish family is well represented in the central Northwest Coast culture, as well as cultures across the Coast Range and further east past the Cascades in the Plateau regions. Figure 1.1 shows a map of the distribution of Salish (and neighboring non-Salish) languages (taken from Kroeber 1999).

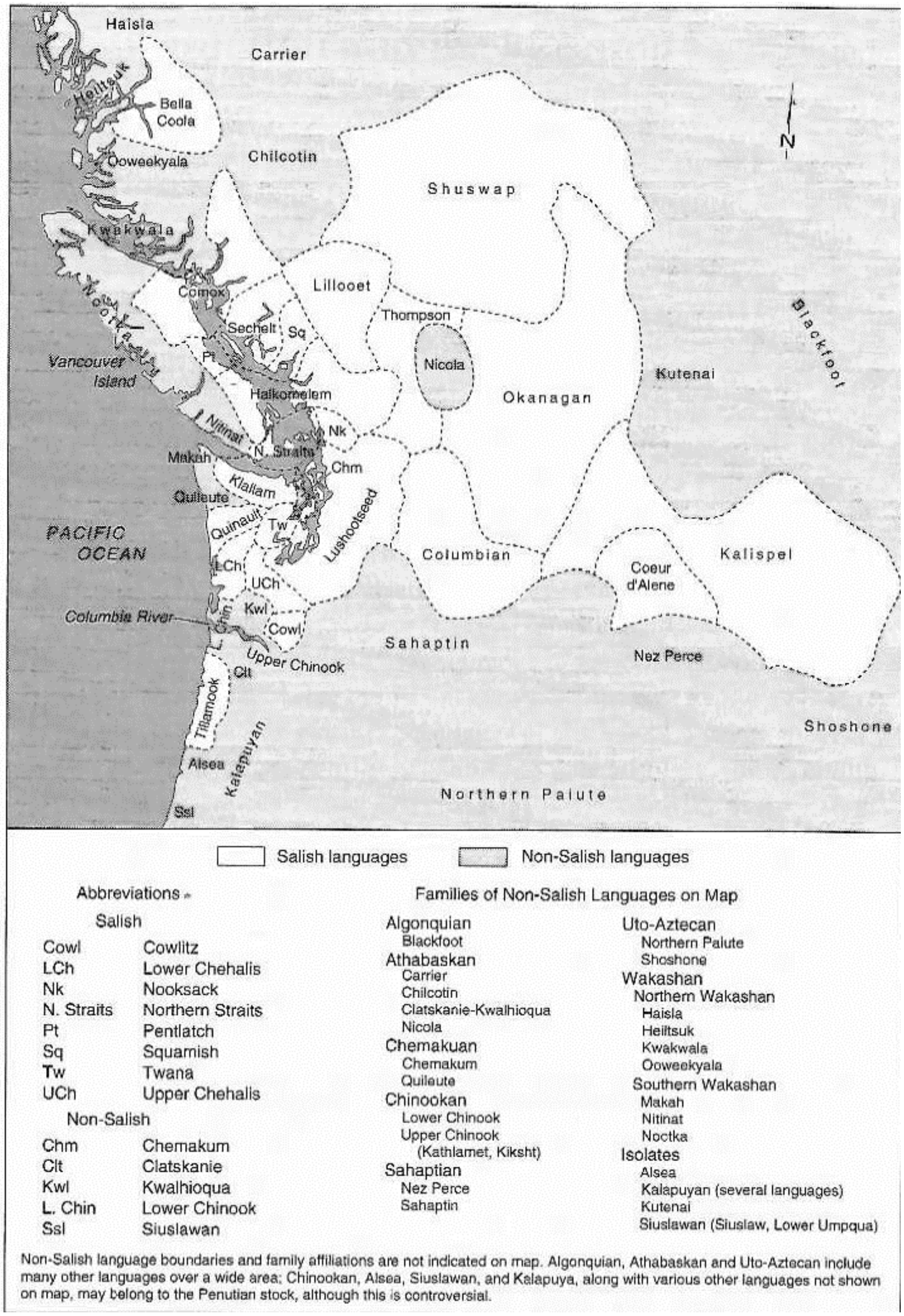



**Figure 1.1** Map of Salish (and neighboring non-Salish) languages. From Kroeber (1999)

## 1.2 GEOGRAPHIC DISTRIBUTION OF LUSHOOTSEED

The geographic distribution of Lushootseed spans across the Puget Sound region of the Pacific Northwest. Lushootseed was spoken natively by tribes living in the Puget Sound region. The borders extend from south Puget Sound and north past Skagit Valley. It also encompasses western parts of the Cascades. Along with Twana, Lushootseed forms the Southern branch of the Central Salish division (Bates et al. 1994). There are two regional dialects of Lushootseed: Southern Lushootseed and Northern Lushootseed. Tribes (or bands) that are associated with the Southern Lushootseed dialect include Muckleshoot, Puyallup, Nisqually, Suquamish, Snoqualmie, Duwamish, Skykomish, Sahewamish, and Squaxin. Tribes (or bands) that are associated with the Northern Lushootseed dialect include Tulalip, Snohomish, Stillaguamish, Swinomish, Upper Skagit, Samish, and Sauk-Suiattle. Figure 1.2 illustrates a map of the distribution of the two branches.

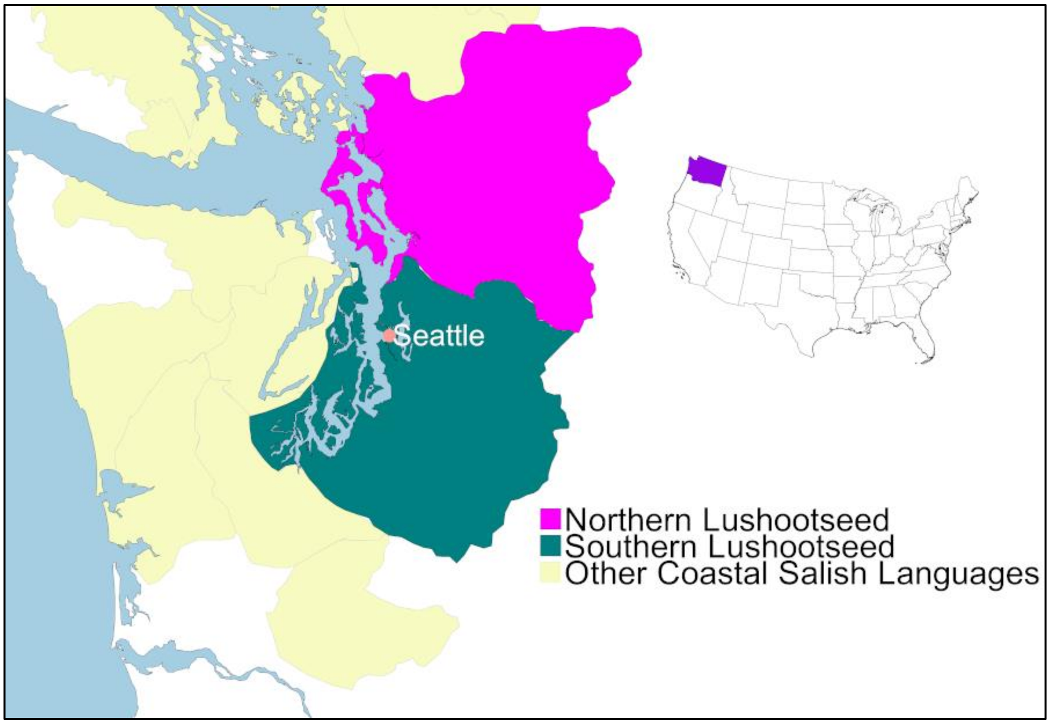



**Figure 1.2** Regional dialects of Lushootseed. Adapted from "Maps Relating to Central Coast Salish Languages and Culture" by B. Thom (Thom 2011), in Brian Thom's Coast Salish Homepage. Accessed 2020.

## 1.3 Tribes and Bands of Lushootseed Natives

Before European contact, indigenous speakers of Lushootseed inhabited numerous villages that spanned across various parts of the Puget Sound area (Bates et al. 1994; Gibbs 1877; Waterman 1920, 1922). However, once U.S settlement took place in the Puget Sound area around the 1850's (established by the U.S government through the Treaty of Point Elliott and the Treaty of Medicine Creek), many of these villages became obliterated due to reservation settlements (Eells 1887, Hess 1977). Lushootseed and many other indigenous languages around the area were still spoken natively within these reservations (Eells 1887). There are currently 11 federally registered tribes that can be identified with Lushootseed heritage. These are the Muckleshoot Indian Tribe (‹bəqəlšuɬ›), Puyallup Tribe of the Puyallup Reservation (‹puy̓aləp›), Sauk-Suiattle Indian Tribe of Washington (‹suiʔaƛ̓bixʷ›), Stillaguamish Tribe of Indians of Washington (‹stuləkʷabš›), Swinomish Indian Tribal Community (‹swədəbš›), Tulalip Tribes of Washington (‹dxʷlilap›), Upper Skagit Indian Tribe of Washington (‹sqaǰət›), Nisqually Indian Tribe (‹dxʷsqʷaliʔabš›), The Suquamish Tribe (‹suq̓ʷabš›), Snoqualmie Tribe (‹sdukʷalbixʷ›), and Squaxin Island Tribe (‹sqʷax̌sədəbš›). As of 2018, these tribes make up a population of over 20,000.

There are several bands and tribes of indigenous natives who identify themselves with Lushootseed heritage. Some of these bands and tribes belong to a larger group – i.e., a group that receives federal recognition (e.g., the Tulalip Tribes of Washington, which includes Snohomish, Snoqualmie, Skagit, Suiattle, Samish, Stillaguamish, as well as other allied bands living in the region). Other known tribes/bands that do not receive federal recognition include Duwamish (‹dxʷdəwʔabš›) and Snohomish (‹sduhubš›).

## 1.4 Language Name

Lushootseed is the name of the language spoken by indigenous Natives of the Puget Sound region. Today, it is pronounced /ləʃut͡sid/ ‹ləšucid›, though it has been variously pronounced as /dxʷləʃut͡sid/ ‹dxʷləšucid›, /txʷəlʃut͡sid/ ‹txʷəlšucid›, and /xʷəlʃut͡sid/ ‹xʷəlšucid› by modern speakers. Some scholars referred to the language as Puget Salish. Today, the language is widely known as Lushootseed. The root of the word is ‹ləš›, which designates the Puget Sound region (Bates et al. 1994; Hess 1976). Wayne Suttles suggested that the root ‹ləš› may be related to the word Salish (Bates et al. 1994:vii). The end of the word, ‹-ucid›, is a lexical suffix that means ‘language’. It is unknown if first language speakers prior to Hess & Hilbert (1976) used the word ‹ləšucid› to name their language. However, there is evidence of first language speakers identifying the name of their language with their respective tribes. For example, native speakers from

Suquamish ‹suq̓ʷabš› or Muckleshoot ‹bəqəlšuɬ› would identify their language as ‹suq̓ʷabš-ucid› ‘Suquamish-language’ or ‹bəqəlšuɬ-ucid› ‘Muckleshoot-language’ respectively.

## 1.5 LITERARY HISTORY OF LUSHOOTSEED STUDIES

The literary history of Lushootseed studies can be divided into three periods: (1) 19th-century documentation (Section 1.5.1), (2) early-to-mid 20th-century documentation (Section 1.5.2), and (3) mid-late 20th-century to present documentation (Section 1.5.3). In this section, I provide a brief outline of the literary history of Lushootseed studies based on these three periods.

### 1.5.1 *19th-century documentation*

Systematic data collection began around the early-to-mid 19th-century. Active data collectors included Horatio Hale and George Gibbs. Many of these works provided some of the earliest classifications of Salish as a language family in the northwest (see Section 1.1 for more details). It was during this period that ethnologists, missionaries, and philologists were documenting the grammar and vocabularies of indigenous languages.

The earliest known systematic data collection of Lushootseed that was published comes from the ethnographic and philological works of Horatio Hale (1846). In his work, Hale provided a list of vocabulary words (used for comparative analysis) from multiple languages of the Pacific Northwest. In this list, Hale included the language of *Skwale* (i.e., Nisqually, which is a Southern Lushootseed group), which was grouped together with a family of languages Hale called “Tsihaili-Selish Family”. The Salish languages that were compared with *Skwale* included Spokane-Kalispel (which Hale called *Selish (Flatheads)*), Shuswap, Coeur d’Alene, Cowlitz, and other groups whose languages could not be identified. Hale’s data for *Skwale* was obtained from an interpreter. It is unknown who this interpreter was. However, there was evidence of ethnographic reports being transacted with the U.S government during this time. These reports were made by the ethnologist George Gibbs during the mid-19th-century (Stevens 1854). The former governor at the time, Isaac Stevens, was relying on the reports of George Gibbs in surveying indigenous Americans of the Pacific Northwest. It was possible that Hale obtained his data of *Skwale* from Gibbs at the time. However, there was no evidence of any transactions taking place between Hale and Gibbs.

In the *Annual report of the Commissioner of Indian Affairs, for the year 1854* (pp. 184-254), Governor Isaac Stevens (relying on reports from ethnologist George Gibbs) mentioned the interchangeable use of /m/ and /b/, and /n/ and /d/ in the language. This was one of the earliest attestations of the denasalization shift in Lushootseed. There were also vocabularies compiled for the Skagit and Snohomish (both are Northern Lushootseed groups) by Dr. R. O. Craig (1858), which is currently stored in the Smithsonian's Archive (a copy of this vocabulary, made by George Gibbs, is also found in the same archive). There were also census records that were developed by the Hudson's Bay Company in 1834. In these census records, names of indigenous tribes with Lushootseed heritage were listed. A census record compiled by Sir James Douglas in the years 1838-39 (Douglas 1853), titled *Census of Indian Population in Fort Nisqually District as taken in the years 1838-39*, lists Lushootseed names of various tribes in the area.

There were a lot of missionary works that were developed during this period. It was widely accepted at the time that missionaries use the indigenous language as the medium of communication (especially when preaching prayers and catechisms). Missionaries believed that it was nearly impossible to teach English to the natives. As Lee & Frost (1844) wrote in a report to the U.S government, "… the prospect of teaching them the English language… would be the nearest thing to an impossibility" (1844:311). Similarly, the difficulty of teaching English to the natives was attested by the missionary Cushing Eells during the 1840's, who wrote in a letter, "It is perhaps absolutely impossible to give this people [i.e., the indigenous Natives of the Pacific Northwest] a correct knowledge of the English language." (1892:93). As such, it was expected for missionaries during this period to work extensively with indigenous languages of the Pacific Northwest.

There were two missionaries at the time who worked with Lushootseed in Tulalip (sometime between 1850 and 1880). They were Father Eugene C. Chirouse (c. 1860s) and Monsignor Jean-Baptise Boulet (1879). Chirouse authored books of prayers and catechisms in Lushootseed. Chirouse, who was part of the Oregon Missions of 1847, lived among Tulalip natives from 1857-1878. Chirouse documented the lifestyle, culture, and language of the speakers, compiling handwritten wordlists and grammars of the language. There were several unpublished (handwritten) prayers and catechisms that Chirouse wrote in Lushootseed. Monsignor Jean-Baptise Boulet (1879), who replaced Chirouse in Tulalip in 1878, also wrote prayers and catechisms in Lushootseed. Many of Boulet's prayers and catechisms were written in print.

The ethnologist George Gibbs (1877) worked extensively with tribes and bands of natives in the Pacific Northwest. As mentioned above, Gibbs was hired by the U.S government to help with treaty negotiations. In his work *Tribes of Western Washington and Northwestern Oregon* (Gibbs 1877), Gibbs documented the culture, lifestyle, geographic distribution, and languages of natives in the Pacific Northwest. In this book, Gibbs provided a comparative vocabulary of Salish languages with ethnographers Tolmie and Mengarini. It was also in this book that Gibbs compiled the earliest known dictionary of Lushootseed. The dictionary was titled *Dictionary of the Niskwalli*. There were 1,754 entries in Gibbs' dictionary. Gibbs provided both Lushootseed-English and English-Lushootseed entries in his dictionary (see Section 1.6.1 on the difficulties with Gibbs's system of transcribing Lushootseed).

### 1.5.2 *Early-to-mid 20th-century documentation*

During the early-to-mid 20th-century, there were many ethnographic and anthropological works documenting Puget Salish language, culture, and geography. Geographic materials that included many Lushootseed place names were compiled (Waterman 1920, 1922). Other works involved Puget Salish mythology (Ballard 1927, 1929; Haeberlin & Boaz 1924; Snyder 1968b), Puget Salish kinship (Ballard 1935), Puget Salish houses (Waterman & Greiner 1921), songs (Roberts & Haeberlin 1918), religion (Waterman 1924), calendric terms (transcribed in Lushootseed) (Ballard 1950), and other cultural and traditional practices such as fishing and canoe building (Waterman & Coffin 1920). Systematic data collection on the grammar of Lushootseed began during the 1950's and 1960's (Tweddell 1947, 1950; Snyder 1957, 1968b).

During the early 1920's, the ethnographer Thomas Talbot Waterman did extensive work on the geography of Puget Sound. Waterman worked closely with native elders of Lushootseed, collecting place names, history, genealogy, and culture. Most of his geographical materials were organized in an unpublished manuscript of Puget Sound geography (Waterman 1920). However, there were other works on Puget Salish geography by Waterman that were published (Waterman 1922). In his geographical materials, there were over 1,000 Lushootseed place names containing descriptions of its geography, history, and culture. It wasn't until 1998 when Vi (taqʷšəblu) Hilbert began re-transcribing and transliterating Waterman's place names into today's Lushootseed alphabet (Hilbert et al. 2001).

Around the same time Waterman was collecting data on Puget Salish geography, Arthur Ballard collected several language data from several tribes of south Puget Sound. Ballard lived in Auburn, Washington, next to the Muckleshoot Reservation, where he was introduced to the language and culture. Ballard documented a variety of Puget Salish myths from Duwamish, Muckleshoot, Snoqualmie, and Puyallup speakers (Ballard 1927, 1929). In his work *Mythology of Southern Puget Sound* (Ballard 1929), Ballard provided a list of speakers who provided different Puget Salish myths and legends (as well as variants of those myths and legends) that were a part of their local tradition (where Ballard wrote these in English). In his work, Ballard documented the names, family histories, and approximate date of births of his speakers (as well as the time and place where the events from the local myths and legends took place). According to Ballard, all the groups of southern Puget Sound "bore traces of relationship with the Sahaptin tribes to the east" (1929:35). Ballard stated,

> … beyond a certain point upstream to the east and even beyond the summit of the Cascades the people spoke two languages, the Puget Sound Salish [i.e., Lushootseed] and the language of the northern Sahaptin people to the east, popularly called Klickitat (1929:35).

This suggests that there was linguistic contact between Southern Lushootseed and Sahaptin. Some of Ballard's speakers were later recorded by Leon Metcalf during the early 1950's (see Chapter 2 on Annie Jack for more details). Ballard also published a work titled *Southern Puget Sound Salish Kinship Terms* (1935), where Ballard systematically analyzed the kinship terminological system used among Southern Puget Salish natives. Ballard also analyzed calendric terms in Southern Lushootseed (Ballard 1950), where Ballard documented several terms for months and seasons from various speakers of different tribes in South Puget Sound.

During this period, a series of audio recordings were made on local native speakers. Some of the earliest audio recordings come from the anthropologist Melville Jacobs during the 1930's, where Jacobs used Edison devices to record the Puget Salish (and other) languages. Although Jacobs pioneered the use of tape recorders for native languages, he later discouraged its use (Hilbert 1997:ix). Jacobs believed that the use of recording devices discouraged researchers from transcribing the language, which Jacobs believed was important for developing grammatical proficiency in the language (Hilbert 2005:65). It was likely for this reason that only a small handful of recordings were done on Lushootseed by Jacobs during this period. One of the speakers Jacobs recorded was Julia Siddles in 1930, who was recorded with an Edison device and who was telling Salish myths. The ethnomusicologist Leon Metcalf, who was a student of Jacobs in 1950, was also encouraged to transcribe the speakers before each recording session. Unlike Jacobs, however, Metcalf strongly believed in the value of using reel-to-reel tape recorders to preserve the voices of the native elder speakers (Hilbert 2005:65). There were a series of recordings that were made by Leon Metcalf during the early 1950's. There are currently 62 tape recordings of elder Lushootseed speakers made by Leon Metcalf during the early 1950's, which can be found in the Burke Museum's special collections (see Chapter 2 for more details).

Sometime in the mid-20th century, systematic data analysis on the grammar of Lushootseed was conducted by anthropologists Colin Tweddell (1947, 1950) and Warren Snyder (1957, 1968ab). Before the second World War (WWII), Colin Tweddell was a teaching assistant in the Far Eastern Department of the University of Washington, where he was instructing the Chinese language (Tweddell 1950). When he returned from his duties in the armed services (i.e., after WWII), Tweddell began extensive field research on Lushootseed. In his book *The Snoqualmie-Duwamish dialects of Puget Sound Coast Salish: an outline of phonemics and morphology* (Tweddell 1950), Tweddell analyzed the phonemics and morphology of the Snoqualmie-Duwamish dialect. Some of the terms Tweddell used for describing the different phonemes were outdated (though they were commonly used during his time). For example, he used the words *sonant* for voiced consonants and *surd* for voiceless consonants. Tweddell included the phoneme /$t^w$/ when it is (in fact) the cluster /$tx^w$/. Moreover, Tweddell included seven contrastive vowels, /i e ə a ɔ o u/, when there are (in fact) only four, /i ə a u/, in Lushootseed. Although Tweddell described some vowel allophones, Tweddell did not provide evidence from the conditioning environment that predicted the distribution of these allophones. Most of the vowels that Tweddell transcribed phonemically were used in “free variation” with the other vowels that he transcribed phonemically.

The anthropologist Warren Snyder began his work with the Suquamish during the winter of 1952, where the Suquamish tribe sponsored his ethnographic research “in connection with their claims case against the Federal government” (Synder 1957:1). However, it wasn’t until the summer of 1953 where Snyder began intensive field research on Southern Lushootseed. Snyder consulted speakers from the Suquamish, Duwamish, and Snoqualmie tribes. Some of his principal consultants included Lucy Mullholland of the Suquamish, Julie Jacobs of Indianola, and Amelia Sneatlum (mother of Mrs. Mullholland) at Tulalip. At some point during the early 1950’s, Snyder used a reel-to-reel tape recorder to record some of his speakers. For instance, there were recordings of Snyder eliciting words and phrases in citation form to Amelia Sneatlum.

In his dissertation, Snyder provided a phonemic and morphological analysis of Southern Lushootseed (Snyder 1957). In his phonemic analysis, Snyder claimed that there were three vowels and 34 consonants in the language (Snyder 1957:2-3). Snyder attested a wide range of allophonic variations in his study. However, most of his observations on Lushootseed allophones were based on impressionistic analysis. Snyder also provided a comprehensive overview of the morphology of Lushootseed, describing the different word classes and word formation processes such as affixation, nominal morphology, and reduplication. However, there are some discrepancies between Snyder’s morphological analysis and how the morphology of Lushootseed is analyzed today. For instance, the oblique particle ‹ʔə› and the locative preposition ‹ʔal› (which usually combines with determiners, such as ‹ʔə tiiɬ› ‘OBL that’ or ‹ʔal tiiɬ› ‘at/in/on that’) were not treated as separate morphemes in Snyders' analysis. Instead, Snyder analyzed these as inflectional prefixes *a-* and *al-* that combines with determiners, such as *a-te* (modern form: ‹ʔə ti›) and *al-te* (modern form: ‹ʔal ti›).

Snyder wrote another book on the phonology and morphology of Southern Lushootseed in 1968 (Snyder 1968a). On that same year, Snyder published a work that included Lushootseed texts, place names, and a dictionary (1968b). Most of the texts were transcriptions of Salish myths that were recorded from Suquamish speakers (such as Amelia Sneatlum, Julie Jacobs, and Jerry Kanim) he worked with. Many of the place names that Snyder documented were found along the Kitsap peninsula, where he provided a map of the Kitsap peninsula with various locations that were indexed to designate each Lushootseed place name.

### 1.5.3 *Mid-late 20$^{th}$-century to present documentation*

During this period, two prominent figures played a significant role not only in the literary development of Lushootseed, but also in the preservation, revitalization, pedagogy, and education of the language. They were Thom Hess and Vi Hilbert (who also collaborated with each other extensively, providing major contributions to the field). Much of their work would not have come into fruition without their extensive collaboration, as well as their collaboration with the many elders who made a contribution to their works. It was from the works of Hess and Hilbert that brought greater attention to Lushootseed from a wider range of audiences, which included linguists, anthropologists, literary scholars, and others. During this period, the introduction of Lushootseed dictionaries that were (and still are) widely used today among scholars, language educators, linguists, anthropologists, and others working with the language were made. Several linguistic works on Lushootseed have been developed during this period, where several articles documenting the grammar of Lushootseed have been published. It was around this period when the International Conference on Salish and Neighboring Languages (ICSNL) (and proceedings of ICSNL) was formed. Thom Hess was among its earliest contributors.

#### 1.5.3.1 Thomas Melville Hess

Thomas Melville Hess was a linguist who began working with Lushootseed in 1962 (Hess 1976). Hess wrote his dissertation on June 1, 1967, at the University of Washington. His work was in connection with the survey of Northwest Indian languages that was sponsored by the Department of Linguistics in the University of Washington (Hess 1967a:iii). Hess's dissertation was on the grammatical structure of Snohomish, where much of the data was based on field research that he conducted from June to August of 1963 to 1966. Hess was also one of the earliest contributors of ICSNL, with over 13 contributions to the proceedings. In the first known proceedings of ICSNL in 1967, Hess wrote a paper on the morpheme *-əb* in Snohomish (Hess 1967b). Much of Hess's later publications for the proceedings of ICSNL included work on directional phrases in Lushootseed (Hess 1968); affixation in Lushootseed (Hess 1969, 1970); lexical sets, word class, word formation processes, and comparative vocabularies in Lushootseed (Hess 1972, 1979; Hess & van Eijk 1985); pedagogical work on Lushootseed and Salish (Hess 1973a, 1984); and many other topics (Hess 1974, 1986, 1990; Hilbert & Hess 1975; Hess & Bates 1998). Hess also published for the journals *Anthropological Linguistics* and the *International Journal of American Linguistics*, where he wrote papers on the different dialects of Lushootseed (Hess 1977) and the semantic role of Agent in Lushootseed (1973b), respectively.

Hess met Vi Hilbert in 1967, which was during the time Hess was conducting research for his *Dictionary of Puget Salish* (Bates et al. 1994). Hess and Hilbert collaborated extensively since then, working on several projects and teaching materials, such as *Lushootseed I and II* (1995ab), which are introductory textbooks used to teach Lushootseed grammar at a beginners and intermediate level. In Spring of 1972, the American Indian Studies Department at the University of Washington engaged the services of Thom Hess and Vi Hilbert to conduct an introductory course in Lushootseed (Hilbert & Hess 1982). The course was later taught exclusively by Vi Hilbert, who continued to teach Lushootseed at the University of Washington. Hess wrote a dictionary of Lushootseed in 1976, titled *Dictionary of Puget Salish* (Hess 1976). Much of the data he collected for this dictionary came from several elder speakers whom he worked with since 1962 (Hess 1976). Hess also worked with the linguist David Beck, where they published a two volume book series titled *Tellings from our Elders: Lushootseed syəyəhub* (Beck & Hess 2014, 2015), which were published after the time of his passing. These two volumes contained Lushootseed passages from narratives told by the Snohomish speaker Martha Lamont, which included transcriptions, Interlinear Glossed Texts (IGTs), and translations. At some point in his career, Hess became a linguist at the University of Victoria, British Columbia (Hilbert 1995, 1997; Hilbert & Hess 1982). Hess devoted much of his time working with Lushootseed. The Lushootseed orthography that is used today was developed by Thom Hess (see Section 1.6.2 for more details).

Hess worked with many elder speakers throughout his career, where he worked with 40 (or so) elder speakers. Many of the elder speakers he worked with were recorded through analog and digital cassette tapes, where their voices can now be heard by future generations. These recordings are now a part of the Vi Hilbert Collection (under the Thom Hess collection) through University of Washington's Ethnomusicology Archives.

Thom Hess passed away on August 27, 2009. He was described as a kind-hearted person by those who worked closely with him (Hilbert 1997). According to Tami Hohn (personal communication), Hess did not come across as a "strict" authority figure of the language. Rather, he was described as very humble, kind-hearted, and open-minded. When Tami was doing a presentation on language education for ICSNL, Hess was one of the few linguists who attended her presentation. Tami gave Hess a gift, a Salish basket, as a sign of gratitude for everything he has done for the language. Vi Hilbert also thanked Tami for thanking Hess, where Hilbert told Tami, "He [Thom Hess] does not get enough thanks for what he did". Tami, as well as many indigenous natives who have worked with the language (today and in the past), have learned much of Lushootseed because of his work. For this reason, Thom Hess is (and will continue to be) one of the most important pioneers in the Lushootseed literature.

#### 1.5.3.2 Vi *taqʷšəblu* Hilbert

Vi *taqʷšəblu* Hilbert was one of the last fluent speakers of Lushootseed. She was born in 1918, near Lyman, Washington, on the Upper Skagit River. Vi Hilbert grew up listening to her parents speak Lushootseed to each other and to their friends, where she would often speak Lushootseed with her parents. Hilbert's parents would often move to different places in search of work. This led Hilbert to receive education from different schools as she was growing up. She would later attend a boarding school in Tulalip (Yoder 2004). At one point in her life, Vi Hilbert lived next to the elder speaker Aunt Susie Sampson Peter, who considered Vi Hilbert her daughter (Hilbert 1995:xiii). It was during this time when Vi Hilbert and Susie Sampson Peter built a long-lasting relationship, where much of Susie's ancestral knowledge was passed down to Hilbert. According to Hilbert's granddaughter, Jill La Point, the preservation of the language, culture, and ancestral wisdom was foremost in all of Vi *taqʷšəblu* Hilberts' endeavors (Yoder 2022:x). Vi *taqʷšəblu* Hilbert is widely considered the most important figure in the Lushootseed literature, where she played several important roles in the preservation and revitalization of the Lushootseed language, culture, and ancestral history.

Hilbert first met Thom Hess in 1967. Hess was the first to encourage Hilbert to learn to read, write, and transcribe in Lushootseed. As Hilbert wrote, "I will always thank him for believing in my ability when I was uncertain that I could ever learn to read, write, and transcribe Lushootseed" (Hilbert 1997:xv). Together, they published many works (Hess & Hilbert 1976; Hilbert & Hess 1975, 1982; Hess & Hilbert 1995ab; Bates et al. 1994). Since that time, Hilbert worked on transcribing many of the elders who she was close with. Some of her close relations that she transcribed included Aunt Susie Sampson Peters, Alice Williams, Lucy Williams, "Gram" Ruth Sehome Shelton, and Isadore Thom.

In the early 1970's, Hilbert began working extensively on transcribing the tapes in the Metcalf collection (Hilbert 1974, 1976). The tapes included many recordings of Hilberts' relatives, including Aunt Susie Sampson Peters and Gram Ruth Sehome Shelton. Hilbert was provided a computer, printer, and software from the King County Cultural Development Fund and the Seattle Foundation, which were used to prepare Susie's and Shelton's words (Hilbert 1995:vii). From her work, Hilbert published two invaluable books that included transcriptions and translations of the many oral histories and narratives spoken by Susie Sampson Peters and Ruth Shelton (Hilbert 1995, 2005). In these books, an extensive biography of both speakers, as well as transcriptions and translations of stories, myths, oral histories, and the many private correspondences between these two speakers (and more), were provided. Hilbert transcribed tapes of other Lushootseed speakers in the Metcalf collection as well, including the Southern Lushootseed speaker Annie Jack.

As mentioned above, Hilbert was strongly devoted to the preservation of the language, culture, and ancestral wisdom of the elders. She played a pivotal role in language education and pedagogy, where she was an important teacher of Lushootseed. Hilbert began teaching Lushootseed language courses in the spring of 1972, when the American Indian Studies

Department at the University of Washington engaged the services of Thom Hess and Vi Hilbert to conduct an introductory course in Lushootseed (Hilbert & Hess 1982). The course was very popular at the time. There were many diverse students who took her course (Yoder 2022). At the end of the quarter in Spring of 1972, Hess moved to Victoria, so Hilbert subsequently took over the course (Hilbert 1995:ix). Hilbert and Hess published books that introduced Lushootseed language, history, and culture (Hess & Hilbert 1976). An introductory and advanced book on Lushootseed grammar were also published by Hess and Hilbert (Hess & Hilbert 1995ab).

During the time Lushootseed courses were offered in the University of Washington, Hilbert and Hess were also engaged in helping elders teach Lushootseed courses within various reservations (Hilbert & Hess 1982:72). Hilbert and Hess began the Lushootseed Language Project (1982), where the goals were (1) to instill in each Native student a pride in their ancestral language and the culture it expresses; (2) build a mastery of a small set of words and phrases that can be used at longhouse ceremonies and other gatherings; (3) develop what they called "home research", where students who were curious in the old ways would elicit words from elders who were present at the time; and (4) develop language proficiency to the extent that students could speak and cooperate with one or more fluent speakers without the need of specific guidance from a classroom teacher or lesson materials (Hilbert & Hess 1982:74-77).

Hilbert retired from teaching Lushootseed courses at the University of Washington in 1986-1987. Since her retirement, Hilbert worked on publishing transcriptions and translations of the Metcalf tapes (Hilbert 1995, 2005). Hilbert passed away on December 19, 2008 (Yoder 2004). She was one of the last fluent elder speakers of Lushootseed. Even in passing, Hilbert's legacy will continue to make an impact to the larger speech community. Her works and endeavors will never be forgotten.

#### 1.5.3.3 Lushootseed dictionaries

In 1976, Thom Hess wrote a 770-page dictionary on Lushootseed, titled *Dictionary of Puget Salish* (Hess 1976). Hess hoped that the information contained in the dictionary would stimulate the indigenous elders to expand on it and make emendations to it, where it can be passed on to future generations. The dictionary consisted of several entries, containing words decomposed into its roots and affixes. Hess also included short bibliographies in some of the entries, referring to some anthropological or linguistic works that described objects denoted by certain words. Hess wrote that the dictionary was "only a small part of the total vocabulary; and further study continues" (1976:vii). Most of the word forms and grammatical details were collected from Skagit and Snohomish speakers, including Vi Hilbert, Louise George, and Levi Lamont (1976:xiv). However, there were many more elder speakers who contributed to the dictionary, many of whom included Southern Lushootseed speakers Ernest Barr, Eva Jerry, Joyce Cheeka, Bertha McJoe, and Bernice Tanewasha. There was only one discrepancy between the orthography used in this dictionary and the orthography used today. At the time, Hess used the symbol ‹j› for the voiced alveolar affricate /d͡z/, which is transcribed as ‹dᶻ› in today's Lushootseed orthography. It can be presumed that the introduction of ‹dᶻ› was due to pedagogical purposes, where this form was easier and more accessible for learners to understand as the voiced alveolar affricate /d͡z/ instead of the voiced post-alveolar affricative /d͡ʒ/, which is often confused with how ‹j› is often used in English.

Since Hess's publication of the *Dictionary of Puget Salish* (Hess 1976), researchers Thom Hess, Vi *taqʷšəblu* Hilbert, and Dawn Bates continued to update the Lushootseed dictionary. The Lushootseed Dictionary Project was supported by grants from the National Endowment of the Humanities and an independent federal agency to Lushootseed Research (which is a non-profit corporation dedicated to the study and preservation of Lushootseed). The projects staffs included principal investigators Vi *taqʷšəblu* Hilbert (who at the time was Director of Lushootseed Research), Thom Hess, and Dawn Bates (Arizona State University). Several contributions were made by others, including Robert Hsu (University of Hawaii), Pamela Cahn, Crisca Bierwert (who gave assistance in integrating textual and lexical materials), Toby Langen (Tulalip Language Project), Zalmai Zahir, Joy McGinnis, and Nancy Turner. There were several elder consultants who contributed to the project, many of whom included speakers from Hess's first dictionary in 1976 and many others. In 1987, Dawn Bates began data entry and analysis, where much of her work was subsequently developed into the project. This project led to the development and publication of the *Lushootseed Dictionary* in 1994 (Bates, Hess & Hilbert 1994), which is the dictionary widely used today among linguists, language educators, anthropologists, and other various scholars of the language. Many of the lexical entries are taken from texts that come from rich traditional oral narratives told by many speakers who were consulted (1994:xi). Moreover, many of the speakers were encoded in the Lushootseed texts in each dictionary entry. Entries were organized by two columns (unlike Hess's first dictionary, where each entry was listed top-down in each page, subsequently leading to more pages than needed). There were several entries for affixes as well, with detailed descriptions of each component. Various reduplications that occurred to each root were well represented in the entries for roots. The dictionary provided detailed descriptions of the different kinds of reduplications that can occur in the language. This dictionary is a culmination of three decades of work, where materials were collected throughout those three decades. According to Tami Hohn (personal communication), Hess informed her that the *Lushootseed Dictionary* (1994) is still incomplete, where there are many words that have not been entered or have yet to be translated into English.

#### 1.5.3.4 Other works

There were many other works done on Lushootseed during this period. Some of these involved analyzing pronominal morphology in Lushootseed (Hagiwara 1989, Hukari 1976). For instance, Hukari (1976) wrote a paper on person markers in Lushootseed, characterizing the relationship (and distinction) between person markers and noun phrases based on their position within sentences and their cooccurrence restrictions. Other works included the expression of NPs in Lushootseed (Bates 2004). There were several works done on the characterization (and classification) of argument structures and valency-changing operators in Lushootseed (Barthmaier 2000; Beck 1996a, 2007; Kiyosawa 2006; Zahir 2019). There were also works that involved the analysis of reduplication in Lushootseed (Bates 1986, Kirkham 1993, Urbancyzk 2001). Urbancyzk (2001) wrote a seminal book on the patterns of reduplication in Lushootseed, classifying the different kinds of reduplication patterns that can occur in the language. Urbancyzk's findings provided several implications that these reduplication patterns posed towards theories in phonology.

It was also during this period when the first acoustic phonetic work was done on Lushootseed (Barthmaier 1998), where Barthmaier analyzed vowel quality and the role of vowel reduction in the language. There were also works done by David Beck (and colleagues) that involved characterizing the prosodic structure of Lushootseed narratives, as well as the theoretical implications that their findings posed on notions of prosodic hierarchy and prosodic phrasing (Beck 1996b, 1999; Beck & Bennett 1998, 2007).

There are also many anthropological and literary studies of Lushootseed. Anthropologist Jay Miller (1999, 2005, 2014) has done extensive work on Lushootseed culture and language. Miller has also published a book that consists of an interview with the elder speaker Ed Davis

(Snoqualmish). The book included detailed depictions of the language (Miller 2014). Crisca Biewert was a scholar of Lushootseed for many years. She was the editor of the book *Lushootseed Texts: An Introduction to Puget Salish Narrative Aesthetics* (1996), which included Lushootseed stories (and some songs) told by the elder speakers Martha Lamont, Edward (Hagen) Sam, and Emma Conrad. The stories in her book, which contains transcriptions and English translations, were compiled by Vi Hilbert, Thom Hess, and Dawn Bates.

## 1.6 Lushootseed Orthography

In this section, I discuss the Lushootseed orthography. I begin (Section 1.6.1) by providing a historical overview of the different orthographic representations that were previously developed for Lushootseed. I also discuss some inconsistencies between these earlier systems of transcription and the phonological representation of the language that is known today. In Section 1.6.2, I discuss the current Lushootseed alphabet, the development of the current Lushootseed alphabet, some discrepancies between the Lushootseed alphabet and the International Phonetic Alphabet (IPA), and how the transcriptions will be used throughout this dissertation.

### 1.6.1 *Early developments*

Some of the earliest systems of transcribing Lushootseed were developed around the 19$^{th}$- and early 20$^{th}$-century. However, these earlier systems of transcribing Lushootseed did not use a "unified" system of transcribing Native American languages. Often, these earlier developments were quite limited and could only be interpreted through the lens of the collectors or interpreters. These earlier systems are not reliable enough to use for linguistic analysis and they are nearly impossible to transliterate into the modern Lushootseed orthography. One of the earliest systems was developed by the ethnologist George Gibbs, who relied on a system he developed in an extract called *Instructions for Research relative to the Ethnology and Philology of America* (Gibbs 1867). It was hinged on a system of Romanization used in the English orthography and included a few descriptive modifications to each of the symbols. In fact, it was difficult to discern which symbols corresponded to which phonemes in his earlier writing system. Often, the number of "symbols" used in these earlier representations did not add up to the number of phonemes that we know exist in Lushootseed. For instance, George Gibbs (1872) used 29 symbols for transcribing consonants, when there are (in fact) 37 consonants in Lushootseed. Some of the descriptions Gibbs used for consonants were difficult to interpret. For example, Gibbs described the symbol GH as "a sonant guttural aspirate (Arabic ghain); other compounds, like the clucks occurring in T'sinuk, &c., to be represented by kl, tkl, tlk, &c., according to their analysis" (1872:251). It is uncertain what "clucks" referred to in his description of the GH symbol.

There were no symbols in Gibbs' system used to distinguish ejectives from sounds involving a pulmonic airstream mechanism. In fact, Gibbs and many of his contemporaries do not seem to acknowledge the existence of non-pulmonic speech sounds in their writing system. Evidence of this comes from Gibbs' transcription of the word "mom" in Lushootseed, where he transcribed it as *skoi*. Notice how this form contrasts from today's orthographic transcription of the word, which is ‹sk̓ʷuy›. Today's transcription of the word uses an apostrophe ‹'› over the ‹kʷ› symbol (as in ‹k̓ʷ›) to indicate a non-pulmonic (glottalic egressive) consonant (like the conventional IPA). The lack (or apparent absence) of representing ejectives in these earlier writing systems might be a result of this contrast (i.e., between different airstream mechanisms) not being formally introduced (or known) until the $20^{th}$-century (Beach 1938; Catford 1939, 1988; Doke 1923, 1926), where the term "ejective" (used to describe consonants that involve a glottalic egressive airstream mechanism) was coined by Doke (1923:707)[2]. It was unlikely the case that Gibbs and his contemporaries understood how ejectives worked at the time. In fact, ethnographers, ethnologists, linguists, linguistic anthropologists, and speech scientists during the 19th- and early 20th-century who were working with languages that contrasted ejectives had difficulty describing them (Fallon 2001). According to Meinhof (1915), "We had great trouble over the 'glottal stop' sounds, of which one was sometimes disposed to think that there could be no such thing, and which nevertheless do exist" (1915:56). This may suggest that Gibbs and his contemporaries either did not know how to represent ejectives in their writing system, or (as Meinhof stated) did not believe such sounds existed.

There were other systems that were developed by missionaries around the mid-19th century. Many prayers and catechisms in Lushootseed were developed by missionaries Eugene C. Chirouse in 1878 (Lonsdale 2021) and Jean-Baptise Boulet in 1879 (Boulet 1879), where they used their own system of transcribing Lushootseed. Again, many of these earlier developments lacked the appropriate symbols needed to convey all the phonemic contrasts in the language. Other systems that were later developed around the 1920's and the early 1930's showed slight "improvements" (Ballard 1929; Waterman 1920, 1921), though these systems also appeared to show their own difficulties due to some inaccuracies. Providing a transliteration of the written forms used from these earlier representations (Gibbs 1872; Ballard 1929; Waterman 1920, 1921) into today's Lushootseed orthography can never be attained with 100% accuracy (it can only be partially attained). Regardless, many of these earlier developments can provide some insight

---

[2] The first use of the apostrophe notation for ejective sounds, however, dates as early as 1661, in Ludolf's work *Grammatica Æthiopica* (1661), which was a grammar of Amharic. However, it appears Ludolf's work was not widely accessible to scholars during the 19th-century (especially to ethnographers and ethnologists of the Americas during this time). The later innovation of apostrophes for ejectives didn't occur until the early 20th-century, where a report from the committee of American Anthropological Association, titled *Phonetic Transcription of Indian Languages* (1916), introduced the use of an apostrophe for glottalized stops. This subsequently led to Sapir (1923) and Trubetzkoy (1926) innovating apostrophes into their transcriptions of sounds in the languages of the Americas and Caucasus.

towards the kinds of phonemes that existed (and the developments of different phonemes) during these earlier periods (for example, the nasal stops [m n] that were once contrastive in Lushootseed, which was (and still is) transcribed the same way (i.e., *m* and *n*) as any other alphabetic system that utilizes the Roman alphabet).

### 1.6.2 *Current orthography*

The current orthography used for Lushootseed was developed by Thom Hess during the 1960's. Some of Hess's earliest publications adopted this system when transcribing Lushootseed (Hess 1967ab, 1969, 1976). The system of orthography used for Lushootseed was derived from the Americanist IPA system of transcription, which emphasizes the importance of utilizing single symbols (sometimes with diacritics) instead of digraphs to transcribe phonemes of North American languages (Herzog et al. 1934). This system was mainly used to disambiguate clusters from single identifiable segments that were phonemically contrastive (e.g., the difference between the cluster *qw* and the segment $q^w$, as well as representing the voiceless post-alveolar fricative as a single symbol *č* instead of a cluster *ch*).

However, Hess was not the only linguist who adopted this system of transcription for Lushootseed. Prior to Hess's earlier works, American anthropologists Warren Snyder and Colin Tweddell used this system to transcribe Lushootseed sounds (Snyder 1957, 1968ab; Tweddell 1947, 1950). However, Snyder's transcriptions were much narrower than Hess's, often conflicting with the assumption that phonemes could be analyzed as a single contrastive unit in the language. There were also some inaccuracies in the transcription of different phonemes by Snyder and Tweddel. For example, Tweddell (1947, 1950) included the phoneme ‹$t^w$›, which is (in fact) a cluster between /t/ and /$x^w$/ (as in /$tx^w$/). Moreover, laryngealized approximants (i.e., glottalized resonances) were not represented in Synders' nor Tweddells' writing system, although it is represented in today's alphabet (Snyder and Tweddell may not have known that such sounds were contrastive in the language). Hess developed the writing system by consulting several elders who spoke the language. Many of the elders agreed with Hess's alphabetic system of Lushootseed. The system of transcribing Lushootseed (developed by Hess) is highly accurate in mapping graphemes to phonemes. There are similarities between this system of writing and the International Phonetic Alphabet (IPA) that is widely used today among phoneticians.

Table 1.2 lists the symbols used in the Lushootseed alphabet, their corresponding phonological descriptions, and their IPA equivalents'. There are 43 symbols in the Lushootseed alphabet.

**Table 1.2** Symbols used in the Lushootseed orthography.

| Symbols | Description | IPA |
|---|---|---|
| ʔ | Glottal stop | /ʔ/ |
| a | Open central unrounded vowel | /a/ |
| b | Voiced bilabial stop | /b/ |
| c | Voiceless alveolar affricate | /t͡s/ |
| c’ | Ejective alveolar affricate | /t͡s’/ |
| č | Voiceless post-alveolar affricate | /t͡ʃ/ |
| č̓ | Ejective post-alveolar affricate | /t͡ʃ’/ |
| d | Voiced alveolar stop | /d/ |
| d$^{z}$ | Voiced alveolar affricate | /d͡z/ |
| ə | Mid central unrounded vowel (i.e., Schwa) | /ə/ |
| g | Voiced velar stop | /g/ |
| g$^{w}$ | Voiced labio-velar stop | /g$^{w}$/ |
| h | Voiceless glottal fricative | /h/ |
| i | Close front unrounded vowel | /i/ |
| ǰ | Voiced post-alveolar affricate | /d͡ʒ/ |
| k | Voiceless velar stop | /k/ |
| k̓ | Ejective velar stop | /k’/ |
| k$^{w}$ | Voiceless labio-velar stop | /k$^{w}$/ |
| k̓$^{w}$ | Ejective labio-velar stop | /k’$^{w}$/ |
| l | Voiced lateral approximant | /l/ |
| l̓ | Laryngealized lateral approximant | /l̰/ |
| ɬ | Voiceless lateral fricative | /ɬ/ |
| ƛ̓ | Ejective lateral affricate | /t͡ɬ’/ |
| m | Voiced bilabial nasal | /m/ |
| n | Voiced alveolar nasal | /n/ |
| p | Voiceless bilabial stop | /p/ |
| p̓ | Ejective bilabial stop | /p’/ |
| q | Voiceless uvular stop | /q/ |
| q̓ | Ejective uvular stop | /q’/ |
| q$^{w}$ | Voiceless labio-uvular stop | /q$^{w}$/ |
| q̓$^{w}$ | Ejective labio-uvular stop | /q’$^{w}$/ |
| s | Voiceless alveolar fricative | /s/ |
| š | Voiceless post-alveolar fricative | /ʃ/ |
| t | Voiceless alveolar stop | /t/ |
| t̓ | Ejective alveolar stop | /t’/ |
| u | Close back rounded vowel | /u/ |
| w | Voiced labio-velar approximant | /w/ |
| w̓ | Laryngealized labio-velar approximant | /w̰/ |
| x$^{w}$ | Voiceless labio-velar fricative | /x$^{w}$/ |
| x̌ | Voiceless uvular fricative | /χ/ |
| x̌$^{w}$ | Voiceless labio-uvular fricative | /χ$^{w}$/ |
| y | Voiced palatal approximant | /j/ |
| y̓ | Laryngealized palatal approximant | /j̰/ |

There are noticeable features in the orthography that can provide articulatory details to each sound. For the set of symbols used for lingual fricatives and affricates, a "wedge" diacritic ‹ˇ› is used to indicate retraction. This is observed when comparing ‹s› [s] with ‹š› [ʃ], ‹c› [t͡s] with ‹č› [t͡ʃ], and ‹x› [x] with ‹x̌› [χ]. In each of these forms, the latter forms ‹š č x̌› indicate an articulatory gesture that is more retracted than the former ‹s c x› respectively. This contrasts from the traditional IPA, which uses different symbols to differentiate the consonants apart due to their distinct places of articulation (i.e., [s] vs. [ʃ], [x] vs. [χ]). This is because, according to the Principles of the IPA, "when two sounds occurring in a given language are employed for distinguishing one word from another, they should wherever possible be represented by two distinct symbols without diacritics" (International Phonetic Association 1999:159). Like the IPA, the Lushootseed alphabet uses a superscripted ‹ʷ› to indicate the secondary articulation of labialization. Moreover, the Lushootseed alphabet uses the apostrophe ‹'› to indicate an ejective or glottalized resonant. There are also many symbols in the Lushootseed alphabet that are used the same way as the IPA.

There are notable differences between the Lushootseed alphabet (which uses the Americanist IPA) and the traditional IPA. An example of this difference can be observed when transcribing affricates. Unlike the Americanist IPA system, which transcribes affricates as a single grapheme (e.g., voiceless alveolar affricate as ‹c›), the traditional IPA transcribes affricates as a sequence between two symbols that convey a transition from one manner of articulation to another (i.e., stop to fricative, as in [t͡s]). There are several reasons for this. One reason is that the traditional IPA is conveying information about the acoustic consequences on the realization of affricates. Affricates are acoustically signaled by a brief period of silence (which indicates the stop gesture) followed by frication noise. The transcription for affricates reflects a strictly phonetic interpretation in the traditional IPA system. Another reason why the traditional IPA departs from the Americanist IPA system is some symbols in the Americanist IPA are used for different consonants/vowels than the traditional IPA. For example, the symbol ‹c› is already used for a different consonant: in the traditional IPA, the letter *c* is used for the voiceless palatal stop [c]. There are several diacritics in the Americanist IPA system that are used differently from the traditional IPA system. For instance, the "wedge" diacritic ‹ ˇ ›, which indicates retraction in the Americanist IPA, is used for a rising pitch contour [ ˇ] in the traditional IPA. Moreover, the symbol used for the voiced palatal approximant ‹y› in the Americanist IPA system is used for the close front rounded vowel [y] in the traditional IPA system (the traditional IPA uses the symbol [j] for the voiced palatal approximant).

There are several symbols (and means of transcribing sounds) in the traditional IPA that are not represented in the Americanist IPA. For instance, the Americanist IPA doesn't have a set of symbols for clicks (i.e., consonants involving a velaric ingressive airstream mechanism), such as the bilabial click [ʘ], alveolar click [!], palatal click [ǂ], etc…. There is no way the Americanist IPA can convey double articulations either (for example, the labio-velar stops [k͡p] and [b͡g] that occur in many west and central African languages). Such discrepancies are primarily due to the separate historical development between the traditional IPA and the Americanist IPA. The Americanist IPA system was developed to transcribe indigenous languages of the Americas. However, the traditional IPA was developed to convey sounds that have been attested in many spoken languages around the world (not just the Americas). The traditional IPA system is a unified system that was developed to transcribe the world's spoken languages (including languages of the Americas).

Despite these differences, the Lushootseed alphabet (which uses the Americanist IPA) is highly accurate in mapping graphemes to phonemes. When broadly transcribing Lushootseed words, I will (wherever possible) provide both an IPA transcription and the Lushootseed orthographic transcription of the words. That way, both systems of transcriptions are well represented and accessible to readers who are more familiar with either one of these systems. In some instances, narrow transcriptions will be used in the texts that follow. However, a narrow transcription cannot be conveyed in the Lushootseed alphabet. For this reason, narrow transcriptions will be represented using the traditional IPA. The symbols that are used to broadly (or phonemically) transcribe the language will be enclosed in slash brackets /…/, whereas symbols that are used for a narrow (or systematic) transcription will be enclosed in square brackets […]. Orthographic representations will be *italicized* in the main body only if the orthography alone needs to be represented (*italics* will also be used in tables and examples in Part III). However, they will be enclosed in small-angled brackets ‹…› in numbered and/or listed examples (sometimes in tables, such as the ones used in Part II), as well as when accompanying IPA transcriptions in the main body. In Interlinear Glossed Texts (IGTs), orthographic representations are neither *italicized* nor enclosed in ‹…›. Orthographic representations will not accompany the IPA transcriptions when the orthographic representation matches the IPA transcription of the word (e.g., /ti/ ‘this’, which is transcribed the same way as ‹ti› in the orthography). An example of a broad transcription and an orthographic transcription can be seen in the word /skʷ’ujʔ/ ‹sk̓ʷuyʔ› ‘mother’. An example that provides both a broad, narrow, and orthographic transcription can be shown for the following word /q’il/ [q’el] ‹q̓il› ‘ride, load vehicle’.

## 1.7 Conclusion

In this chapter, I provided a brief background of Lushootseed, the language family that Lushootseed belongs to, the literary history of Lushootseed, and the Lushootseed orthography (and the development of the Lushootseed orthography). Section 1.1 briefly covered the Salish language family, and what branch of the family Lushootseed belongs to. In Section 1.2, I covered the geographical distribution of Lushootseed speakers. Section 1.3 and 1.4 discusses the indigenous tribes affiliated with Lushootseed, as well as the different names for Lushootseed. Section 1.5 covered the literary history of Lushootseed, where I distinguished three different stages of its literary history: (1) 19$^{th}$-century documentation (section 1.5.1); (2) early-to-mid 20$^{th}$-century documentation (section 1.5.2); and (3) mid-late 20$^{th}$-century to present documentation (section 1.5.3), where the most important figures and pioneers on the literary history of Lushootseed were Thom Hess and Vi Hilbert. Finally. In Section 1.6, I covered the Lushootseed orthography, where I discussed the historical development of the orthography in Lushootseed, parallels between the Lushootseed orthography (which utilizes the Americanist IPA) and the traditional IPA, and how Lushootseed is transcribed throughout this dissertation.

# Chapter 2. DATA, SPEAKERS, AND RECORDINGS

## 2.1 INTRODUCTION

The data used for this project comes from recordings dating to the 1950's. These are recordings of indigenous elder speakers who spoke Lushootseed as their first language. The recordings come from the Metcalf Collection, which is part of the Burke Museum's Special Collections in University of Washington. In this chapter, I cover further details on the data and recordings used for this project. In Section 2.2, I discuss the goals of the dissertation research, where I discuss the gaps that exist in the literature on Lushootseed. Section 2.3 discusses the archive of the recordings (i.e., what archive the recordings come from). Section 2.4 covers the speakers whose recordings are examined for this project. Section 2.5 covers the very nature of the recordings, which includes a discussion of (a) who produced the recordings (and how they were produced); and (b) the quality of the recordings, and how the quality of the recordings affects the analysis of the data. Section 2.6 discusses how the data will be used and analyzed for this project.

## 2.2 SCOPE OF DISSERTATION RESEARCH

In this dissertation, I document the phonetics, phonology, and morphology of Lushootseed from a corpus of recordings recovered from the archives of the University of Washington's Burke Museum. There are several goals of this dissertation. One goal is to fill in an important gap in the literature on Lushootseed (and Coast Salish) phonetics, where the phonetics of Lushootseed is critically under documented. Previous linguistic work primarily focused on the morphology and syntax of Lushootseed (Hess 1967, 1968, 1969, 1970, 1972, 1979; Hess & van Eijk 1985; Hess & Bates 1998; Hagiwara 1989; Hukari 1976; Barthmaier 2000; Beck 1996; Zahir 2019; Bates 1986). Moreover, pedagogical materials of Lushootseed focused primarily on morphology and syntax

(Hess 1974, 1986, 1990; Hilbert & Hess 1975). However, little attention was given to the phonetics and phonology of Lushootseed. The goal of the dissertation research is to characterize the pattern of speech sounds in Lushootseed by conducting the first instrumental acoustic analysis of speech sounds produced by elder first language speakers from archival recordings dating to the 1950s. Another goal is to address questions concerning the morphology of Lushootseed that has not been previously investigated. Some of these questions concerns the morphological typology of Lushootseed, the position class of verbal affixes, allomorphs, the role of independent pronouns, as well as a descriptive overview of Lushootseed determiners.

Another goal of the dissertation research is to produce transcriptions, translations, and annotations of the recordings. The plan is to disseminate these materials to family members of the speakers, as well as indigenous language educators who are culturally affiliated with the elder speakers' heritage. Indigenous tribal communities who are affiliated with the elder speakers' heritage expressed interest in providing these materials to students and community members to teach traditional Salish myths, oral history, traditions, and customs as told by elders in the original language. By making these materials available to indigenous tribal communities, family members and community members will have further resources towards rich oral narratives as told by the indigenous elder speakers.

## 2.3 ARCHIVE

Recordings for this project come from the Metcalf Collection, which can be found in the University of Washington's Burke Museum of Natural History. Although the tapes were initially offered to Melville Jacobs at the University of Washington, Jacobs later added them to the Thomas Burke Museum. As of today, the recordings are still archived in the University of Washington's Burke Museum of Natural History (Hilbert 1995:ix). The recordings are also a part of the University of

Washington's Ethnomusicology Archives (part of the Vi Hilbert Collection), courtesy of the Burke's Museum.

## 2.4 SPEAKERS

There are two speakers examined for the phonetic portion of this project: (1) Annie Jack, and (2) Martha Lamont. Recordings for both speakers come from the Metcalf Collection. The recordings that were selected for acoustic phonetic analysis were based on their sound quality. Data from other speakers (which includes the two speakers named above) for the morphology portion of this project comes from primary and secondary sources. It also includes data from some of these speakers in the Metcalf recordings.

### 2.4.1 *Annie Jack*

Annie Jack was a female native elder speaker of the Southern Lushootseed dialect. Annie Jack was born near the Green River in either the 1870's or 1880's. She was a Muckleshoot and Duwamish speaker who lived in the Muckleshoot tribal reservation. Her father was Stuck Jack, who was from the village of Stuck near the White River.

A detailed description of Annie Jack's family was documented by Arthur Ballard (1929). In Ballard's work *Mythology of southern Puget Sound*, Ballard listed several speakers who provided the Puget Salish myths and legends for his work. He documented the names, family histories, and approximate dates of birth of each speaker. In this work, Ballard listed Annie Jack (indigenous name transcribed as *xolo'p* ‹x̌uluʔp›), who was from Green River. The approximate date of birth Ballard listed for her was 1880. Ballard stated that Annie Jack was the daughter of Ann Jack (indigenous name transcribed as *twa'itidolıtsə*) (i.e., the mother), who was also from Green River and was born around 1840, and Stuck Jack (indigenous name transcribed as *tika'kı.t,* *ka'kɪ.ed*) (i.e., the father), who was from the village of *stʌq!* on White River and was born about 1845 (Ballard 1929:38-39). Ballard provided some detailed information of Annie Jack's mother, Ann Jack. According to Ballard, Ann Jack's father, *take'l*, was from Yakima or some other Sahaptin group (1929:38-39). It was said that in his early life, he was taken prisoner and lived several years with the Umatilla people. On Green River, he was later introduced to "a phallic ceremony which he had learned during his captivity" (1929:39). Ann Jack's mother, *xolo'p* ‹x̌uluʔp›, was from Green River. Annie Jack's indigenous name, *xolo'p* ‹x̌uluʔp›, was named after her grandmother (i.e., Ann Jack's mother, *xolo'p* ‹x̌uluʔp›).

Some of Annie Jack's descendants include Iola Bill (daughter); Willard Bill, Sr. (grandson); and her living descendants: Denise Bill (great-granddaughter); Willard Bill, Jr. (great-grandson); Elise Bill-Gerrish (great-great-granddaughter, and daughter of Denise Bill); and Justice Bill (great-great-grandson, and son of Willard Bill, Jr.). Willard Bill, Jr. has begun his professional career at the Muckleshoot Tribal School. Since 1992 he has served the local Native population in a variety of roles including classroom teacher, building and district administrator, cultural director and now Assistant Director for the Office of Native Education, OSPI. Denise Bill is an educator who works with adult and higher education, where she is the current director of the Muckleshoot Tribal College. She is also an adjunct professor for other public colleges (such as the Green River Community College). Elise Bill-Gerrish is a language educator who teaches Lushootseed and works for the Muckleshoot tribe's language program. Justice Bill is a historian who is currently receiving his education at UC Berkeley.

According to Denise Bill (2012), Annie Jack was an Indigenous doctor, a medicine woman; a basket maker in the Muckleshoot Tribe (2012:8). Denise (2012) interviewed her father, Willard Bill, Sr., on March 5, 2004, who spoke of his two grandmothers, Clara Siddle and Annie Jack.

According to Willard Bill, Sr., Annie Jack lived her whole life in the Muckleshoot Tribal reservation. She was described as a very traditional woman. The following is an excerpt from the interview:

> I turned to my grandmothers, Clara Siddle and Annie Jack. These are the two inspirational people who motivated me to do a lot of things. Grandma Annie lived here [Muckleshoot] on the reservation her whole life and was a very traditional Indian woman. She was a Shaker, healer, herbalist, and really lived the life of a traditional Indian. She would cook, hunt, gather berries, and was very active in the Shaker Church. She was a very important person.
>
> My other grandmother, Clara Siddle, was raised at Muckleshoot also and was eventually literate and very active in her own personal education through the years. So, the interaction with both grandmothers was really instrumental for me and showed me what you can do in two different settings. Where one grandmother never spoke English-well, she did speak English, but she didn't read or pay much attention to money [Annie Jack] – the other grandmother was more simulated in a way [Clara Siddle] but was very committed to her culture. They were both very spiritually oriented people, and both prayed before every meal, and were very proud of their particular faiths. They were the two women who inspired me. (Willard Bill, Sr., interviewed March 5, 2004).

According to Annie Jack's descendants (i.e., Denise Bill, Will Bill Jr., and Elise Bill-Gerrish) (personal communication), local pharmacists would sometimes visit Annie and asked for medicine that they could use for their clients. The family of Annie Jack have very strong ties with each other, cherishing their culture, family/tribal history, and traditions. They have also informed me that the late Julia Siddles (who was recorded by Melville Jacobs in the 1920's) is an ancestral elder among the family. The legacy of Annie Jack continues to live on within her descendants.

### 2.4.2 *Martha Lamont*

Martha Lamont was a female elder speaker of the Northern Lushootseed dialect. Martha was identified as a Snohomish speaker and was born around 1880. She was married to Levi Lamont, who was also a Northern Lushootseed speaker from Tulalip. Martha Lamont was an active member of the Shaker Church. According to her grandson, Hank Williams (personal communication), Martha Lamont was a minister for the Shaker's church. Hank stated that Martha would always give prayers to those whom she knew needed it the most. Martha Lamont owned several land properties in the Tulalip reservation, which was subsequently owned by her grandson, Hank. During the 1930's, tribal leader William Shelton and his family conducted an outreach program to make the people of Tulalip better known to the outside (non-reservation) world (Beck & Hess 2014:29). Although many people in Tulalip disapproved of his work, there were many photographs of Martha Lamont standing aside with the Shelton's to support their efforts.

During the early 1950's, Leon Metcalf made several recordings of Martha Lamont. Many of these were recordings of Salish myths and private correspondences. There were several private correspondences between Martha Lamont and other elder speakers, including Annie Jack. Because Martha Lamont never learned to read or write, she was always enthusiastic about being tape recorded for the preservation of the language and traditional teachings. She devoted herself toward the preservation of treasures from the past. She worked with different collectors (such as Leon Metcalf and Thom Hess) who spent many years tape recording her stories.

### 2.4.3 *Other speakers*

There were additional speakers for whose texts and speech were examined for this project. Two of these speakers (who were examined for the morphology portion of this project) were Susie Sampson Peters (Hilbert 1995) and Ruth Shelton (Hilbert 2005).

Susie Sampson Peters was a native elder speaker from the Skagit Valley. She was born around 1863 and was the oldest among seven children (Hilbert 1995:xi-xii). Susie Sampson Peters grew up speaking Lushootseed. She spent her entire life speaking the Skagit language. At one point in her life, she also learned to communicate in Chinook Jargon when she was young and working for local white families (1995:xii). She never learned to speak English. She often relied on her children, Martin Sampson (born 1888) and Alfonso (Al) Sampson (born 1894), as her English translators. Based on the many private correspondences that took place between Susie Sampson Peters and the other elders in the Metcalf Collection, Susie was very close friends with the Snohomish speaker Ruth Shelton.

Ruth Shelton was born between 1855 and 1859. Her ancestry was Klallam and Samish (Hilbert 2005:viii). Her father was a Dungeness Klallam whose mother had connections at Lummi. Ruth's father left Dungeness after his father died and went to stay with Ruth's mother at Samish. Sometime in 1878, she moved to Tulalip. Ruth was fluent in both Lushootseed and Klallam. She was also proficient in English.

Another speaker whose recordings were examined (later in Chapter 10, which covers stress and intonation in Lushootseed) is Louise George, where the recordings of Louise George came from the Thom Hess collection (which is separate from the Metcalf collection). Louise George was a Northern Lushootseed (Skagit) speaker who resided in Nooksack. Thom Hess spent many years working with Louise George, developing lesson materials that were used for introductory and advanced learners of Northern Lushootseed (Hess & Hilbert 1976), as well as making recordings from field work sessions.

## 2.5 Background on Recordings

### 2.5.1 *Leon Metcalf*

The recordings used for this project were produced by Leon Metcalf in the 1950's. Leon Metcalf, who was born on May 18, 1899, in Ohio, was a musicologist who spent most of his early life in Marysville, Washington. During his early life, he was bartering with a local Tulalip native, Little Sam, who sold shellfish to him and his family. He learned to speak Chinook Jargon (a pidgin language of limited vocabulary and simplified grammar) through these barterings. It was also during his early life when Metcalf grew close with many indigenous natives from Tulalip. Metcalf was also exposed to Lushootseed during this time, though he did not learn it successfully (Hilbert 2005:63). Metcalf was fascinated with the language (Hilbert 2005:65). In 1950, Metcalf took a summer course in language transcription from Melville Jacobs, who was a renowned linguist of the region at the time. Jacobs told Leon that “at least 3 years had to be spent transcribing with a fountain pen into a notebook before recordings could be made” (Hilbert 2005:65). However, Metcalf decided to use tape recorders (which was discouraged by Jacobs) to record elder speakers instead. His first reel-to-reel tape recorder was obtained from Foster High School, which was the school he worked in. Shortly afterwards, he purchased his own tape recorder.

Because he feared the loss of important cultural treasures, Metcalf spent over five years (1950-56) visiting and tape recording indigenous elder speakers around the Puget Sound (Hilbert 1995:viii). Although Metcalf’s collection included samples of languages all over the world, most of the recordings were done on Lushootseed speaking elders. Because of his close ties with several natives from Tulalip, Metcalf was able to meet and record several indigenous elders in the Puget Sound region. Metcalf recorded a variety of language materials from these elders. Many of these language materials included recordings of Salish myths, legends, songs, oral histories, and private correspondences. As of today, the recordings are stored in the University of Washington’s Burke Museum of Natural History.

### 2.5.2 *Recording quality*

It is unknown exactly what recording device (or brand of device) Metcalf used to record the elder speakers (Hilbert 2005:68). However, it is possible to get an idea of what recording device was used by considering both extrinsic factors (e.g., the hard physical tapes themselves) and intrinsic factors (e.g., audio quality) of the recordings. The extrinsic factor is simple: The recordings come from analog reel-to-reel tapes deposited in the Burke Museum. This suggests that the tapes came from a reel-to-reel recording device. Intrinsic factors can also suggest the type of tape recorder used by Metcalf in the early- to mid-1950's. The most important intrinsic factor to consider is the background noise that was present in these recordings.

The type of background noise that was present in the Metcalf recordings is "mains hum". Mains hum is a noise generated from devices that uses an alternating current (i.e., AC current). Mains hum is caused by strong magnetic fields that causes the enclosure and accessories of devices to vibrate. The intensity of the noise, which is a function of the applied voltage (in this case, an AC current), depends on the size of the magnetic field. When the electrical current is exposed to an inductance, this creates a magnetic field around the conductor. This will often come in the form of a noise that's emitted from the power supply (Vidyalal et al. 2003; Hood 1998). Nearby appliances may affect the magnitude of the field that is introduced by the inductance. This is a typical cause of mains hum, where the AC electromagnetic field comes from nearby appliances. The noise that is generated (i.e., mains hum) is periodic, and can differ between either 50Hz or 60Hz (this depends on the region of the device. For devices that come from Europe, the fundamental frequency of the mains hum is 50Hz. However, for devices that come from the US, the fundamental frequency of the mains hum is 60Hz).

It can be suspected that the recording devices (or medium) that Metcalf used were from the same region (i.e., the US) in each recording session because the frequency of the current was always around 60Hz, which can directly be measured by calculating the average fundamental frequency of each cycle from the mains hum. However, the intensity of the mains hum differed across recordings. I suspect this was because the microphone was placed at varying distances from the power supply (i.e., the source of the mains hum) in each recording session. According to Richard Wright (personal communication), it is possible that the battery supply used for some of the recordings came from a car[3]. Mains hum generated from a car's battery supply is often loud and may result in undesirable affects to the speech signal. However, some of the Metcalf recordings (e.g., recordings of Annie Jack and Martha Lamont) were suitable for phonetic analysis, where the amplitude of the mains hum signal was minimal.

Given this information, we may infer that the analog tape-recording devices that Metcalf used had a strong AC current (in other words, it must have been an analog recording device). Because mains hum is a kind of background noise (a feeble noise generated at 60Hz), the quality of the recordings may be considered poor. Regardless, any speech signal that was detected through the microphone during the time of recording is preserved in the time-domain. Like any sound in nature, speech sounds come from changes/disturbances to the atmospheric pressure radiating from a source (in the case of speech sounds, the lips). If the microphone was able to detect these changes/disturbances, this would yield an effect on the time-domain of the signal, even in the presence of background noise (i.e., mains hum). Speech sounds are readily traceable in the time-domain of the signal from these recordings. The intensity of the mains hum was not large enough to entirely mask the speech signal in the time-domain. Acoustic information of the speech signal that is traceable from the time-domain was preserved because the microphone was able to detect these changes during each recording session.

However, there are some limitations on what can be measured from these recordings. For example, in most of these recordings (especially the recordings that dates before 1954), there was an upper frequency cutoff near 5~6kHz, despite being digitized at 44.1kHz with a 16-bit depth. The upper frequency range for some speech sounds such as the voiceless alveolar fricative [s]

[3] It was said that when Melville Jacobs (who was a teacher of Leon Metcalf) was recording speakers during his time, a tape recorder powered from a car battery (made by the engineering department at the University of Washington) was used by Jacobs (Hilbert 2005:65). Metcalf may have adopted a similar approach of using a car battery to supply power to the recording devices.

usually reaches its peak intensity well above 7kHz (Shadle & Scully 1995; Shadle 1985, 2012, 2023; Koenig et al. 2013). However, these peaks are not traceable in some of these recordings, which was most likely due to the cutoff frequency of the microphone (which is the upper frequency limit in which sound signals can be attenuated). For this reason, it was difficult to obtain reliable measurements of Center of Gravity for speech sounds such as [s] and [ts]. However, relative differences in fricative and affricate place of articulation was still observable after using different measures to obtain measures of spectral moments (see Chapter 6 for more details). Regardless, it is still possible to obtain (somewhat) reliable acoustic measurements of speech sounds from these recordings because the speech signal was readily traceable in the time-domain (especially for speech sounds whose frequency components is observable below 5~6kHz).

## 2.6 Data Analysis

As mentioned above, several recordings were recovered from UW's Burke Museum. These recordings come from analog reel-to-reel tapes that belong to the Metcalf collection. There are 109 tapes in the Metcalf collection. 62 of these tapes are used for the dissertation research (the other 47 tapes are recordings of other languages that are not relevant for the dissertation research). From these recordings, two elder speakers are examined: Annie Jack and Martha Lamont (see Section 2.4 for more details). Most of these recordings are recordings of traditional Salish narratives and private correspondences. In other words, that data used for this project are recordings of connected (spontaneous) speech. These recordings are digitized with a sampling rate of 44.1kHz with a 16-bit depth. Data that is produced from these recordings include annotations (word-level, morpheme-level, and phonological-level), texts and translations (as well as Interlinear Glossed Texts for annotations and existing texts), and acoustic measurements (i.e., formants, duration, fundamental frequency, etc…) for phonetic analysis.

The software used for analyzing and annotating the digitized recordings is Praat (Boersma & Weenink 2023). Textgrids are used to annotate each of the recordings. Each of the recordings' Textgrids has an interval tier that specifies word-level annotation, where each word is transcribed using the standard Lushootseed orthography. Each of the recordings were inspected for their sound quality. This was to determine the recordings that were suitable for obtaining acoustic measurements. For those recordings that were suitable for acoustic phonetic analysis, an additional interval tier was included in the Textgrid that specified segment-by-segment annotations. Each segment in this tier were transcribed using the International Phonetic Alphabet (IPA). The relevant acoustic measures for this project included formants, fundamental frequency, intensity, jitter, duration (VOT and vowel duration), and spectral moments (which includes center of gravity, kurtosis, skew, and variance). The software that was used for statistical analysis is R Studio (R core team 2018).

In Part 3 of the dissertation, several texts will be used from the recordings, as well as primary and secondary sources. There are many recordings in the Metcalf collection that is already transcribed and translated by Vi Hilbert (Hilbert 1995, 2005). However, many of these existing texts do not have corresponding Interlinear Glossed Texts (IGTs). IGTs were developed for the existing texts. Texts used to accompany the recordings used for this paper include transcriptions, translations, and Interlinear Glossed Texts (IGTs). Most of the abbreviated glosses in the IGTs follow the Leipzig Glossing Rules (Bernard et al. 2015). However, other glossed abbreviations that do not occur in (or are departures from) the Leipzig Glossing Rule include glossed abbreviations and functional descriptions that are used in the Lushootseed literature (Barthmaier 2000, Beck 2007, Bates et al. 1994). IGT's are used throughout to illustrate morphological patterns that occur in Lushootseed. Most of the data for the IGT's come from texts used to accompany the recordings, as well as primary and secondary sources. Table 2.1 lists the sources and abbreviations used for the IGT's. Although examples from secondary sources will be used in Part 3, most of the examples will come from primary sources.

**Table 2.1** Abbreviated sources for IGT's

| **Source** | **Abbreviation** | **Citations** |
|---|---|---|
| Primary | SSP = Susie Sampson Peters | Hilbert 1995, Beck & Hess 2015 |
| | AJ = Annie Jack | Hilbert 2000 |
| | RS = Ruth Shelton | Hilbert 2005 |
| | ML = Martha Lamont | Beck & Hess 2014 |
| Secondary | LD = Lushootseed Dictionary | Bates et al. 1994 |
| | TH = Thom Hess | Hess 1995 |
| | PB = Paul Barthmaier | Barthmaier 2000 |
| | ZZ = Zalmai Zahir | Zahir 2019 |
| | B&H = Bates & Hess | Bates & Hess 2001 |

# Chapter 3. LANGUAGE PEDAGOGY, EDUCATION, AND REVITALIZATION

## 3.1 INTRODUCTION

In this chapter, I cover language pedagogy, education, and revitalization of Lushootseed by looking into two tribal communities: Tulalip and Muckleshoot. This chapter will cover the two tribes' language programs and discuss how they differ in terms of providing language pedagogy and education to K-12 students.

## 3.2 LUSHOOTSEED LANGUAGE EDUCATION

There are many K-12 schools in the state of Washington where Lushootseed is being taught as a second native language. Many of these schools are either tribal schools (schools that are sanctioned within the tribe) or public schools that are located near the tribal reservations. The tribal schools that provide Lushootseed language education include the Muckleshoot Tribal School (Muckleshoot) and the Wa-he-lut Indian School (Nisqually). However, there are several (local) public school districts that offer Lushootseed language course to K-12 students.

In 2015, the Legislature passed a bill (Senate Bill 5433) that made the *Since Time Immemorial* (STI)*: Tribal Sovereignty in Washington State* or other tribally developed curriculums to become a requirement in all public schools in the state of Washington. Part of these curriculums include language education and tribal history. Local school districts next to the reservations are required to work with the tribes to teach language, culture, and local tribal history. Tribes of Lushootseed heritage that work with local school districts for K-12 students include Suquamish, Tulalip, Snoqualmie, Squaxin, and many others. Although some of these tribes do not have tribal schools within their reservations, public schools that fall along the borders of these reservations are required to provide tribal education to K-12 students. Under the Senate Bill, public schools are required to teach local tribal history and (sometimes) language. In some cases, courses that facilitate tribal history and language education replaces social studies. Public schools cannot hire a language teacher unless the teacher is certified to teach the language by a local tribe. The tribal community decides who gets certified. Tribal communities usually certify somebody who is a part of the tribal community (i.e., an indigenous native) (Tami Hohn and Michele Balagot, personal communication). Materials and resources that are used to teach local tribal history and/or language education in these public schools must be obtained from the local tribes.

Lushootseed courses are also taught at the University of Washington. Tami Hohn, who is indigenous to the Puyallup tribe, is currently the head faculty of Southern Lushootseed courses in the University of Washington. Faculty members who teach Lushootseed at public colleges or universities do not need to be certified by the tribal community to teach the language.

In what follows, examples of language education and teaching curriculums are discussed from two tribes: Tulalip and Muckleshoot. Information on Tulalip comes from a personal interview with Michele Balagot, who is the Lushootseed Department Manager in Tulalip. For Muckleshoot, the information comes from an interview with Elise Bill-Gerrish (see Chapter 2 for more details). The kind of language program that these two tribes offer is very different from each other. The Tulalip tribe does not have a tribal school(s) for K-12 students but works with the public school district of Marysville. On the other hand, the Muckleshoot tribe has a tribal school for K-12 students within their reservation. Due to the distinct circumstances, the two tribes adopt different approaches towards providing language education to K-12 students. Regardless, both programs strive towards the revitalization of the language back in their communities.

### 3.2.1 *Tulalip*

Tulalip is a tribe that does not have a tribal school (i.e., a school within the reservation) for K-12 students. (However, Tulalip has a preschool within the reservation that is not a part of the public school district of Marysville). Tulalip works primarily with public schools in Marysville. These public schools include Quil Ceda Tulalip Elementary School, Totem Middle School, Marysville Pilchuck High School, and Heritage High School. Each of these schools belong to the public school district of Marysville. According to Michele Balagot (personal communication), approximately 95% of the student population in these schools are indigenous Natives from Tulalip.

The preschool in Tulalip provides some basic language education (such as learning basic words, phrases, and pronunciation in the Tulalip Language), as well as cultural and tribal practices (such as learning how to smoke salmon) to children around the age of 5 or under. However, some parts of the course curriculum in the Tulalip preschool cannot apply to public schools in Marysville (such as the provision of a Lushootseed language course). Public schools in Marysville cannot provide language courses that teach Lushootseed as a second language. However, teachers who are trained in the Tulalip Language incorporate language materials into the curricular activities of other courses. Part of the curricular activities that were developed by the Tulalip Language Department involves incorporating the Tulalip Language into the lesson plans of different disciplines. For example, in science and math classes, students are taught to use Lushootseed words (such as the root ‹x̌ʷib›, which is a unit of measure in Lushootseed that forms the distance from the tip of the middle finger to the tip of the thumb when the fingers are spread out) for different units of measurements. Through semantic extension of words such as ‹x̌ʷib›, children can extend the meaning of the word to other units of measurements (such as inches or centimeters) that are taught in science and math courses. K-12 students are also taught how to do basic arithmetic in the

Tulalip Language, which involves the semantic extension of different words in the language. From 3rd-grade and up, students start learning the writing system of the language. By incorporating language materials into the lesson plans of other disciplines, students are taught and exposed to the language in the absence of a second language course.

Educators within the public schools of Marysville must be certified by the State and the Tulalip tribe to teach in these public schools. State certification must be renewed every five years and tribal certification must be renewed every two years. Educators must take part in specific training requirements to receive state certification. These requirements include taking Tulalip Language courses (i.e., Lushootseed 101, 102, and 103), two Tulalip Language workshops, 10 community public speaking sessions (e.g., Tulalip Language prayers, land acknowledgements in the Tulalip Language), receive 45 credits towards their AA (which includes taking a course on local tribal history), and must pass a proficiency test in the Tulalip Language with a score of 90% or greater. Once these requirements are met, educators get promoted to Teacher 1 position. Teacher 1 position allows the educator to take the next step of requirements (mandated by the state) that allows them to receive state certification to teach in the public schools of Marysville. These requirements include (but are not limited to) taking an abuse class, health class, a course on local tribal history, and making a 5-minute-long video where they speak only in the Tulalip Language.

Although Tulalip does not have a tribal school, the tribe (and especially those working in the Lushootseed Department of Tulalip) is working towards developing one. Tulalip previously had a tribal elementary school. However, primary education for kindergarten to 5th-grade was later moved to the Quil Ceda Tulalip Elementary School, which is a public school in Marysville. The old tribal elementary school is now the headquarters for the Lushootseed Department in Tulalip.

Educators from these public schools are a part of the Lushootseed Department, which provides the training needed to qualify for state certification.

### 3.2.2 *Muckleshoot*

The Muckleshoot Indian Tribe has a tribal language program that provides services to the Muckleshoot community. Moreover, the language program collaborates with the neighboring public school districts of Auburn, Enumclaw, and Highline. Their tribal language program has provided services to the tribes' Child Care Development Fund (CCDF) Infant and Toddler Center, Muckleshoot Early Learning Academy, Muckleshoot Child Development Center, the Muckleshoot Tribal School, and the overall Muckleshoot community. Some of their services take the form of community song and dance practice, weekly community language classes, multimedia production, and played a large role in helping host canoe journey this year.

Unlike Tulalip (which does not have a tribal school), Muckleshoot has their own tribal school that has provided Muckleshoot Language education to K-12 students. The Muckleshoot Language Program, which is a separate organization from the tribal school, has provided language courses to the tribal school that teaches the Muckleshoot dialect. According to Elise Bill-Gerrish (personal communication), the Muckleshoot Language Program has creative control and designs their own curriculum to meet the students' learning needs. One of the primary goals is to foster and build confidence in students at an early age (from preschool to elementary school) to acquire the Muckleshoot Language. Many of the curricular activities is centered around creating language games, which are designed to help students in preschool and elementary school acquire the language in a fun and productive way. These games help build confidence in students acquiring the language. Some of these games include Lushootseed Bingo, Go Fish, Hot Potato, and other games used to facilitate the child's acquisition of Lushootseed sound systems and grammar. The

Muckleshoot Language Program also provides services to community programs, such as weekly community classes and Muckleshoot community song and dance. There are also language phone apps and many language videos that were developed by the Muckleshoot Language Program. These were developed to provide easily accessible language learning opportunities during and after the pandemic. These everyday technological tools are used to facilitate the revitalization of the Muckleshoot Language.

Like the Tulalip language program, the Muckleshoot Language Program requires certification to teach the Muckleshoot Language. Current Muckleshoot Language teachers started out as apprentices. During that time, they learned to speak, read, write, and teach the language. Apprentices took part in specific training requirements to receive certification to teach the language. To teach in public schools, teachers are required to attain their First Peoples' Language, Culture, and Oral Traditions certificate through the Office of Superintendent Public Instruction (OSPI). They are first certified by the Language Program Director and then asked to complete the paperwork for certification. The Muckleshoot tribe is a sovereign nation and reserves the right to certify teachers in the fields of language and culture. Although there are no certified teachers who exclusively teaches the Muckleshoot Language within the public schools of Auburn, Enumclaw, and Highline, the language program nonetheless provides services to public schools by integrating the language in the form of translation requests.

According to Elise Bill-Gerrish (personal communication), the language program has moved away from the previous procedure of certifying educators to teach the Muckleshoot language and will be redesigning the procedure in the future. However, at present, the language program is focusing on community engagement, developing new language videos and services.

Elise Bill-Gerrish is the most recently certified Muckleshoot Language Teacher, having completed her certification process in 2020.

## 3.3 CONCLUSION

The language programs of Tulalip and Muckleshoot highlight important differences in terms of language pedagogy and education. Tulalip, having no tribal school, offers Lushootseed education within public schools of Marysville. Although there are no Lushootseed language courses within the public schools, the Tulalip language program incorporates Lushootseed materials into the curricular activities of other courses. Educators who work for the Tulalip language program must receive state certification to teach within the public schools of Marysville. On the other hand, Muckleshoot has a tribal school that offered Lushootseed courses to K-12 students. Both programs (Tulalip and Muckleshoot) provide services to public schools. They also incorporate some aspects of the STI, as well as designing their own curricular activities to facilitate the acquisition of Lushootseed to K-12 students.

# PART 2. PHONETICS & PHONOLOGY

# Chapter 4. LUSHOOTSEED PHONEMES

## 4.1 INTRODUCTION

In this chapter, I provide a brief illustration of Lushootseed sounds. The consonant and vowel inventories are provided. Data for (near) minimal sets comes from the Lushootseed dictionary (Bates et al. 1994). Allophones are also discussed. Data for allophones comes from recordings of the Southern Lushootseed speaker Annie Jack and the Northern Lushootseed speaker Martha Lamont.

## 4.2 CONSONANTS

### 4.2.1 *Consonant inventory*

Table 4.1 illustrates the set of consonant phonemes in Lushootseed (with orthography in parentheses).

**Table 4.1** Lushootseed consonants. Orthography in parentheses.

| | Bilabial | Alveolar | Post-Alveolar | Palatal | Velar | Labio-Velar | Uvular | Labio-Uvular | Glottal |
|---|---|---|---|---|---|---|---|---|---|
| Stops | p b | t d | | | k g | kʷ gʷ | q | qʷ | ʔ |
| Ejective | p’ | t’ | | | k’ | kʷ’ | q’ | qʷ’ | |
| Affricate | | t͡s d͡z<br>(c dᶻ) | t͡ʃ d͡ʒ<br>(č ǰ) | | | | | | |
| Ejective | | t͡s’<br>(c̓) | t͡ʃ’<br>(č̓) | | | | | | |
| Lat. Ejv | | t͡ɬ’<br>(ƛ̓) | | | | | | | |
| Fricative | | s | ʃ<br>(š) | | | xʷ | χ<br>(x̌) | χʷ<br>(x̌ʷ) | h |
| Lat. Fric. | | ɬ | | | | | | | |
| Approximant | | | | j<br>(y) | | w | | | |
| Laryng. | | | | jˀ<br>(y̓) | | wˀ<br>(w̓) | | | |
| Lat. Approx. | | l | | | | | | | |
| Laryng. | | lˀ<br>(l̓) | | | | | | | |

Lushootseed has 37 contrastive consonants. There are 31 contrastive obstruents: 17 stops (10 pulmonic, six ejectives, and one glottal stop), seven affricates (four pulmonic and three ejectives), and seven fricatives (all pulmonic). For the pulmonic obstruents, stops (except for the glottal stop) and affricates have a voicing contrast; however, stops with a uvular place of articulation do not contrast voicing (all uvular consonants are voiceless). Alveolar and post-alveolar affricates contrast voicing except for the lateral affricate /t͡ɬ’/‹ƛ̓› (which is only glottalic egressive and voiceless). Stops and affricates have a non-pulmonic ejective counterpart for each place of articulation. (1) and (2) provides a list of words (with near-minimal sets) illustrating the contrasts in stops and affricates (respectively) for each place of articulation in word-initial position (note: many of these consonants can also occur in word-final position. However, I will only be illustrating these consonants in word-initial position for convenience).

(1) **Stops**

| | <u>Voiceless</u> | <u>Voiced</u> | <u>Ejective</u> |
|---|---|---|---|
| Bilabial | (a) /pəlχʷ/ ‘boil’ ‹pəlx̌ʷ› | (b) /bəkʷ’/ ‘all’ | (c) /p’əqʷ’/ ‘drift’ |
| Alveolar | (d) /tiləb/ ‘suddenly’ | (e) /diɬ/ CLEFT | (f) /t’ixʷ/ ‘brush off’ |
| Velar | (g) /kajəʔ/ ‘grandma’ ‹kayəʔ› | (h) /gaqʃədid/ ‘pass by’ ‹gaqšədid› | (i) /k’ak’a/ ‘crow’ |
| Uvular | (j) /qa/ ‘a lot’ | | (k) /q’albid/ ‘believe’ |
| Glottal | (l) /ʔa/ ‘exist, be there’ | | |

(2) **Affricates**

| | <u>Voiceless</u> | <u>Voiced</u> | <u>Ejective</u> |
|---|---|---|---|
| Alveolar | (a) /t͡səkʷ’/ ‘correct’ ‹cək̓ʷ› | (b) /d͡zəgʷəʔ/ ‘monster’ ‹dᶻəgʷəʔ› | (c) /t͡s’əl/ ‘win’ ‹c̓əl› |
| Post-Alveolar | (d) /t͡ʃalaʃ/ ‘chase‘ ‹čalaš› | (e) /d͡ʒat͡ʃ’/ ‘to flood’ ‹ǰac̓̌› | (f) /t͡ʃ’at͡ʃ’aʃ/ ‘child’ ‹c̓̌ac̓̌aš› |
| Lateral | | | (g) /t͡ɬ’əl/ ‘silent’ ‹ƛ̓əl› |

All fricatives are pulmonic and voiceless. (3) provides a list of (near) minimal sets illustrating plain (without the secondary articulation of labialization, which is illustrated later) fricatives for each place of articulation in Lushootseed.

(3) **Fricatives**

| | Alveolar | Post-alveolar | Uvular | Glottal |
|---|---|---|---|---|
| Central | (a) /saq$^{w}$'/ 'fly' | (b) /ʃat͡s'/ 'end'<br>‹šac̓› | (c) /χat͡s'/ 'cover'<br>‹x̌ac̓› | (d) /haʔk$^{w}$/ 'ago' |
| Lateral | (e) /ɬaχ/ 'night'<br>‹ɬax̌› | | | |

Dorsal consonants contrast plain dorsals from labialized dorsal consonants (except for the labiovelar fricative /x$^{w}$/, which does not have a plain counterpart */x/). Labialized dorsal consonants can appear word-initially and word-finally. (4) provides a list of (near) minimal sets illustrating the contrast between plain and labialized dorsal consonants.

(4)

| | Plain | Labialized |
|---|---|---|
| Velar | (a) /kajəʔ/ 'grandma'<br>‹kayəʔ› | (b) /k$^{w}$atat͡ʃ/ 'climb a hill'<br>‹k$^{w}$atač› |
| | (c) /gaqʃədid/ 'pass by'<br>‹gaqšədid› | (d) /g$^{w}$aχ$^{w}$/ 'stroll, go for a walk'<br>‹g$^{w}$ax̌$^{w}$› |
| | (e) /k'ak'a/ 'crow' | (f) /k$^{w}$'aɬ/ 'examine, scrutinize'<br>(g) /x$^{w}$ak$^{w}$'il/ 'tired' |
| Uvular | (h) /qa/ 'a lot' | (i) /q$^{w}$al/ 'mark, paint' |
| | (j) /q'albid/ 'believe' | (k) /q$^{w}$'al/ 'tame' |
| | (l) /χaχaʔ/ 'sacred, taboo'<br>‹x̌ax̌aʔ› | (m) /χ$^{w}$aq$^{w}$'/ 'worry, preoccupied'<br>‹x̌$^{w}$aq̓$^{w}$› |

There are only two words in the Lushootseed dictionary where the plain dorsal consonant precedes the close back rounded vowel [u]. These words are /squʔq$^{w}$at͡ʃ/ ‹squʔq$^{w}$ač› 'sea pigeon' and /q'upʃəd/ ‹q̓upšəd› 'leg cramp'. However, all other words beginning with a dorsal consonant that is followed by a close back rounded vowel [u] has been entered as labialized in the Lushootseed dictionary.

There are six approximants in Lushootseed. These include the plain approximants /l j w/ ‹l y w› and their laryngealized counterparts /lˀ jˀ wˀ/ ‹l̓ y̓ w̓›. Laryngealized approximants can only occur in syllable-final position. (5) provides a list of minimal (and near-minimal) pairs illustrating the contrast between the plain approximants /l j w/ ‹l y w› and their laryngealized counterparts /lˀ jˀ wˀ/ ‹l̓ y̓ w̓›.

| (5) <u>Plain</u> | <u>Laryngealized</u> |
|---|---|
| (a) /χʷul/ ‘place near something’<br>‹x̌ʷul› | (b) /χʷulˀ/ ‘only, merely, just’<br>‹x̌ʷul̓› |
| (c) /huj/ ‘do, make’<br>‹huy› | (d) /hujˀ/ ‘then, next’<br>‹huy̓› |
| (e) /χaw/ ‘caw’<br>‹x̌aw› | (f) /χawˀs/ ‘new, fresh’ [NL]<br>‹x̌aw̓s› |

Laryngealized approximants are realized with creaky voicing (see Chapter 9 for more details).

### 4.2.2 *Consonant allophones*

In this section, I provide a brief overview of consonant allophones in Lushootseed. Voiced stops /b d/ are often fully voiced. However, there is evidence of prenasalized voiced stops [mb] and [nd] (as well as devoiced [d̥][4], though rare) in prosodic domain-initial positions (see Chapter 8 for more details). The voiced velar stop /ɡ/ occurs at a relatively low frequency because there are only a few words containing this stop in Lushootseed. However, for words that are initialized with the voiced velar stop /ɡ/, it is often devoiced, as in [ɡ̊]. This can be observed for the word /ɡaqʃədid/ ‹ɡaqšədid› ‘pass by (TR)’, which is realized as [ɡ̊aqʃədid̥]. Like the voiced velar stop /ɡ/, the voiced labio-velar stop /ɡʷ/ is often devoiced, as in [ɡ̊ʷ], in word-initial position (see Chapter 6 for more details). This can be observed in the word /ɡʷələ/ ‘and’, which was realized as [ɡ̊ʷl̥ə]. However, voiced

[4] All devoiced variants of the voiced stops in Lushootseed have a shorter VOT than their voiceless counterparts, which is why the voiceless diacritic is used to differentiate devoiced variants from voiceless stops (see Chapter 6 for more details).

velar and labiovelar stops [ɡ] and [ɡʷ] are fully voiced intervocalically. Voiced bilabial stop /b/ is sometimes realized as a voiced bilabial fricative [β] in intervocalic position. For example, /kʷ’it’əbəxʷ/ ‘take to shore (PASS)’ is realized as [kʷ’it’əβəxʷ]. Voiced stops are devoiced or (sometimes) unreleased in word-final position. This is observed in the word /χajəb/ ‹x̌ayəb› ‘laugh’, which is realized as [χa̠jəb̥].

The glottal stop /ʔ/ is often realized as creaky voiced. This tends to occur when the glottal stop /ʔ/ is in intervocalic position. As the waveform and spectrogram in Figure 4.1 illustrates (for the word /ʔuʔəɬəd/ ‘eat (PFV)’), there was a period of irregular glottal pulses when the glottal stop is flanked by the two vowels /u/ and /ə/, suggesting that it is creaky voiced. In other words, there is evidence of creaky voicing on neighboring segments, such as the vowels in Figure 4.1 (see Chapter 9 for more details).

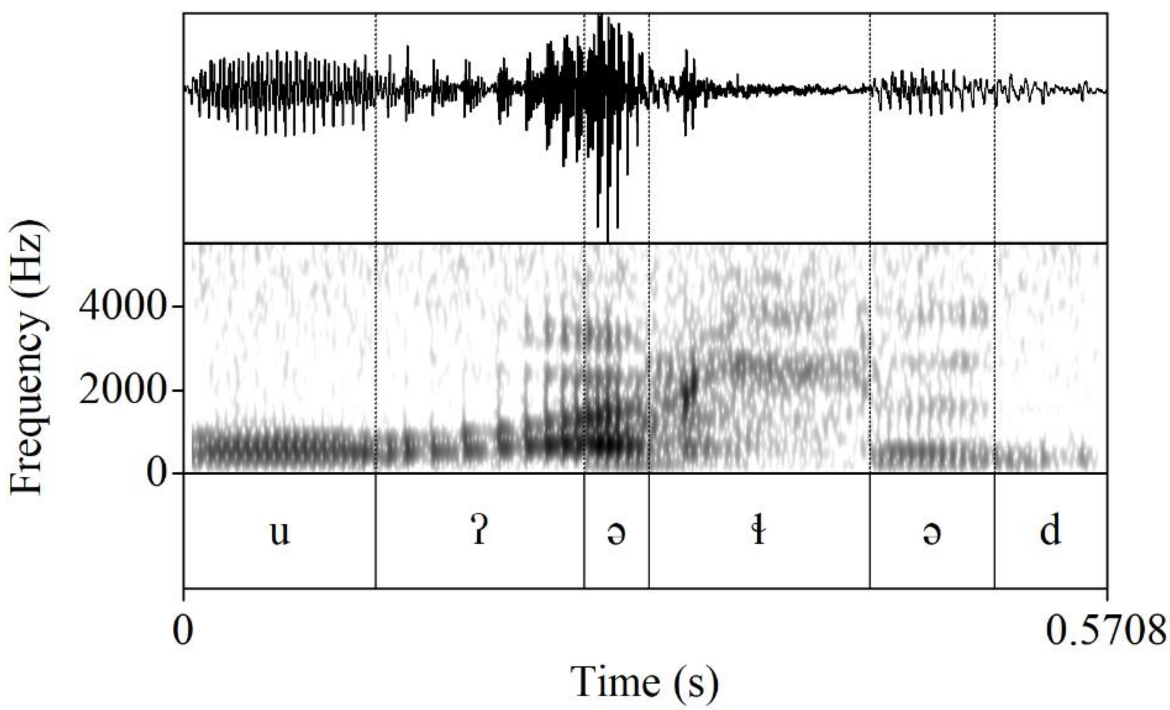



**Figure 4.1** Example of glottal stop /ʔ/ in intervocalic position, from the word /ʔuʔəɬəd/ ‘eat (PFV)’ (note: the initial glottal stop /ʔ/ was omitted from the selection)

The voiceless glottal fricative /h/ is sometimes lost in connected speech. However, when word-initially or in the onset of a stressed syllable, /h/ is sometimes fully realized in speech. In most cases, however, the voiceless glottal fricative /h/ is realized as voiced [ɦ] in word-initial position. Moreover, the voiceless glottal fricative /h/ is sometimes voiced [ɦ] in intervocalic position.

The voiced lateral approximant /l/ is often deleted in word-forms that ended in /-il/ INCH, where the morpheme is realized as [-i]. This can be observed in the word /ɬuʔusil/ ‘dive (FUT)’, which is realized as [ɬuʔusi]. However, when the form /-il/ is followed by a vowel-initial morpheme, the lateral approximant /l/ becomes resyllabified as the onset of the following vowel-initial morpheme. Sometimes, the lateral approximant is realized as a voiced alveolar lateral flap [ɺ] in this context because of the relatively short duration of the alveolar lateral gesture. This can be observed in the waveform and spectrogram in Figure 4.2, where the form /t͡ɬ’uʔusil/ ‹ƛ̓uʔusil› ‘dive (HAB)’ is followed by the morpheme /=əxʷ/ ‘now’, being realized as [t͡ɬ’uʔusiɺəxʷ].

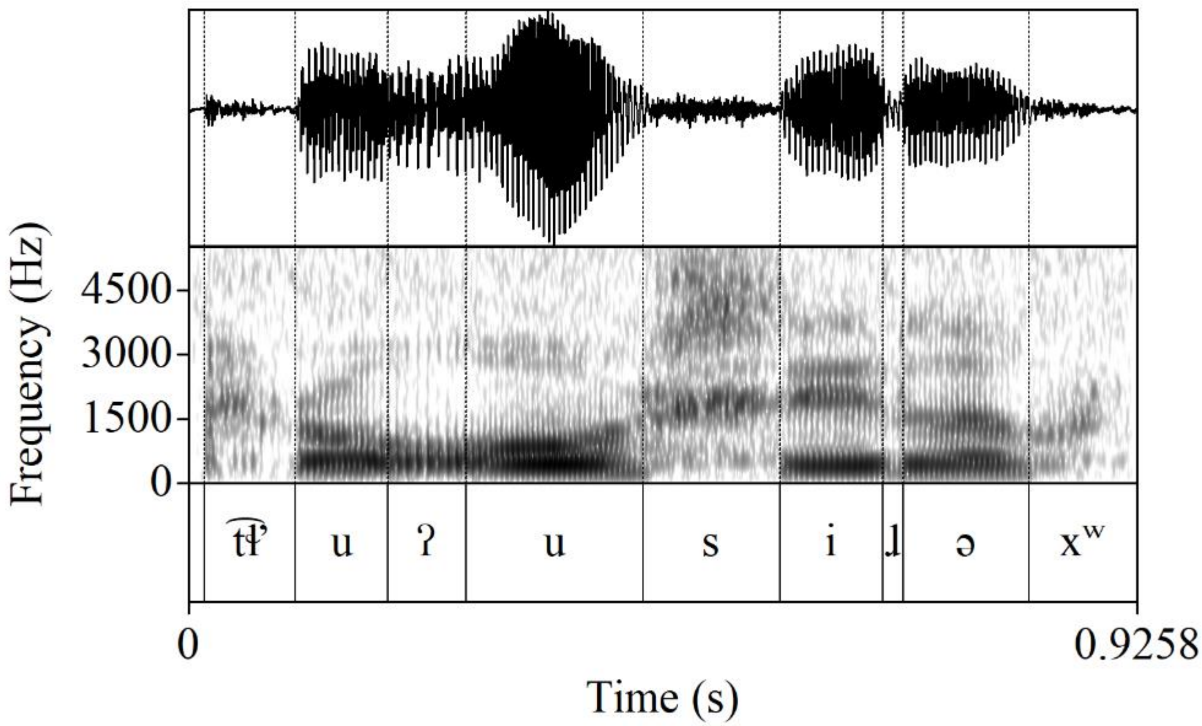



**Figure 4.2** Example of lateral approximant /l/ realized as a lateral flap [ɺ], in the word form /t͡ɬ'uʔusiləxʷ/ ‹ƛ̓uʔusiləxʷ› 'dive now (HAB)'.

The deletion of the lateral approximant /l/ in word-forms ending with /-il/ INCH is found only in the Southern dialect. In Northern Lushootseed, the lateral approximant /l/ is fully realized in word-forms ending with /-il/. This can be observed in the waveforms and spectrograms in Figure 4.3, where the lateral approximant /l/ is fully realized at the end of the word /sləχil/ ‹sləx̌il› 'day' in the Northern dialect (Figure 4.3a), whereas /l/ is not produced in the Southern dialect (Figure 4.3b).

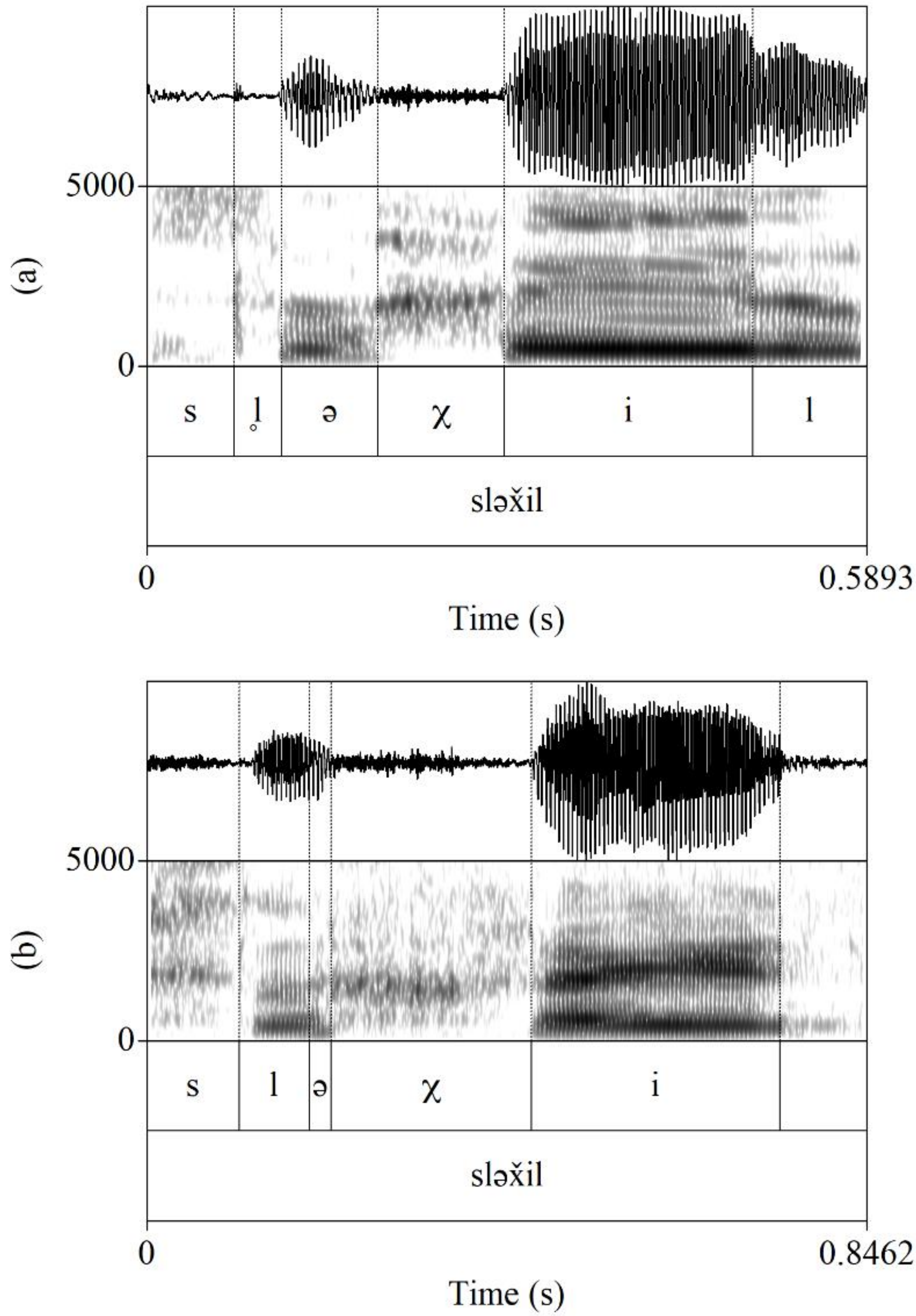



**Figure 4.3** Waveform and spectrogram of the form /-il/ INCH for the word /sləχil/ ‹sləx̌il› ‘day’ in two dialects: (a) Northern Lushootseed (speaker: Martha Lamont), and (b) Southern Lushootseed (speaker: Annie Jack).

When the lateral approximant /l/ is preceded by an unstressed schwa /ə/, the schwa is deleted and the lateral approximant /l/ becomes syllabic, as in [l̩]. This can be observed in the word /gʷəl/ 'and', which is realized as [g̊ʷl̩].

### 4.2.3 *Summary*

In summary, there are 37 contrastive consonants in Lushootseed. Lushootseed (like all Salish languages) utilizes two airstream mechanisms (i.e., pulmonic and ejective) to contrast consonants. There are several allophonic variations in the realization that was observable for these consonants.

## 4.3 VOWELS

### 4.3.1 *Vowel inventory*

Table 4.2 summarizes the set of vowel phonemes in Lushootseed.

**Table 4.2** Lushootseed Vowels

| | Front | Central | Back |
|---|---|---|---|
| Close | i iː | | u uː |
| Mid | | ə | |
| Open | | a aː | |

Lushootseed has four contrastive vowels. (6) is a list of (near) minimal sets illustrating the contrast between each vowel (where each vowel is in **bold**).

(6) (a) /ts'**a**ʔkʷ/ 'wash'
‹c̓**a**ʔkʷ›
(b) /sts'**ə**kʷ'/ 'worm'
‹sc̓**ə**k̓ʷ›
(c) /ts'**i**kʷ/ 'raw, fresh'
‹c̓**i**kʷ›
(d) /ts'**u**ʔkʷs/ 'seven'
‹c̓**u**ʔkʷs›

Some vowels contrast in length. Lengthened vowels are sometimes (but not always) predictable forms of unlengthened vowels (e.g., /tsut/ ‹cut› 'say' becomes [tsuːd] ‹cuu-d› 'say (TR)' when combined with the transitivizer /-d/). However, there are a few words that contrast long vowels, as shown in (7), which illustrates the near-minimal pairs for the vowels /a aː i iː u uː/.

| (7) SHORT | LONG |
|---|---|
| /padats/ ‹padac› ‘ten’ | /haːts/ ‹haac› ‘long’ |
| /diɬ/ CLEFT | /hiːɬ/ ‹hiiɬ› ‘happy’ |
| /ɬup/ ‘early morning’ | /skʷuːp/ ‹skʷuup› ‘sucker fish’ |

The length contrast only occurs on peripheral vowels (i.e., /a i u/). There are no long schwas /ə/ in Lushootseed, and schwas cannot be lengthened.

### 4.3.2 *Vowel allophones*

Variation in vowel quality has been briefly documented (Hess & Hilbert 1976, Snyder 1957, Zahir 2019). According to Hess & Hilbert (1976) and Zahir (2019), Northern Lushootseed tends to realize /i/ as [i] and /u/ as [u], whereas Southern Lushootseed tends to realize /i/ as [e] and /u/ as [o]. However, both sources note that these are tendencies and are not absolute (see Chapter 5 for more details on dialectal differences in Lushootseed vowels). Snyder (1957) transcribed the vowels phonemically as /e/, /o/, and /a/ for speakers of Southern Lushootseed, stating that [i] and [u] are free variations of /e/ and /o/ respectively. Snyder also noted the influence of uvular consonants on vowel quality in the Southern dialect, where /e/ is realized as an open-mid front vowel [ɛ] when preceding uvular consonants (see Chapter 7 for more details on the effects of uvular consonants on vowel quality in Lushootseed).

All vowels are realized as more open and retracted in uvular environments (see Chapter 7 for more details). As such, /i/ is realized as [e], /u/ is realized as [o] or [ɔ], /a/ is realized as [a̠], and /ə/ is realized as [ɐ], when preceding or following a uvular consonant. An example of this comes from the word /t͡ʃ’iqʷ’il/ ‹č̓iq̓ʷil› ‘dirty’, which is realized as [t͡ʃ’eqʷ’e].

There are instances of an epenthetic schwa [ə] that is inserted between consonant clusters, where the first consonant in the cluster is a voiceless alveolar fricative [s] and the following consonant is a voiced obstruent. The duration of the epenthetic schwa [ə] is very short, but it is predictable in this environment. This can be observed in the waveform and spectrogram in Figure 4.4 for the word-form /ʔəsgʷədil/ 'sit' (which can be broken down into /ʔəs-gʷəd-il/ STAT-down-INCH), where the epenthetic schwa [ə] is inserted between the voiceless alveolar fricative /s/ and the voiced labiovelar stop /gʷ/.

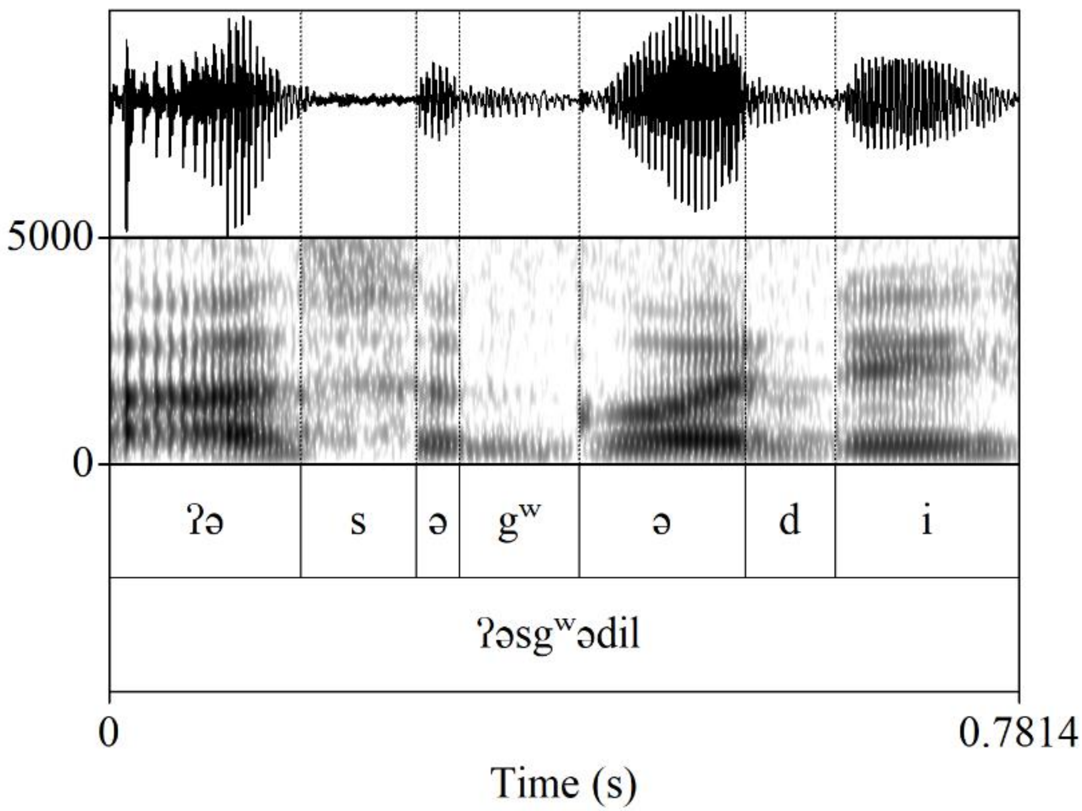



**Figure 4.4** Epenthetic schwa [ə] after the voiceless alveolar fricative /s/ and before the voiced labiovelar stop /gʷ/.

Figure 4.4 illustrates that the schwa [ə] is inserted between the morphemes /ʔəs-/ STAT (which ends with a voiceless alveolar fricative /s/) and the morpheme /gʷəd/ 'down' (which begins with the voiced labiovelar stop /gʷ/), which suggests that the epenthetic schwa [ə] is predictable in this environment.

In unstressed syllables, when the schwa /ə/ is followed by a labio-dorsal consonant, the schwa becomes rounded, which could narrowly be transcribed as [ʉ]. This can be observed for the clitic /=əxʷ/ 'now', which is realized as [ʉxʷ]. However, in stressed environments, all vowels (including schwas) are not rounded when followed by a labio-dorsal consonant. This can be observed for the root /ˈtəxʷ/ 'buy', which is just realized as [ˈtəxʷ].

### 4.3.3 *Summary*

In summary, Lushootseed has four contrastive vowels: The close front /i/, close back rounded /u/, open central /a/, and the schwa /ə/. There is also a length contrast among peripheral vowels /aː iː uː/, but not for schwas /ə/. There are a few allophonic variations in Lushootseed vowels, such as the opening and retracting of vowels when adjacent to uvular consonants. Moreover, a schwa [ə] is inserted between a voiceless alveolar fricative [s] and a following voiced obstruent.

## 4.4 CONCLUSION

To summarize, Lushootseed has 37 contrastive consonants and four contrastive vowels. There are many allophones in Lushootseed, many of which are predictable from their phonological environments. There are also dialect-specific allophones in Lushootseed (for example, the deletion of the lateral approximant /l/ at the end of the inchoative *-il* in the Southern dialect but not the Northern dialect).

# Chapter 5. DIALECTAL DIFFERENCES OF LUSHOOTSEED VOWELS

## 5.1 INTRODUCTION

Lushootseed has four vowels in its phonemic inventory: The close front /i/, close back rounded /u/, open central /a/, and the schwa /ə/. Dialectal differences in the realization of these vowels have been documented in the literature (Hess & Hilbert 1976, Snyder 1957, Zahir 2019). According to Hess & Hilbert (1976) and Zahir (2019), Northern Lushootseed tends to realize /i/ as [i] and /u/ as [u], whereas Southern Lushootseed tends to realize /i/ as [e] and /u/ as [o]. However, both sources note that these are tendencies and are not absolute. Snyder (1957) transcribed the vowels phonemically as /e/, /o/, and /a/ for speakers of Southern Lushootseed, stating that [i] and [u] are free variations of /e/ and /o/ respectively.

Systematic phonetic analysis on the realization of vowel qualities in Lushootseed has not been conducted to confirm the claims mentioned above. In this chapter, I conduct an acoustic phonetic analysis that compares the vowel qualities between the two dialects of Lushootseed to test these claims. Based on my own impressionistic analysis of the vowels /i/ and /u/, the vowels did not sound different between the two dialects. As we will see in the following sections, there are little-to-no systematic differences in the vowel qualities between the two dialects.

## 5.2 METHODS

### 5.2.1 *Speakers*

To compare differences in vowel quality between the two dialects, two speakers from each dialect (one Northern and one Southern) were examined. The Northern Lushootseed speaker was Martha Lamont (ML), and the Southern Lushootseed speaker was Annie Jack (AJ).

### 5.2.2 *Materials*

Five recordings (with a combined length of 44mins) were examined for the Southern Lushootseed speaker AJ. These were recordings of traditional Salish myths. One recording (with a length of 8 mins 16 secs) was examined for the Northern Lushootseed speaker ML. It should be noted that the rate of speech for the speaker ML was approximately 1.4x faster than the Southern Lushootseed speaker AJ, where the speaker ML would produce 12~14 syllables every 3 seconds (i.e., approximately 4~4.7 syllables per-second), whereas the speaker AJ would produce about 8~10 syllables every 3 seconds (i.e., approximately 2.7~3.3 syllables per-second). For this reason, it was possible to collect the same number of samples from the recording of ML as from the recordings of AJ. The recording of ML was a recording of a private correspondence. These recordings were selected for their sound qualities.

### 5.2.3 *Sampling procedure*

Each of the vowels (i.e., /ə i a u/) was selected for analysis. At least 50 or more observations for each sample of vowels were examined for each speaker. As Chapter 7 will show, uvular consonants have the coarticulatory effect of increasing the frequencies of the first formant (F1) and decreasing the frequencies of the second formant (F2) on adjacent vowels. To minimize the amount of consonant-vowel coarticulation from uvular consonants, vowels adjacent to uvular consonants (i.e., /q q’ $q^w$ $q^w$’ χ $χ^w$/) were omitted from the analysis. Vowels that were adjacent to glides were excluded from the analysis because it was difficult to determine the onset of the vowel when glides were adjacent. Vowels were also excluded when the voices of other speakers were present in the background of each recording. Each speaker would sometimes sing during a recording session. Vowels that occurred during these intervals were excluded from the analysis. Loud or abrupt noises that interfered with the speech signal (e.g., sounds of the door slamming shut, or sounds of a car passing by) were excluded from the analysis. Vowels that were positioned to the right (CV) of a rounded obstruent (i.e., /gʷ kʷ kʷ’ xʷ qʷ qʷ’ χʷ/) were also excluded from the analysis because the rounding of the consonant obscured the selection of the vowel’s midpoint by rounding the vowel. This was not observed for stressed vowels that were positioned to the left (VC) of a rounded obstruent and for close back rounded vowels /u/ in CʷV environments. This is illustrated in Figure 5.1, where the preceding vowel (that was stressed) showed little (to no) effect of rounding (F2 lowering), while the following vowel showed a strong effect of rounding. For this reason, to increase the sample size for each vowel, stressed vowels that were positioned to the left (VC) of rounded obstruents, or vowels that were close back rounded /u/ in CʷV environments, were included in the data.

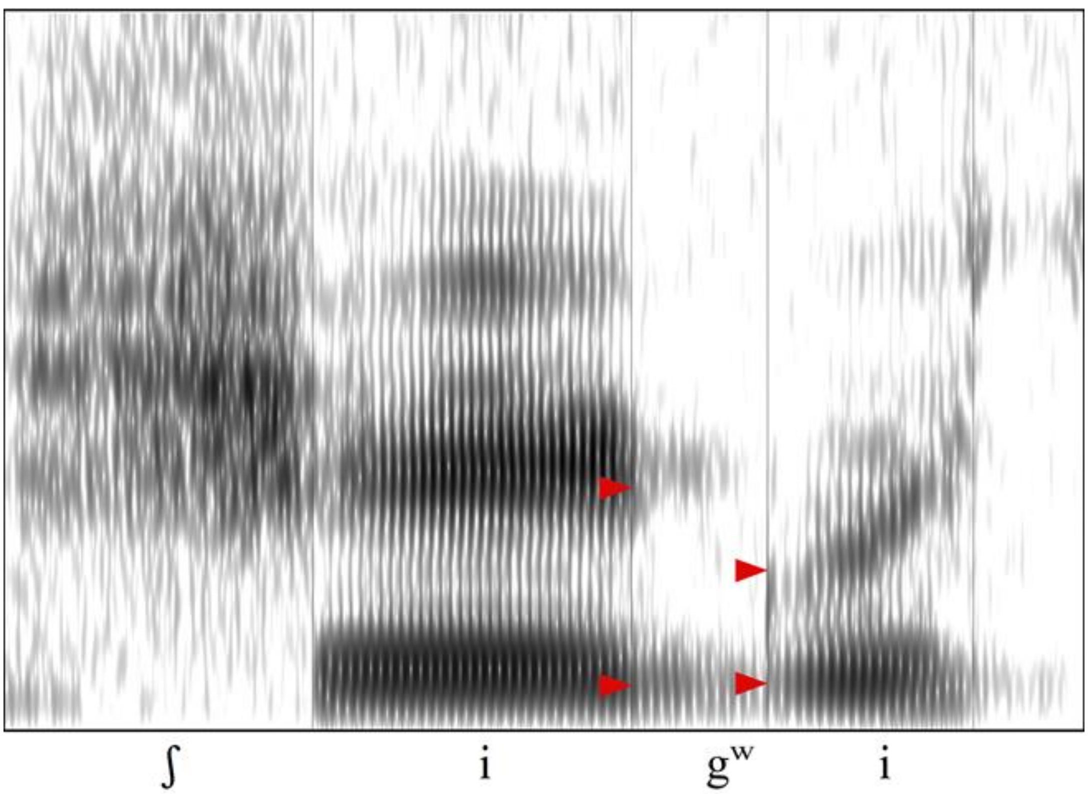



**Figure 5.1** Comparison of formant transitions for the vowel /i/ in VCʷ and CʷV environments for a labialized pulmonic velar stop. Arrows point to where the transition ends and where the transition begins.

### 5.2.4 *Measurements*

To obtain an approximation of vowel height and vowel backness, the first two formants were extracted from each selection. Each recording was annotated manually with a corresponding TextGrid, which was used to define each interval of vowels in the speech signal. The software that was used to analyze these recordings was Praat (Boersma & Weenink 2021). Formants were extracted at the midpoint of the total vowel duration. The script that was used to automatically extract formants was the *Semi-auto formant analysis* by Dan McCloy (McCloy 2014). The maximum formant setting was adjusted to 5500Hz for the speaker AJ and 6500Hz for the speaker ML. The window length in the formant setting was 25ms long with a dynamic range of 35dB. A broadband spectrogram was used to analyze the speech signal. The transient signal of the burst release noise was the start selection for vowels in syllables with initial stop consonants. The glottal pulse for voicing and the onset of visible formant structure was selected as the vowel's start selection for syllables initialized with a fricative, affricate, ejective, or lateral consonant. End selections were made when the voicing of the vowel ended or if there were clear signs of dissipation of the vowel formants in the spectrogram.

### 5.2.5 *Statistical models*

The software *R-Studio* (2018) was used to run statistics. Formants were normalized by speakers using *z*-scores to remove unwanted variability in formants due to gross anatomical differences in individual vocal tract size and length, while preserving "desirable" variation of interest – i.e., differences due to linguistic or dialectal factors (Lobanov 1971, Adank et al. 2004, Watt et al. 2010, DiPaolo et al. 2005). A formant plot was used through the package *phonR* (McCloy 2016) to compare the distribution of each vowel (with the average normalized F1 and F2 plotted for each vowel). A two-sample t-test was used to test for the mean difference of normalized F1 and F2 for each vowel between the two speakers.

## 5.3 RESULTS

Table 5.1 summarizes the means and standard deviations of the raw F1 values for the two speakers AJ and ML. As Table 5.1 summarizes, there were slightly greater values of F1 for the speaker ML than AJ, which suggests that the vocal tract size for the speaker ML was probably smaller than AJ's. However, the F1 of /u/ for the speaker AJ was greater than the F1 of /u/ for the speaker ML.

**Table 5.1** Raw F1 means and standard deviations (with 95% CI) for speakers AJ and ML.

| | AJ | | | ML | | |
|---|---|---|---|---|---|---|
| Vowel | *n* | *M (SD)* | *95% CI* | *n* | *M (SD)* | *95% CI* |
| ə | 86 | 503 (72.54) | [487, 518] | 119 | 532 (86.3) | [516, 547] |
| i | 107 | 391 (27.82) | [385, 396] | 81 | 418 (41.01) | [410, 428] |
| a | 55 | 684 (75.88) | [664, 705] | 77 | 731 (55.59) | [718, 743] |
| u | 58 | 476 (40.29) | [464, 488] | 86 | 456 (45.7) | [447, 465] |

Note: *n* = number of observations, *M* = mean, *SD* = standard deviation, *CI* = confidence interval

Table 5.2 summarizes the means and standard deviations of the normalized (z-scores) F1 values for the two speakers AJ and ML. As Table 5.2 summarizes, the values of normalized F1 for the two speakers were approximately the same for three of the four vowels.

**Table 5.2** Normalized F1 means and standard deviations (with 95% CI) for speakers AJ and ML

| | AJ | | | ML | | |
|---|---|---|---|---|---|---|
| Vowel | *n* | *M (SD)* | *95% CI* | *n* | *M (SD)* | *95% CI* |
| ə | 86 | 0.102 (0.63) | [-0.03, 0.24] | 119 | 0.01 (.67) | [-0.11, 0.13] |
| i | 107 | -0.87 (0.24) | [-0.92, -0.82] | 81 | -0.87 (0.32) | [-0.94, -0.8] |
| a | 55 | 1.67 (0.66) | [1.5, 1.84] | 77 | 1.55 (0.43) | [1.46, 1.65] |
| u | 58 | -0.13 (0.35) | [-0.22, -0.04] | 86 | -0.58 (0.36) | [-0.66, -0.51] |

Figure 5.2 is a boxplot of the normalized F1 values between the two speakers AJ and ML.

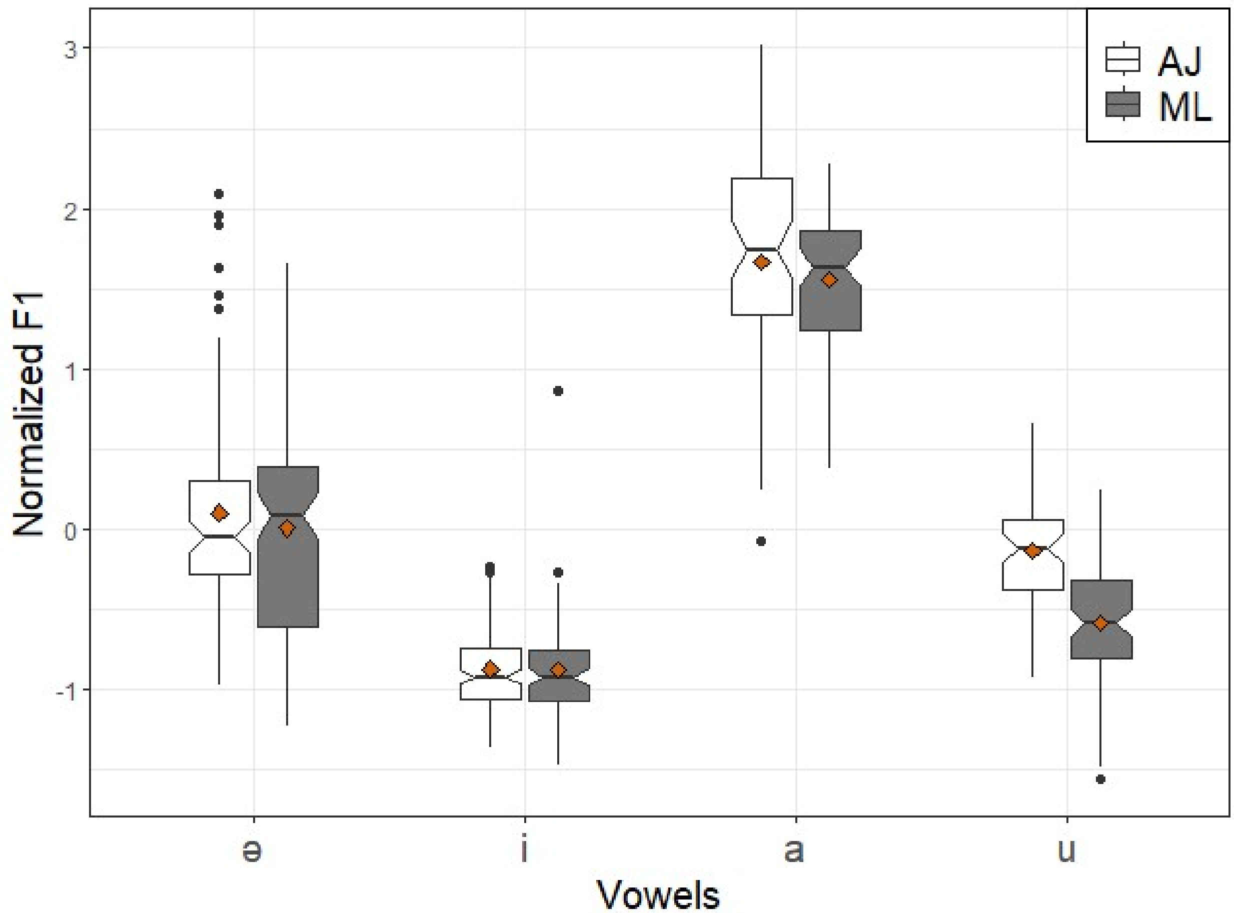



**Figure 5.2** Boxplot for normalized F1, with means (represented in red diamonds) plotted. Box = 25%-75%, line = median, whisker = 10%-90%, black dots = outliers beyond 10%-90%.

Table 5.3 summarizes the means and standard deviations of the raw F2 values for the two speakers AJ and ML. Like the raw F1 values, the raw F2 values were slightly greater for the speaker ML than AJ, which (again) suggests that the vocal tract size for the speaker ML was most likely smaller than the speaker AJ.

**Table 5.3** Raw F2 means and standard deviations (with 95% CI) for speakers AJ and ML.

| | AJ | | | ML | | |
|---|---|---|---|---|---|---|
| Vowel | *n* | *M (SD)* | *95% CI* | *n* | *M (SD)* | *95% CI* |
| ə | 86 | 1521 (215.79) | [1475, 1567] | 119 | 1558 (197.61) | [1523, 1594] |
| i | 107 | 2014 (106.77) | [1994, 2035] | 81 | 2122 (199.55) | [2079, 2166] |
| a | 55 | 1484 (78.16) | [1463, 1505] | 77 | 1493 (137.02) | [1462, 1524] |
| u | 58 | 1302 (222.9) | [1243, 1361] | 86 | 1128 (240.27) | [1077, 1179] |

Table 5.4 summarizes the means and standard deviations of the normalized (z-scores) F2 values for the two speakers AJ and ML. As Table 5.4 summarizes, the normalized F2 for the speaker ML was slightly greater than the speaker AJ, suggesting that the vowels may have been slightly more front for the speaker ML than AJ.

**Table 5.4** Normalized F2 means and standard deviations (with 95% CI) for AJ and ML.

| | AJ | | | ML | | |
|---|---|---|---|---|---|---|
| Vowel | *n* | *M (SD)* | *95% CI* | *n* | *M (SD)* | *95% CI* |
| ə | 86 | -0.38 (0.65) | [-0.52, -0.25] | 119 | -0.02 (0.5) | [-0.11, 0.07] |
| i | 107 | 1.13 (0.33) | [1.07, 1.2] | 81 | 1.41 (0.51) | [1.3, 1.52] |
| a | 55 | -0.5 (0.24) | [-0.56, -0.43] | 77 | -0.19 (0.35) | [-0.27, -0.11] |
| u | 58 | -1.06 (0.69) | [-1.23, -0.88] | 86 | -1.12 (0.61) | [-1.25, -0.99] |

Figure 5.3 is a boxplot of the normalized F2 values between the two speakers AJ and ML.

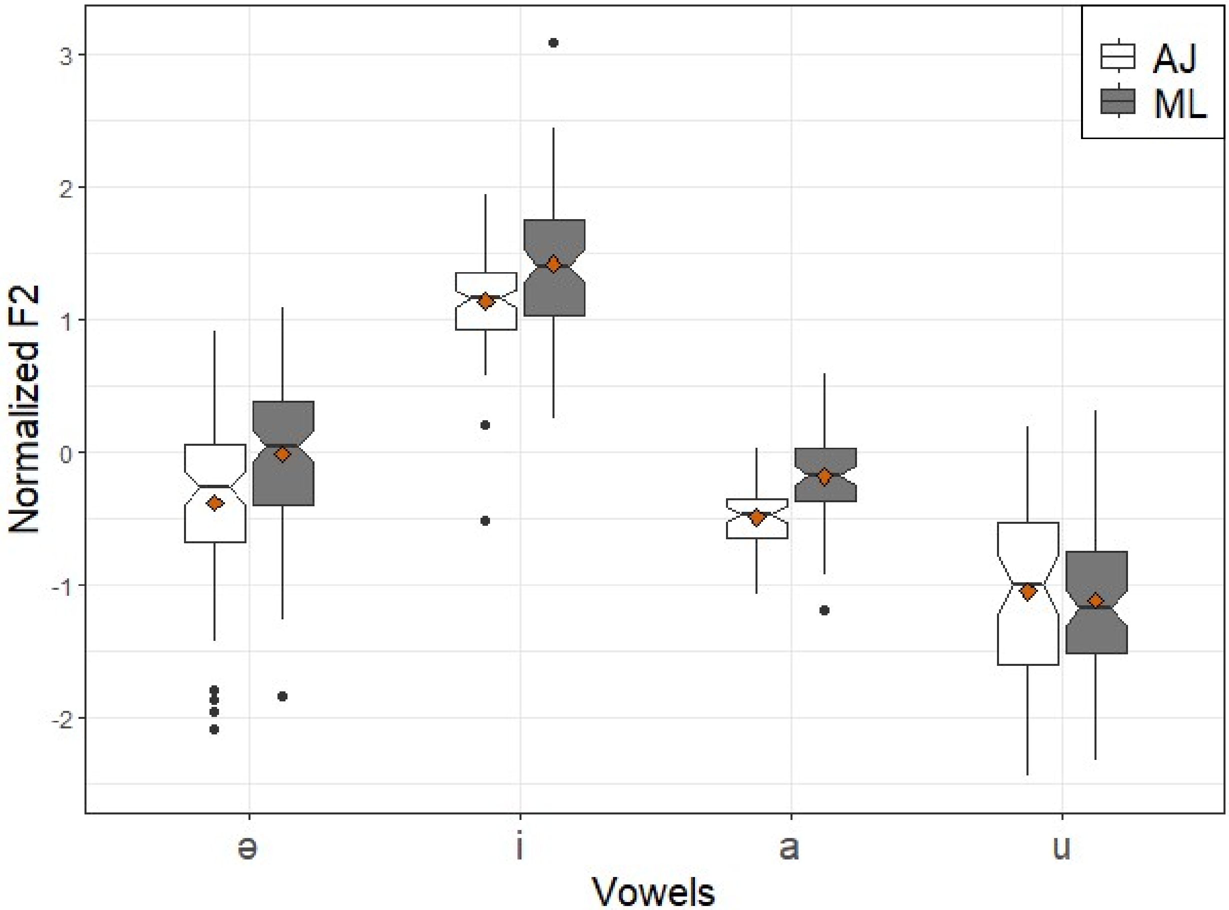



**Figure 5.3** Boxplot for normalized F2, with means (represented in red diamonds) plotted. Box = 25%-75%, line = median, whisker = 10%-90%, black dots = outliers beyond 10%-90%.

Figure 5.4 is a vowel polygon (plotting the means of normalized F1 and F2 for each vowel) that compares the distribution of each vowel between the two speakers AJ and ML. As Figure 5.4 illustrates, vowels /ə i a/ were slightly more front for the Northern Lushootseed speaker ML than the Southern Lushootseed speaker AJ. The close back rounded vowel /u/ was slightly lower for the Southern Lushootseed speaker AJ than the Northern Lushootseed speaker ML.

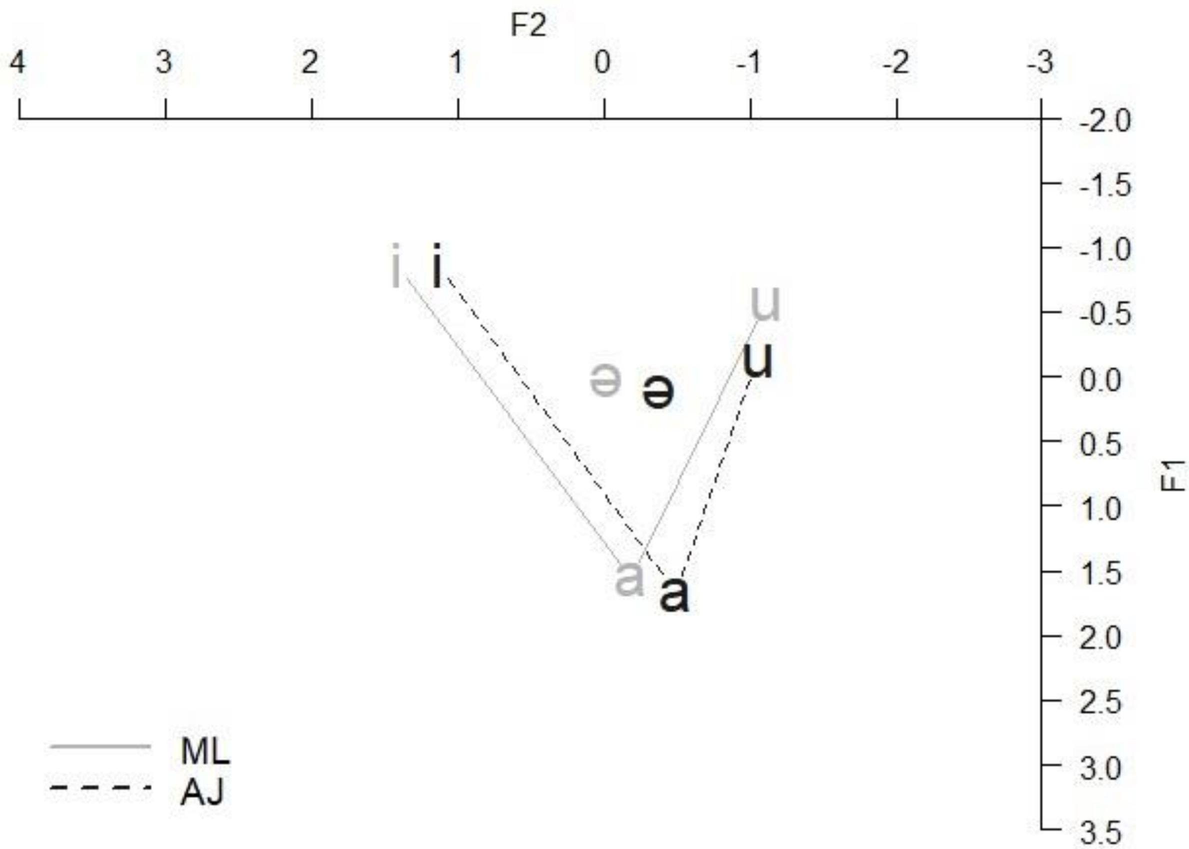



**Figure 5.4** Vowel polygon plotting the means of normalized F1 and F2 (using *z*-scores) for each vowel comparing the two speakers AJ and ML.

The one-degree-of-freedom contrast of primary interest (the mean difference between speakers AJ and ML) for normalized F1 was not statistically significant for the schwa /ə/, $t(203) = 1.03$, $p = .305$; close front /i/, $t(186) = 0.047$, $p = .963$; and open central /a/, $t(130) = 1.21$, $p = .227$. However, the mean difference between speakers AJ and ML for normalized F1 was statistically significant for the close back rounded /u/, $t(142) = 7.5$, $^{***}p<.001$.

The one-degree-of-freedom contrast of primary interest (the mean difference between speakers AJ and ML) for normalized F2 was statistically significant for the schwa /ə/, $t(203) = 4.45$, $^{***}p<.001$; close front /i/, $t(186) = 4.57$, $^{***}p<.001$; and open central /a/, $t(130) = 5.64$, $^{***}p<.001$. However, the mean difference between speakers AJ and ML for normalized F2 was not statistically significant for the close back rounded /u/, $t(142) = 0.58$, $p = .563$.

## 5.4 Discussion

As the results showed, the vowels /ə i a/ for the Southern Lushootseed speaker AJ were not any lower than those of the Northern Lushootseed speaker ML. However, these vowels were slightly more fronted for the Northern Lushootseed speaker ML than the Southern Lushootseed speaker AJ. The close back rounded vowel /u/ was slightly lower for the Southern Lushootseed speaker AJ than the Northern Lushootseed speaker ML. This pattern does not corroborate how these vowels were transcribed and represented between the two dialects in the past (Hess & Hilbert 1976, Zahir 2019, Snyder 1957).

Based on the findings, it is difficult to determine whether there were dialectal differences in the realization of vowel qualities. Although the current findings showed that the vowels /ə i a/ were slightly more fronted for the Northern Lushootseed speaker than the Southern Lushootseed speaker, it should not be taken as evidence for Hess & Hilbert's (1976) and Zahir's (2016) claim that the vowel /i/ tends to be realized more like [e] in the Southern dialect and more like [i] in the Northern dialect. As the results showed, the distribution of /i/ in the Southern dialect had about the same vowel height as the distribution of /i/ in the Northern dialect, suggesting that /i/ was not more-or-less lower (as in [e]) in the Southern dialect than the Northern dialect. In fact, the raw F1 values of /i/ looked like values that is expected of /ɪ/ from female speakers of other languages, such as some varietes of American English, as well as languages such as German and Gitskan (Peterson & Barney 1952, Hagiwara 1997, Wassink 2015, Geng & Mooshammer 2009, Brown et al. 2016, Babel et al. 2012). It is lower than the canonical /i/ for female speakers; however, it is not as low as Snyder's (1957) phonemic transcription of the vowel as /e/.

The only significant difference (with respect to vowel height) that was observed from the current data was the close back rounded vowel /u/, which was slightly lower for the Southern

Lushootseed speaker than the Northern Lushootseed speaker. The distribution of /u/ (based on the raw formant measurements) was not as high as the distribution of /u/ for females speakers of languages such as English, German, Ja'a Kumiai, Bemba, Gitksan, and Setswana (Hagiwara 1997, Wassink 2015, Peterson & Barney 1952, Geng & Mooshammer 2009, Mai et al. 2019, Hamann & Kula 2015, Brown et al. 2016, Bennett et al. 2016); however, it did appear to be as low as the distribution of /u/ for female speakers of languages such as Kazakh and Mono Lake Northern Paiute (McCollum & Chen 2021, Babel et al. 2012). For this reason, the vowel can simply be transcribed as /u/ for both speakers. Moreover, the difference (while significant) between the two speakers was too subtle to suggest that there was a genuine difference in the vowel height of /u/ between the two dialects. In other words, it was difficult to determine whether the close back rounded /u/ was underlyingly lower for the Southern dialect than the Northern dialect.

In the current data, there was word-level differences in the realization of vowels [i] and [u]. For example, based on impressionistic analysis, the Northern Lushootseed speaker ML produced the vowel /i/ in the word /tsitsk$^{w}$'/ ‹cick̓$^{w}$› 'very' as [e], as in [tsetsk$^{w}$'], while the vowel was realized as [i] in the word /t'iwiɬ/ 'thank, pray'. Another example is when the same speaker produced the vowel /u/ in the root /hud/ 'hot, fire' as [o], as in [hod], while the vowel was realized as [u] in the word /put/ 'just, merely'. It is possible that F1 for /u/ was greater for the Southern dialect because words where /u/ is realized as [o] was overrepresented in the sample for the Southern speaker. This may suggest that the difference in F1 for /u/ between the Northern and Southern speaker may have been due to word-level differences, not necessarily dialectal differences.

## 5.5 CONCLUSION

The current findings showed that the vowels /ə i a/ were slightly more front for the Northern Lushootseed speaker than the Southern Lushootseed speaker, as well as /u/ being slightly lower for the Southern Lushootseed speaker than the Northern Lushootseed speaker. However, the differences were too subtle to suggest that there was a genuine difference in vowel height and backness between the two speakers. The current findings do not appear to confirm the claims made by Hess & Hilbert (1976) and Zahir (2019). The distribution of /i/ for the Southern Lushootseed speaker had about the same vowel height as the Northern Lushootseed speaker, which suggests that /i/ in the Southern dialect was not more-or-less like [e] than the Northern dialect. Although there was a significant difference in the normalized F1 of /u/ between the two speakers, it was difficult to interpret this as evidence of /u/ being realized as [o] in the Southern dialect because the difference was too subtle.

# Chapter 6. LUSHOOTSEED OBSTRUENTS

## 6.1 INTRODUCTION

Like other Salish languages, Lushootseed is known for having many obstruents in its phonemic inventory. Of the 37 consonants in Lushootseed, 31 are obstruents (i.e., 84% of consonants are obstruents in Lushootseed). The 31 obstruents are as follows: /p b p’ t d t’ k ɡ k’ kʷ ɡʷ kʷ’ q qʷ q’ qʷ’ ts dz ts’ tʃ dʒ tʃ’ tɬ’ ʔ s ʃ xʷ χ χʷ ɬ h/. Moreover, there are many instances of obstruent clusters in Lushootseed, e.g., /ʔiɬʃxʷ/ ‹ʔiɬšxʷ› ‘paddling’, which ends with the cluster /ɬʃxʷ/ (discussed in more detail in Section 6.5).

In this chapter, I provide the first acoustic phonetic analysis of Lushootseed obstruents. Although there was some work that’s been done on obstruents for other Salish languages (Bird et al. 2016; Flemming et al. 2008; Percival 2019), only a few conducted a rigorous acoustic analysis of obstruents (Flemming et al. 2008; Percival 2019). The goal of this chapter is to fill a major gap in the literature on the realization of obstruents in the language.

Cross-linguistically, ejectives are known to differ in VOT and the voice onset quality of the following vowel (Kingston 1985; Warner 1996; Wright et al. 2002; Stevens & Hajek 2008; Hargus 2011; Percival 2015, 2016ab, 2019). According to Lindau (1984) and Kingston (1985, 2005), there are cross-linguistic differences in the realization of ejectives. These cross-linguistic features differ in several acoustic properties. According to Kingston (2005), stiff ejectives are characterized by a silent period between the consonant release and voice onset. This results in a long VOT. Moreover, stiff ejectives are achieved with increased longitudinal tension and medial compression of the vocal folds, resulting in a raised f0 at voice onset and a tense or modal voice quality. Other characteristics of stiff ejectives include a sharp rise in the amplitude of the vowel and relatively intense burst. Stiff ejectives apparently occur in Tigrinya (Kingston 1985), Nez

Perce (Aoki 1970), Montana Salish (Flemming et al. 2008), K'ekchi (Ladefoged & Maddieson 1996), and Navajo (Lindau 1984). On the other hand, slack ejectives are characterized by a short VOT and little longitudinal tension, resulting in a depressed f0 at voice onset. The voice quality at voice onset is creaky. Other characteristics of slack ejectives include a slow rise time in the amplitude of the vowel and normal burst. Slack ejectives apparently occur in Hausa (Lindau 1984, Lindsay et al. 1992), Quiche (Kingston 1985), and Gitksan (Ingram & Rigsby 1987). provides a summary of the Lindau/Kingston classification of stiff and slack ejectives. Table 6.1 provides a summary of the Lindau/Kingston classification of stiff and slack ejectives.

**Table 6.1** Proposed ejective typology following Lindau (1984) and Kingston (1985, 2005)

| | Stiff ejective | Slack ejective |
|---|---|---|
| VOT | long | short |
| f0 | raised | depressed |
| voice quality | modal or tense | creaky |
| burst | intense | normal |
| rise time | fast | slow |

However, Warner (1996), Kingston (1985), and Wright et al. (2002) report language-dependent and speaker-dependent variation in these acoustic features for ejectives. Although a relatively short VOT, irregular voicing at voice onset, weak burst, and a slow rise time are observed for ejective stops in Ingush (like slack ejectives), there is a raised pitch at voice onset (like stiff ejectives) (Warner 1996). Kingston (1985) reports speaker variation in f0 following ejectives in Tigrinya. Contrary to the predictions of ejective typology proposed by Lindau (1984) and Kingston (1985, 2005), Wright et al. (2002) found considerable variation across speakers in Witsuwit'en. Some speakers showed properties of stiff and slack ejectives, such as short VOT (like slack ejectives) and modal/tense voice quality at voice onset (like stiff ejectives). Other speakers showed depressed f0 (like slack ejectives) and long VOT (like stiff ejectives). In an acoustic analysis of ejectives in Hul'q'umi'num', Percival (2019) found that although ejectives tend to show longer VOT (like stiff ejectives), they also showed depressed fundamental frequency and lower (negative) spectral tilt (like slack ejectives).

Another goal of this study is to examine the acoustic properties of Lushootseed ejectives and compare it against the Lindau (1984) and Kingston (1985, 2005) model for ejectives. As we will see later, Lushootseed ejectives show acoustic properties that are observed in both stiff and slack ejectives. This suggests that there is no need to classify Lushootseed ejectives as either stiff or slack.

In Section 6.2, I cover the methods used to analyze obstruents in Lushootseed. In Section 6.3, I analyze and characterize the acoustic properties of stops and affricates. In Section 6.4, I analyze fricatives, where I characterize the acoustic properties of fricatives, as well as discussing problems in the analysis of fricatives in Lushootseed. In Section 6.5, I briefly cover obstruent clusters in Lushootseed. Finally, in Section 6.6, I conclude with a summary of the findings.

## 6.2 METHODS

In this study, I examine six recordings of the Southern Lushootseed speaker Annie Jack. These recordings have a combined length of approximately one hour and 30 minutes. These are recordings of traditional Salish myths.

An acoustic analysis of stops and affricates is conducted by using Voice Onset Time (VOT) measurements and the burst intensity of each stop. VOT has been used to measure aspiration contrasts in stops (Lisker & Abramson 1964, 1971). It has also been used to compare ejectives with other laryngeal settings, as well as a comparison between affricates (Ladefoged & Maddieson 1996; Cho & Ladefoged 1999). According to Lisker & Abramson, VOT is “the single most effective measure whereby homorganic stop categories in languages generally may be distinguished physically and perceptually….” (Lisker & Abramson 1971:136). In this chapter, I measure VOT by taking the interval between the initial burst release to the first positive or negative movement of periodicity (i.e., voice onset). For obstruents realized with voicing, VOT was measured by taking the interval from the first positive or negative movement of periodicity (i.e., voice onset) to the initial burst release. The VOT of obstruents realized with voicing was entered as a negative value because the voicing occurred prior to the burst release (hence, a negative VOT, also known as pre-voicing). VOT was measured at the beginning of words or the beginning of roots (which were always stressed). For affricates, VOT and the duration of release frication were measured, where release duration was measured from the initial burst release to the first positive or negative movement of periodicity (i.e., onset of voicing) of the following vowel.

RMS energy was calculated from the absolute amplitude values in a frame and was divided by the duration of the frame. Decibels of Sound Pressure Level (dB SPL) was calculated from 10 times the log (base 10) of RMS energy values. Burst intensity (dB SPL) was measured for stop consonants. For affricates, intensity (dB SPL) was measured at five time points (10%, 30%, 50%, 70%, 90%) throughout the affricates release frication duration.

To examine the voice onset quality of stops and affricates, f0, jitter, and amplitude rise (i.e., intensity difference) were examined. Average f0 and jitter was obtained from a 30ms window at voice onset and vowel midpoint. Voiced period marks (pulses) were generated in Praat. These marks were inspected for errors and corrected by hand if necessary. Jitter is the variation in the duration of successive fundamental frequency cycles (Gordon & Ladefoged 2001). The mean percent jitter ratio was calculated by taking the average absolute difference between consecutive pulses divided by the average period and multiplied by 100 (Koike 1973). Fundamental frequency f0 was measured by interpolating the pitch track and then extracting the f0 at voice onset from the interpolated pitch. The interpolated pitch was extracted from the voicing component of the vowel.

Intensity was obtained at the voice onset and the vowels peak amplitude. f0, jitter, and intensity were normalized, as shown in Table 6.2, where f0 perturbation was calculated by subtracting the mean f0 at vowel onset from the mean f0 at vowel midpoint. Jitter perturbation was calculated in a similar way, where the mean jitter at voice onset was subtracted by the mean jitter at the vowel midpoint. RMS amplitude difference was calculated by subtracting the RMS energy (in dB) at the vowel's peak amplitude from the RMS energy (in dB) at the vowel onset.

**Table 6.2** Formulas for normalized measures

| **Measurement** | **Formula** |
|---|---|
| f0 perturbation | (mean f0 at onset) – (mean f0 at midpoint) |
| jitter perturbation | (mean jitter at onset) – (mean jitter at midpoint) |
| RMS amplitude difference | (RMS energy at vowel peak) – (RMS energy at vowel onset) |

For fricatives and affricates in Lushootseed, I examined five acoustic measurements: Center of Gravity, Kurtosis, Skew, Variance, and Spectral Peaks (for fricatives). The methods that were used to analyze the acoustic properties of fricatives and affricates comes from Shadle (2012; 2023) and Forrest et al. (1988). A Discrete Fourier Transform (DFT) power spectrum was computed for each fricative using a 15ms window. The spectrum window was extracted from six time points across the fricative duration. Fricatives with a duration less than 56ms were omitted from the analysis to avoid excessive overlap in each windowed frame. The DFTs from each windowed spectrum were averaged using time-averaging (Shadle 2012; 2023), where multiple DFTs were extracted across the total duration of the fricative and averaged through a matrix of intensity and sampling frequencies for each token. Because the affricates release frication duration is shorter than the duration of fricatives, 5ms windows were extracted at four time points across the affricates release frication duration. The Center of Gravity (CoG) (also known as the centroid or spectral mean) is calculated for each fricative and affricate for the time-averaged spectrums, which is a common method used to measure how high the frequencies in a spectrum are (on average) for fricatives and affricates (Munson 2001; Forrest et al. 1988; Jongman et al. 2000; Gordon et al. 2002). Other measures for each fricative and affricate from the time-averaged spectrum include Kurtosis (which measures how narrow the peak is around the center of gravity, where the higher the Kurtosis, the narrower the peak), Skew (which measures the direction of the skew (right or left) from the center of gravity), and Standard Deviation (also called “Variance”, which measures how much the frequencies in the spectrum deviate from the CoG) (Forrest et al. 1988). Altogether, these measurements are called “spectral moments” (Forrest et al. 1988; Hargus et al. 2020; Munson 2001; Gordon et al. 2002). Moreover, spectral peaks were calculated from the power spectrum (extracted from the midpoint) for fricatives. The Praat script that was used to calculate spectral moments from time-averaged spectrums comes from DiCanio (2021).

This chapter ends with an analysis of obstruent clusters in Lushootseed, where I conduct a qualitative analysis of obstruent clusters through a spectrogram and waveform. The types of obstruent clusters that are observed in this chapter include non-homorganic stop-fricative clusters, stop-fricative clusters with a following obstruent (i.e., stop, fricative, or affricate), fricative-fricative clusters, and stop-stop clusters (including clusters between ejective stops).

## 6.3 Stops and Affricates

### 6.3.1 *Stops in Lushootseed*

As mentioned in Chapter 4, Lushootseed has 17 underlying stops. The primary articulators that are involved for Lushootseed stops include labial /p p’ b/, coronal /t t’ d/, dorsal /k k’ g $k^w$ $k^w$’ $g^w$ q q’ $q^w$ $q^w$’/, and glottal /ʔ/. Dorsal stops can be distinguished based on the presence/absence of the secondary articulation of labialization. Only dorsal obstruents (i.e., obstruents involving a velar or uvular place of articulation) can have the secondary articulation of labialization in Lushootseed. In this section, I analyze each stop based on their VOT, amplitude characteristics, and voice onset quality. VOT and amplitude is analyzed for stops in word-initial and root-initial position. In Section 6.3.1.1, I discuss duration measurements and amplitude characteristics of Lushootseed stops, where I compare the VOT of voiceless stops for each place of articulation, the VOT and amplitude characteristics of plain voiced stops, and the VOT of labio-dorsal stops in Lushootseed. In Section 6.3.1.2, I cover the voice onset quality of Lushootseed stops.

#### 6.3.1.1 Duration and amplitude characteristics of stops

There are four voiceless (non-labialized) pulmonic stops in Lushootseed: /p t k q/. Table 6.3 summarizes the means and standard deviations of VOT's for each stop consonant in Lushootseed.

**Table 6.3** Means and standard deviations of VOT's (in milliseconds) for voiceless stops.

| Consonant | *n* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /p/ | 19 | 29.10 | 9.91 | 2.27 |
| /t/ | 116 | 30.72 | 12.77 | 1.19 |
| /k/ | 17 | 54.38 | 13.55 | 3.29 |
| /q/ | 25 | 56.28 | 26.94 | 5.39 |

Note: *n* = number of observations, *M* = means, *SD* = standard deviation, *SE* = standard error.

Figure 6.1 is a box plot illustrating the distribution of VOT for the voiceless (plain) pulmonic stops /p t k q/.

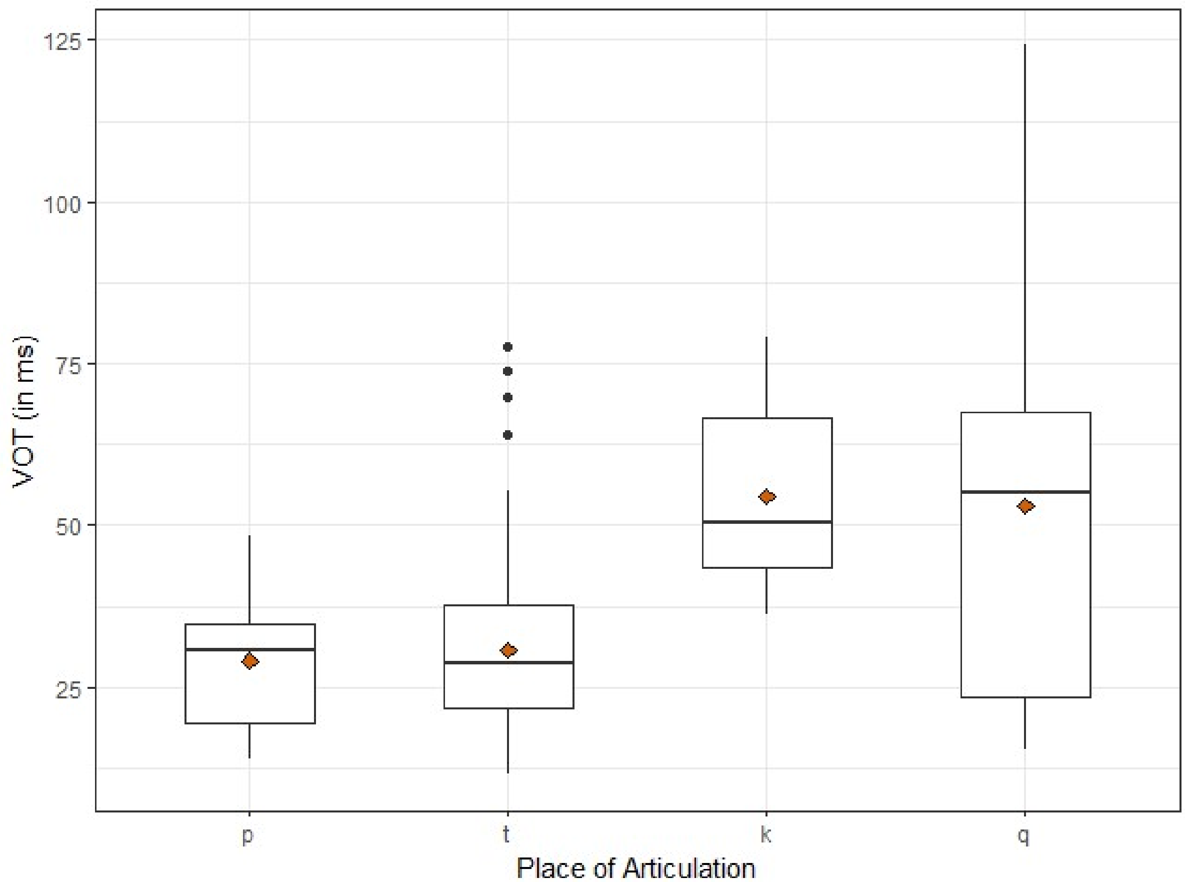



**Figure 6.1** VOT for voiceless (non-labialized) pulmonic stops /p t k q/. Red diamonds plots the means here and throughout.

As Table 6.3 summarizes, the VOT was shortest for the voiceless bilabial stop /p/ and was longest for /k/ and /q/. The VOT of dorsal stops cross-linguistically tends to be greater than the VOT of stops with a more anterior closure (Cho & Ladefoged 1999; Lisker & Abramson 1964). This is due to physiological constraints in the vocal tract. The tongue dorsum (which has a larger mass) cannot move as quickly as the tip of the tongue or the lips (Fischer-Jørgensen 1954, Kuehn & Moll 1976). This causes the transglottal pressure difference needed for voicing to be achieved later in the case of velar stops than alveolar or bilabial stops. Moreover, velar (and uvular) stops have a more extended area of contact (Stevens et al. 1986). According to Stevens (2000), the rate of change in intraoral pressure following the release depends on the rate of increase in cross-sectional area at the constriction. When there is a long narrow constriction, the Bernoulli effect causes the articulators forming the constriction to be sucked together. Because velar (and uvular) stops have a more extended area of contact between the tongue dorsum and the soft palate, the Bernoulli force is larger. This leads to a slower rate of increase in the cross-sectional area for velar (and uvular) stops than bilabial or alveolar stops. For this reason, the decrease in intraoral pressure following the release of a velar (and uvular) closure is slower, whereas bilabial and alveolar closures are rapid (Stevens 2000, Fujimura 1961). This often results in a longer (more fricated) burst for velar (and uvular) stops than bilabial or alveolar stops.

When compared with the world's languages, the VOT of these stops appear to closely match the VOT of voiceless stops in Montana Salish and Yapese (Flemming et al. 2008, Cho & Ladefoged 1999:219). When compared with languages that contrast aspirated stops from unaspirated stops, the VOT of the plain stops were not as long as the VOT of aspirated stops in languages such as Gaelic, Apache, Navajo, Khonoma Angami, or Tlingit (Cho & Ladefoged 1999; Maddieson 2001). However, it was not as short as the VOT of unaspirated stops in those languages. The plain voiceless stops in Lushootseed could be interpreted as being slightly aspirated.

Voiced stops /b d/ were fully voiced in word-initial position (the voiced velar stops /g $g^w$/ are covered later because, unlike /b d/, /g $g^w$/ have a positive VOT). In some cases, these stops were partially nasalized in prosodic domain-initial position (see Chapter 8 for more information on prenasalized voiced stops in Lushootseed). Most voiced stops in the data were realized with negative VOT because voicing occurred prior to the burst release (however, there were only two instances where /d/ was devoiced in word-initial position). Table 6.4 summarizes the negative VOT's of /b/ and /d/ in Lushootseed. As Table 6.4 summarizes, the average (absolute) VOT for

/b/ was greater than /d/ in terms of absolute values. However, there was considerable variability in the VOT of /d/, as illustrated by the standard deviation and standard error of /d/ in Table 6.4.

**Table 6.4** Means and standard deviations of negative VOT's (in milliseconds) for the voiced stops /b/ and /d/ in Lushootseed (excluding the two /d/'s that were devoiced).

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /b/ | 25 | -104.32 | 23.5 | 4.7 |
| /d/ | 17 | -93.9 | 55.54 | 13.47 |

Figure 6.2 is a box plot illustrating the distribution of VOT's (in milliseconds) for the voiced stops /b d/ in Lushootseed.

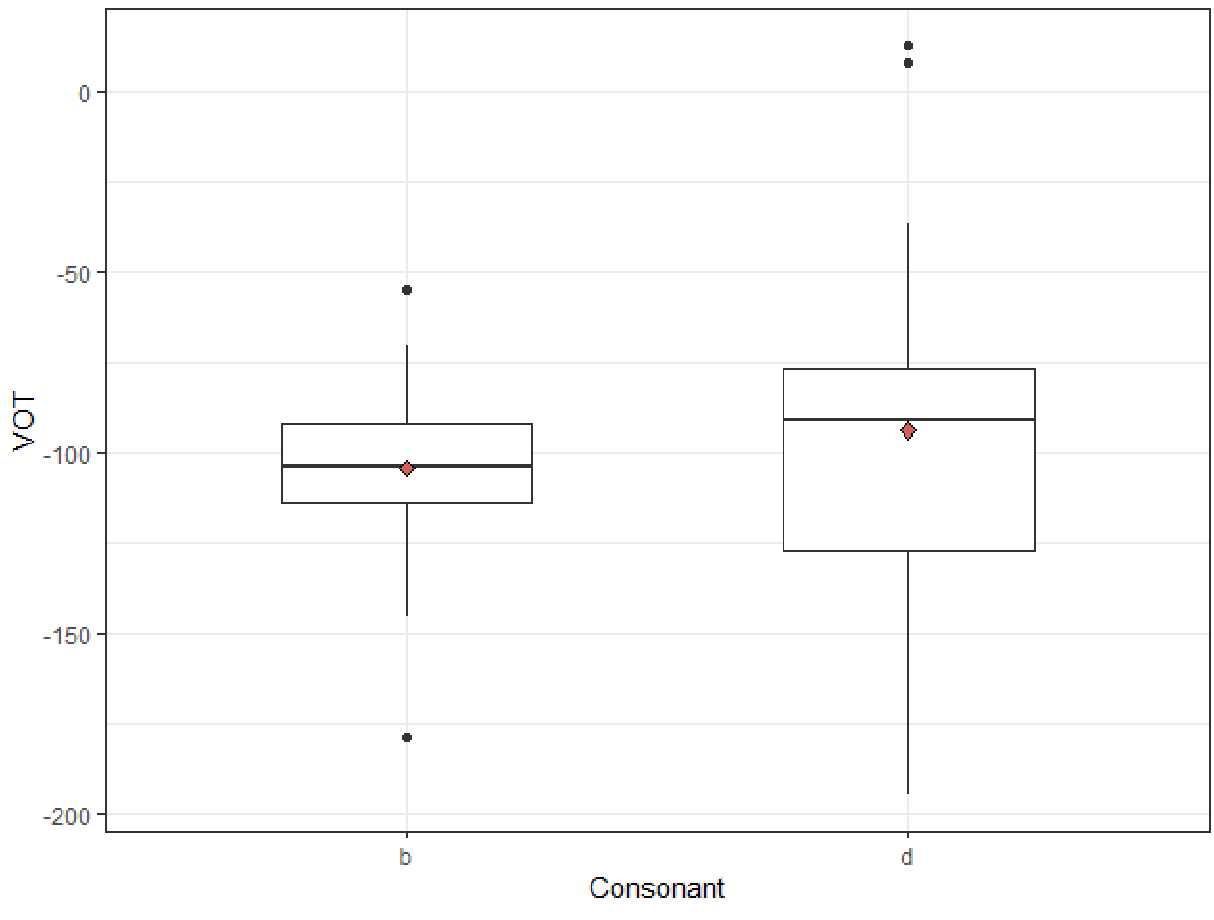
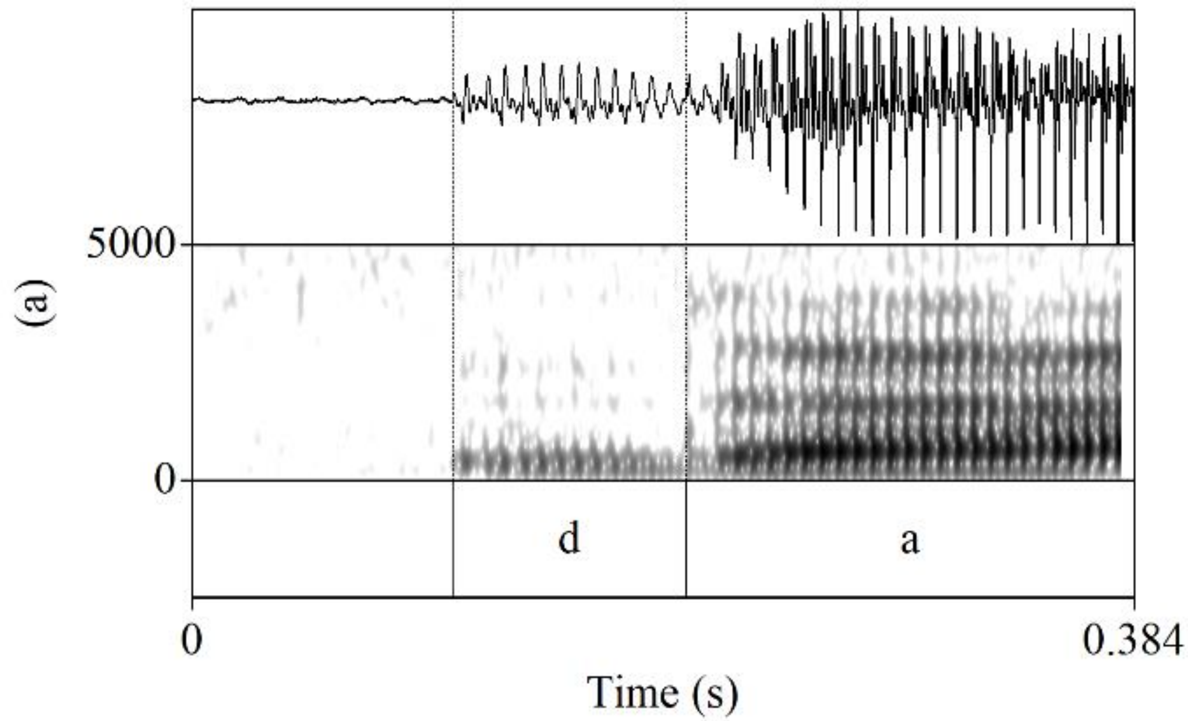



**Figure 6.2** Boxplot illustrating the negative VOT for voiced stops /b d/.

Figure 6.3 shows a waveform and spectrogram of (a) the voiced alveolar stop /d/, and (b) the voiced bilabial stop /b/.



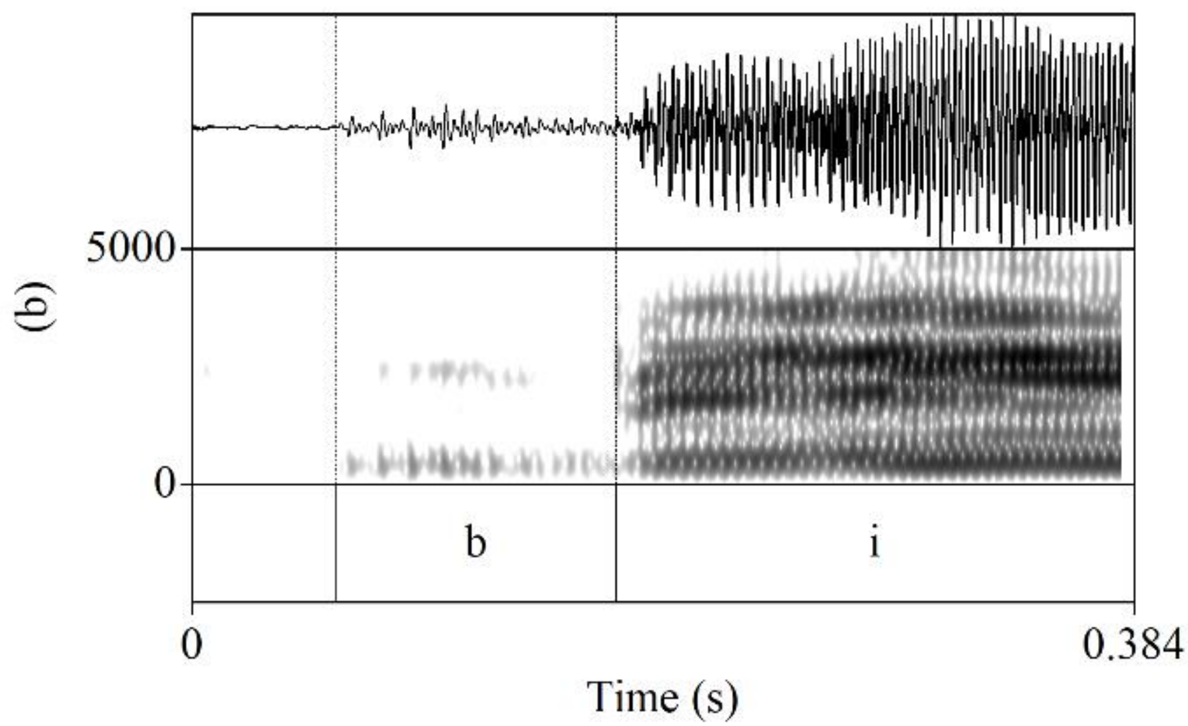




**Figure 6.3** Waveform and spectrogram of (a) voiced alveolar stop /d/, and (b) voiced bilabial stop /b/.

As Figure 6.3 illustrates, the amplitude of the vocal fold vibration for both /b/ and /d/ gradually increased from the onset to about the middle of the voicing component and steadily decreased as it reaches the burst release. The mechanism behind voicing amplitude at the beginning of the stop closure is caused by a slight lowering of the larynx, which expands the cavity above the glottis, allowing vocal fold vibration to be maintained (Westbury 1979, 1983; Ewan & Krones 1974; Riordan 1980; Kent & Moll 1969; Perkell 1969). This is accompanied by a passive expansion of the pharyngeal cavity, where the depression of the hyoid bone pulls the tongue body forward, creating a greater volume in the pharyngeal cavity (Kent & Moll 1969; Ladefoged & Madieson 1996). The arytenoid cartilages are in a neutral position, which is neither pulled apart nor pushed together (Ladefoged & Maddieson 1996:50). However, once the larynx ceases to lower, the expanded cavity above the vocal folds remains static throughout the articulatory closure. This leads to the gradual build-up of intraoral pressure, which causes a gradual decrease in amplitude as it reaches the burst release. As the intraoral pressure increases, airflow through the glottis decreases, and eventually voicing dies out (Lindau 1984:148). This contrasts from implosives, where the larynx continually lowers throughout the articulatory closure. In the case of implosives, the lowering of the larynx keeps the supraglottal pressure from increasing. This allows the amplitude of the vocal fold vibration to gradually increase throughout the closure (Lindau 1984, Ladefoged & Maddieson 1996). It was suggested that Lushootseed is one of the few Indigenous American languages that has implosives (and not voiced stops) in its phonemic inventory (Cun Xi 2009, Maddieson 2008). However, as the current findings show (illustrated in Figure 6.3), the amplitude of the voicing component gradually decreased over time (unlike implosives, which increases over time). This suggests that voiced stops /b d/ are pulmonic voiced stops and not implosives.

The voiced velar stop /ɡ/ was quite rare in the current data. There were only 10 instances of /ɡ/ from the recordings. However, unlike /b d/, which were realized with a negative VOT in word-initial position, word-initial /ɡ/ (seven out of 10 instances) had a positive VOT, suggesting that /ɡ/ was devoiced in word-initial position and could narrowly be transcribed as [ɡ̊]. This can be observed in the waveform and spectrogram in Figure 6.4, where word-initial /ɡ/ is realized with a positive VOT.

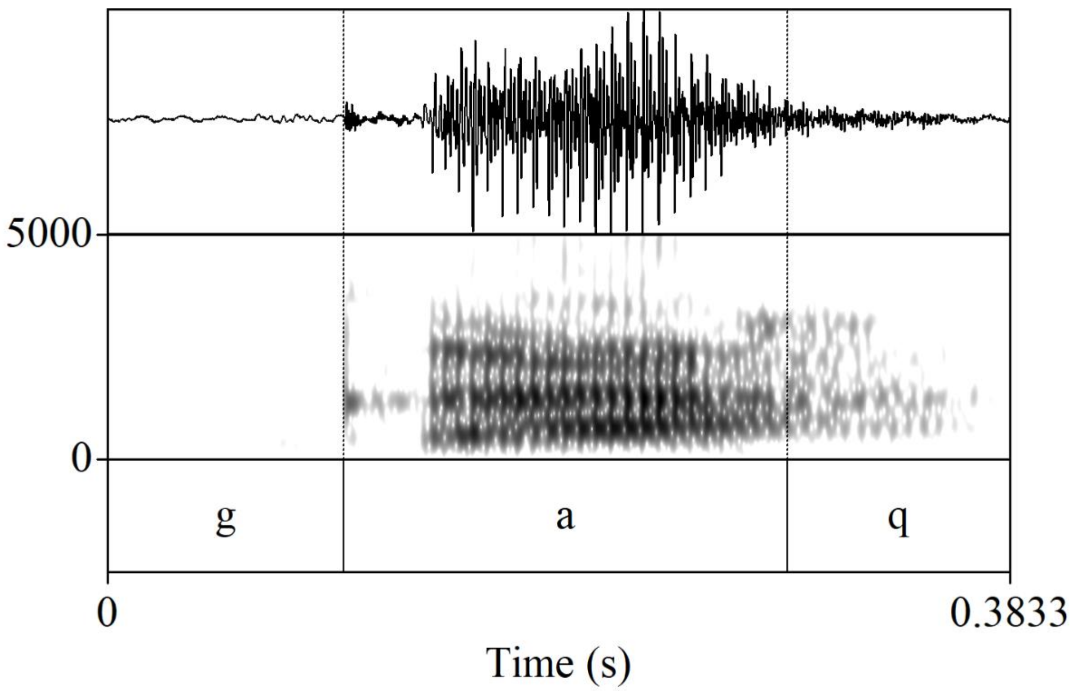



**Figure 6.4** Waveform and spectrogram of /ɡ/ in word-initial position, in the word /ɡaqʃədid/ ‹gaqšədid› 'moved aside'.

However, intervocalically, /ɡ/ was fully voiced (three out of 10 instances of /ɡ/). The VOT of word-initial /ɡ/ (realized as [ɡ̊]) was shorter than the voiceless velar stop /k/. Table 6.5 summarizes the means and standard deviations of the VOT's for word-initial /ɡ/, /k/ and /q/.

**Table 6.5** Means and standard deviations of VOT's (in milliseconds) for word-initial /g/, /k/ and /q/ in Lushootseed.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /g/ | 7 | 28.41 | 15.89 | 6.01 |
| /k/ | 17 | 54.38 | 13.55 | 3.29 |
| /q/ | 25 | 56.28 | 26.94 | 5.39 |

As Table 6.5 summarizes, the VOT of word-initial /g/ was (on average) approximately 23.3ms shorter than /k/. The VOT for the voiceless uvular stop /q/ was quite variable, as indicated by its standard deviation in Table 6.5. There were many instances where /q/ appeared to be "affricated". However, as discussed above, this is expected because uvular stops (like velar stops) have a more extended area of contact. The change in cross-sectional area at the constriction for uvulars is much slower because of the extended area of contact between the tongue dorsum and the uvula. It was shown that the tongue dorsum usually forms a constriction near the upper pharynx in the production of uvular consonants (Delattre 1971; Ghazelli 1977), which has a greater surface area. The rate of change in the cross secional area would be much slower at this region, which would generate a longer period of frication noise following the burst release.

There were only a few instances of ejective stops from the current data. There were 10 instances of the ejective bilabial stop /p'/, only four instances of the ejective velar stop /k'/, and 11 instances of the ejective uvular stop /q'/. The ejective alveolar stop /t'/ was well represented in the data, where there were 43 instances of this stop. Table 6.6 summarizes the means and standard deviations of VOT's comparing ejective stops with pulmonic voiceless stops in Lushootseed.

**Table 6.6** Means and standard deviations of VOT's (in milliseconds) for the ejective stops and pulmonic voiceless stops in Lushootseed.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /p/ | 19 | 29.10 | 9.91 | 2.27 |
| /p'/ | 10 | 55.07 | 34.41 | 10.88 |
| /t/ | 116 | 30.72 | 12.77 | 1.19 |
| /t'/ | 43 | 70.06 | 23.56 | 3.59 |
| /k/ | 17 | 54.38 | 13.55 | 3.29 |
| /k'/ | 4 | 87.71 | 21.78 | 10.89 |
| /q/ | 25 | 56.28 | 26.94 | 5.39 |
| /q'/ | 11 | 103.16 | 38.95 | 11.74 |

As Table 6.6 summarizes, ejective stops tended to have a longer VOT than the pulmonic voiceless stops. According to Cho & Ladefoged (1999), ejectives do not show the same restrictions as plain stops do in terms of VOT for different places of articulation. However, Table 6.6 reveals that, like voiceless stops, there appears to be a place effect on VOT of ejective stops, where bilabial /p'/ has the shortest VOT, and /q'/ having the longest VOT. The effects of place of articulation on the VOT of ejectives has also been observed in other languages, where ejective bilabial and/or alveolar stops have a significantly shorter VOT than velars (Bayraktar & Ridouane 2016; Hargus 2011; Maddieson 2001; Percival 2015, 2019; Hajek & Stevens 2005; Stevens & Hajek 2008; Vicenik 2010; Warner 1996). The current findings appear to pattern with many languages, such as Yapese (Cho & Ladefoged 1999; Maddieson 2001), Nez Perce (Maddieson 2001), Witsuwit'en (Hargus 2011), Georgian (Vicenik 2010), Hul'q'umi'num' and Déline̜ Slavey (Percival 2015, 2019), and Waima'a (Hajek & Stevens 2005) where the velar and/or uvular place of articulation has a longer VOT than the alveolar and bilabial place of articulations. Unlike languages such as Montana Salish (Cho & Ladefoged 1999), the VOT of the ejective bilabial stop in Lushootseed appeared to be the shortest on average (whereas in Montana Salish, it was longer than the alveolar place of articulation). Figure 6.5 is a box plot illustrating the VOT of ejective and plain stops for four different places of articulations. As Figure 6.5 illustrates, the VOT of ejectives was the longest for the velar and uvular place of articulation while it was the shortest for the bilabial and alveolar place of articulation. This suggests that, like plain voiceless stops, there is a place effect on the VOT of ejective stops.

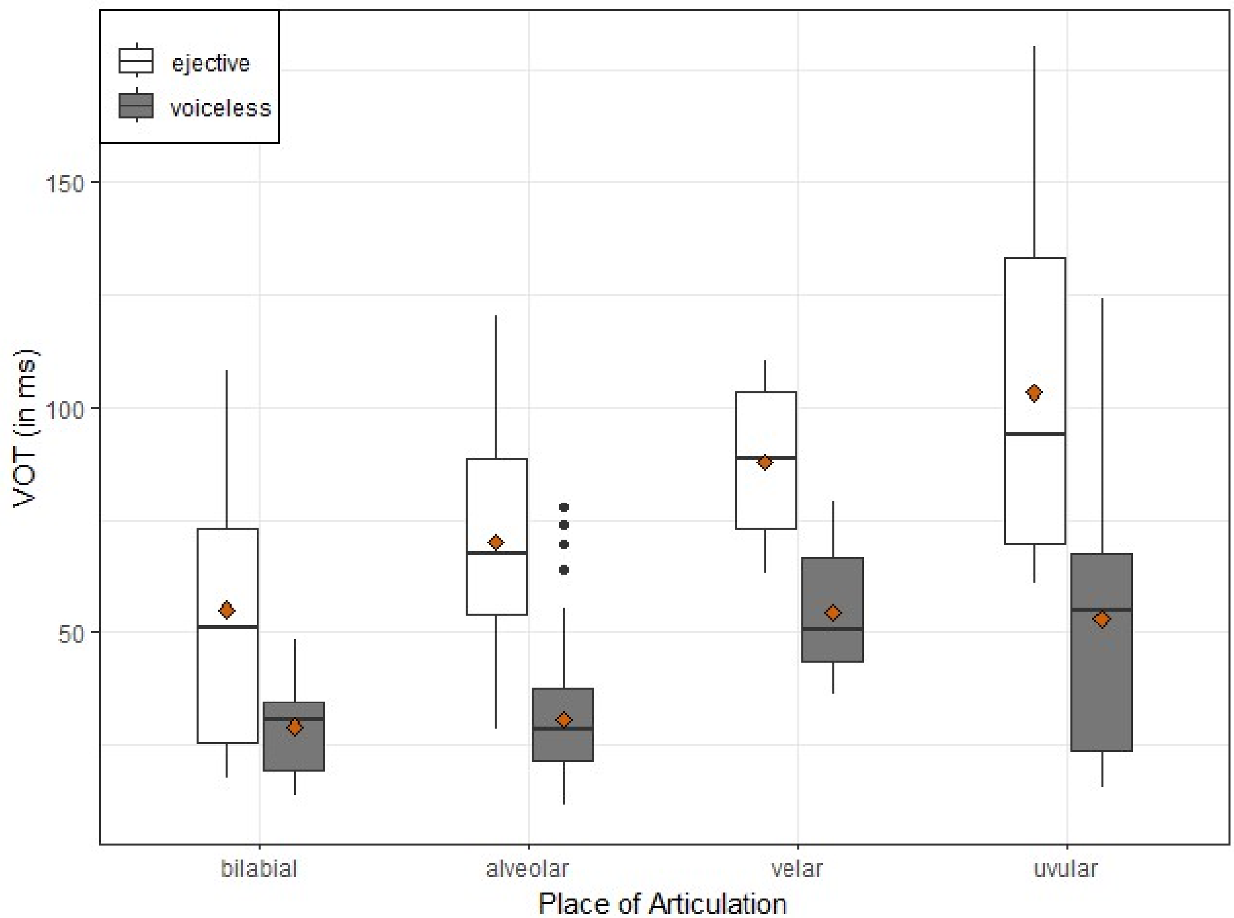



**Figure 6.5** Box plot illustrating the average VOT (in ms) of ejective and plain voiceless stops for four different places of articulation.

Although the VOT of ejective stops were (on average) greater than voiceless pulmonic stops, there was considerable variability in the distribution of VOT. This can be observed for the ejective bilabial stop /p’/, where the lower quartile of /p’/ crosses the upper quartile of /p/ (illustrated in Figure 6.5). There was also considerable variability to the VOT of uvular ejectives. This suggests that ejectives had variable VOT. Figure 6.6 are waveforms that illustrates the variable VOT of [p’], where Figure 6.6a has a long VOT (approximately 67ms) while Figure 6.6b has a short VOT (approximately 30ms).

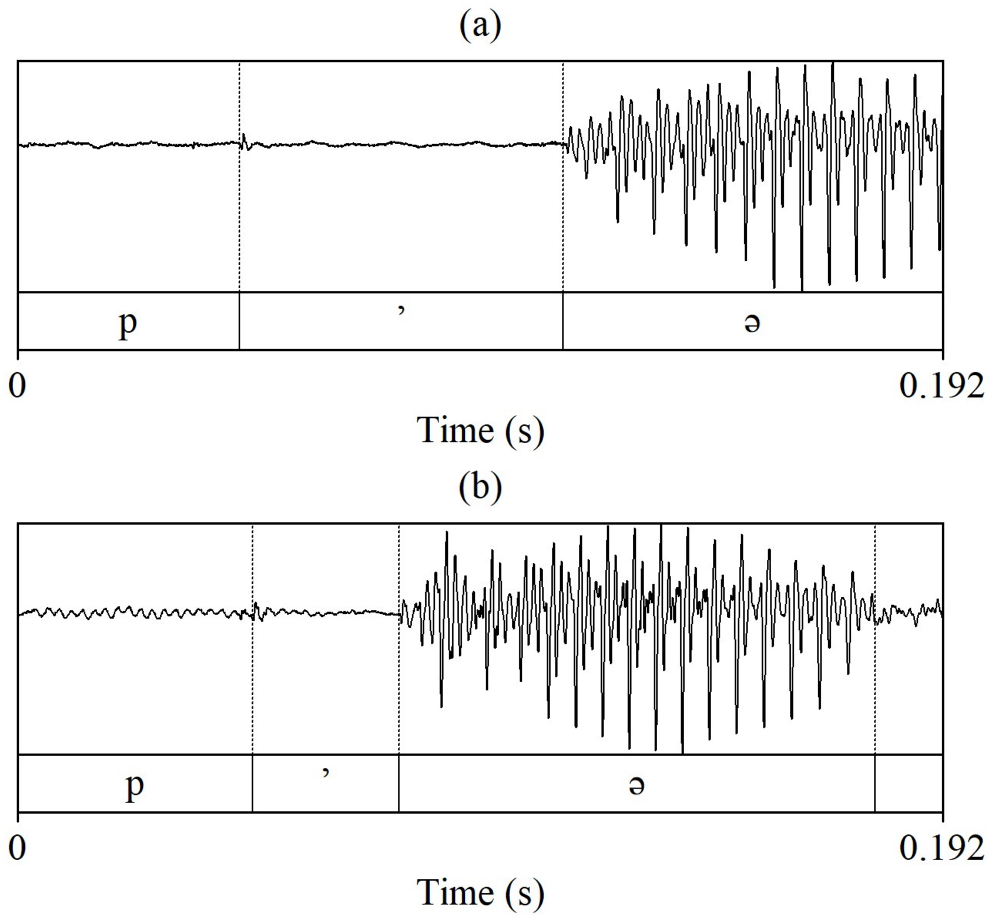



**Figure 6.6** Waveform of ejective bilabial stops [p’] with (a) long VOT (approximately 67ms), and (b) short VOT (approximately 30ms).

Table 6.7 summarizes the means and standard deviations of VOT’s for non-labialized dorsal stops and labialized dorsal stops (note: the VOT of /g/ and /gʷ/ in Table 6.7 was measured in word-initial position, which, as mentioned above, always had a positive VOT).

**Table 6.7** Means and standard deviations of VOT's (in milliseconds) for non-labialized dorsal stops /g k q/ and labialized dorsal stops /$g^w$ $k^w$ $q^w$/.

| Consonant | *n* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /g/ | 7 | 28.41 | 15.89 | 6.01 |
| /$g^w$/ | 63 | 28.03 | 13.56 | 1.71 |
| /k/ | 17 | 54.38 | 13.55 | 3.29 |
| /$k^w$/ | 30 | 52.87 | 22.99 | 4.2 |
| /q/ | 25 | 56.28 | 26.94 | 5.39 |
| /$q^w$/ | 11 | 69.69 | 21.14 | 6.37 |

Figure 6.7 is a box plot illustrating the VOT for non-labialized dorsal stops /g k q/ and labialized dorsal stops /$g^w$ $k^w$ $q^w$/. As Table 6.7 summarizes, there was considerable overlap between plain velar stops and labiovelar stops (where the upper limit for the plain velar stops crossed the lower limit of the labiovelar stops). The secondary articulation of labialization did not appear to affect the VOT of velar stops. This suggests that the mean difference between plain velar stops and labiovelar stops was unlikely to be significant. For the uvular place of articulation, however, there was greater separation between plain uvular stops and labiouvular stops. It should be noted that the quality of the following vowel could not be controlled for all these consonants. Some of the variation may be due to vowel coarticulation.

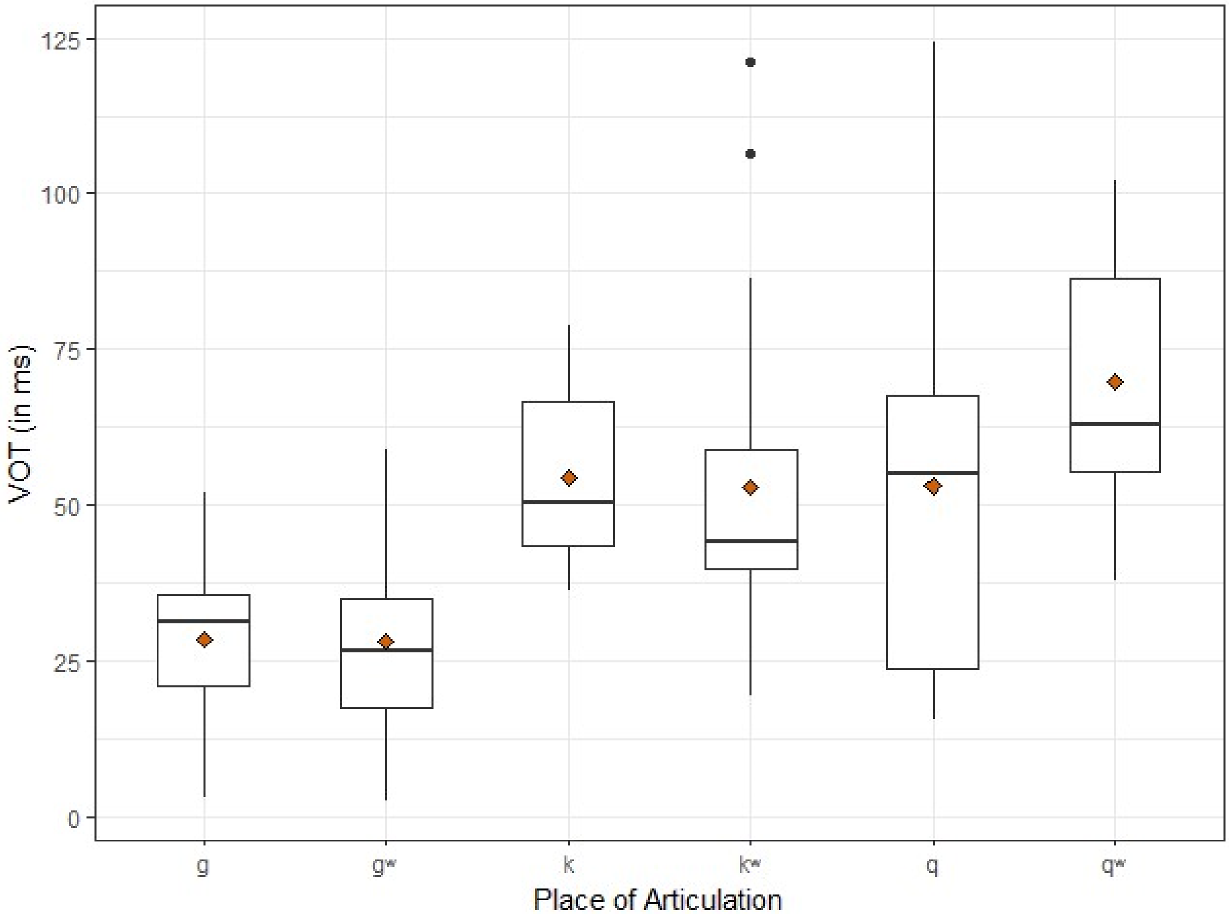



**Figure 6.7** Box plot illustrating the distribution of VOT (in ms) for non-labialized dorsal stops /g k q/ and labialized dorsal stops /$g^w$ $k^w$ $q^w$/.

Like the voiced velar stop /g/, the voiced labiovelar stop /$g^w$/ had a positive VOT in word-initial position. This can be compared with the VOT of the voiceless labiovelar stop /$k^w$/, as summarized in Table 6.8.

**Table 6.8** Means and standard deviations of VOT's (in milliseconds) for word-initial /$g^w$/ and /$k^w$/

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /$g^w$/ | 63 | 28.03 | 13.56 | 1.71 |
| /$k^w$/ | 30 | 52.87 | 22.99 | 4.2 |

As Table 6.8 summarizes, the voiceless labiovelar stop /$k^w$/ had a longer VOT than word-initial voiced labiovelar stops /$g^w$/. This suggests that voiced dorsal stops (which are always devoiced in word-initial position) in general have a shorter VOT than voiceless dorsal stops.

Table 6.9 summarizes the means and standard deviations of VOT's for the ejective labial dorsal stops and the voiceless pulmonic labial dorsal stops. As Table 6.9 summarizes, ejective labial dorsal stops (on average) had a longer VOT than the voiceless pulmonic labial dorsal stops.

**Table 6.9** Means and standard deviations of VOT's (in milliseconds) for ejective labial dorsal stops and voiceless pulmonic labial dorsal stops.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /$k^w$/ | 30 | 52.87 | 22.99 | 4.2 |
| /$k^w$'/ | 30 | 93.73 | 31.09 | 5.68 |
| /$q^w$/ | 11 | 69.69 | 21.13 | 6.37 |
| /$q^w$'/ | 15 | 117.39 | 46.02 | 11.88 |

Figure 6.8 is a box plot illustrating the distribution of VOT for the voiceless pulmonic labial dorsal stops and ejective labial dorsal stops. As Figure 6.8 illustrates, the VOT of labiouvular stops tend to be greater than labiovelar stops, which (again) may suggest that there was a greater area of contact between the tongue dorsum and the uvular region (near the upper pharynx) than velars.

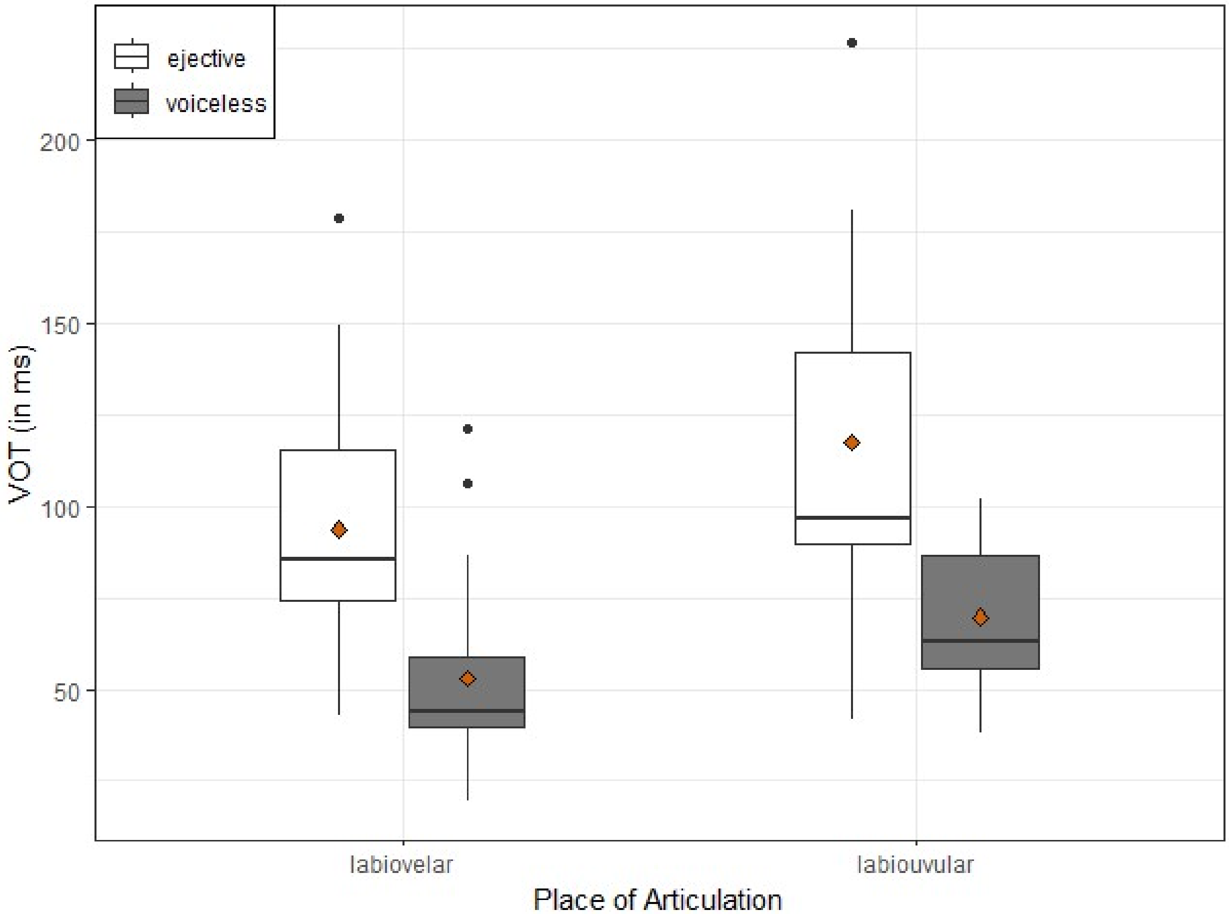



**Figure 6.8** Box plot illustrating the distribution of VOT (in ms) for the voiceless pulmonic labial dorsal stops and ejective labial dorsal stops.

Overall, the VOT of ejective stops (labialized and/or non-labialized) was greater than voiceless stops across each place of articulation (see Table A.0.1 in Appendix A for a summary of VOT for all stops in Lushootseed, including voiced stops). Figure 6.9 is a boxplot of VOT for all ejective and voiceless stops across each place of articulation, illustrating the relatively greater VOT for ejective stops than voiceless pulmonic stops (however, as mentioned earlier, there was considerable variability in the VOT of ejective stops). This suggests that ejectives have a long VOT, which is a property of stiff ejectives.

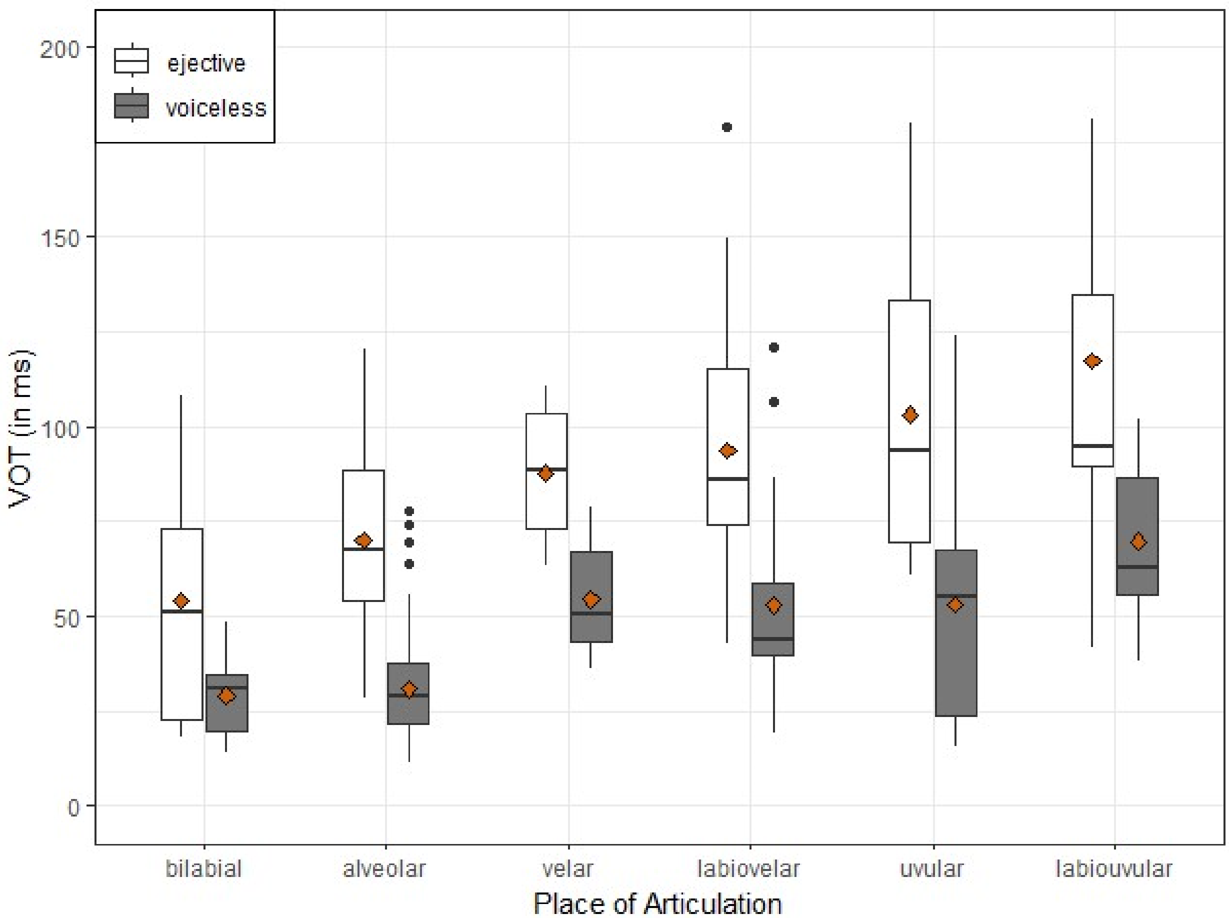



**Figure 6.9** Box plot illustrating the distribution of VOT for voiceless and ejective stops across each place of articulation.

When comparing the burst intensity of ejective stops with voiceless stops, the burst intensity for ejective stops was relatively greater than voiceless stops across each place of articulation. Table 6.10 summarizes the means and standard deviations of burst intensity comparing voiceless pulmonic stops with ejective stops. As Table 6.10 summarizes, the burst intensity for ejective stops was relatively greater than their voiceless pulmonic counterparts across each place of articulation. Figure 6.10 is a box plot illustrating the distribution in burst intensity for voiceless and ejective stops. As Figure 6.10 illustrates, burst intensity for ejectives was relatively greater than the burst intensity of voiceless pulmonic stops across each place of articulation.

**Table 6.10** Means and standard deviations of burst intensity (in dB SPL) for voiceless and ejective stops across each stop places of articulation.

| Consonant | *N* | *M* (in dB) | *SD* | *SE* |
|---|---|---|---|---|
| /p/ | 19 | 50.18 | 3.25 | 0.75 |
| /p'/ | 10 | 52.93 | 4.73 | 1.49 |
| /t/ | 116 | 47.21 | 5.95 | 0.55 |
| /t'/ | 43 | 56.39 | 5.58 | 0.85 |
| /k/ | 17 | 51.21 | 3.15 | 0.77 |
| /k'/ | 4 | 64.74 | 4.47 | 2.23 |
| /kʷ/ | 30 | 53.04 | 4.65 | 0.85 |
| /kʷ'/ | 30 | 59.35 | 5.65 | 1.03 |
| /q/ | 25 | 56.19 | 4.67 | 0.98 |
| /q'/ | 11 | 66.49 | 4.77 | 1.44 |
| /qʷ/ | 11 | 56.82 | 4.79 | 1.44 |
| /qʷ'/ | 15 | 62.39 | 5.02 | 1.32 |

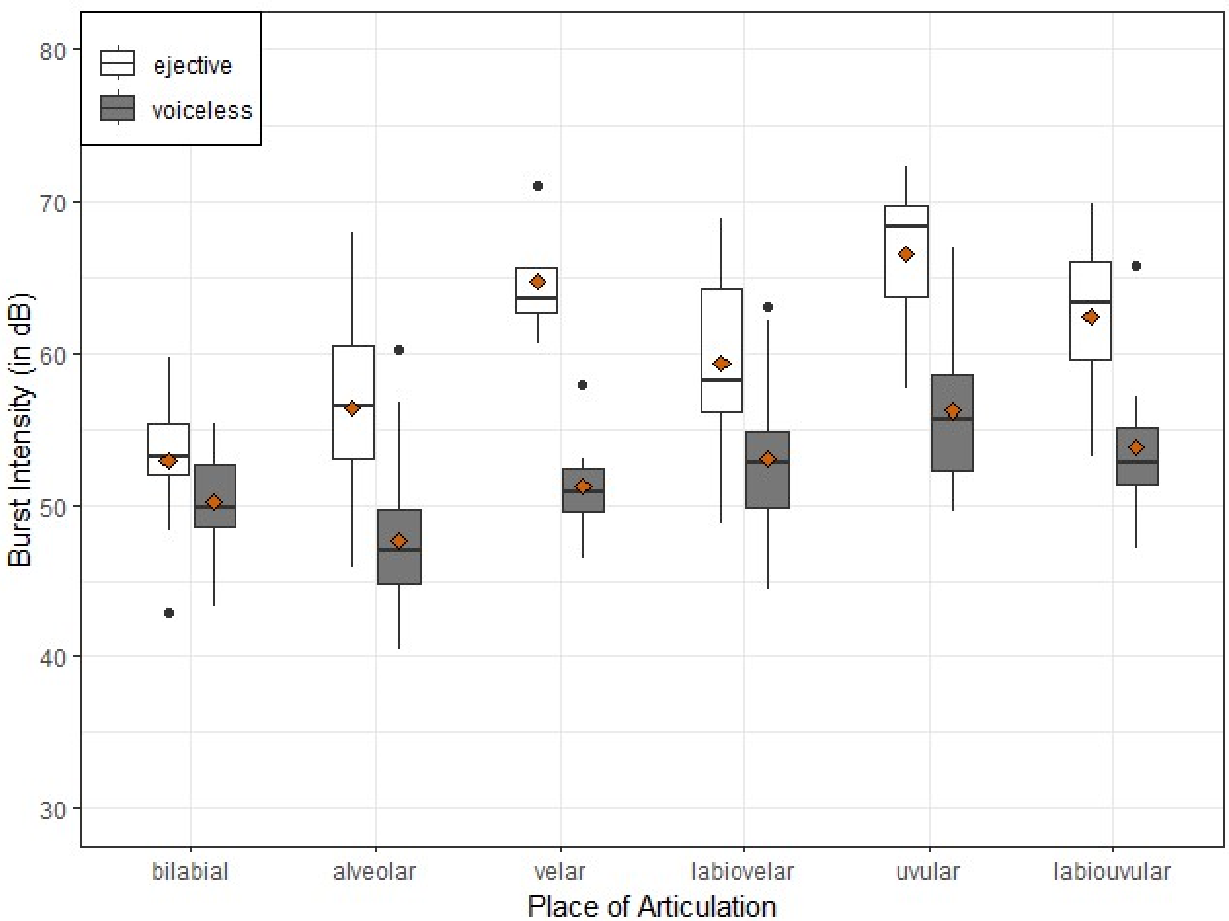



**Figure 6.10** Box plot illustrating the distribution of burst intensity (in dB) for voiceless and ejective stops across each place of articulation.

The data for VOT and burst intensity suggests that ejectives in Lushootseed may have properties of stiff ejectives because of the relatively louder burst intensity and longer VOT, which was always greater than voiceless pulmonic stops. However, as we will see in the next section, ejectives also show properties of slack ejectives, where the f0 perturbation and voice onset quality are depressed and creaky, respectively.

#### 6.3.1.2 Voice onset quality for stops

Table 6.11 summarizes the means and standard deviations of f0 perturbation for the stops three laryngeal types (voiced, voiceless, and ejective) (see Table A.0.2 in Appendix A for a summary of f0 perturbation for all stop places of articulation).

**Table 6.11** Means and standard deviations of f0 perturbation for the stops three laryngeal type (voiced, voiceless, and ejective).

| Laryngeal type | *N* | *M* | *SD* | *SE* |
|---|---|---|---|---|
| Voiced | 109 | -3.59 | 10.41 | 1.03 |
| Voiceless | 216 | 2.90 | 13.06 | 0.89 |
| Ejective | 113 | -12.75 | 23.61 | 2.22 |

Figure 6.11 is a bar graph illustrating f0 perturbation for the stop’s three laryngeal types (voiced, voiceless, and ejective).

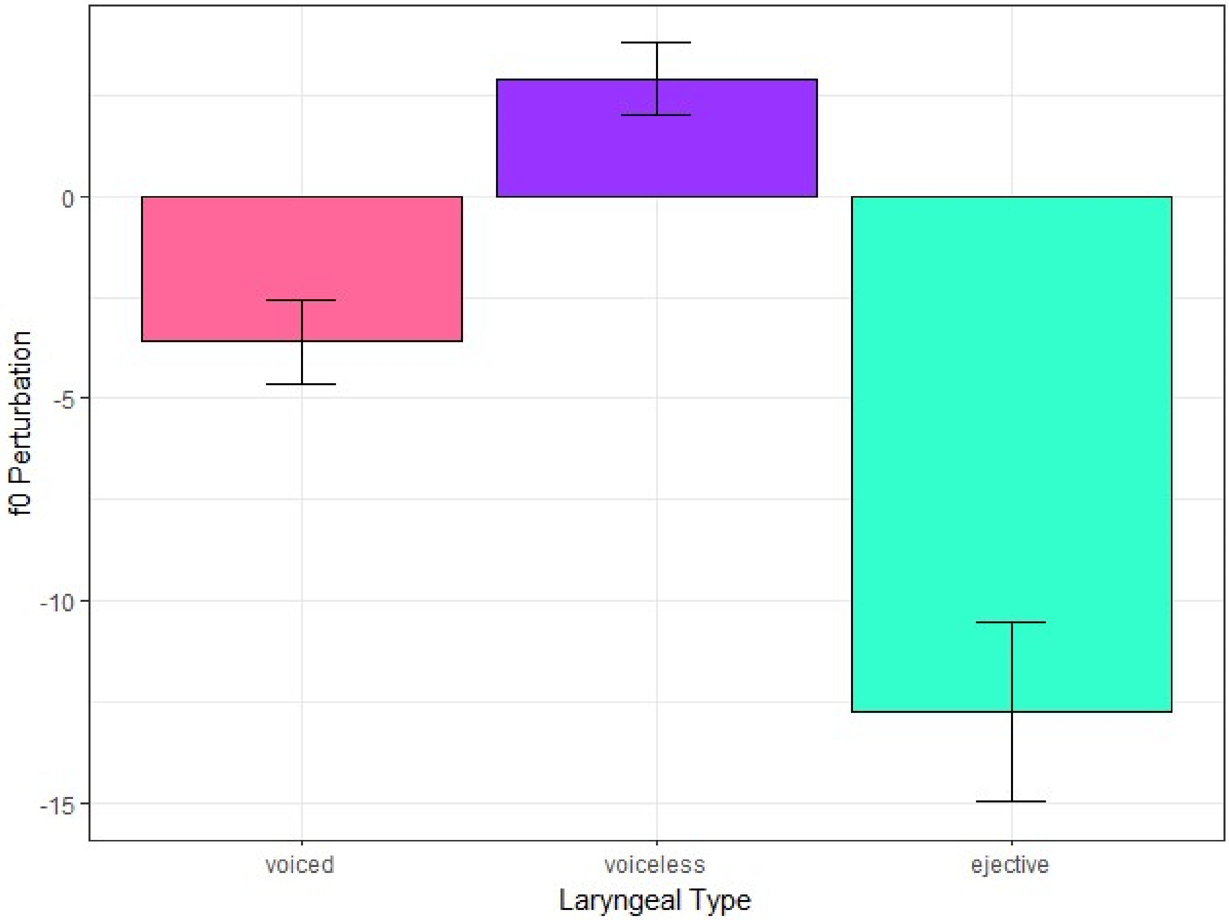



**Figure 6.11** Bar graph illustrating f0 perturbation for the stops three laryngeal types (voiced, voiceless, and ejective).

As Figure 6.11 illustrates, the f0 perturbation for ejective stops are the most depressed. Voiced stops also show depressed f0 perturbation, though not to the same extent as ejectives. The f0 perturbation for voiceless stops are slightly raised but close to zero. A one-way ANOVA was used to test the main effects of laryngeal type on f0 perturbation of the following vowel. The results indicate that the effects of laryngeal type on f0 perturbation was significant, $F(1, 2) = 35.63$, ***$p$<0.001, where the f0 perturbation was the most depressed for ejective stops, voiced stops less depressed than ejectives, and voiceless stops slightly raised (i.e., Voiceless > Voiced > Ejective).

Table 6.12 summarizes the means and standard deviations of jitter perturbation for the stops three laryngeal types (voiced, voiceless, and ejective) (see Table A.0.3 in Appendix A for a summary of jitter perturbation for all stop places of articulation).

**Table 6.12** Means and standard deviations of jitter perturbation for the stops three laryngeal type (voiced, voiceless, and ejective).

| Laryngeal type | *N* | *M* | *SD* | *SE* |
|---|---|---|---|---|
| Voiced | 104 | 2.85 | 3.64 | 0.36 |
| Voiceless | 206 | 2.78 | 2.49 | 0.17 |
| Ejective | 113 | 7.21 | 5.45 | 0.51 |

Figure 6.12 is a bar graph illustrating jitter perturbation for the stop's three laryngeal types (voiced, voiceless, and ejective).

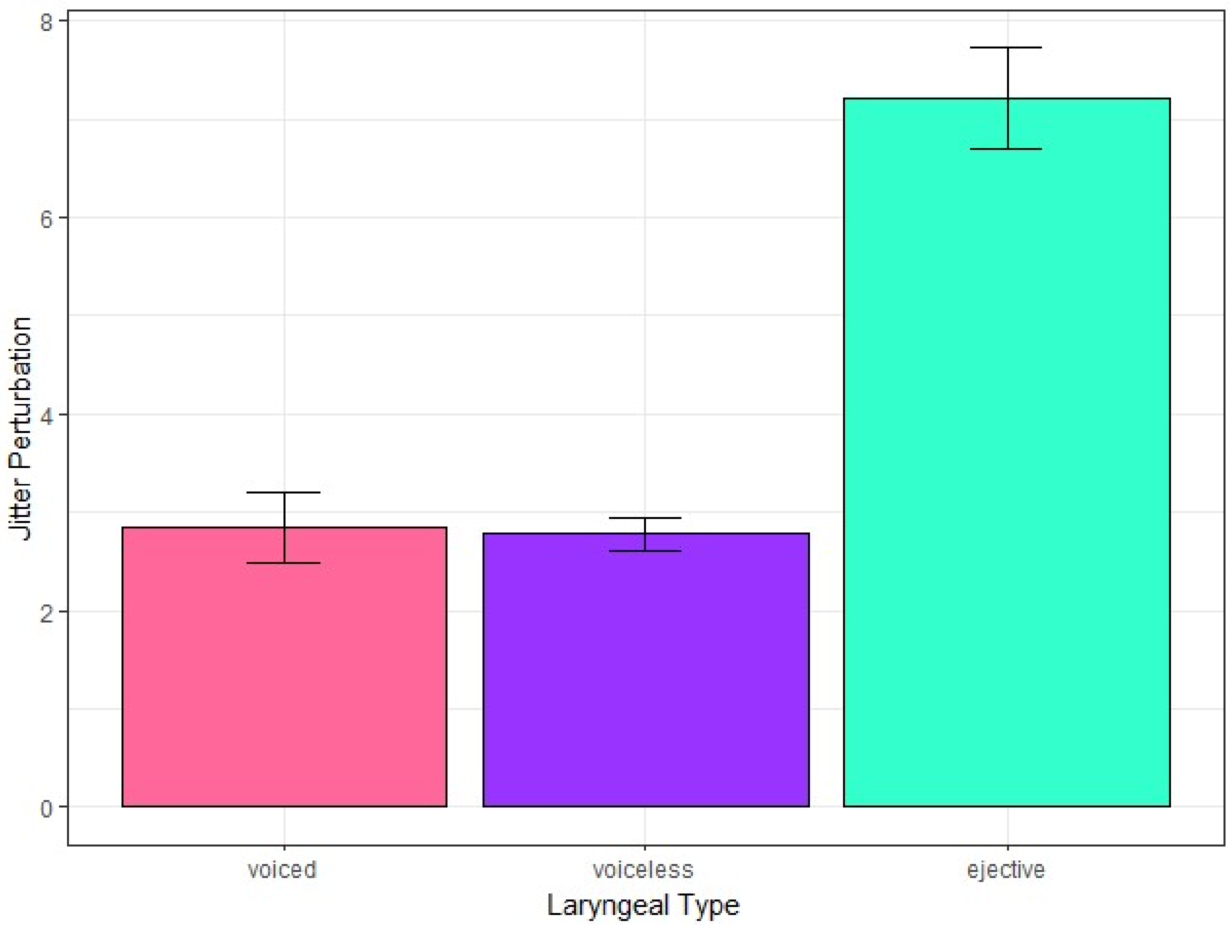



**Figure 6.12** Bar graph illustrating jitter perturbation for the stops three laryngeal types (voiced, voiceless, and ejective).

As Figure 6.12 illustrates, jitter perturbation was the greatest for ejectives, which suggests that ejectives are realized with a creaky voice onset. However, jitter perturbation for voiced and voiceless stops were very similar. This suggests that voiced and voiceless stops tend to be realized as more modal voiced with a lower jitter perturbation than ejectives. A one-way ANOVA was used to test the main effects of laryngeal type on jitter perturbation of the following vowel. The results indicate that the effects of laryngeal type on jitter perturbation was significant, $F(1, 2) = 35.77$, $***p<0.001$, where the jitter perturbation for ejectives were greater than voiced and voiceless stops (i.e., Ejective > Voiced, Voiceless).

Table 6.13 summarizes the means and standard deviations for amplitude rise time for the stops three laryngeal types (voiced, voiceless, and ejective). As Table 6.13 summarizes, the rise time for ejectives and voiceless stops were very similar. However, the rise time for voiced stops were slightly greater (or steeper) than voiceless and ejective stops.

**Table 6.13** Means and standard deviations of rise time (in dB) for the stops three laryngeal type (voiced, voiceless, and ejective).

| Laryngeal type | *N* | *M* | *SD* | *SE* |
|---|---|---|---|---|
| Voiced | 109 | 4.99 | 3.83 | 0.27 |
| Voiceless | 216 | 4.22 | 2.15 | 0.15 |
| Ejective | 113 | 4.14 | 2.45 | 0.23 |

Figure 6.13 illustrates the intensity difference (in dB) for the stops three laryngeal types (voiced, voiceless, and ejective).

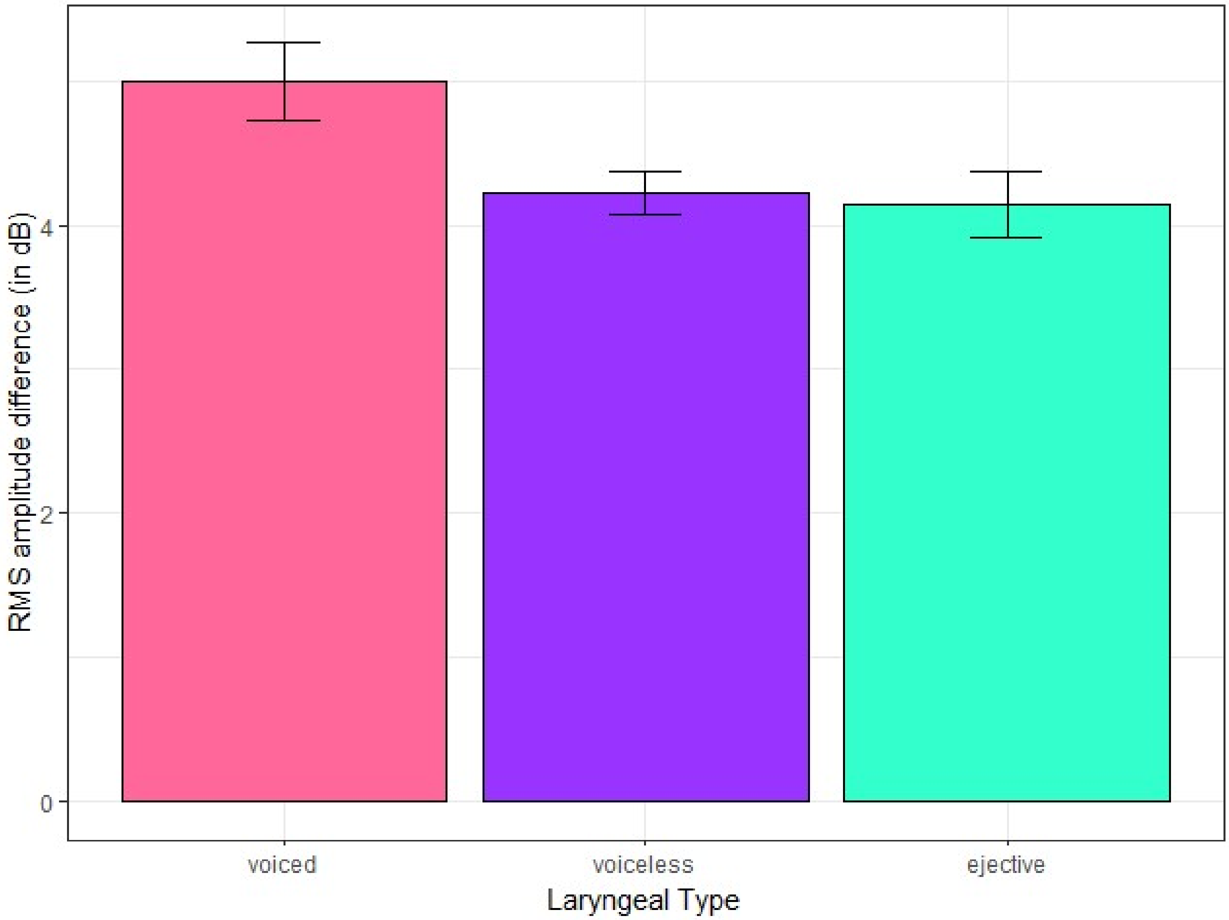



**Figure 6.13** Bar graph illustrating RMS amplitude difference (in dB) for the stops three laryngeal types (voiced, voiceless, and ejective).

As Figure 6.13 illustrates, the intensity difference for voiced stops was slightly greater than voiceless and ejective stops. A one-way ANOVA was used to test the effects of laryngeal type (voiced, voiceless, and ejective) on intensity difference of the following vowel. The results from the one-way ANOVA reveal that the main effects of laryngeal type on intensity difference was significant, $F(1, 2) = 4.517$, $*p = .011$, where the intensity difference for voiced stops was slightly greater than voiceless and ejective stops (i.e., Voiced > Voiceless, Ejective).

Contrary to the Lindau (1984) and Kingston (1985, 2005) model for ejectives, intensity difference (calculated as the difference between the maximum intensity of the vowel and the intensity at voice onset) for ejective stops was not greater than voiceless stops, despite having depressed f0 perturbation and creaky voiced onset. However, as we will see in Section 6.3.2.3, this is not observed for ejective affricates (where the intensity difference for ejective affricates was greater than voiceless and voiced affricates).

### 6.3.2 *Affricates in Lushootseed*

In this section, I cover affricates in Lushootseed. There are three primary articulators for affricates: Alveolar /ts dz ts'/ ‹c dᶻ c̓›, post-alveolar /tʃ dʒ tʃ'/ ‹č ǰ č̓›, and lateral /tɬ'/ ‹ƛ̓›. There are four pulmonic affricates in Lushootseed: /ts dz tʃ dʒ/ ‹c dᶻ č ǰ›. Pulmonic affricates in Lushootseed are sibilants, which are the most common types of affricates that can be found in the world's languages (Ladefoged & Maddieson 1996). The other affricates involve a glottalic egressive airstream mechanism (i.e., ejectives), which include /ts' tʃ' tɬ'/ ‹c̓ č̓ ƛ̓› (where /tɬ'/ ‹ƛ̓› does not have a pulmonic counterpart). In this section, I examine each affricate in Lushootseed. In Section 6.3.2.1, duration measurements (VOT and release duration) for each affricate are examined. In Section 6.3.2.2, spectral moments and intensity measurements for affricates are examined. In Section 6.3.2.3, measurements of voice onset quality of the following vowel are examined.

#### 6.3.2.1 Duration measurements (VOT and release frication duration)

The voiceless alveolar affricate /ts/ ‹c› had a shorter VOT than the voiceless post-alveolar affricate /tʃ/ ‹č›. Of the 10 instances of the voiced alveolar affricate /dz/ ‹dᶻ› that were examined, three were realized with a positive VOT, which could narrowly be transcribed as [d̥z]. The realization of the voiced alveolar affricate /dz/ ‹dᶻ› as either devoiced (i.e., positive VOT) or voiced (i.e., negative VOT) was not predictable from its conditioning environment. Means and standard deviations of VOT's for each affricate are summarized in Table 6.14.

**Table 6.14** Means and standard deviations of VOT’s (in milliseconds) for each affricate in Lushootseed.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /dz/ ‹d$^{z}$› (positive) | 3 | 42.98 | 7.86 | 3.52 |
| /dz/ ‹d$^{z}$› (negative) | 7 | -87.55 | 28.3 | 10.7 |
| /ts/ ‹c› | 54 | 66.75 | 15.84 | 2.17 |
| /ts’/ ‹c̓› | 7 | 102.66 | 20.3 | 7.67 |
| /dʒ/ ‹ǰ› | 4 | -72.74 | 23.41 | 11.71 |
| /tʃ/ ‹č› | 35 | 80.92 | 18.08 | 3.06 |
| /tʃ’/ ‹č̓› | 18 | 98.39 | 21.12 | 4.98 |
| /tɬ’/ ‹ƛ̓› | 19 | 87.6 | 18.3 | 4.31 |

As Table 6.14 summarizes, voiced alveolar affricates /dz/ ‹d$^{z}$› that were realized with a positive VOT had the shortest VOT when compared with /ts/ ‹c› and /tʃ/ ‹č›. Moreover, the voiceless post-alveolar affricate /tʃ/ ‹č› had a longer VOT than the voiceless alveolar affricate /ts/ ‹c›. This may suggest that voiceless post-alveolar affricates involve a more extended area of contact between the tongue blade and the post-alveolar ridge as opposed to the voiceless alveolar affricate /ts/ ‹c›, which may have been apical and alveolar.

From the current data, there were only four instances of the voiced post-alveolar affricate /dʒ/ ‹ǰ› that were produced by the speaker. All instances of the voiced post-alveolar affricate /dʒ/ ‹ǰ› were realized with a negative VOT. Of the 12 voiced alveolar affricates /dz/ ‹d$^{z}$› that were examined, seven were realized with a negative VOT (as mentioned above, the occurrence of /dz/ ‹d$^{z}$› as either devoiced or voiced was not predictable from its conditioning environment). Table 6.15 summarizes the means and standard deviations of the voiced alveolar affricate /dz/ ‹d$^{z}$› with negative VOT and the voiced post-alveolar affricate /dʒ/ ‹ǰ›.

**Table 6.15** Means and standard deviations of VOT’s (in milliseconds) for /d͡z/ ‹d$^{z}$› with negative VOT and /d͡ʒ/ ‹ǰ›.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /dz/ ‹d$^{z}$› (negative) | 7 | -87.55 | 28.3 | 10.7 |
| /dʒ/ ‹ǰ› | 4 | -72.74 | 23.41 | 11.71 |

Table 6.16 summarizes the means and standard deviations of the release frication duration for voiced, voiceless, and ejective affricates.

**Table 6.16** Means and standard deviations of the release frication duration (in milliseconds) for voiced, voiceless, and ejective affricates.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /dz/ ‹dᶻ› | 8 | 46.95 | 22.02 | 7.79 |
| /ts/ ‹c› | 54 | 66.75 | 15.84 | 2.17 |
| /ts'/ ‹c̓› | 7 | 60.10 | 9.03 | 3.41 |
| /dʒ/ ‹ǰ› | 4 | 52.44 | 18.36 | 9.18 |
| /tʃ/ ‹č› | 35 | 80.92 | 18.08 | 3.06 |
| /tʃ'/ ‹č̓› | 18 | 68.15 | 16.52 | 3.89 |
| /tɬ'/ ‹ƛ̓› | 19 | 54.82 | 15.03 | 3.54 |

Figure 6.14 is a box plot illustrating the distribution of the release frication duration (in ms) for each affricate.

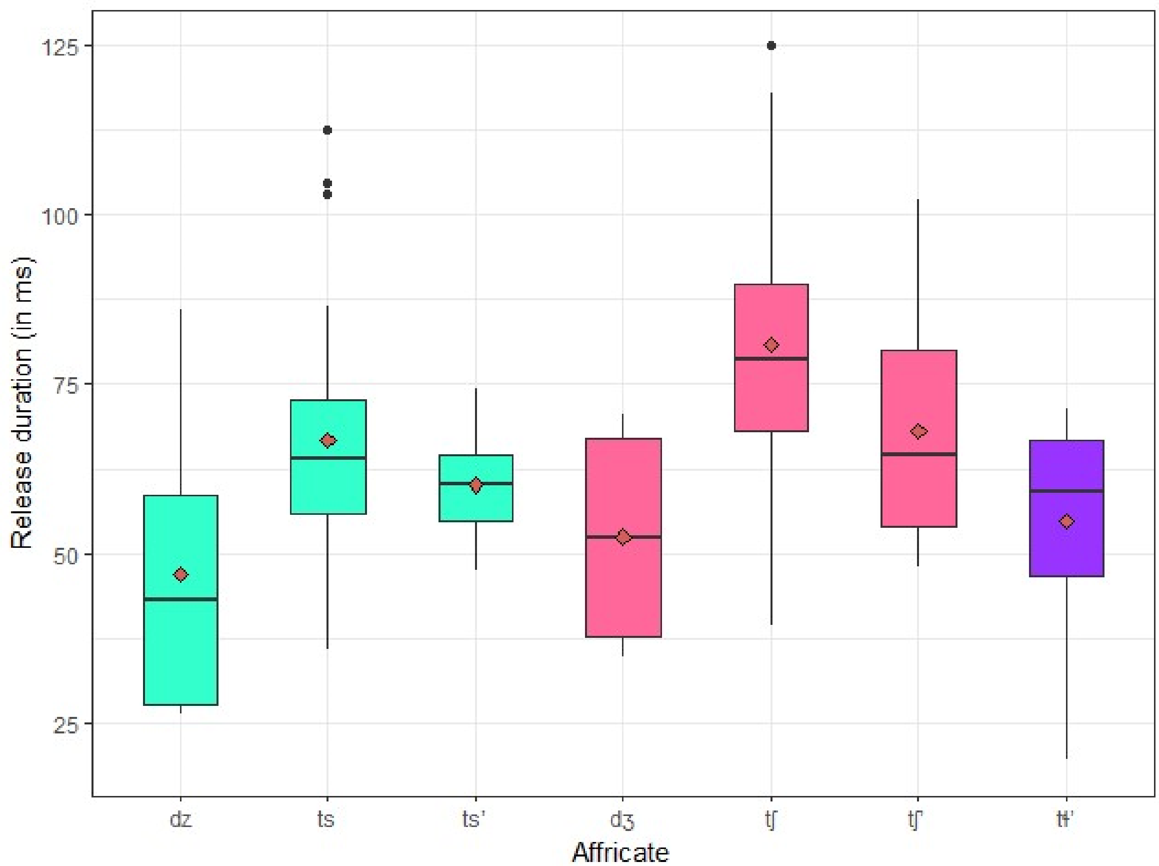



**Figure 6.14** Box plot illustrating the distribution of the affricates release frication duration (in ms). Mint green is the alveolar place of articulation, pink is post-alveolar, and purple is lateral.

As Figure 6.14 illustrates, the release frication duration for voiceless affricates was the longest, voiced affricates shortest, and ejective affricates in-between. Although there was a place effect on the release duration for voiceless affricates, this was not observed for ejective affricates, where the release frication duration for the ejective alveolar affricate was similar to the release frication duration of the ejective post-alveolar affricate.

A waveform of the lateral ejective affricate /tɬ’/ ‹ƛ̓› is shown in Figure 6.15. As Figure 6.15 illustrates, there was a prolonged period of frication following the transient burst, which suggests that these segments are realized as affricates. However, there were a few instances where the frication duration was short. This can be observed in Figure 6.16, which is a waveform of /tɬ’/ ‹ƛ̓› with a shorter release frication.

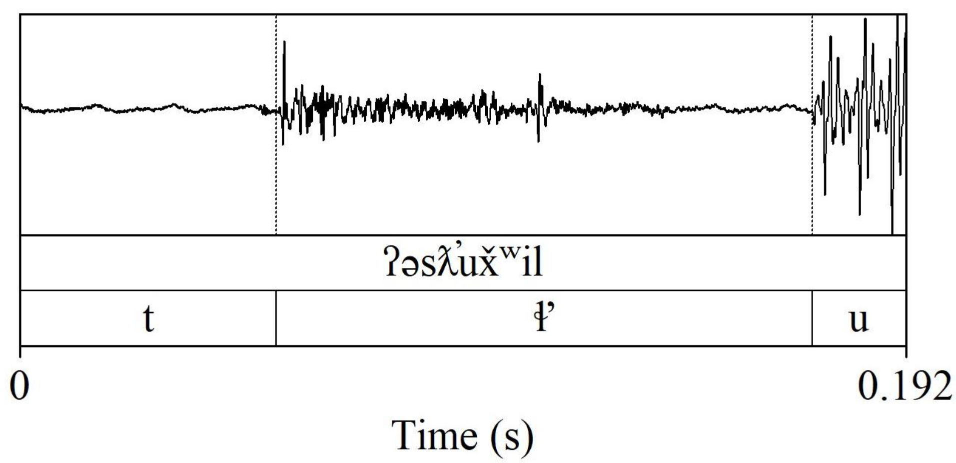



**Figure 6.15** Waveform of the lateral ejective affricate /tɬ’/ ‹ƛ̓› with a longer release frication.

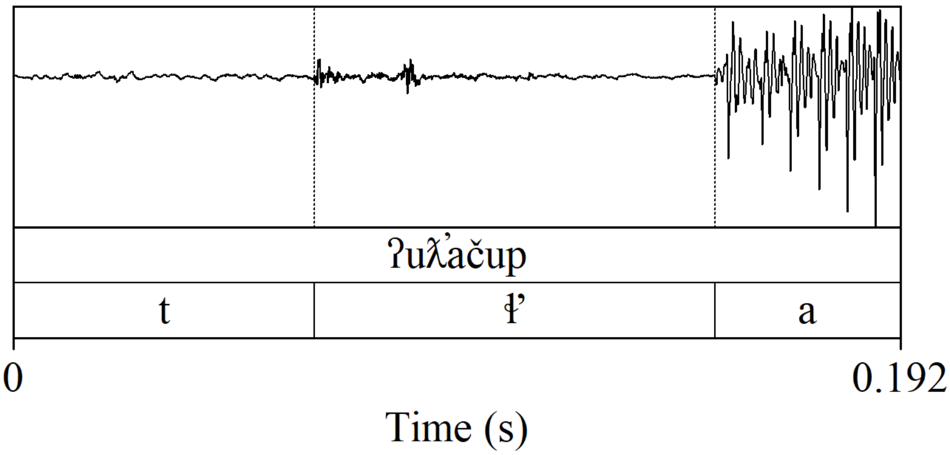



**Figure 6.16** Waveform of the lateral ejective affricate /tɬ’/ ‹ƛ̓› with a shorter release frication.

6.3.2.2 Spectral moments and intensity

Table 6.17 summarizes the spectral moment measurements (Center of Gravity (CoG), kurtosis, skew, and variance) for each affricate in Lushootseed. (It should be noted that the spectral moments were measured along the frication component for voiced affricates).

**Table 6.17** Means and standard deviations for spectral moment measurements (CoG, Kurtosis, Skew, and Variance) for each affricate in Lushootseed.

| Consonant | *N* | *CoG* (in Hz) | *SD* | *Kurtosis* | *SD* | *Skew* | *SD* | *Variance* | *SD* |
|---|---|---|---|---|---|---|---|---|---|
| [dz] ‹d$^{z}$› | 9 | 4097.11 | 1818.58 | 4.62 | 7.25 | 2.03 | 1.19 | 4959.79 | 1009.90 |
| [ts] ‹c› | 53 | 3016.67 | 955.42 | 65.19 | 81.87 | 4.08 | 2.39 | 2088.89 | 1662.59 |
| [ts’] ‹c̓› | 7 | 3193.93 | 1209.76 | 10.48 | 6.01 | 2.10 | 1.31 | 2730.38 | 1014.83 |
| [dʒ] ‹ǰ› | 3 | 1843.23 | 202.93 | 37.27 | 28.39 | 3.17 | 2.03 | 1377.79 | 277.22 |
| [tʃ] ‹č› | 35 | 2438.71 | 421.69 | 204.09 | 173.32 | 7.64 | 3.61 | 976.66 | 849.49 |
| [tʃ’] ‹č̓› | 18 | 2733.33 | 460.39 | 169.94 | 154.83 | 5.87 | 3.09 | 980.45 | 920.45 |
| [tɬ’] ‹ƛ̓› | 18 | 1518.90 | 458.81 | 50.24 | 27.69 | 5.03 | 2.31 | 1612.93 | 768.38 |

As Table 6.17 summarizes, CoG for alveolar affricates [dz ts ts’] was higher than post-alveolar [dʒ tʃ tʃ’] and lateral [tɬ’]. Moreover, the CoG for the lateral ejective affricate [tɬ’] was the lowest. Kurtosis was greatest for voiceless and ejective post-alveolar [tʃ tʃ’], as well as voiceless alveolar [ts]. Variance was highest for alveolar affricates (especially the voiced alveolar [dz]). Figure 6.17 is a box plot illustrating the distributions of CoG for each affricate. As Figure 6.17

illustrates, the alveolar place of articulation (especially voiced [dz] ‹$d^{z}$›) had the widest distribution, whereas post-alveolars were the narrowest.

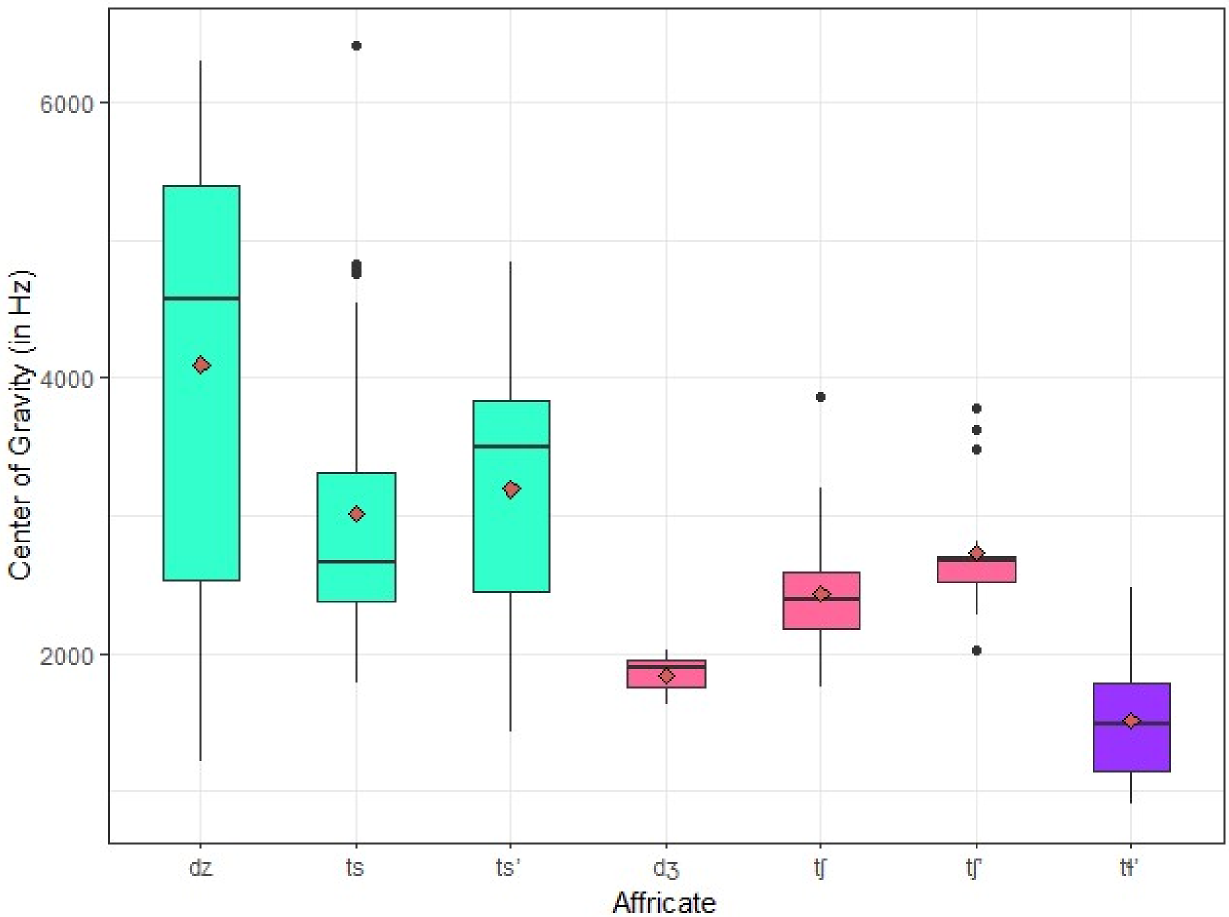



**Figure 6.17** Boxplot for Center of Gravity (in Hz) for each affricate. Mint green is alveolar place of articulation, pink is post-alveolar, and purple is lateral.

The wider distribution of CoG for the alveolar place of articulation might be explained by the upper frequency cutoff in these recordings (near 5~7kHz), where there was less noise intensity concentrated at the upper frequency range. Alveolars tend to show peaks well above 7kHz (Shadle & Scully 1995; Shadle 1985, 2023; Koenig et al. 2013). Unfortunately, these peaks were not traceable in the speech signal from these recordings because of the upper frequency cutoff. This may have obscured measures of CoG for the voiceless alveolar affricate.

A one-way ANOVA was used to test the effects of affricates on CoG, where the independent variable was the affricates place of articulation, and the dependent variable was CoG. The results show that alveolar place of articulation has a slightly higher CoG than post-alveolars, and post-alveolars have a significantly higher CoG than laterals, $F(1,6) = 29.03$, $^{***}p<.001$. In other languages, CoG for lateral affricates and fricatives tend to be closer to the center of gravity of post-alveolar affricates and fricatives (Gordon et al. 2002; Percival 2016; Ladefoged & Maddieson 1996; Hargus et al. 2020). However, the center of gravity for the lateral ejective affricate was significantly lower than post-alveolars in the current data. It is possible that the articulatory release for the lateral ejective affricate was made posteriorly along the sides of the palate. The more posterior the constriction, the lower the center of gravity (Gordon et al. 2002; Forrest et al. 1988). However, it is also possible that the low center of gravity was due to the length of the buccal cavities during the release. These are mere speculations on the articulatory and aerodynamic components of lateral ejective affricates in Lushootseed. It is uncertain where the constriction was made along the sides of the palate without instrumental articulatory and/or aerodynamic measurements.

Intensity of Sound Pressure Level (in dB) for all the affricate's release frication was compared for the three laryngeal types (voiced, voiceless, and ejective) at five different time points: 10%, 30%, 50%, 70%, 90%. Figure 6.18 is an example of a waveform and spectrogram illustrating the time points where intensity was extracted for the affricate [tʃ] ‹č›.

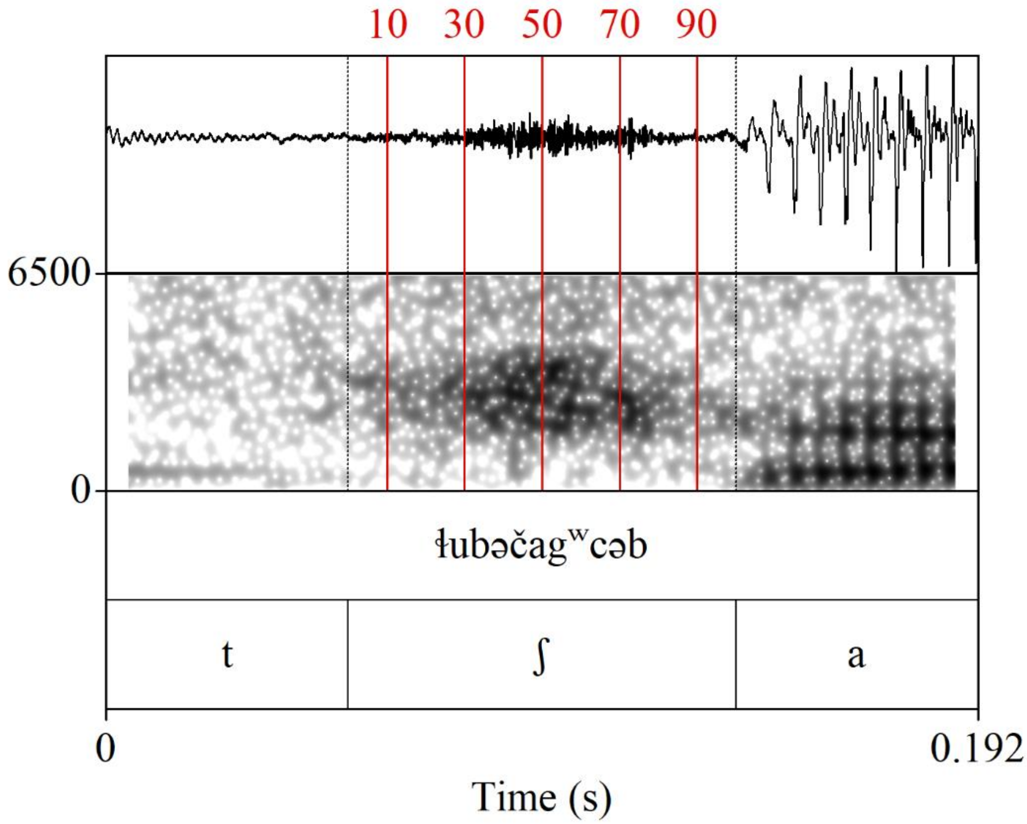



**Figure 6.18** Example of time points in red (10%, 30%, 50%, 70%, 90%) where intensity was extracted for the voiceless post-alveolar affricate [tʃ] ‹č›.

The results of the extracted intensity for each affricates laryngeal type is illustrated in Figure 6.19, which is a line chart (with 95% confidence intervals) plotting the average intensity of the release frication at each time point. As Figure 6.19 illustrates, intensity drops at 90% of the frication component for ejective affricates. However, intensity increases at 90% for voiced affricates. There is a small change in intensity for voiceless affricates at 90%. A one-way ANOVA was used to test the effects of laryngeal type (voiced, voiceless, and ejective) on intensity of the release frication. The results show that there was a significant effect of laryngeal type on intensity of the release frication, $F(1, 2) = 6.08$, $^{**}p = .002$, where the intensity of the release frication for voiced affricates was greater than voiceless affricates, and voiceless affricates greater than ejectives. A similar pattern was observed in Délı̨nę Slavey and Eastern Oromo (Percival 2016ab), where there is a dip in intensity at the end of the release frication period for ejective affricates, a rise in intensity at the end of the release frication period for voiced (or voiceless unaspirated in the case of Délı̨nę Slavey) affricates, and voiceless (or voiceless aspirated in the case of Délı̨nę Slavey) affricates in-between.

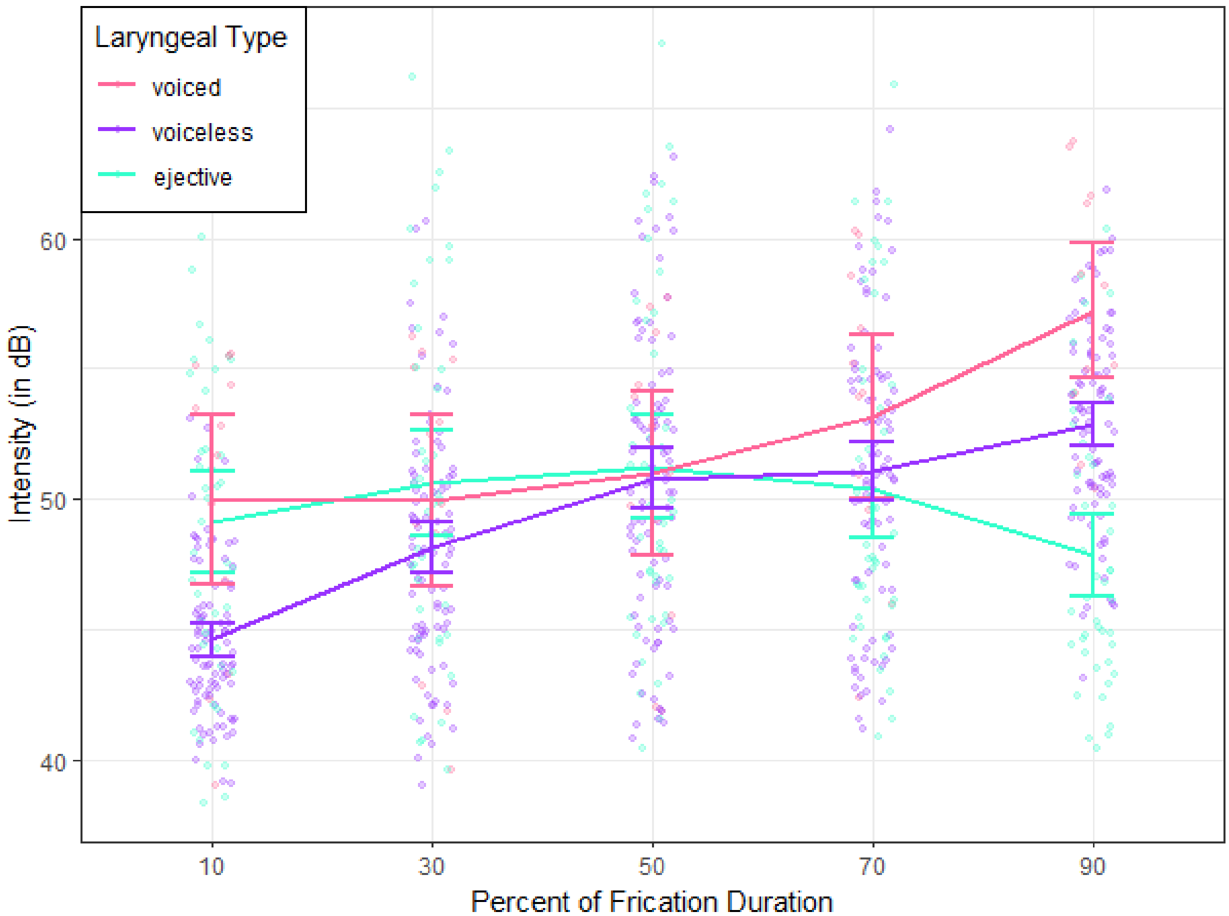



**Figure 6.19** Frication intensity (in dB) for five time points (10%, 30%, 50%, 70%, and 90%) of the total frication duration for voiced, voiceless, and ejective affricates.

6.3.2.3 Voice onset quality for affricates

Table 6.18 summarizes the means and standard deviations of the affricates f0 perturbation for each laryngeal type (voiced, voiceless, and ejective) (see Table A.0.7 for each affricate).

**Table 6.18** Means and standard deviations of f0 perturbation for the affricates three laryngeal type (voiced, voiceless, and ejective).

| Laryngeal type | *N* | *M* | *SD* | *SE* |
|---|---|---|---|---|
| Voiced | 12 | -5.03 | 10.78 | 3.11 |
| Voiceless | 88 | 6.81 | 10.32 | 3.11 |
| Ejective | 43 | -13.1 | 18.02 | 2.75 |

Figure 6.20 is a bar graph illustrating f0 perturbation for each affricates' laryngeal type.

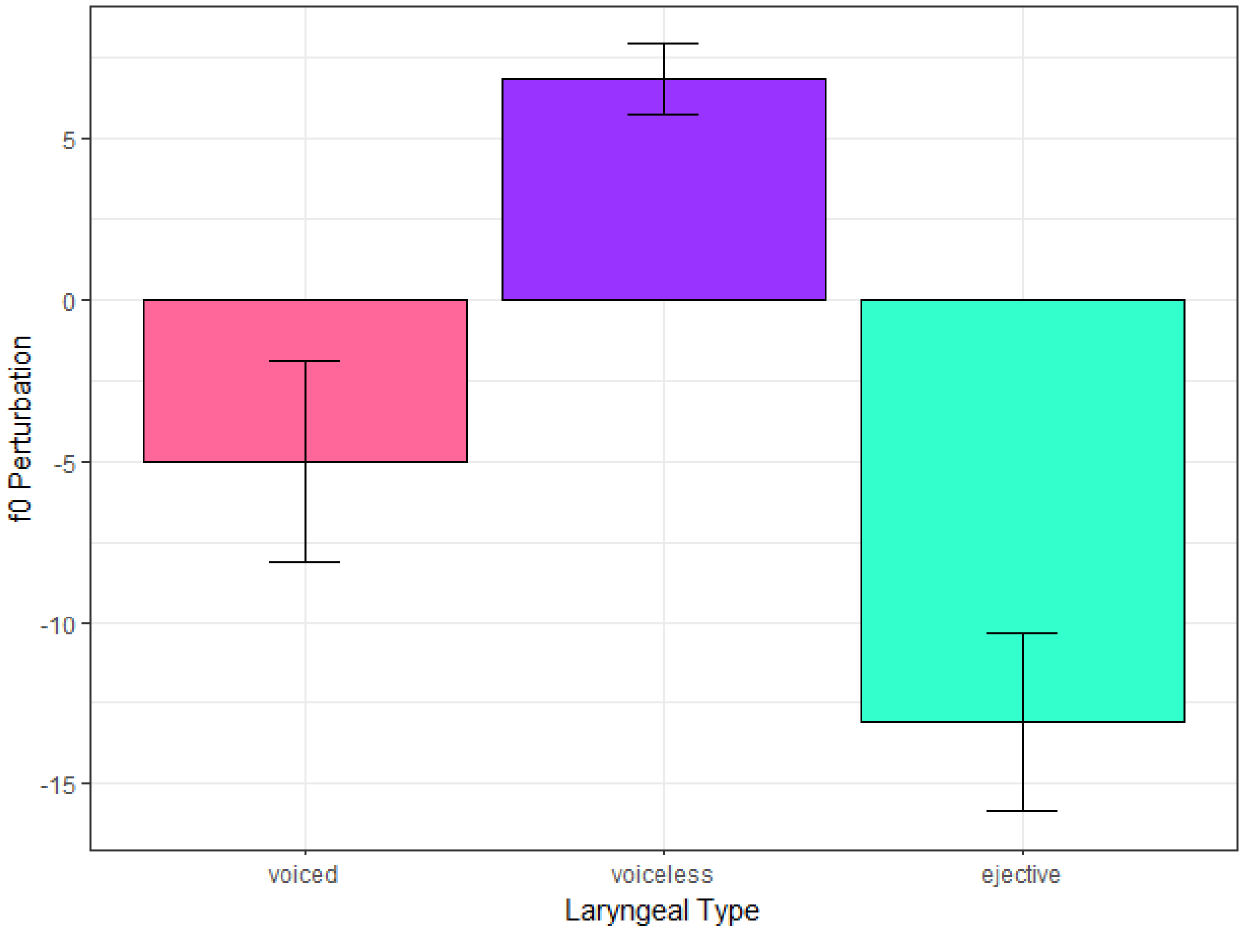



**Figure 6.20** Bar graph illustrating f0 perturbation for the affricates three laryngeal types (voiced, voiceless, and ejective).

As Figure 6.20 illustrates, like stops, the f0 perturbation for voiced and ejective affricates was depressed, which suggests that the f0 at voice onset for voiced and ejective affricates was relatively lower than voiceless affricates. However, the f0 perturbation for ejectives was more depressed (lower at voice onset) than voiced affricates. On the other hand, the f0 perturbation for voiceless affricates was raised, which suggests that the f0 at voice onset for voiceless affricates was relatively higher than voiced and ejective affricates. This was also observed for stops (see Section 6.3.1.2), where the f0 perturbation for ejectives was the most depressed, followed by voiced stops, and voiceless stops showing slightly raised f0 perturbation.

A one-way ANOVA was used to test the effects of laryngeal type (voiced, voiceless, and ejective) on f0 perturbation of the following vowel. The results from the one-way ANOVA indicates that the affricates laryngeal type had a significant effect on the f0 perturbation of the following vowel, $F(1, 2) = 34.05$, $***p<.001$, where (like stops) ejective affricates was the most depressed, followed by voiced affricates, and voiceless affricates raised (i.e., Voiceless > Voiced > Ejective).

Table 6.19 summarizes the means and standard deviations for the affricates jitter perturbation for each laryngeal type (see Table A.0.8 for each affricate).

**Table 6.19** Means and standard deviations of jitter perturbation for the affricates three laryngeal type (voiced, voiceless, and ejective).

| Laryngeal type | *N* | *M* | *SD* | *SE* |
|---|---|---|---|---|
| Voiced | 11 | 1.57 | 1.55 | 0.47 |
| Voiceless | 88 | 2.55 | 2.21 | 0.24 |
| Ejective | 43 | 4.13 | 3.87 | 0.73 |

Figure 6.21 is a bar graph illustrating jitter perturbation for each affricates' laryngeal type.

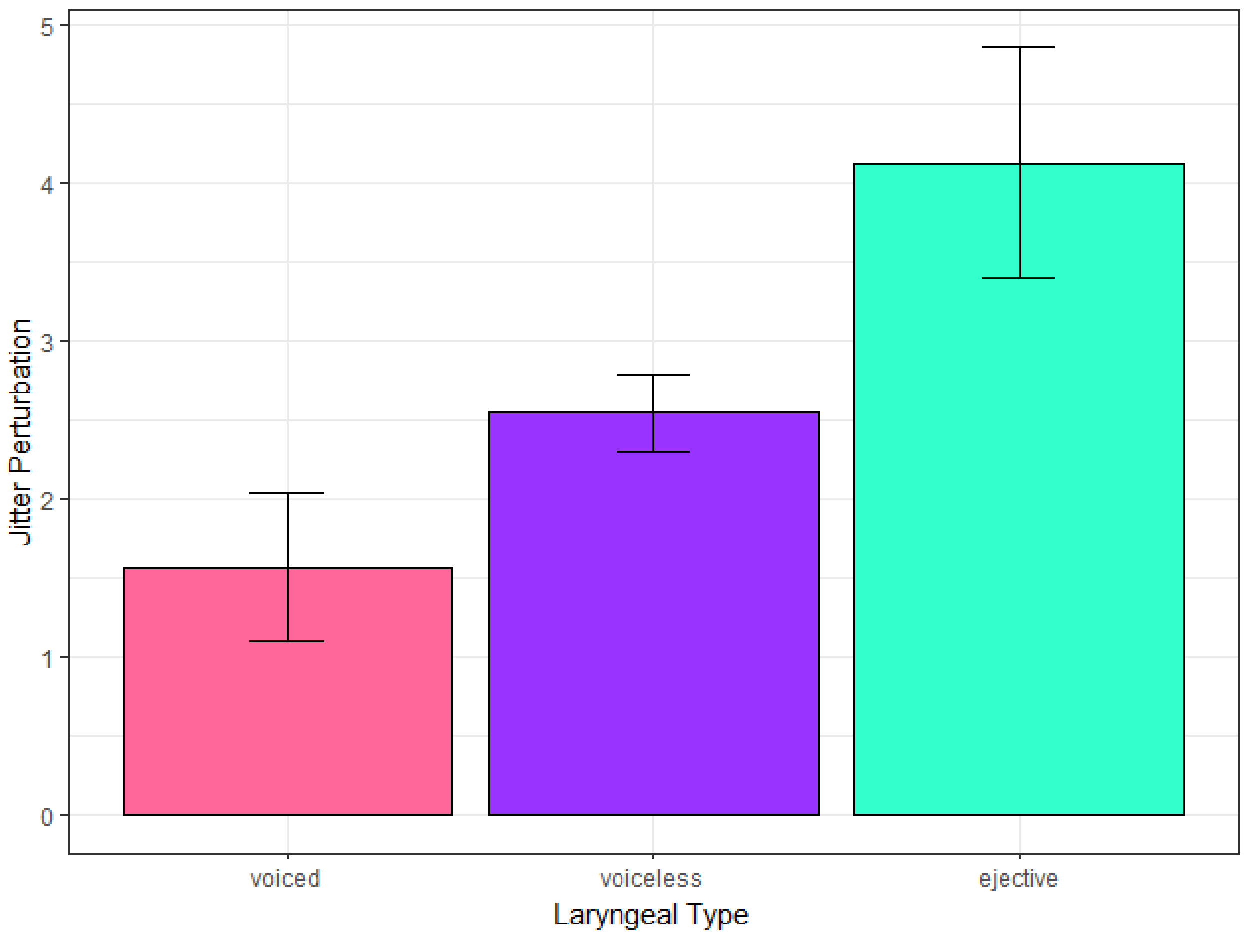



**Figure 6.21** Bar graph illustrating jitter perturbation for the affricates three laryngeal types (voiced, voiceless, and ejective).

As Figure 6.21 illustrates, the jitter perturbation for ejective affricates was the greatest, which suggests that there was greater aperiodicity (or creaky voicing) at the onset of the following vowel[5]. A similar pattern can be observed for stops (see Section 6.3.1.2), where the jitter perturbation was the greatest for ejective stops. However, the jitter perturbation was the lowest for voiced stops, and in-between for voiceless stops. This contrasts from stops, where the jitter perturbation for voiced and voiceless stops were approximately the same. A one-way ANOVA was used to test the effects of the affricates laryngeal type (voiced, voiceless, and ejective) on the following vowel. The results

---

[5] It should be noted, however, that lateral ejective affricates [tɬ’] <ƛ̓> has lower jitter perturbation than alveolar and post-alveolars [ts] <c> and [tʃ] <č>. This is summarized in Table A.0.8 in Appendix A.

from the one-way ANOVA suggests that there was a significant effect of the affricates laryngeal type on the jitter perturbation of the following vowel, $F(1, 2) = 5.165$, $**p = .007$, where ejective affricates had the greatest jitter perturbation, voiceless affricates having a lower jitter perturbation than ejective affricates, and voiced affricates lower than voiceless affricates (i.e., Ejective > Voiceless > Voiced).

Table 6.20 summarizes the means and standard deviations for amplitude rise time for each laryngeal type.

**Table 6.20** Means and standard deviations of rise time for the affricates three laryngeal type (voiced, voiceless, and ejective).

| Laryngeal type | *N* | *M* | *SD* | *SE* |
|---|---|---|---|---|
| Voiced | 12 | 4.49 | 1.76 | 0.51 |
| Voiceless | 88 | 3.81 | 1.82 | 0.19 |
| Ejective | 43 | 5.53 | 3.28 | 0.5 |

Figure 6.22 illustrates the amplitude rise time for the affricates three laryngeal types (voiced, voiceless, and ejective).

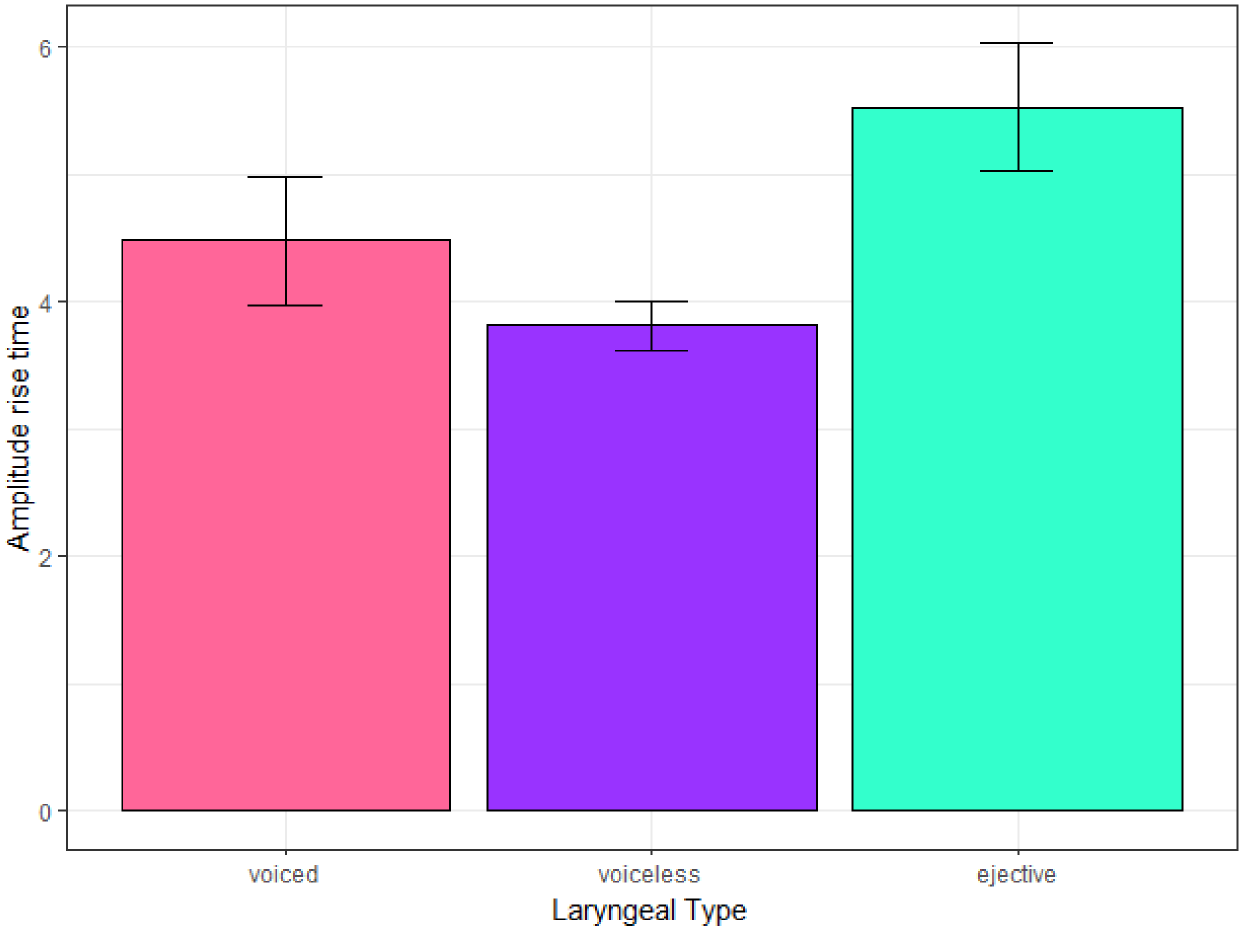



**Figure 6.22** Bar graph illustrating amplitude rise time for the affricates three laryngeal types (voiced, voiceless, and ejective).

As Figure 6.22 illustrates, the amplitude rise time for ejective affricates was greater (or “steeper”) than voiced and voiceless affricates. This suggests that the amplitude at voice onset for ejective affricates was lower than voiced and voiceless affricates. This contrasts from stops (see Section 6.3.1.2), where the amplitude rise time for ejectives is approximately the same as voiceless stops (with voiced stops showing greater rise time than ejective and voiceless stops). The main effects of the affricates laryngeal type on rise time was significant, $F(1, 2) = 7.76$, ***$p<.001$, where ejective affricates had a slowest/steepest rise time, voiceless affricates the fastest, and voiced stops in-between (i.e., Ejective > Voiced > Voiceless).

## 6.4 FRICATIVES

In Lushootseed, all fricatives are pulmonic and voiceless. There are six fricatives in Lushootseed. Each fricative is distinguished based on their place of articulation. These include /s ʃ ɬ xʷ χ χʷ h/ ‹s š ɬ xʷ x̌ x̌ʷ h›. In this section, I examine the acoustic properties of each fricative in Lushootseed. (See Appendix A, Table A.0.9, for a list of summaries of spectral moment measurements for each fricative).

### 6.4.1 *Sibilants*

There were 45 /s/'s and 10 /ʃ/'s ‹š› that were observed in the data. /s/'s tend to reach their peak amplitude near 8kHz (or above 7kHz) (Shadle & Scully 1995; Shadle 1985; Koenig et al. 2013). Unfortunately, there was a frequency cutoff near 5~6kHz in the recordings. This may have been due to the frequency cutoff of the microphone that was used to record the speaker. Information on the spectral components of /s/ could not be reliably measured due to the frequency cutoff of the microphone. However, it was still possible to obtain relative differences in CoG between the fricatives place of articulation (see Section 6.6.3 for more details on the limitations and techniques used for analyzing spectral moments from these recordings). Moreover, there were some noteworthy observations of /s/ in the data.

Of the 45 /s/'s that were observed in the data, 18 of these showed high frequency noise near the upper frequency limit of the cutoff, which was near 4~5kHz. However, the intensity was quite low at this frequency range. The frequencies of the spectral peaks for 18 of the 45 voiceless alveolar fricatives [s] were (on average) greater than the frequencies of the spectral peaks for the voiceless post-alveolar fricative [ʃ] ‹š›. This can be observed in Figure 6.23, where the spectral peak for the voiceless alveolar fricative [s] (in Figure 6.23a) was measured at 4066Hz, whereas the spectral peak for the voiceless post-alveolar fricative [ʃ] ‹š› (in Figure 6.23b) was measured at 1824Hz.

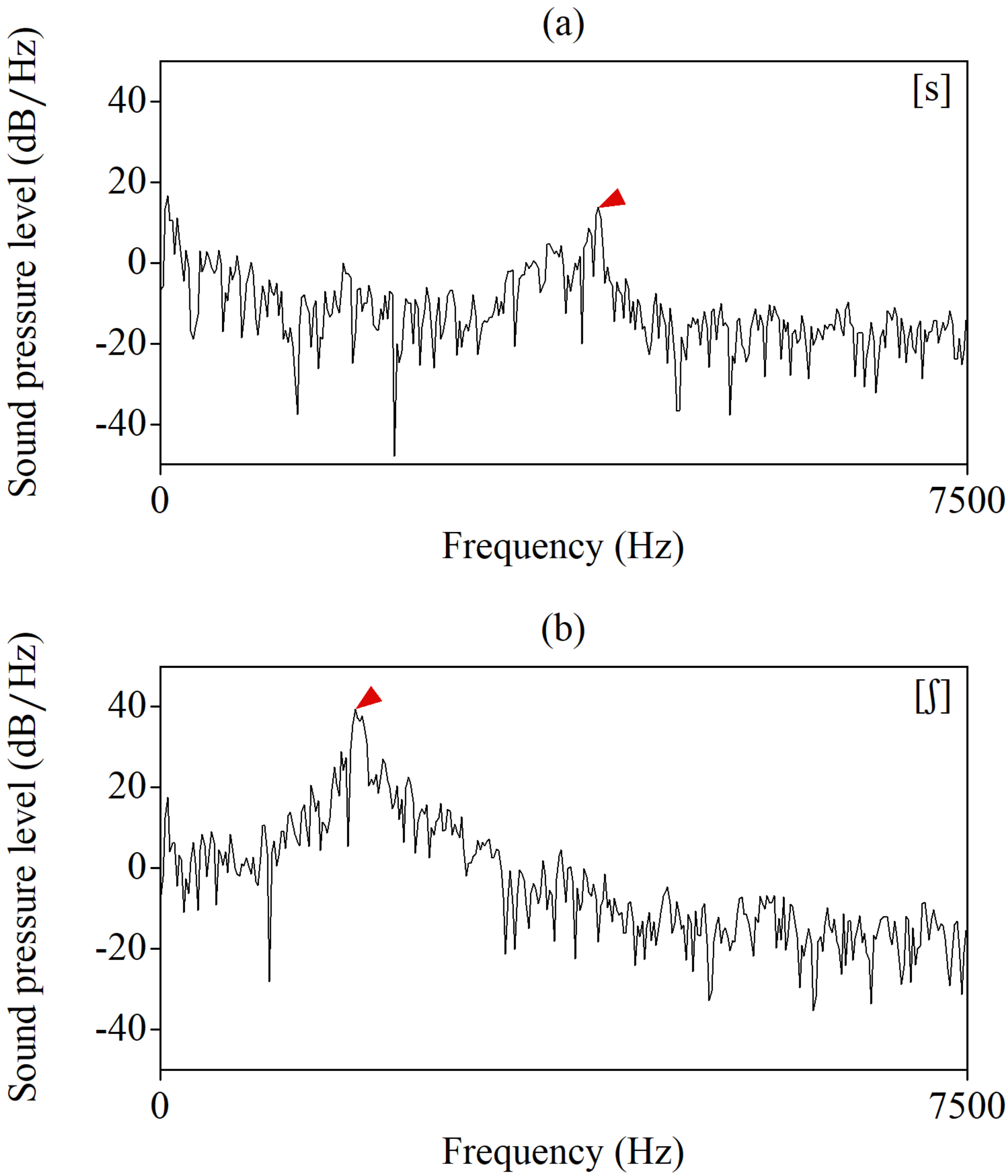



**Figure 6.23** FFT power spectrum measured at the midpoint of the fricative duration, for (a) the voiceless alveolar fricative [s], and (b) the voiceless post-alveolar fricative [ʃ] ‹š›. Red arrows point to the spectral peaks here and throughout.

On average, the intensity peak for the voiceless post-alveolar fricative [ʃ] ‹š› (approximately 24.49dB) was much greater than the intensity peak for the voiceless alveolar fricative [s] (approximately 6.34dB).

However, there were 27 /s/'s that showed second formant bands along the total fricative duration. Figure 6.24 is a waveform and spectrogram illustrating the second formant band along the mid-frequency range for [s] in the word /ʔusil/ 'dive'.

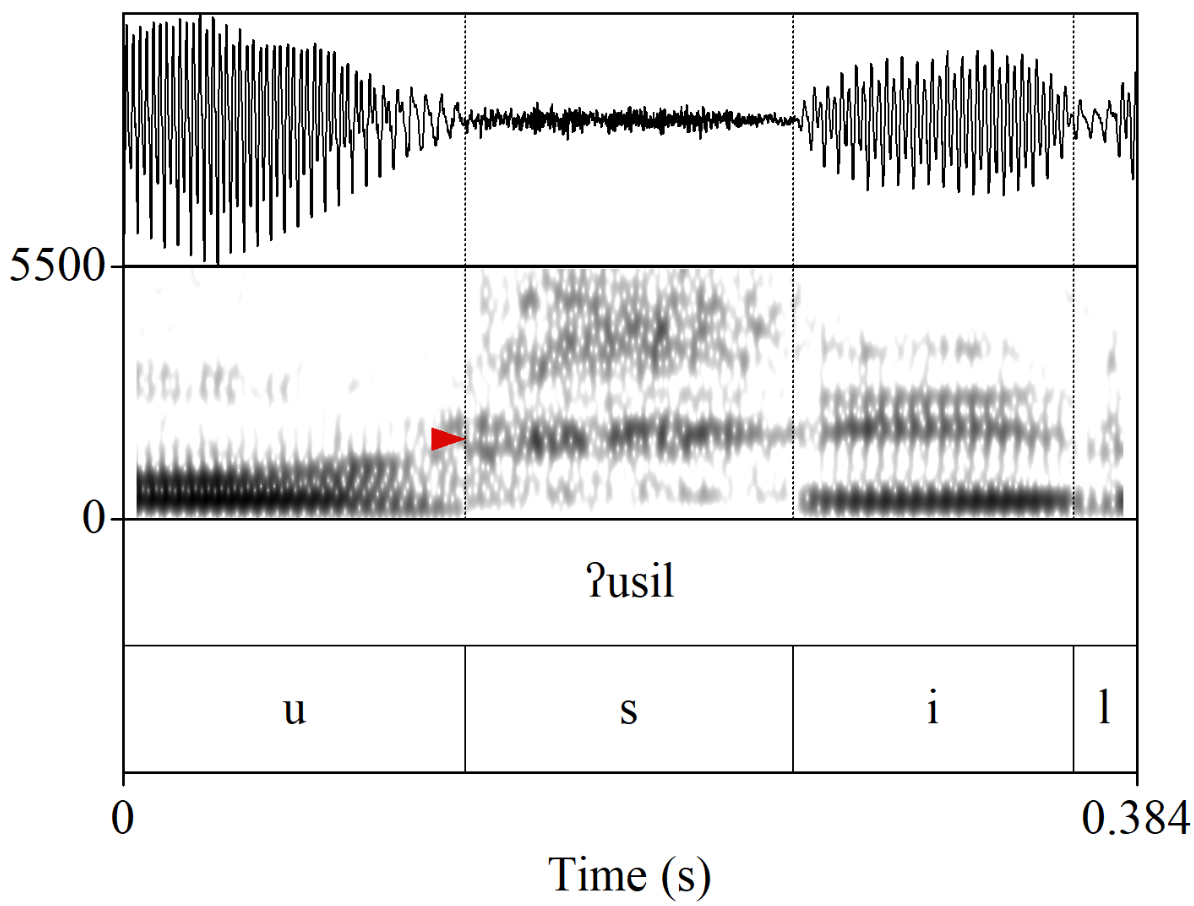



**Figure 6.24** Waveform and spectrogram illustrating the voiceless alveolar fricative [s] with mid-frequency bands, with the red arrow pointing at the formant structure near 1750Hz.

The second formant band was quite common in the data word-initially (when preceded by pauses), medially, and finally. According to Richard Wright and Christine Shadle (personal communication), there tends to be less tongue braising along the sides of the palate for the voiceless alveolar fricative [s] in connected speech of English. The speaker may also have produced [s] in this manner. This would generate turbulent airflow through a wider passage along the surfaces of the palate, which may introduce extra pole(s) in the transfer function of the signal. Moreover, there may be greater vowel-to-consonant coarticulation when [s] is produced in connected speech.

Table 6.21 summarizes the means and standard deviation for spectral moments (CoG, Kurtosis, Skew, Variance) from time-averaged spectrums for [s] and [ʃ] ‹š›.

**Table 6.21** Means and standard deviations for the spectral moment measurements (CoG, Kurtosis, Skew, and Variance) from time-averaged spectrums for [s] and [ʃ] ‹š›.

| Cons. | *N* | *CoG* (in Hz) | *SD* | *Kurtosis* | *SD* | *Skew* | *SD* | *Variance* | *SD* |
|---|---|---|---|---|---|---|---|---|---|
| [s] | 45 | 2769.45 | 948.82 | 16.64 | 11.05 | 3.33 | 0.99 | 3082.86 | 1014.79 |
| [ʃ] ‹š› | 10 | 2093.46 | 271.45 | 352.8 | 256.29 | 13.77 | 6.05 | 805.67 | 471.43 |

As summarized in Table 6.21, the CoG for the voiceless alveolar fricative [s] was considerably lower than expected CoG values for [s] across languages (Gordon et al. 2002; Munson 2001; Forrest et al. 1988)). However, this is likely due to three factors: (1) the amplitude of the low-frequency noise (approximately 60Hz), which comes from the mains hum source (see Chapter 2 for more details); (2) the upper-frequency cutoff (near 5~6kHz); and (3) second formant bands near the mid-frequency range for [s], which was apparent for 27 of the 44 [s]'s. The amplitude of the low-frequency noise was slightly lower than the peak of the frication noise spectrum corresponding to the voiceless alveolar fricative [s]. This noise peak may have obscured the calculation of CoG for the voiceless alveolar fricative [s]. As Table 6.21 summarizes for the CoG frequencies of the voiceless alveolar fricative [s], the standard deviation for [s] was greater than the standard deviation of CoG for the voiceless post-alveolar fricative [ʃ]. Moreover, the variance for [s] was considerably greater than [ʃ] ‹š›. This suggests that absolute measures of CoG could not be reliably calculated for the voiceless alveolar fricative [s] from these recordings. Despite this problem, relative differences across fricative places of articulation could still be obtained (see Section 6.6.3 for more detail on the advantages of using Time-averaging for measuring CoG).

### 6.4.2 *Lateral fricative*

The voiceless lateral fricative [ɬ] had a unique property of introducing two peaks in the FFT power spectrum. This can be observed in Figure 6.25, where the arrows point to the two peaks in the power spectrum.

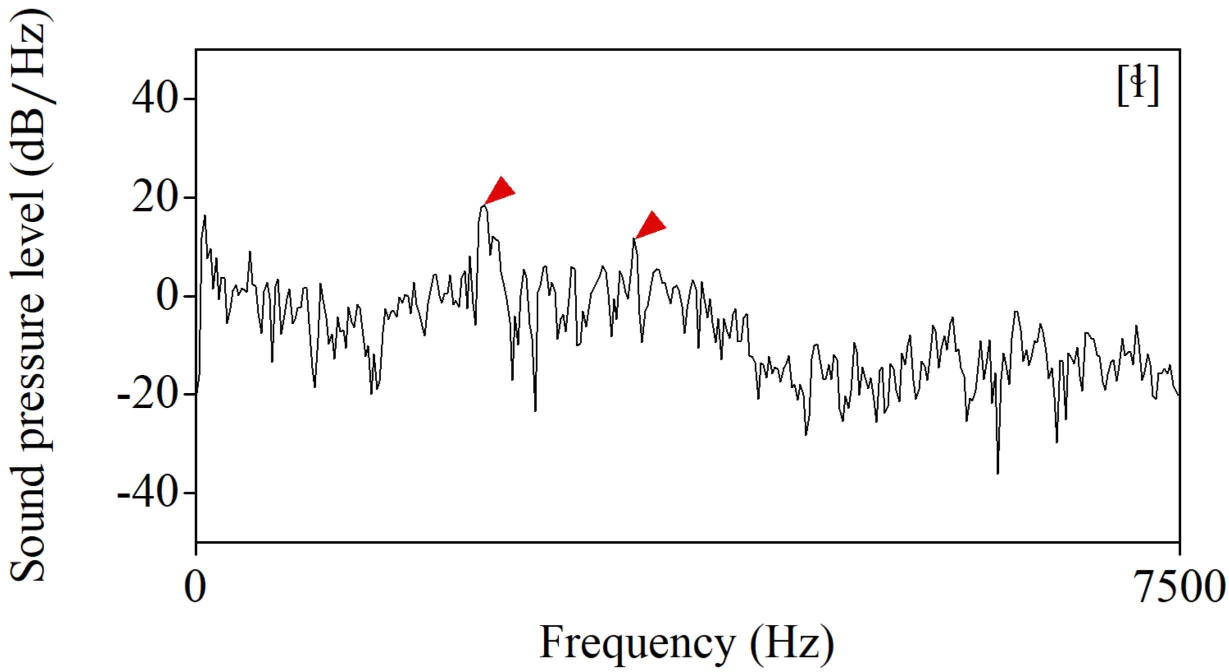



**Figure 6.25** FFT power spectrum for the lateral fricative [ɬ].

As Figure 6.25 illustrates, there was greater amplitude for the first peak (which was near 2000Hz, with a 17.7dB peak) than the second peak (which was near 3200Hz, with a 11.4dB peak). Table 6.22 summarizes the means and standard deviations for the frequencies of the two spectral peaks (in Hz) for the voiceless lateral fricative [ɬ].

**Table 6.22** Means and standard deviations for the frequencies of the two spectral peaks (in Hz) for the voiceless lateral fricative [ɬ].

| Consonant | *N* | *Peak 1* | *SD* | *SE* | *Peak 2* | *SD* | *SE* |
|---|---|---|---|---|---|---|---|
| [ɬ] | 30 | 2093.88 | 224.37 | 40.97 | 3479.36 | 542.63 | 100.76 |

Cross-linguistic evidence showed that [ɬ] and [ʃ] ‹š› have similar Center of Gravity (Gordon et al. 2002; Hargus et al. 2020). Table 6.23 summarizes the means and standard deviations for the spectral moment measurements (CoG, Kurtosis, Skew, and Variance) for [ɬ] (compared with [ʃ] ‹š›). As Table 6.23 summarizes, Kurtosis and Skew was much lower for [ɬ] than [ʃ] ‹š›. Moreover, Variance was much greater for [ɬ] than [ʃ] ‹š›, which suggests that these three measurements differentiated [ɬ] from [ʃ] ‹š› from time-averaged spectrums.

**Table 6.23** Means and standard deviations for measurements of spectral moments (CoG, Kurtosis, Skew, and Variance) from time-averaged spectrums for [ɬ] and [ʃ].

| Consonant | *N* | *CoG* (in Hz) | *SD* | *Kurtosis* | *SD* | *Skew* | *SD* | *Variance* | *SD* |
|---|---|---|---|---|---|---|---|---|---|
| [ɬ] | 37 | 1984.28 | 611.68 | 31.75 | 18.72 | 4.80 | 1.30 | 2589.39 | 845.66 |
| [ʃ] ‹š› | 10 | 2093.46 | 271.45 | 352.8 | 256.29 | 13.77 | 6.05 | 805.67 | 471.43 |

### 6.4.3 *Dorsal fricatives*

In this section, I analyze the dorsal fricatives /xʷ/, /χ/ ‹x̌›, and /χʷ/ ‹x̌ʷ› in Lushootseed. I compare the plain uvular fricative /χ/ ‹x̌› with the labio-uvular fricative /χʷ/ ‹x̌ʷ›. It was claimed that /xʷ/ is a voiceless labio-glottal fricative /hʷ/ in Lushootseed (Zahir 2019 and personal communication). For this reason, I compare the spectral properties of word-initial /xʷ/ with /h/ when followed by the close back rounded vowel /u/ (as in /hu/).

#### 6.4.3.1 Plain uvular vs. labio-uvular fricatives

Figure 6.26 illustrates the power spectrums for the plain uvular fricative [χ] ‹x̌› and the labio-uvular fricative [χʷ] ‹x̌ʷ›.

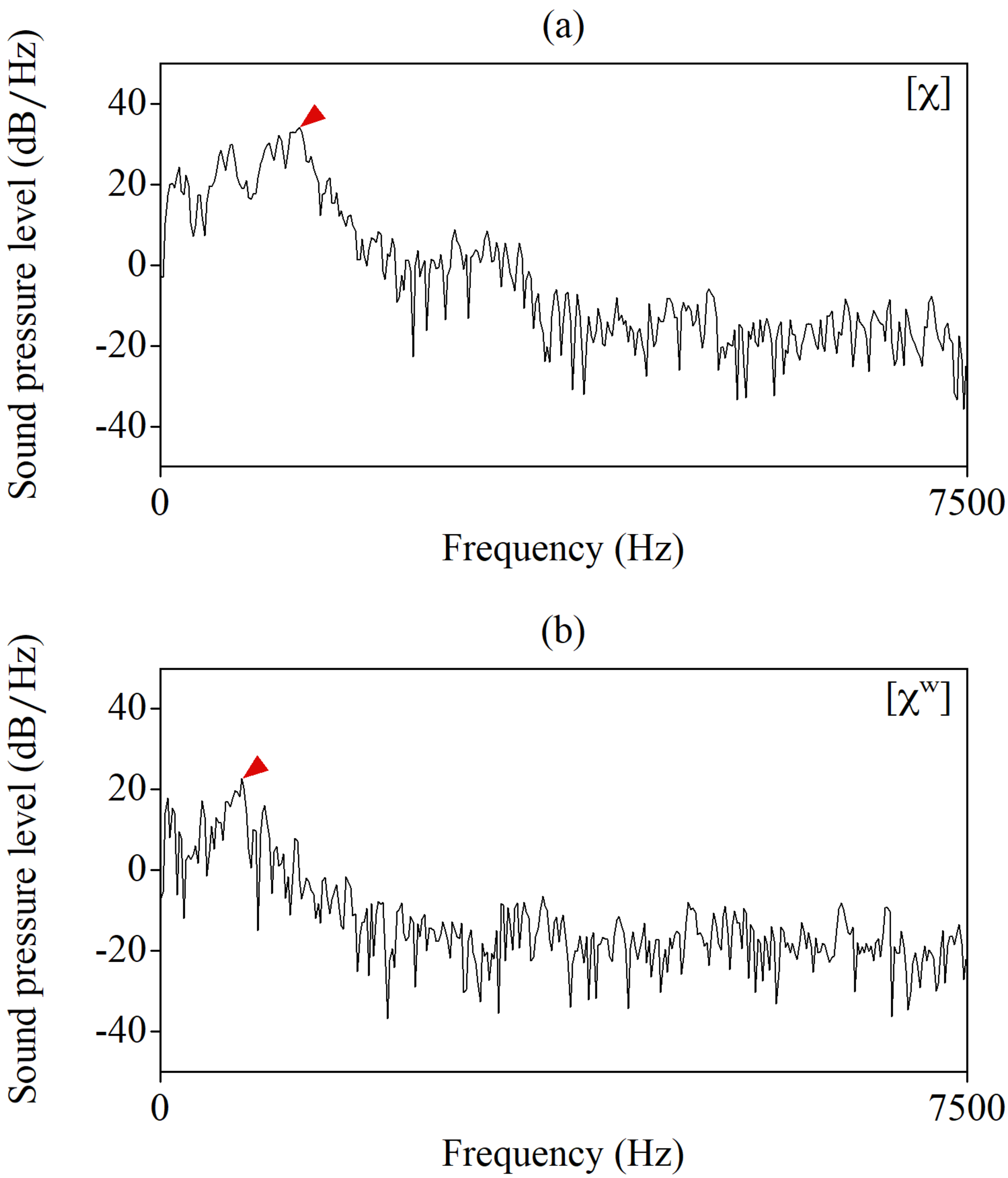



**Figure 6.26** FFT power spectrum for (a) voiceless uvular fricative [χ] ‹x̌›, and (b) voiceless labio-uvular fricative [χʷ] ‹x̌ʷ›.

The spectral peaks for uvular fricatives occurred at a lower frequency than the other non-dorsal fricatives in Lushootseed. In Figure 6.26, the spectral peak for the voiceless uvular fricative [χ] ‹x̌› occurred at a slightly higher frequency (at 1271.85Hz) than the voiceless labio-uvular fricative [$\chi^w$] ‹x̌ʷ› (at 746.97Hz). This suggests that the acoustic coupling of lip rounding with a constriction near the back cavity further lowers the frequency of the spectral peak in the transfer function of the speech signal. Table 6.24 summarizes the means and standard deviations for the frequencies of the spectral peaks for the voiceless uvular fricative [χ] ‹x̌› and the voiceless labio-uvular fricative [$\chi^w$] ‹x̌ʷ› from the current data.

**Table 6.24** Means and standard deviations for the frequencies of the spectral peaks (in Hz) for [χ] ‹x̌› and [$\chi^w$] ‹x̌ʷ›.

| Consonant | *N* | *Peaks* (in Hz) | *SD* | *SE* |
|---|---|---|---|---|
| [χ] ‹x̌› | 13 | 1321.26 | 148.02 | 41.05 |
| [$\chi^w$] ‹x̌ʷ› | 6 | 780.18 | 41.92 | 17.12 |

As Table 6.24 summarizes, the average frequency of the spectral peak for the voiceless labio-uvular fricative [$\chi^w$] ‹x̌ʷ› was 541.08Hz lower than the average frequency of the spectral peak for the voiceless uvular fricative [χ] ‹x̌›.

Table 6.25 summarizes the means and standard deviations for measurements of spectral moments (CoG, Kurtosis, Skew, and Variance) for the voiceless uvular fricative [χ] ‹x̌› and the voiceless labio-uvular fricative [$\chi^w$] ‹x̌ʷ›. As summarized in Table 6.25, the average CoG frequency (in Hz) for the voiceless labio-uvular fricative [$\chi^w$] ‹x̌ʷ› was 339.76Hz lower than the average CoG frequency (in Hz) for the voiceless uvular friactive [χ] ‹x̌›. This suggests that labialized dorsal fricatives (on average) have a spectral peak at a lower frequency range than plain dorsal fricatives.

**Table 6.25** Means and standard deviations for spectral moment measurements (CoG, Kurtosis, Skew, and Variance) from time-averaged spectrums for [χ] ‹x̌› and [$\chi^w$] ‹x̌ʷ›.

| Consonant | *N* | *CoG* (in Hz) | *SD* | *Kurtosis* | *SD* | *Skew* | *SD* | *Variance* | *SD* |
|---|---|---|---|---|---|---|---|---|---|
| [χ] ‹x̌› | 13 | 1236.2 | 193.12 | 177.42 | 89.18 | 10.99 | 2.46 | 1133.76 | 356.29 |
| [$\chi^w$] ‹x̌ʷ› | 6 | 938.83 | 251.93 | 150.998 | 180.32 | 10.47 | 5.52 | 1688.87 | 664.36 |

An ANOVA was used to test the main effect of Consonant Type (i.e., [χ] ‹x̌› vs [$\chi^w$] ‹x̌ʷ›) on the five measurements (i.e., Spectral peak (in Hz), CoG, Kurtosis, Skew, and Variance). There was a main effect of Consonant Type on Spectral peak, $F(1, 22) = 69.18$, $^{***}p<.001$, $\eta^2 = .8$, Center of Gravity (CoG), $F(1, 22) = 10.62$, $^{**}p = .003$, $\eta^2 = .33$, and Variance, $F(1, 22) = 7.18$, $^{*}p = .014$, $\eta^2 = .25$. However, there was no main effect of Consonant Type on Kurtosis and Skew, which suggests that the fricatives [χ] ‹x̌› and [$\chi^w$] ‹$\check{x}^w$› were not distinguished by these two measurements.

#### 6.4.3.2 Labio-velar vs. glottal fricative

As mentioned above, it was previously suggested that ‹$x^w$› is a voiceless labio-glottal fricative /$h^w$/ in Lushootseed (Zahir 2019 and personal communication). To determine whether ‹$x^w$› is a voiceless labio-glottal fricative, word-initial ‹$x^w$› was compared with the closest (matching) equivalent of this form for the voiceless glottal fricative /h/, where /h/ was followed by a close back rounded vowel /u/. If the statement is true, that ‹$x^w$› is a voiceless labio-glottal fricative /$h^w$/, then word-initial ‹$x^w$› should show similar spectral properties as the voiceless glottal fricative /h/ when followed by the close back rounded vowel /u/ because of the coarticulatory rounding that is induced from /u/ on the preceding voiceless glottal fricative /h/. Figure 6.27 compares the two power spectrums for /h/ (followed by /u/) and ‹$x^w$›.

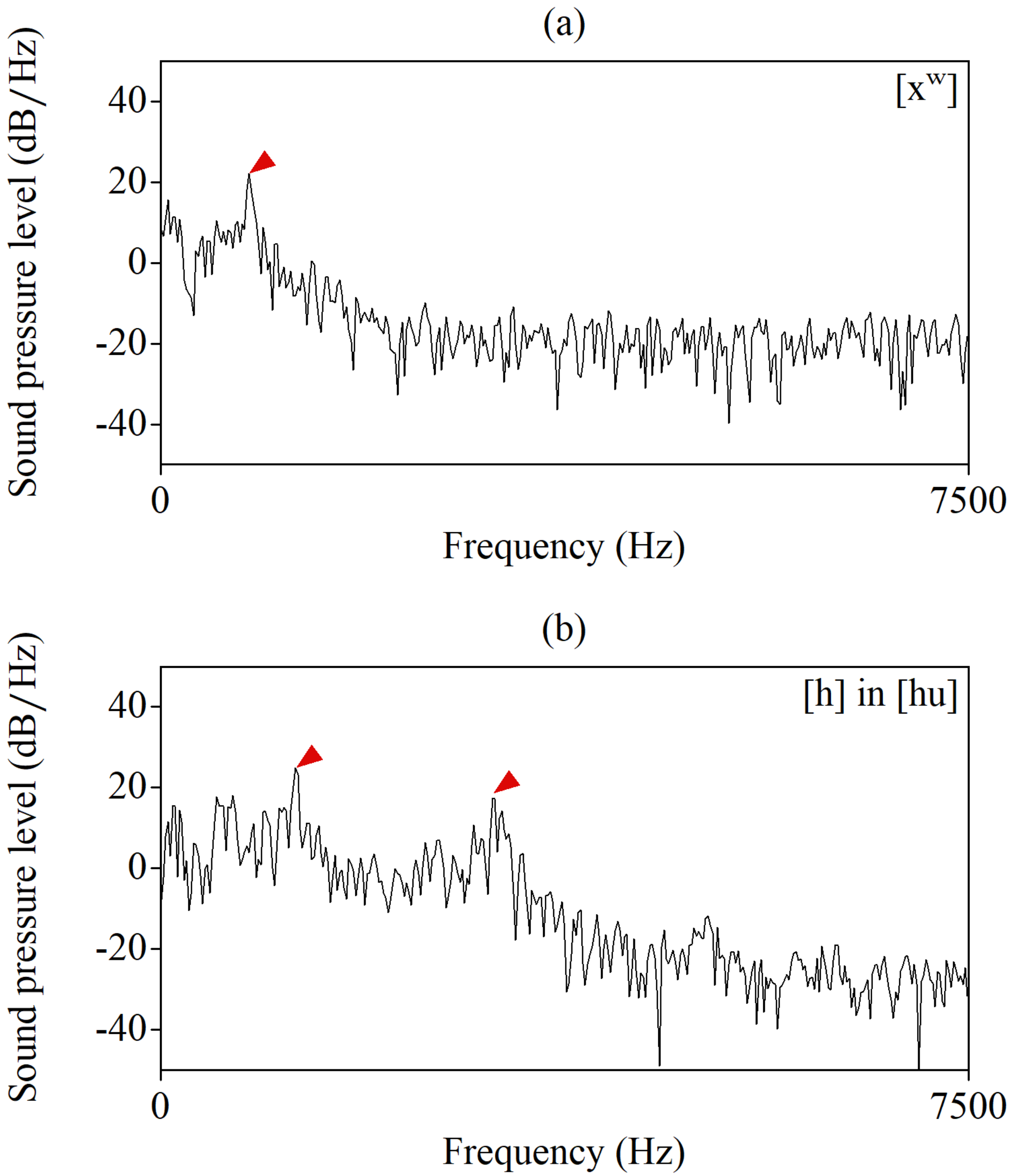



**Figure 6.27** Power spectrum for (a) ‹x$^w$›, and (b) /h/ followed by /u/.

As Figure 6.27 illustrates, there were additional formant peaks along the upper frequency range for the voiceless glottal fricative /h/ when followed by /u/, which was not present in ‹x$^w$›. The reason for this is because glottal fricatives involve acoustic coupling of the front and back cavities of the vocal tract, which yields vowel-like spacing between formants. The filter function of the vocal tract allows [h] to have formant values that closely approximates with the upper formant structures of the following vowel. The first peak in Figure 6.27b closely approximates with the second formant of the following vowel /u/, while the second peak closely approximates with F3 of the following vowel /u/. However, this was not present in ‹xʷ›, which does not show evidence of upper formant structures from the resonating cavities that is formed in anticipation of the following vowel. This suggests that ‹xʷ› was more likely realized as a voiceless labiovelar fricative [xʷ] as opposed to a voiceless labio-glottal fricative [hʷ]. The spectral peak of [xʷ] in Figure 6.27a was estimated at approximately 823Hz, whereas the first peak of /h/ in Figure 6.27b was estimated at approximately 1251Hz. The center of gravity measure for [xʷ] was near 757Hz, whereas the center of gravity measure for /h/ (in /hu/) was near 1239Hz. Because the spectral peak for [xʷ] occurred at a lower frequency than /h/ in /hu/, this suggests that these fricatives must have involved a constriction near the back cavity that was coupled together with lip rounding. In other words, these consonants are most likely produced as a voiceless labiovelar fricative [xʷ] and not a voiceless labio-glottal fricative [hʷ].

## 6.5 SOME NOTES AND OBSERVATIONS ON OBSTRUENT CLUSTERS IN LUSHOOTSEED

Like other Salish languages, Lushootseed is known not only for its large inventory of obstruents, but also the clustering of these obstruents. There are several types of obstruent clusters in Lushootseed. These include stop-fricative and fricative-stop clusters, fricative-fricative clusters, fricative-affricate clusters, as well as a clustering between stop consonants. It should be noted that stop-fricative clusters are not affricates because the gesture of the stop component is not homorganic with the following fricative. In such instances, the two consonants in the stop-fricative cluster involve two distinct places of articulation. This can be observed in the beginning of the word /dxʷʔal/ ‘to’, as well as the prefixes and suffixes /dxʷ-/ ‘permeate’ and /-dxʷ/ LTR respectively.

The initial voiced alveolar stop in the cluster /dxʷ/ is devoiced, which could narrowly be transcribed as [d̥xʷ]. This could be observed in the waveform and spectrogram in Figure 6.28, where the underlying /d/ in the word /dxʷt͡s’agʷusəbs/ ‹dxʷc̓agʷusəbs› ‘he washed his own face’ was voiceless throughout the closure.

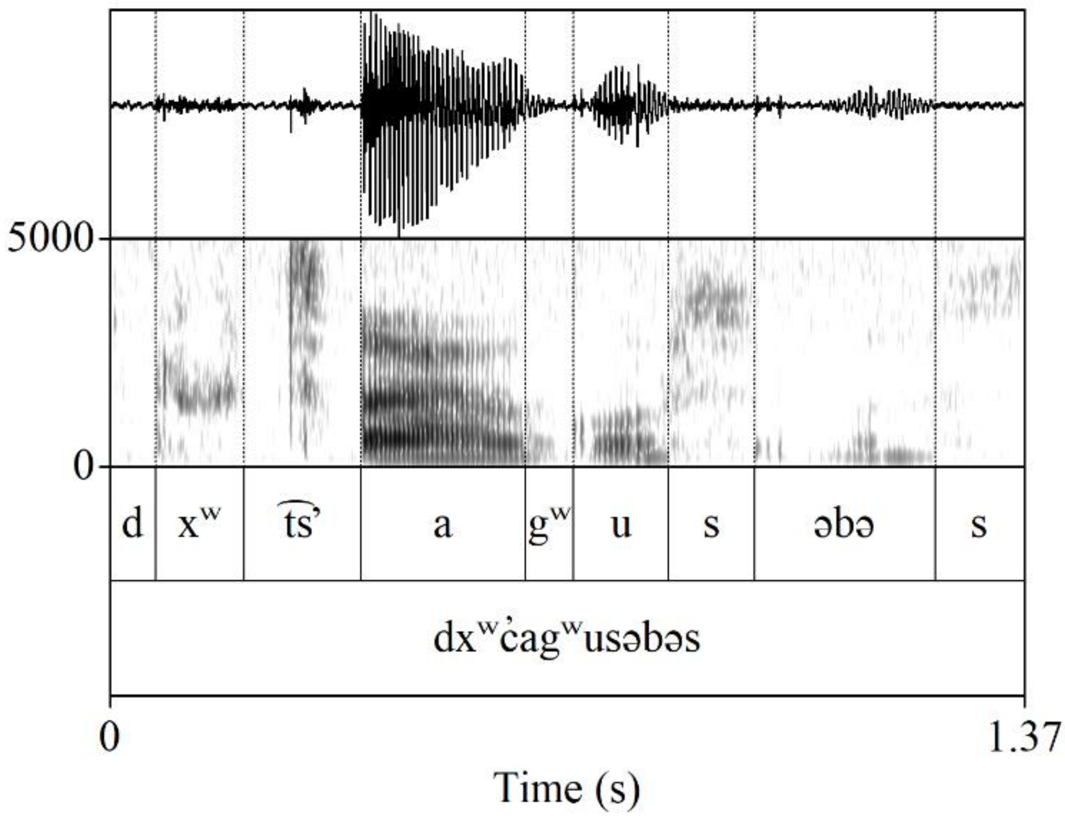



**Figure 6.28** Waveform and spectrogram of the word /dxʷt͡s’agʷusəbs/ ‹dxʷc̓agʷusəbs› ‘he washed his own face’.

Fricative-fricative clusters can be formed on either the onset of a syllable (e.g., /sχʷ/ ‹sx̌ʷ› in /sχʷud/ ‹sx̌ʷud› ‘word’), the coda of a syllable (e.g., /ʃs/ ‹šs› in /tut͡ʃəgʷəʃs/ ‹tučəgʷəšs› ‘his deceased wife’), or across a syllable boundary (e.g., /s.ɬ/ in /ʔəs.ɬaɬlil/ ‘there lived…’). It is possible to observe a cluster between two sibilants with distinct places of articulation in the same syllable position, where the voiceless post-alveolar fricative [ʃ] ‹š› is followed by the voiceless alveolar fricative [s] at the end of the word-form /tut͡ʃəgʷəʃs/ ‹tučəgʷəšs› ‘his deceased wife’. This is illustrated in the waveform and spectrogram in Figure 6.29, where the voiceless post-alveolar fricative [ʃ] ‹š› immediately transitions into the alveolar gesture for [s] in the word-form /tut͡ʃəgʷəʃs/ ‹tučəgʷəšs› ‘his deceased wife’.

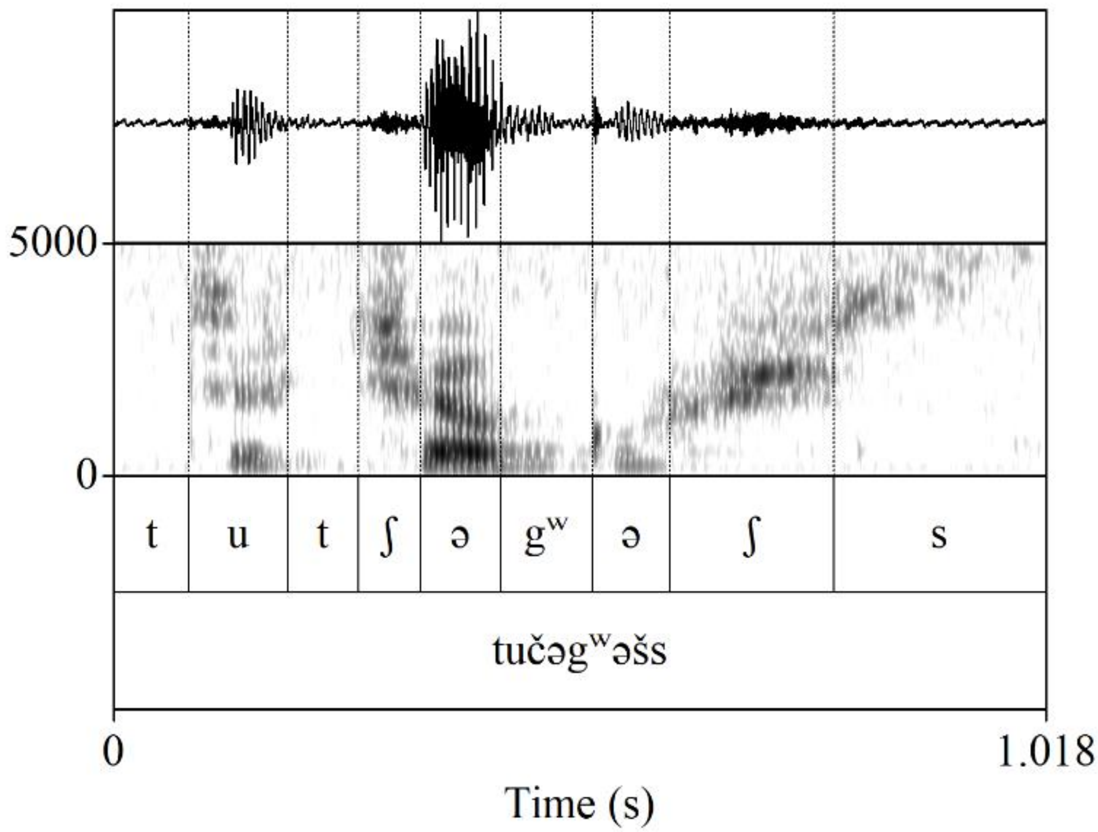



**Figure 6.29** Waveform and spectrogram for the word-form /tutʃəgʷəʃs/ ‹tučəgʷəšs› ‘his deceased wife’.

Another fricative-fricative cluster that can be observed in Lushootseed is [sɬ] clusters. Figure 6.30 is a waveform and spectrogram illustrating the cluster [sɬ] in the word /sɬadaj/ ‹sładaỷ› ‘lady/woman’.

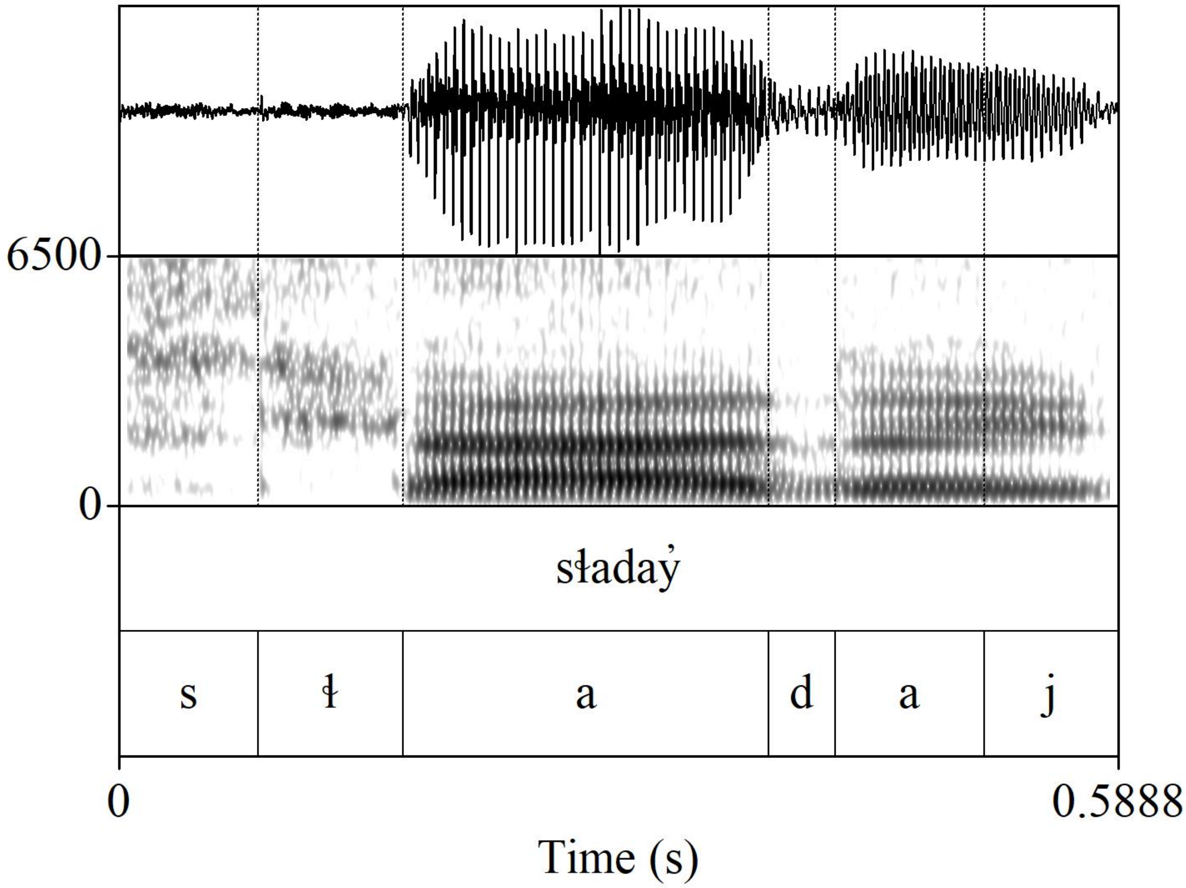



**Figure 6.30** Waveform and spectrogram for the word-form /sładaj/ ‹sładaỷ› ‘lady/woman’.

As Figure 6.30 illustrates, there are mid-frequency bands for [s] that is approximately in the same range as the mid-frequency band for [ɬ], which indicates that there was consonant-to-consonant coarticulation on [s] when followed by [ɬ].

The clustering of stop consonants never occupies a fixed position (e.g., onset or coda) in a syllable. For example, a cluster between the two stops [qq] cannot be restricted to either the onset or coda of a syllable. Rather, the first stop in the cluster [q] forms the underlying onset and the second stop in the cluster [q] forms either the underlying coda or the onset of the following syllable. In these forms, there is an underlying schwa /ə/ that forms the nucleus. The schwa is deleted (via syncope) when stress is placed on the syllable of the following morpheme. This forms the cluster between stop consonants in words such as /qə~qaʔ/ [qʰqaʔ] ‘few’, which can morphologically be decomposed into the root /qaʔ/ ‘a lot’ and the diminutive reduplicant /qə~/. Note that in [qʰqaʔ] ‘few’, the schwa in the reduplicant syllable /qə~/ is deleted via syncope when combined with (and when stress is placed on) the following root /qaʔ/. The initial stop [qʰ] in the cluster is released and is followed by a brief period of aspiration following the transient burst. This is subsequently followed by the duration of the stop closure for the voiceless uvular stop /q/ in the cluster. This can be observed in the waveform and spectrogram for the word [qʰqaʔ] ‘few’ in Figure 6.31.

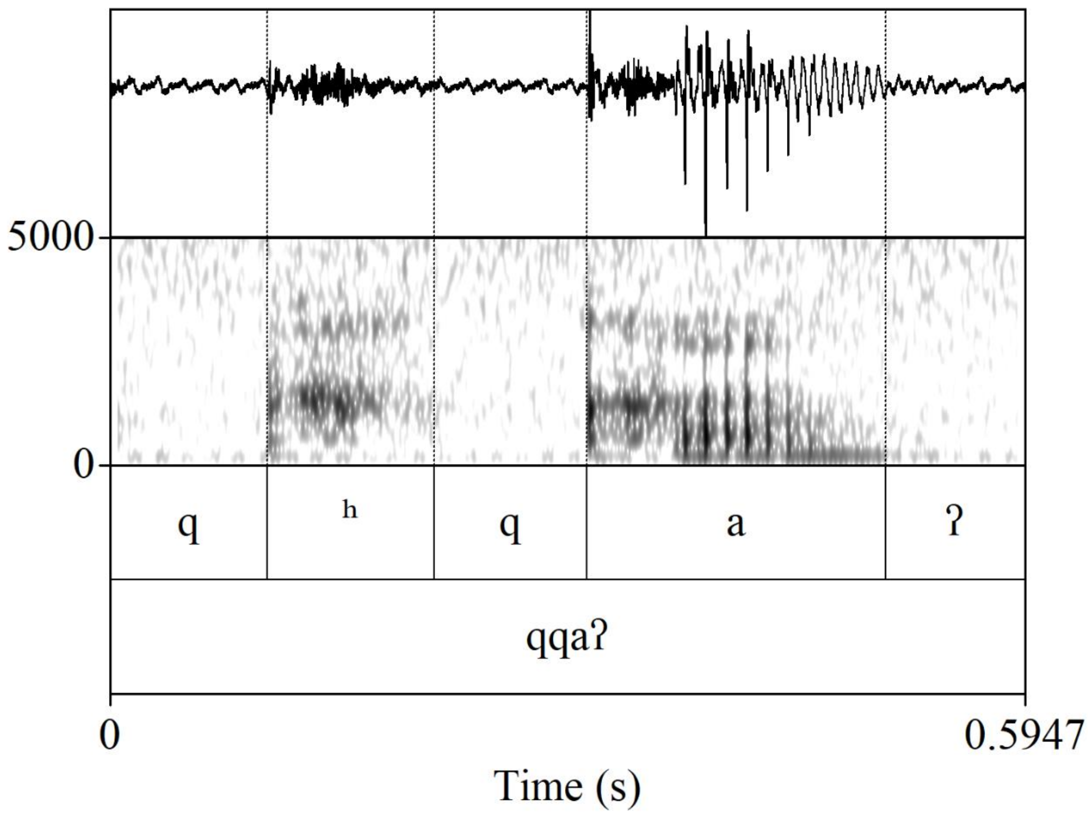



**Figure 6.31** Waveform and spectrogram of the word /qəqaʔ/ ‘few’ realized as [qʰqaʔ].

As Figure 6.31 illustrates, there is a brief period of aspiration following the burst release from the alveolar closure for the first voiceless uvular stop [qʰ]. This is followed by the closure duration of the second voiceless uvular stop [q], which is then subsequently released into the following vowel. This suggests that, although the form [qʰq] is underlyingly syllabic (with an underlying nuclear schwa /ə/), the nuclear schwa was not produced at the phonetic level, suggesting that it was deleted.

This is evidence of a surface cluster (not an underlying cluster) that is formed on the word-form. The aspiration of the initial uvular stop [$q^h$] in the cluster may have been used to enhance the perceptibility of voicelessness of the initial [$q^h$] itself. This is also observed in Montana Salish (Flemming et al. 2007), where the aspiration of stops in clusters "aids considerably in maintaining the perceptibility of all the consonants in a cluster" (Flemming et al. 2007:472-473).

There was also evidence of a clustering between ejective stops in Lushootseed. Evidence of this comes from patterns of reduplication. For example, when the distributive reduplicant CVC+ is used in the word /st'ək$^w$'əb/ 'stick', it forms the word-form /st'ək$^w$'t'ək$^w$'əb/ 'sticks'. However, from the current data, this word-form also involved the deletion (via syncope) of the nuclear schwa in the root syllable (i.e., the bolded **/t'ək$^w$'/** in /st'ək$^w$'**t'ək$^w$'**əb/), realizing /st'ək$^w$'t'ək$^w$'əb/ 'sticks' as [stək$^w$t'k$^w$'əb] (it is also worth noting that the initial ejective alveolar stop /t'/ and the syllable-final ejective labiovelar stop /k$^w$'/ in the reduplicant syllable becomes deglottalized into [t] and [k$^w$] respectively, which is the first syllable of the word-form). This can be observed in the waveform and spectrogram in Figure 6.32, which illustrates the clustering of the medial stops [t'k$^w$'] in [stək$^w$t'k$^w$'əb]. It is possible that each ejective in the cluster [t'k$^w$'] in Figure 6.32 was produced by varying the height of the larynx. As the waveform of the ejective clusters showed, there was a slightly lower amplitude of the burst release for the ejective alveolar stop [t'] than the following ejective labio-velar stop [k$^w$']. It was possible that, although the larynx was raised in the production of both ejectives, the larynx was raised at a slightly lower height for the ejective alveolar stop [t'] than the ejective labio-velar stop [k$^w$'], which would cause a lower intraoral pressure behind the alveolar closure than behind the labio-velar closure (hence, causing a lower amplitude of the burst release for [t'] than [k$^w$']). Once the ejective alveolar stop was released, the larynx raised even higher in the production of the ejective labio-velar stop [k$^{w}$’], making it a quick and easy transition from [t’] to [k$^{w}$’].

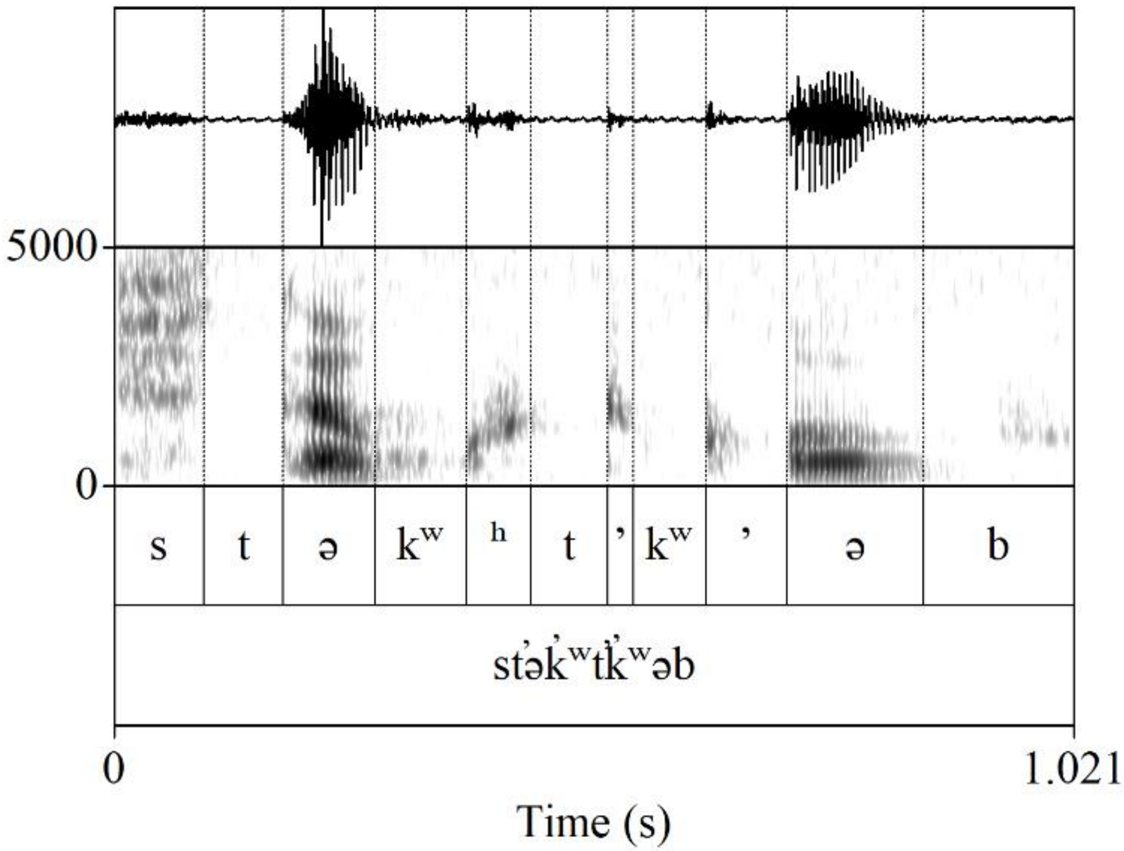



**Figure 6.32** Waveform and spectrogram of the word-form /st’ək$^{w}$’t’ək$^{w}$’əb/ ‘sticks’, which was realized as [stək$^{w}$t’k$^{w}$’əb].

As Figure 6.32 illustrates, the syllable-final labiovelar ejective /k$^{w}$’/ in the reduplicant syllable (i.e., first syllable) became deglottalized to [k$^{w}$]. This is evident from the brief period of aspiration following the burst release. This suggests that deglottalization can occur on the reduplicant syllable, which is consistent with the observations made by Thompson & Thompson (1985) on deglottalization of ejectives in reduplicated stems in other Salish languages. However, the root syllable (which involved the deletion of the nuclear schwa /ə/) involved the surface clustering between the ejective alveolar stop /t’/ and the ejective labiovelar stop /k$^{w}$’/, where both stops were released as glottalic egressive. This suggests that ejectives can be clustered in those positions at the surface level.

## 6.6 DISCUSSION

In this chapter, I conducted the first acoustic analysis of obstruents in Lushootseed. There are several important implications of the findings. In Section 6.6.1, I discuss the implications of the findings on the Lindau (1984) and Kingston (1985, 2005) model of ejectives. In Section 6.6.2, I address some of the misconceptions on the realization of obstruents in Lushootseed. In Section 6.6.3, I discuss the analysis and limitations of obtaining acoustic measurements from these recordings.

### 6.6.1 *Implications on ejective typology*

The following patterns for ejective stops can be observed from this speaker: (i) long (though variable) VOT (like stiff ejectives), (ii) depressed f0 perturbation (like slack ejectives), and (iii) creaky voiced onset (like slack ejectives). The intensity difference for ejective stops are approximately the same as voiceless stops, while voiced stops had a slighter greater intensity difference than voiceless and ejective stops. On the other hand, ejective affricates showed greater intensity difference than voiced affricates, followed by voiceless affricates (i.e., Ejective > Voiced > Voiceless). Given this variability, the Lindau (1984) and Kingston (1985) model doesn't seem to work for Lushootseed. However, some aspects of the Lindau and Kingston model are supported by the data. Some of the characteristics of Lushootseed ejectives (such as depressed f0 perturbation and creaky voiced onset) suggest that this sound is a slack ejective. However, there were many instances where the VOT and voice onset quality (with respect to intensity difference) of ejective stops showed comparable patterns with the VOT and voice onset quality of voiceless pulmonic stops, which suggests that there was considerable variability in the realization of ejectives. This suggests that the typology cannot predict the variation observed in Lushootseed ejectives.

The typology is based on widely held assumptions about vocal fold tension and compression. As Wright et al. (2002:70–71) states, these assumptions may underestimate the complexities of laryngeal muscular adjustments, as well as timing relationships in the production of ejectives. An increase in f0 is primarily manipulated by the lengthening of the vocal folds (Stevens 2000). Vocal fold lengthening is achieved mainly by stretching the vocal folds. The vocal folds are stretched (via longitudinal tension) through contraction of the cricothyroid (CT) muscle, which is responsible for the rocking and horizontal translation of the thyroid cartilage in relation to the cricoid cartilage. The rocking and translation motion of the thyroid cartilage lengthens and stretches the vocal folds. An increase in medial compression accompanies the stiffness of the vocal folds. The muscles that cause adduction to the vocal folds and applies medial compression are the interarytenoid (IA), thyroarytenoid (TA), and lateral cricoarytenoid (LCA) muscles.

Contrary to the assumptions in Lindau's and Kingston's model, there may be strong medial compression due to constriction of the adductor muscles (IA, TA, and LCA) in the absence of longitudinal tension. This would inhibit voicing, which results in a long VOT that is accompanied by depressed f0 and creaky voiced onset (Wright et al. 2002:71). Because f0 perturbation was depressed, the longitudinal tension (CT) of the vocal folds must have decreased prior to the relaxation of medial compression (IA, TA, and LCA). Moreover, the decrease in longitudinal tension (CT) may vary at differing degrees in the production of ejectives. There may also have been differing degrees of larynx raising and medial compression. These would account for the variability observed in the data.

The intensity difference for ejective affricates was greater than voiced and voiceless affricates. The reduced amplitude at voice onset occurs because a constricted glottis (when generating creaky voicing) generally reduces the amplitude itself (Keating et al. 2015). This is because the pressure below the glottis decreases in response to the decrease in abducting forces (Stevens 1999). There is also a reduced intraoral pressure during creaky phonation (Ingram & Rigsby 1987). Because creaky phonation is generated with reduced longitudinal tension and increased medial compression (a result of this is a lower f0), the spectral peak (peak amplitude) is much smaller at lower frequencies than modal phonation. The greater intensity difference for ejective affricates is likely to be a consequence of manipulating the adductor muscles (IA, TA, LCA) to produce creaky voicing (see Chapter 9 and Keating et al. 2015 for more details on the physiology and acoustics of creaky voicing). However, this was not observed for ejective stops, where the intensity difference was comparable with voiceless stops. This suggests that there may have been different types of creaky voicing (types that involve a subglottal pressure that was not reduced in response to the drop in abducting forces) at the vowel onset for ejective stops.

It is possible that stiff and slack ejectives are two extreme endpoints that fall along a continuum of varying realizations for ejectives. Due to the variability in the data, the ejectives observed in this study can fall anywhere along this continuum from most stiff to least stiff and from most slack to least slack. Because Lushootseed ejectives showed instances of both short VOT and long VOT, this suggests that VOT types are not strictly exclusive features that distinguishes ejectives in Lushootseed. This also holds for voice onset quality. The view that stiff and slack ejectives are two extreme endpoints that fall along a continuum of varying realizations of ejectives have also been noted by Hajek & Stevens (2005) in their study on ejective stops in Waima’a.

It should be noted that the data comes from recordings of connected (spontaneous) speech. The variability that was observed may have been due to changes in the rate of speech, as well as the use of different styles and registers in traditional Salish narratives. This study has the advantage of working with data from natural connected (spontaneous) speech, which is the natural output of everyday communication. A problem with previous accounts on the realization of ejectives is that data from other languages primarily focused on words produced in a wordlist. The current findings suggest the possibility that ejectives have more variable realization in natural connected speech than citation (wordlist) form. Future research may require a comparison between ejectives produced from a wordlist and ejectives produced from connected (spontaneous) speech, especially in languages with living speakers.

This study worked with only one speaker, which is a severe limitation. The results are questionable because the effects that were observed come from only one speaker. It is possible that these patterns reflect the idiolect of the speaker. Whether this effect was unique to the Southern dialect cannot be addressed by examining only one speaker. More speakers need to be examined to test whether these effects are observable for more than one speaker. According to Percival (2019), the VOT of ejectives were longer in word-initial position than word-medial position. Moreover, the duration of the release burst for ejectives were the greatest in word-final position, suggesting that the realization of ejectives can vary in different positions of a word. More stops with different places of articulation, as well as stops in different positions of a word, need to be examined to observe these effects.

### 6.6.2 *Addressing misconceptions on the realization of obstruents in Lushootseed*

There were a few misconceptions concerning the underlying representation of some of these obstruents. For example, it was suggested that the voiced stops /b d/ are implosives in Lushootseed

(Cun Xi 2009, Maddieson 2008). However, the current findings showed that these voiced stops are in fact pulmonic, which is evident based on the steady decrease in amplitude of the voicing component of the stop as it reaches the burst release. Another example includes the representation of ‹x$^{w}$› in Lushootseed, which is claimed to be a voiceless labio-glottal fricative */h$^{w}$/ (Zahir 2019 and personal communication). However, as the current findings show, there are no upper formant structures in the production of ‹x$^{w}$› when compared with /h/ preceding /u/, suggesting that ‹x$^{w}$› is most likely produced as a voiceless labio-velar fricative /x$^{w}$/ as opposed to a voiceless labio-glottal fricative */h$^{w}$/.

### 6.6.3 *Implications on the analysis and limitations of obtaining acoustic measurements from archival recordings*

It was difficult to obtain reliable measurements of Center of Gravity (CoG) for affricates and fricatives (in particular, for alveolars [ts] and [s]). This was most likely due to the upper frequency cutoff from the microphone signal during the time of recording. As mentioned in Chapter 2, the type and brand of microphone Metcalf used to record these speakers is unknown and this information is lost. Upon analyzing the acoustics of these recordings, I was able to find an upper frequency cutoff (near 5~7kHz) from each of these recordings, which was probably the upper frequency limit of the microphone that Metcalf used to record these speakers. This made it difficult to measure CoG for the alveolar place of articulation for affricates and fricatives, which normally reaches their peak well-above 7kHz (Shadle & Scully 1995; Shadle 1985; Koenig et al. 2013).

Despite these difficulties, it is still possible to obtain *relative* differences in CoG across affricate and fricative places of articulation. The method that reliably measured these relative differences was *Time-averaging* (Shadle 2012, 2023). When compared to Praat’s default setting for measuring CoG, *Time-averaging* allows relative differences to be obtained, where the alveolar place of articulation had a greater CoG than post-alveolar and lateral, post-alveolar and lateral greater than labio-velar and uvular, etc…. Praat's default setting for measuring CoG could not capture these relative differences when obtaining spectral moments from a single time point (i.e., the midpoint). Table 6.26 summarizes the CoG for [s] and [ʃ] from two different methods of calculating CoG: The Praat default measure (extracted from the midpoint) and time-averaging. As Table 6.26 summarizes, despite the CoG being considerably low for [s] under both methods (far lower than the expected CoG for [s], which is between 5~8kHz (Gordon et al. 2002; Munson 2001; Forrest et al. 1988)), relative (and expected) differences can nevertheless be obtained from the time-averaging method (and not the Praat Default method), where the CoG for [s] is greater than [ʃ]. This suggests that the method of time-averaging is far more accurate in measuring spectral moments for these recordings.

**Table 6.26** Center of Gravity for the [s] and [ʃ] compared between two methods: Praat Default (measured at midpoint) and Time-averaging.

| | | *Praat default (midpoint)* | | *Time-averaging* | |
|---|---|---|---|---|---|
| Cons. | *N* | *CoG* (in Hz) | *SD* | *CoG* (in Hz) | *SD* |
| [s] | 45 | 1662.38 | 339.77 | 2769.45 | 948.82 |
| [ʃ] ‹š› | 10 | 2054.22 | 251.29 | 2093.46 | 271.45 |

## 6.7 Conclusion

In this chapter, I analyzed the acoustic properties of obstruents in Lushootseed. The goal of this chapter was to characterize the acoustic correlates of Lushootseed obstruents. There were several observations that were made in this chapter. In Section 6.3.1, the VOT of voiceless stops indicates that they are slightly aspirated (neither unaspirated nor aspirated). Moreover, the findings also suggest that only voiced stops with a more anterior closure (i.e., /b d/) are fully voiced during the articulatory closure in word-initial position (when preceded by a pause), which was not observed for voiced velar or labiovelar place of articulation. Another key finding was that ejectives showed long (but variable) VOT, depressed f0 perturbation, and creaky voiced onset. This suggests that the data does not fit the Lindau (1984) and Kingston (1985, 2005) model for ejectives. Section 6.3.2 provides a key finding for the acoustic properties of affricates in Lushootseed, where the intensity of the release frication for voiced affricates increases at the end of the frication duration as it transitions into the following vowel. On the other hand, the intensity decreases as it transitions into the period of silence before the following vowel for ejective affricates. For voiceless affricates, the intensity of the release frication was in-between (slightly increases). Section 6.4 covered the acoustic properties of fricatives in Lushootseed. There were some problems with measuring CoG for [s] and [ts], where there was an upper frequency cutoff above 5~7kHz in the microphone signal. This obscured measures of the spectral peak for [s] and [ts], which tend to reach their peak amplitude near 8kHz (or above 7kHz) (Shadle & Scully 1995; Shadle 1985; Koenig et al. 2013). However, relative differences could be obtained using time-averaging (Shadle 2012, 2023). Obstruent clusters showed some unique coarticulatory properties (such as the effect of [ɬ] on a preceding [s]), as well as some position variants (such as the deglottalization of ejectives in reduplicant syllables). Although obstruent clusters have been analyzed in some detail, a characterization of the phonotactic constraints has not been fully conducted. It is possible to conduct an analysis on the phonotactic constraints of obstruent clusters. However, more data from recordings (and data from primary sources) need to be analyzed to characterize the phonotactic constraints of obstruent clusters.

# Chapter 7. EFFECTS OF UVULAR CONSONANTS ON VOWEL QUALITY IN LUSHOOTSEED

## 7.1 INTRODUCTION

The main research question is how faucal consonants interact with vowel quality in Coast Salish. A secondary purpose of this study is to examine the acoustic characteristics of vowels in Lushootseed. The term "faucal" is used for uvular and pharyngeal consonants in Salish linguistics. The effects of faucal consonants on vowel quality have been studied widely in the phonology literature for Interior Salish languages (Reichard 1938, Kinkade 1967). Acoustic evidence shows that faucal consonants affect adjacent vowels by increasing the frequencies of the first formant and decreasing the frequencies of the second formant (Bessell 1998, Flemming et al. 2008). In Flemming et al., uvular consonants have a greater effect on schwas than other vowels in Montana Salish. According to Bessell (1992, 1998), uvular consonants have a greater effect on lowering F2 than increasing F1 in Coeur d'Alene. Bessell (1992) stated also that the articulatory target for uvular consonants is the same as pharyngeals.

Similar observations have been made for Semitic languages. According to McCarthy (1991), guttural (includes laryngeal, uvular and pharyngeal) consonants lower the adjacent vowel. It has also been shown that in Iraqi Arabic, not only is an increase in F1 and a decrease in F2 observed for adjacent vowels, but F1 and F2 converge to a common locus (Alwan 1986, Ghazeli 1977, Zawaydeh 1999). Delattre (1971) observes that in Lebanese Arabic, the articulatory target for uvular consonants is the same as the target for pharyngeal consonants, differing only by the degree of constriction.

A problem for studying the phonetics of Salish languages in general, and Coast Salish languages in particular, is a lack of acoustic data. Phonologists in the past have sought to characterize the sound patterns of these languages. However, they do not have acoustic evidence to support their observations. The last study that examined the acoustic properties of Lushootseed was Barthmaier (1998), who investigated the pattern of stress and timing in Lushootseed. In this study, Barthmaier examined the role of vowel reduction in either stressed or unstressed syllables by examining formants. However, Barthmaier did not report (a) a summary or statistical tests on the data, or (b) the coarticulatory events that could affect the formant estimates from the data. Although acoustic studies have been conducted for Interior Salish languages, only a few have been conducted for Coast Salish languages. The purpose of this chapter is to contribute acoustic data for Lushootseed with a special focus on the interaction of uvular consonants and adjacent vowels. This study examines the effects of uvular consonants on F1 and F2 formants of adjacent vowels. This study predicts that uvular consonants will affect adjacent vowels by increasing F1 and decreasing F2 both pre- and post-vocalically.

## 7.2 METHODS

### 7.2.1 *Speaker and recordings*

The speaker who was examined was Annie Jack Daniels. Five of the recordings from the Metcalf collection was examined. These recordings have a combined length of approximately 44 minutes. These were recordings of traditional Salish myths.

### 7.2.2 *Sampling procedure*

Each of the vowels was selected for either its uvular or nonuvular environment. These vowels were restricted to adjacent environments only. Using this sampling method, vowels that were adjacent to uvular consonants were compared with vowels that were not adjacent to uvular consonants. Vowels that were adjacent to uvular consonants were labelled *Uvular* and vowels that were not adjacent to a uvular consonant were labelled *Nonuvular*. It was difficult to balance for place of articulation in the *Nonuvular* condition because none of the Nonuvular environments could be balanced for each contrastive vowel (e.g., /i a u/, but not /ə/, was observed in the bilabial_alveolar environment; /a ə/, but not /i u/, was observed in the postalveolar_alveolar environment; etc….) Moreover, it was difficult to balance for place of articulation from a corpus of natural connected (spontaneous) speech, where the consonants produced by the speaker vary more dramatically (with respect to place of articulation) than a tightly controlled laboratory setting where place of articulation can easily be controlled through the elicitation of words in citation form. For this reason, the different *Nonuvular* place of articulations were pooled together and compared with the *Uvular* condition. This selection method was applied independently for each contrastive vowel. There were at least 50 or more observations for each sample of vowels in *Nonuvular* and *Uvular* environments. To obtain a sufficient sample size, vowels in stressed and unstressed environments were included in the study. To test whether this effect was perseverative, anticipatory or both, the vowels were assigned labels that matched their position from the uvular consonant. Vowels that were positioned to the right (CV) of uvular consonants were labelled *R*, while vowels that were positioned to the left (VC) of uvular consonants were labelled *L*. Vowels that were not positioned to an adjacent uvular consonant were labelled as *Nonuvular*. At least 20 or more tokens were observed for vowels positioned to the right *R* or positioned to the left *L* of uvulars. (See Table 7.1 for examples of words that were analyzed for each sample). (See Appendix B for a list of words analyzed for the effects of uvular consonants on vowel quality in Lushootseed)

**Table 7.1** Example of words that contain vowels in uvular and nonuvular environments.

| Vowels | Nonuvular | | Uvular | | | |
|---|---|---|---|---|---|---|
| | | | *L* | | *R* | |
| ə | ʧəd | "I" | ləχ | "light" | qəp' | "alight" |
| i | ti | "this" | ʧ'iq'ʷ | "rot" | qid | "top" |
| a | lab | "see" | taχ | "fall" | qaʔ | "a lot" |
| u | t̓uʦ' | "shoot" | ʔuχʷ | "go" | χʷubt | "paddle" |

Note: *L* = vowels positioned to the left of a uvular consonant, *R* = vowels positioned to the right of a uvular consonant.

The procedure used to exclude vowels in certain environments (i.e., when vowels were adjacent to glides) and certain contexts (i.e., when speaker was singing, sounds of other speakers in the background, or loud/abrupt noises such as the door slamming shut in the background) are the same as those discussed in Chapter 5. As discussed in Chapter 5, vowels that were positioned to the left of a rounded obstruent (i.e., VCʷ) and close back rounded vowels /u/ in CʷV environments were included in the data.

### 7.2.3 *Measurements*

To obtain an approximation of vowel height and vowel backness, the first two formants were extracted from each selection, where vowel height is inversely correlated with the first formant (i.e., higher F1 corresponds to a lower vowel, lower F1 corresponds to a higher vowel), while vowel backness and rounding is associated with F2 (higher F2 corresponds to a more front vowel, lower F2 corresponds to a lower and/or more rounded vowel). Each recording was annotated with a corresponding TextGrid, which was used to define each interval of the speech signal. The software that was used to analyze these recordings was Praat (Boersma & Weenink 2021). Formants were extracted at the midpoints, using the *Get duration, pitch, intensity, formants* script by Lennes (2003). The maximum formant setting was adjusted for female speakers (i.e., 5500Hz). The window length for the formant setting was 25ms long, with a dynamic range of 30dB. A broadband spectrogram was used to analyze the speech signal. The transient signal of the burst release noise was the start selection for vowels in syllables with initial stop consonants. The glottal pulse for voicing and the onset of visible formant structure was selected as the vowel's start selection for syllables with initial fricative, affricate, or ejective consonants (see Figure 7.1 for examples of the selections). End selections were made when the voicing of the vowel ended or if there were clear signs of dissipation of the vowel formants in the spectrogram.

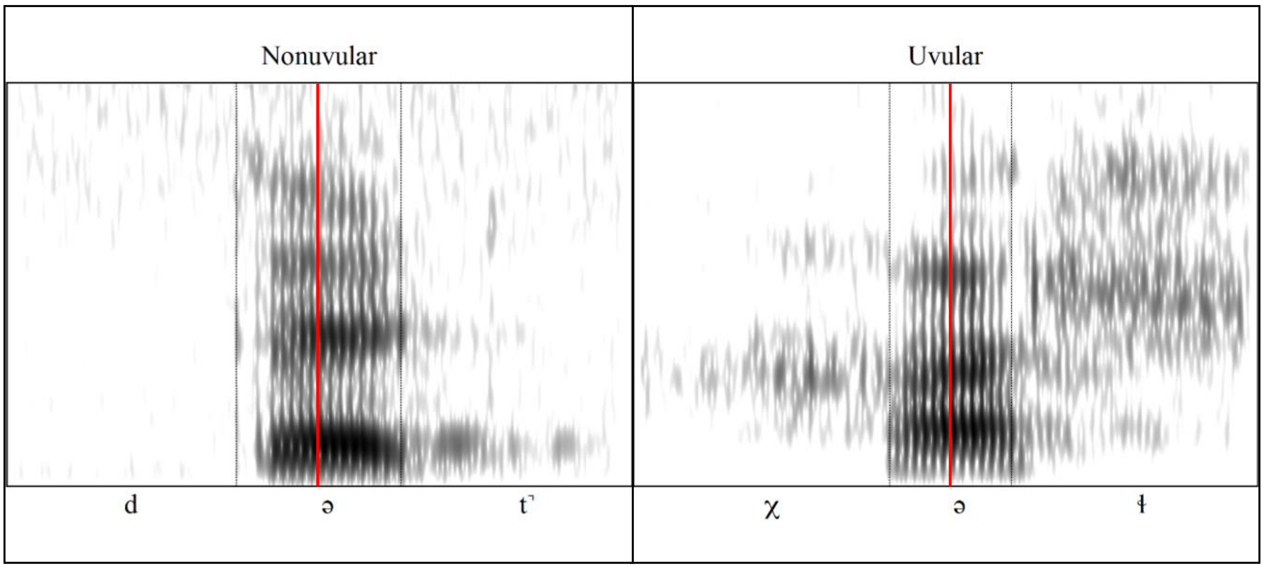



**Figure 7.1** Examples of start selections and end selections (dotted black lines) for vowel duration. Solid red lines are the midpoints of the selections.

### 7.2.4 *Hypotheses*

It was observed that uvular consonants do not increase F1 or decrease F2 for open (low) vowels in other languages (Alwan 1986, Bessell 1992, Delattre 1971). Based on these studies, the prediction I make for this study is that there will be an increase in F1 and decrease in F2 for the close front vowel /i/, close back vowel /u/ and schwa /ə/, but not for the open central vowel /a/.

### 7.2.5 *Statistical models*

The software that was used to run statistics was *R-Studio* (2018). A two-way Analysis of Variance (ANOVA) was used to test the interaction of Consonant type (Uvular-Nonuvular) and Vowel quality (/ə/, /i/, /a/, /u/) as main effects. Using the package *HH* (Heiberger & Holland 2014), post-hoc comparisons using Tukey's HSD test were used to compare perseverative *R*, anticipatory *L* and *Nonuvular* effects on F1 and F2 estimates of adjacent vowels. To test whether the effect of decreasing F2 was greater than the effect of increasing F1 for each vowel, Cohen's *d* was used to estimate the effect sizes for each vowel.

## 7.3 RESULTS

Means and standard deviations of F1 for vowels /ə/, /i/, /a/ and /u/ in Nonuvular and Uvular environments are given in Table 7.2.

**Table 7.2** F1 means and standard deviations in Nonuvular and Uvular environments.

| | NonUvular | | | Uvular | | |
|---|---|---|---|---|---|---|
| Vowel | *n* | *M (SD)* | *95% CI* | *n* | *M (SD)* | *95% CI* |
| ə | 86 | 503 (72.54) | [487, 518] | 57 | 664 (99.49) | [638, 690] |
| i | 107 | 391 (27.82) | [385, 396] | 56 | 507 (51.3) | [493, 521] |
| a | 55 | 684 (75.88) | [664, 705] | 52 | 814 (68.75) | [795, 833] |
| u | 58 | 476 (40.29) | [465, 487] | 57 | 532 (57.1) | [517, 547] |

As Figure 7.2 shows, means for F1 were greater for each of the vowels in uvular environments.

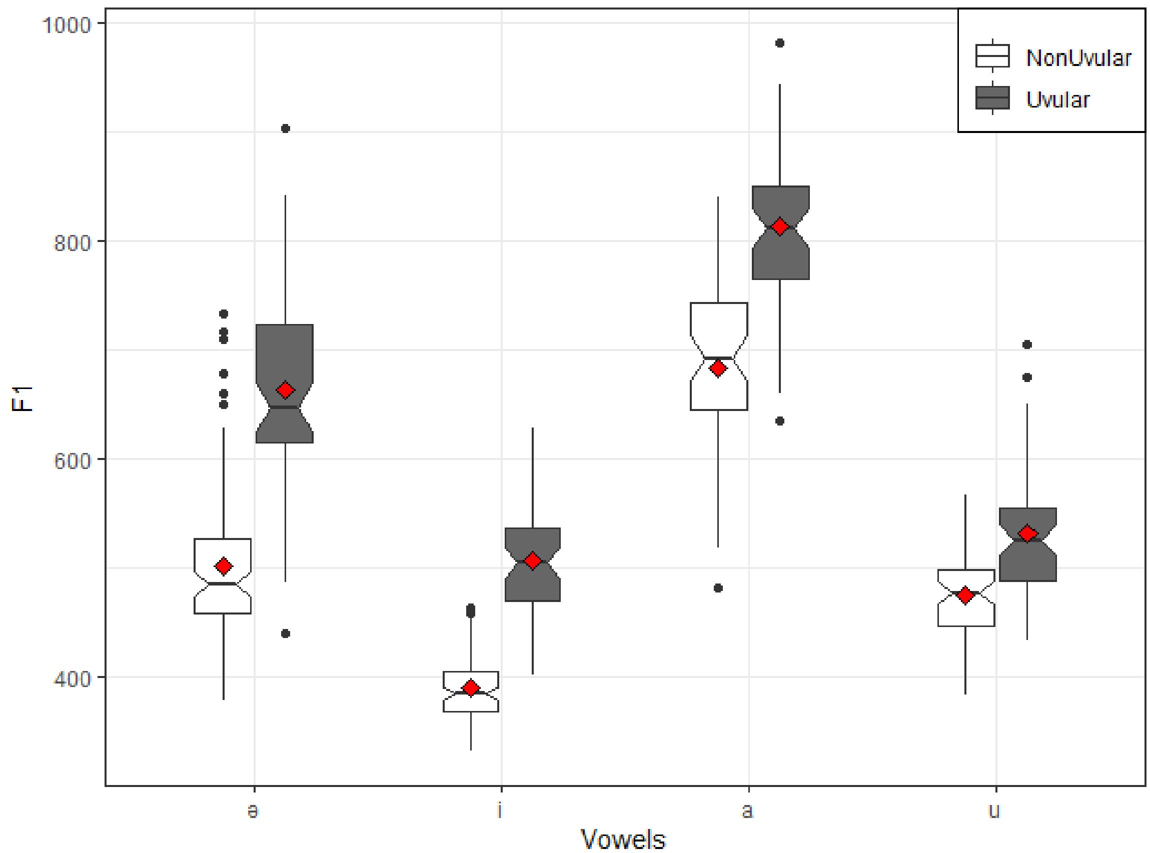



**Figure 7.2** Box plot for F1 measures, with means (represented in red diamonds) plotted. Box = 25%-75%, line = median, whisker = 10%-90%, black dots = outliers beyond 10%-90%.

Means and standard deviations of F2 for vowels /ə/, /i/, /a/ and /u/ in Nonuvular and Uvular environments are given in Table 7.3.

**Table 7.3** F2 means and standard deviations in Nonuvular and Uvular environments.

| | NonUvular | | | Uvular | | |
|---|---|---|---|---|---|---|
| Vowel | *n* | *M (SD)* | *95% CI* | *n* | *M (SD)* | *95% CI* |
| ə | 86 | 1521 (215.79) | [1475, 1567] | 57 | 1394 (150.01) | [1354, 1434] |
| i | 107 | 2014 (106.77) | [1994, 2035] | 56 | 1874 (104.71) | [1846, 1902] |
| a | 55 | 1484 (78.16) | [1463, 1505] | 52 | 1389 (78.84) | [1367, 1411] |
| u | 58 | 1302 (222.9) | [1243, 1361] | 57 | 1063 (184.27) | [1014, 1112] |

As Figure 7.3 shows, means for F2 were lower for each of the vowels in uvular environments.

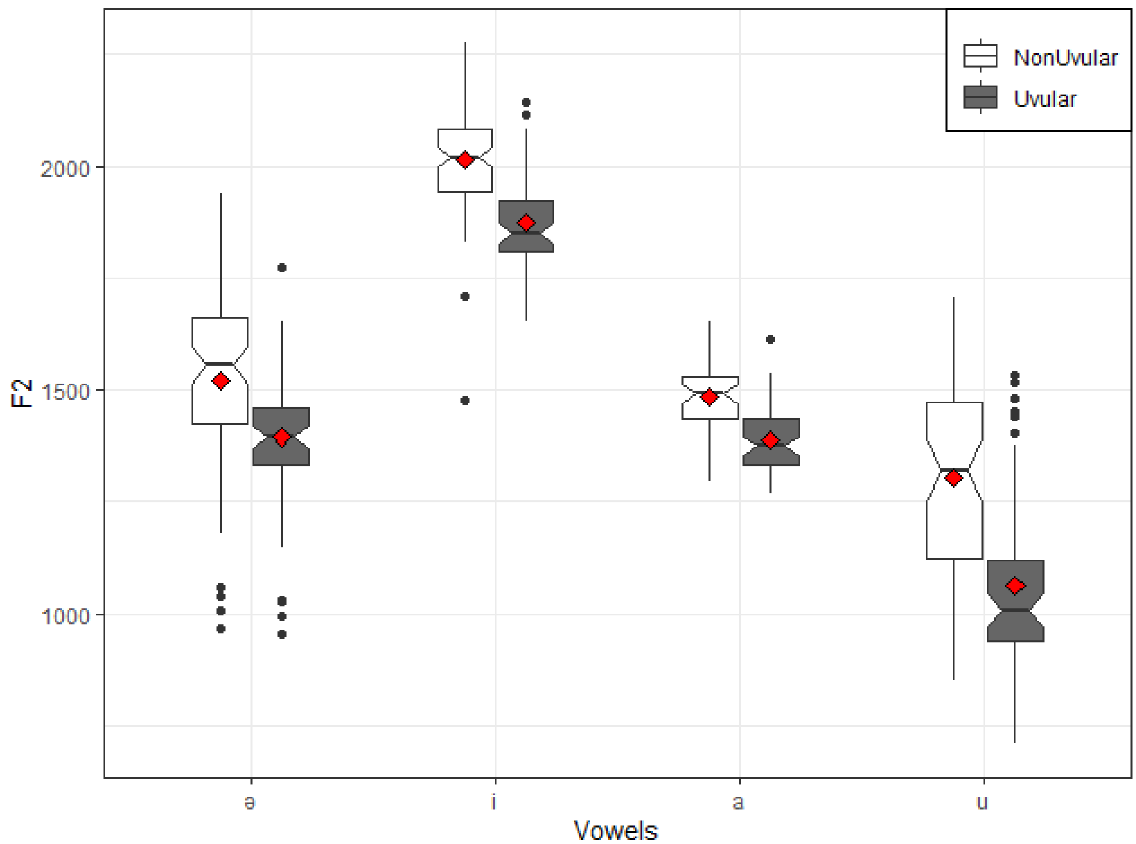



**Figure 7.3** Box plot for F2 measures, with means (represented in diamond shapes) plotted. Box = 25%-75%, line = median, whisker = 10%-90%, black dots = outliers beyond 10%-90%.

As the formant plot in Figure 7.4 shows, vowel quality tended to be more open and retracted along the total vowel space under uvular conditions as opposed to non-uvular conditions.

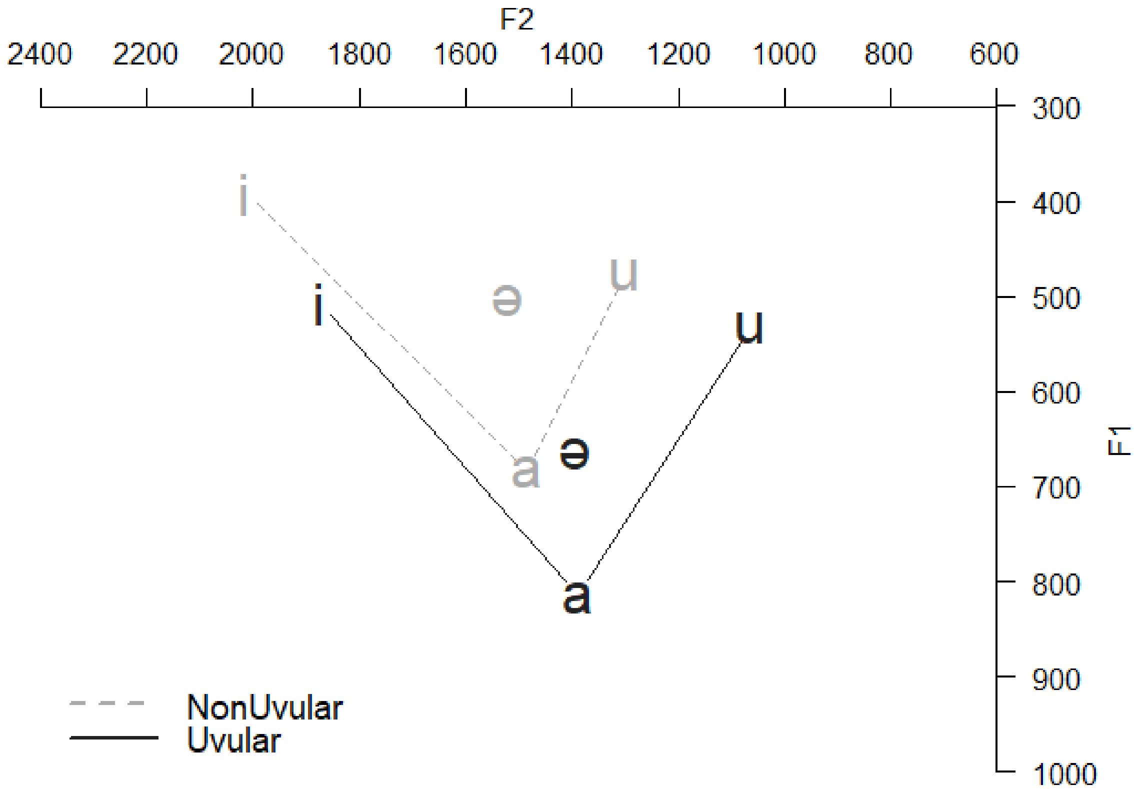



**Figure 7.4** Vowel polygon plotting F1 and F2 measures for uvular and nonuvular environments.

A two-way Analysis of Variance (ANOVA) was used to test the main effects of Consonant Type (Nonuvular and Uvular) on F1 for adjacent vowels. The results showed that F1 was significantly higher in uvular environments, $F(1, 3) = 23.23$, $^{***}p<.001$, $\eta^2 = .13$. The one-degree-of-freedom contrast of primary interest (the mean difference between Nonuvular and Uvular) was also statistically significant at the specified .05 level for each vowel, which includes schwa /ə/, $t(141) = 11.18$, $^{***}p<.001$; close front /i/, $t(161) = 18.74$, $^{***}p<.001$; open central /a/, $t(105) = 9.27$, $^{***}p<.001$; and close back /u/, $t(113) = 6.09$, $^{***}p<.001$.

The results from the two-way ANOVA showed that F2 was significantly lower in uvular environments, $F(1, 3) = 5.11$, $^{**}p = .002$, $\eta^2 = .06$. The one-degree-of-freedom contrast of primary interest (the mean difference between Nonuvular and Uvular) was also statistically significant at the specified .05 level for each vowel, which includes schwa /ə/, $t(141) = 3.87$, $^{***}p<.001$; close front /i/, $t(161) = 8.17$, $^{***}p<.001$; open central /a/, $t(105) = 6.29$, $^{***}p<.001$; and close back /u/, $t(113) = 6.26$, $^{***}p<.001$.

As the effect sizes in Table 7.4 summarizes, the effects of increasing F1 for adjacent vowels were considerably greater than the effects of decreasing F2 of adjacent vowels for schwas /ə/, close front /i/, and open central /a/. This was not observed for close back rounded /u/, which showed only a slightly greater effect of decreasing F2 than the effects of increasing F1.

**Table 7.4** Effect size of F1 increase and F2 decrease for Lushootseed vowels.

| Vowel | Effect size (Cohen's *d*) for F1 increase | Effect size (Cohen's *d*) for F2 decrease |
|---|---|---|
| /ə/ | 1.91 | 0.66 |
| /i/ | 3.27 | 1.32 |
| /a/ | 1.79 | 1.21 |
| /u/ | 1.14 | 1.17 |

Post hoc comparisons using Tukey's HSD test indicate that the mean differences for perseverative conditions *R* and anticipatory conditions *L* were not significant for F1 measures. However, the mean differences for *Nonuvular* vs. *R* and *Nonuvular* vs. *L* were significant (see Table 7.5 for details on Tukey's HSD test from F1 estimates), suggesting that uvular effects on vowel quality were both perseverative and anticipatory.

**Table 7.5** Comparisons of levels for Consonant Positions that affects F1 estimates.

| | | | | | | *95% CI* | |
|---|---|---|---|---|---|---|---|
| Levels compared | *MD* | *SE* | *t* | *df* | *p*-value | *LL* | *UL* |
| R-L | 41.34 | 23.95 | 1.73 | 220 | .09 | -25.18 | 107.87 |
| R-Nonuvular | 121.82 | 18.24 | 6.69 | 430 | <.001 | 71.15 | 172.49 |
| L-Nonuvular | 80.48 | 19.77 | 4.07 | 400 | <.001 | 25.55 | 135.40 |

Note. *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit; *MD* = mean differences

The results from the post hoc comparisons for F2 measures were the same: The mean differences between *R* and *L* were not significant for F2 measures. Similarly, the mean differences for *Nonuvular* vs. *R* and *Nonuvular* vs. *L* conditions were significant for F2 (see Table 7.6 for details on Tukey's HSD test from F2 estimates), again suggesting that uvular effects on vowel quality were both perseverative and anticipatory.

**Table 7.6** Comparisons of levels for Consonant Positions that affects F2 estimates.

| | | | | | | *95% CI* | |
|---|---|---|---|---|---|---|---|
| Levels compared | *MD* | *SE* | *t* | *df* | *p*-value | *LL* | *UL* |
| R-L | 17.53 | 63.35 | 0.28 | 220 | .38 | -158.47 | 193.52 |
| R-Nonuvular | 229.07 | 48.25 | 4.75 | 430 | <.001 | 95.01 | 363.13 |
| L-Nonuvular | 246.6 | 52.31 | 4.72 | 400 | <.001 | 101.28 | 391.91 |

## 7.4 DISCUSSION

These results suggest that the effects of uvular consonants on adjacent vowels were an increase in F1 and decrease in F2. The results also suggest that both positions of uvular consonants yield the same effects on adjacent vowels. Specifically, the results suggest that when vowels were positioned to the left or right of uvular consonants, the effects were the same: F1 increases and F2 decreases. The effect of increasing F1 was greater than the effect of decreasing F2 for the vowels /ə/, /i/ and /a/. Although the estimated effect size of decreasing F2 was slightly greater than the effect size of increasing F1 for close back rounded /u/, the difference in effect size is too small to be significant. It should be noted that the vowel must be adjacent to a uvular consonant to observe an effect. Anticipatory or perseverative coarticulation cannot be inferred from nonuvular environments because the place of articulation was not systematically controlled for this condition.

Formant values can be influenced by prominence (i.e., stress or phrasal accent). A possible limitation to the findings is that the data does not control stress in each environment. The data consists of vowels in both stressed and unstressed syllables. However, after analyzing only stressed vowels, the results were the same: F1 increases and F2 decreases for each vowel in uvular environments. Moreover, the effect of increasing F1 was greater than the effect of decreasing F2 for /ə/, /i/ and /a/ in stressed environments. The difference in effect size for the close back rounded /u/ was too small to be significant. In other words, the results were the same.

The change in F1 can be approximated by a Helmholtz resonator. Alwan (1986) suggests that an increase to the area of the constriction and decrease to the length of the constriction for uvular consonants relative to the back cavity (approximately 7cm away from the source) would shift the Helmholtz resonator upwards. The location of the constriction would be the back cavity, where the constriction is approximately 7cm away from the source (Alwan, 1986). The drop in F2 could be explained by the change in shape and size of the back cavity of the vocal tract (Chiba & Kajiyama, 1941; Stevens, 2000). It is possible that the area of the pharyngeal cavity was decreased when the speaker was producing a uvular consonant. Ghazeli (1977) observed that in Iraqi Arabic, the area of the pharyngeal cavity was reduced when constriction was made in the uvular region. The speaker in the present study may also have reduced the area of the pharyngeal cavity. Anti-node (location of maximum velocity) for the second-formant resonator is in the back cavity. Constriction at this region would cause F2 to decrease.

The results from this study are consistent with prior studies on effects of faucal (guttural) consonants on vowel quality in other languages (Alwan, 1986; Bessell, 1992; Delattre, 1971; Flemming et al., 2008; Kinkade, 1967; McCarthy, 1992; Reichard, 1938). A comparison between the effect size estimates suggest that uvular consonants have a greater effect of increasing F1 than decreasing F2 for schwas /ə/, close front /i/ and open central /a/, which is different from the results for Interior Salish languages (e.g., Couer d'Alene and Moses-Columbian) of Bessell (1992, 1998) who observed that the effect of decreasing F2 was greater than the effect of increasing F1 for all non-open vowels in Interior Salish. In the current study, there was a slightly greater effect of decreasing F2 than increasing F1 for close back rounded /u/. The findings also show that uvular consonants have a greater effect of increasing F1 for close front /i/ than other vowels, which is different from the results for Montana Salish of Flemming et al. (2008) who reported a greater effect of increasing F1 for schwas in uvular environments. The effect of increasing F1 for close front /i/ is greater than the effect of increasing F1 for schwas /ə/, open central /a/, and close back rounded /u/. It should be noted that Bessell (1992) measured the formants from the midpoint and the offset of the vowel. Moreover, Bessell analyzed vowels preceding uvular consonants but not vowels following uvular consonants. This study contrasts from Bessell, where the effects were observed up to the effective midpoint in both perseverative and anticipatory conditions. The findings were robust despite these differences in methods.

This study provides implications on the effects of uvular consonants on vowel quality across Salish languages. In many Salish languages (which includes Coast Salish languages such as Northern Straits, Halkomelem, as well as Northern Interior Salish languages such as Lillooet and Coeur d'Alene), the vowel space in these languages appears to be more "crowded" than Lushootseed (where Lushootseed has a simple four-vowel system, consisting of /i ə a u/). For example, a diachronic chain shift occurred in Northern Straits and Halkomelem, where the basic vowel system is /i/, /e/ or /ɛ/ (or /æ/) (from *a), /a/ (from *u, and from *a in some contexts), and /ə/. In Lillooet, the open central vowel *a fronted to /ɛ/ and /æ/ except in uvular environments (where they remained the same). Because the vowel inventory (particularly the front vowels and non-schwa unrounded vowels) in these languages is more crowded, it is possible that uvulars lower adjacent vowels to a lesser degree (i.e., a smaller magnitude) in these languages than Lushootseed. Findings from Bessell (1992) may confirm this, where in Interior Salish languages (such as Coeur d'Alene and Moses-Columbian), the effects of decreasing F2 were greater than the effects of increasing F1. This may suggest that the effect of vowel lowering (i.e., F1 increase) may be smaller in these languages. However, a crucial difference between the method of the current study and Bessell's finding is that the current study compared effect sizes (i.e., Cohen's d) to estimate the magnitude of the effect on F1 and F2. As the effect sizes showed, the effects of increasing F1 were considerably greater than the effects of decreasing F2 for three (i.e., /i ə a/) of the four vowels. The magnitude of the effect on F1 and F2 for the close back rounded /u/ were about the same, suggesting that neither of the four vowels showed a greater effect of decreasing F2 than increasing F1. Bessell's study did not compare effect sizes to test the magnitude of the effects on the formants (in fact, it is uncertain how Bessell arrived at the conclusion that the effect of decreasing F2 was greater than the effect of increasing F1 for all non-open vowels). This also appears to be the case in the literature for Semitic languages (such as Arabic), where it is claimed that the effects of decreasing F2 was greater than the effects of increasing F1 in Arabic (Alwan, 1986; Ghazeli, 1977). None of these studies compared effect sizes to test the magnitude of the effects on F1 and F2. At this point, it is uncertain whether the magnitude of the effects of lowering vowels (i.e., increasing F1) is smaller in other Salish languages (i.e., the languages that have a "crowded" vowel space) than Lushootseed.

Although these patterns were observed for adjacent vowels, this effect has not been observed for distant coarticulation. Bessell (1998) observed that this effect was significant for vowels that were six segments preceding the faucal closure in Coeur d'Alene. One limitation to the present study was the absence of data that tested for distant coarticulation. The effects of uvular consonants on nonadjacent vowels might be the same as the effects of uvular consonants on adjacent vowels. Although this effect has been attested in only Coeur d'Alene (and was certainly not attested in Coast Salish languages), the possibility of distant coarticulation in the data may be worth investigating in the future. This possibility suggests that future work is required to gain a more complete understanding of vowel faucalization in Salish languages.

It is worth noting that Bessell (1998) observed vowels preceding (not following) faucal consonants. One limitation to Bessell's work is that vowels following faucal consonants were not observed in Coeur d'Alene. As the current findings show, vowels that followed a uvular consonant were just as likely to be affected as vowels preceding uvular consonants. The question of whether distant coarticulation can occur for vowels following the faucal closure (in other Salish languages) has yet to be addressed in the literature.

There are other limitations that can be inferred from this study. First, this study worked with only one speaker. It is unknown if these results can be generalized to all speakers of Lushootseed because the effects that were observed come from only one speaker. Whether this effect was unique to the Southern dialect cannot be addressed by examining only one speaker. More speakers need to be examined to test whether these effects are observable for more than one speaker. Second, this study worked with recordings that date to the early-1950's. The amount of noise that was present in these recordings might have obscured the measures of F1. This suggests that the present data provide only a partial answer. Although further work is needed to address these problems, the results suggest that the effects of uvular consonants on adjacent vowels was an increase in F1 and decrease in F2. The regularities of the patterns were strong enough to overcome the lack of precision. There was also the benefit of working with data from natural connected (spontaneous) speech, which is the natural output of everyday communication. This makes it an ideal setting for analyzing natural speech processes.

There may also be other effects from consonants within Nonuvular environments. A severe limitation to the study was that place of articulation could not be balanced in the Nonuvular condition. Although this study had the benefit of working with natural connected (spontaneous) speech data, there were also flaws to this approach. As mentioned in Section 7.2.2, it was difficult to control for different places of articulation in the Nonuvular condition because the data comes from a corpus of natural connected (spontaneous) speech, where the consonants produced by the speaker vary more dramatically (with respect to place of articulation) than a tightly controlled laboratory setting where place of articulation could easily be controlled through the elicitation of words in citation form. Future research may require an analysis of data that attempts to balance place of articulation in the Nonuvular condition. It has been shown that glottal stops have an effect of lowering schwas in Interior Salish languages (Bessell 1992, Brunner & Zygis 2011, Rose 1996). For instance, in Moses-Columbian (Bessell 1992), there were no cases of the schwa /ə/ preceding a glottal stop (only the open central vowel /a/ could precede a glottal stop). This suggests that the contrast between /ə/ and /a/ was neutralized in this environment (Bessell 1992:142). This has also been observed in Lillooet, where /ə/ is realized as [a] when preceding a glottal stop (Brunner & Zygis 2011, Rose 1996). However, Bessell (1992) notes that glottal stops do not affect the formants of close front /i/, close back rounded /u/ and open central /a/, suggesting that glottals do not impose a co-articulatory effect on vowels. Whether glottal stops affect schwas in Lushootseed is unknown. Future work on the effects of glottal stops on vowel quality (particularly schwas) in Lushootseed may be required. It is also known that palatals and postalveolars could affect the formants of schwas in other languages. This has been observed in Kabardian (Choi 1991), whose phonemic vowel inventory generally lacks a front-back dimension (the distribution of the formants depends on their consonant environment). In Kabardian, F2 generally raises in environments where a central vowel is adjacent to a palatal consonant. It has also been shown that palatals and postalveolar consonants affect central vowels in Amharic (Hayward & Hayward 1992), where central vowels become more fronted in these environments. Whether this effect holds for Lushootseed is unknown. Future work on the effects of palatals and postalveolars on central vowels in Lushootseed may be required. Regardless, these effects (if present in Lushootseed) are unlikely to change the results: F1 increases and F2 decreases in uvular environments. The effects of different place articulators in the Nonuvular group would fall within the range of distribution in the Nonuvular condition, which was significantly different from the Uvular condition. In other words, balancing the different places of articulation in the Nonuvular group would unlikely change the results.

## 7.5 CONCLUSION

The results from this study indicate that the effects of uvular consonants on adjacent vowels were an increase in F1 and a decrease in F2. As predicted, this effect can be observed for both perseverative and anticipatory environments, which corroborates the original prediction. The secondary hypothesis (that open central vowels /a/ would not be affected by uvular consonants) was not supported because the effect was observed uniformly for all vowels.

The study provides evidence that the effects of uvular consonants on adjacent vowels can be observed in Coast Salish languages. The acoustic properties of speech production are poorly understood for Coast Salish languages. This study is a contribution to the Coast Salish literature by providing acoustic phonetic data with a special focus on the interaction of uvular consonants and adjacent vowels.

# Chapter 8. ON DENASALIZATION IN LUSHOOTSEED

## 8.1 INTRODUCTION

Lushootseed has undergone a historical process of denasalization, where historically nasal stops became voiced oral stops (i.e., */n/>/d/ and */m/>/b/). In fact, there are sub-areas of the Pacific Northwest with languages that lack phonemic nasals. These include Twana (another Central Salish language), Quileute (Chimakuan), Nitinat, and Makah (Nootkan, of the broader Wakashan family). The lack of phonemic nasals has been analyzed as a Sprachbund, or an areal feature (Hockett 1955, Thompson & Thompson 1972). According to Haas (1969), Nitinat and Makah underwent denasalization due to contact between languages, which arose from the influence of languages without phonemic nasals (such as Lushootseed and Twana) in the linguistic area. However, the closely related Nootka has retained its phonemic nasal consonants in its inventory (Campbell 1997:333-4). A language related to Lushootseed, Twana, is also known for denasalization, where */n/>/d/ and */m/>/b/. Because denasalization in Nitinat and Makah may have occurred due to influences from languages that have already undergone denasalization (i.e., Lushootseed and Twana), the question becomes how Lushootseed underwent the denasalization shift. Denasalization in Lushootseed has been shrouded in mystery and is poorly understood in the literature.

Although it has been maintained in that Lushootseed (and other languages that have undergone denasalization) lost nasality entirely (Hockett 1955, Thompson & Thompson 1972, Campbell 1997, Botma 2004), there has not yet been an account of whether this loss could be observed at the phonetic level or phonological level. Differences between phonological nasality and phonetic nasality in Lushootseed is poorly understood. The question of whether traces of nasality can be observed at the phonetic level has not been examined.

Moreover, there are conflicting views on the phonological representation of voiced stops in Lushootseed. On the one hand, it has been argued that voiced stops in Lushootseed pattern with sonorants (Urbancyzk 1996). In this view, nasals do not contrast with voiced stops in the language. Evidence for this view comes from phonotactic data on Lushootseed clusters. On the other hand, it has also been argued that voiced stops in Lushootseed pattern as obstruents, rather than as sonorants (Botma 2004). Evidence for this view comes from data on reduplication in Lushootseed, namely that sonorants in reduplicated stems behave differently from voiced stops. Neither of these views consider the presence/absence of phonetic nasality in Lushootseed, and what implications phonetic nasality has for the underlying representation of voiced stops in the language.

In this chapter, I analyze voiced stops in Lushootseed. The goal of this chapter is to address whether traces nasality could be observed for voiced stops at the phonetic level. I also discuss what the possible motivations (or expected direction of change) was for denasalization. In Section 8.2, I begin with a historical overview of denasalization in Lushootseed, as well as how nasals are used today in Lushootseed. Next, I discuss some of the evidence and explanations that were proposed for this phenomenon in Lushootseed. In Section 8.3, I discuss denasalization in other languages such as Twana and Korean, and how the evidence from other languages could provide some insight towards denasalization in Lushootseed. In Section 8.4, I conduct an acoustic analysis of voiced stops in Lushootseed from a set of recordings. I also provide a novel analysis of denasalization in Lushootseed. In Section 8.5, I discuss the phonological representation of voiced obstruents in Lushootseed, as well as some additional problems that need to be addressed.

## 8.2 HISTORICAL OVERVIEW

Some of the earliest records of denasalization in Lushootseed dates to the mid-1800s, where missionaries and ethnologists were documenting the grammar and vocabulary of the language. The

French missionary Father Eugene C. Chirouse (c. 1860s) authored books of prayers and catechism in Lushootseed. Chirouse, who was part of the Oregon Missions of 1847, lived among the Tulalip from 1857-1878. Chirouse documented the lifestyle, culture, and language of the speakers, compiling wordlists and a grammar of the language. Chirouse developed an orthographic system of transcribing Lushootseed, where he used the roman alphabet to transcribe the language. Nasals were transcribed as how they are typically transcribed in the roman alphabet (i.e., as ‹m› and ‹n› for [m] and [n] respectively). Unpublished prayers and catechisms in Lushootseed by Chirouse show evidence of nasals in the language. Based on Lonsdale's (2021) analysis of the corpus, of the 3,548 words in Chirouse's corpus, 507 words contained nasals (approximately 14.29% of the words). The French missionary Monsignor Jean-Baptise Boulet (1879), who later replaced Chirouse in Tulalip in 1878, also wrote prayers and catechisms in Lushootseed (Boulet also used the roman alphabet to transcribe Lushootseed). In Boulet's published work in 1879, 352 of the 5,437 words contained nasals (approximately 6.47%). The shift appeared to be further along in Boulet's record, where the number of words containing nasals dropped by approximately 7.82% from Chirouse's record to Boulet's (Lonsdale 2021). According to Lonsdale (2021), over half of Chirouse [m]'s shifted to [b] in Boulet. [n] was under-represented in both records, which may suggest that the change from [n]>[d] was more prevalent than [m]>[b].

The documentation of nasals in Lushootseed could also be found in the works of the ethnologist George Gibbs (1877), who worked with the Southern Puget Salish group Nisqually (then *Niskwalli*) in the mid 19th-century. George Gibbs was an ethnologist who worked with tribes and bands of natives in the Pacific Northwest region. He was hired by the U.S. government to help with treaty negotiations. In his work *Tribes of Western Washington and Northwestern Oregon* (1877), Gibb's documented the culture, lifestyle, geographic distribution, and languages of natives in the Pacific Northwest region. In this work, Gibbs compiled the earliest dictionary of Lushootseed (see Chapter 1 for details on the system of transcription used by Gibbs). In some of the entries from this dictionary, Gibbs would sometimes include a pair of words where the nasals [m] and [n] were used interchangeably with the voiced oral stops [b] and [d]. For example, Gibb's would provide the following entry for a word denoting 'a chief': *si-āb', si-ām'* (transcribed as ‹siʔab› /siʔab/ in the Lushootseed alphabet used today). There were 1,754 entries in Gibbs' dictionary. Out of the 1,754 entries, 118 entries contained nasals (approximately 6.73%). 90 of the 118 entries were unique words (i.e., uninflected and/or non-derived stems). Of the 90 unique entries that contained nasals, 23 of the words contained the nasal stops [m] and [n] that were used interchangeably with the voiced stops [b] and [d].

In fact, it was well documented since the 1850's that nasals and voiced oral stops were used interchangeably by speakers of Lushootseed. Relying on a report by George Gibbs in 1854, Governor Isaac Stevens (who was superintendent of Indian Affairs at the time) mentioned that the /m/'s and /n/'s were used interchangeably with the /b/'s and /d/'s respectively (Stevens 1854). As Stevens stated, "… several letters of their alphabet are convertible, as D and N, B and M, …." (Stevens 1854:245). Stevens provided further evidence of the interchangeable use of nasals and voiced oral stops when discussing the names of different bands and tribes in the Puget Sound area. He stated, "the band are differently termed N'wa-mish and Dwa-mish; another clan of the same tribe, Sa-ma-mish, are also called Sa-ba-bish" (Stevens 1854:245). This was one of the earliest attestations of the denasalization shift that was documented in the Lushootseed literature.

Exactly when the shift started to occur is unknown. However, it could be suspected that the shift occurred around the time American English settlers made their first arrival to the Pacific Northwest, which was around the 1830's. According to Hess & Hilbert (1976:33), when American

English settlers first arrived in the Pacific Northwest, Lushootseed used /m/'s and /n/'s. The Lushootseed words (particularly names of tribes) that were borrowed into English contained nasals. For example, tribal names such as *Suquamish*, which is /suqʷ'abʃ/ ‹suq̓ʷabš› in today's Lushootseed orthography (see Chapter 1 for details on today's Lushootseed orthography and IPA equivalents to the symbols used in the orthography), contained the bilabial nasal /m/ in the English form. Evidence dating back to the 1830's (presumably the earliest years of English settlement in the Puget Sound area) confirms this. A census record titled *Census of Indian Population in Fort Nisqually District as taken in the years 1838-39* (Douglas 1853:23) was compiled by Sir James Douglas of Fort Nisqually (a trading post that was formed by the Hudson's Bay Company in 1832). The census record listed names of indigenous tribes near the area. Many of these names contained symbols that corresponded to nasals /m/ and /n/ (Taylor 1974). For instance, this census record listed the tribal names *Nesqually ah mish* (IPA and Lushootseed orthography equivalents: /dxʷsqʷaliʔabʃ/ ‹dxʷsqʷaliʔabš›, present English: *Nisqually*) and *So qua mish* (IPA and Lushootseed orthography equivalents: /suqʷ'abʃ/ ‹suq̓ʷabš›, present English: *Suquamish*). This suggests that nasals were most likely intact at the time of the earliest American English settlement.

Among the most recent native speakers (as well as current non-native speakers), Lushootseed uses nasals in very limited circumstances. According to Hess & Hilbert (1976), nasals are occasionally used in special vocabularies, such as in proper names and religious terms that were borrowed from English. For example, the Lushootseed elder Susie Sampson Peters (SSP) said /masi/ for the word "mercy" (used religiously to connote a prayer to her loved ones). Moreover, nasals are sometimes used in certain styles of speaking (where nasalization was used in entire utterances, which included the use of nasals in place of voiced oral stops, as well as nasalizing vowels). These include prayers, quoting (and imitating) the speech of certain animals or other supernatural beings in Salish myths, talking endearingly to children, as well as singing (Hess & Hilbert 1976, Hess 1982) (see Section 8.5.3 for more details).

There is only one word in Lushootseed that appeared to retain its nasals: The word /mimuʔan/ 'small, little'. However, it is unknown if the word was borrowed from a neighboring Central Salish language. Cognates of this word appear in other Central Salish languages, such as Saanich /méʔmən/ 'small' (Montler 2018) and Upriver Halkomelem /ʔəmíːməl/ 'small bit, a few' (Galloway 2009). One reason to suspect borrowing is that the word does not appear to fit the minimality requirement for roots in Lushootseed (which is usually monosyllabic and CVC) (see Chapter 11 for more details). Another reason to suspect borrowing is that cognates of this word is morphologically complex in other Salish languages, whereas it is morphologically simple in Lushootseed. According to Galloway (2009), in Upriver Halkomelem, the word /ʔəmíːməl/ 'small bit, a few' (which is the cognate of Lushootseed /mimuʔan/ 'small, little') could be decomposed into /ʔə=/ (the oblique particle) and the reduplicant syllable /míː~/, which is the diminutive reduplicant of the root /məl/. However, the word /mimuʔan/ 'small, little' in Lushootseed is morphologically simple (i.e., it cannot be decomposed into more than one morpheme). Because the word-form is morphologically simple in Lushootseed (but morphologically complex in other Salish languages such as Upriver Halkomelem), it could be suspected that the word was borrowed from another Central Salish language as a full, non-decomposable lexical item. Nasals are not used contrastively in Lushootseed except in the word /mimuʔan/ 'small, little'. However, as will be discussed in Section 8.5.4, evidence of borrowing may not preclude evidence of a nasal contrast in Lushootseed.

## 8.3 Some Explanations and Evidence of Denasalization in the Literature

Previous explanations of denasalization in Lushootseed seem either too vague or unclear. Jay Miller (2014) believed that denasalization may have been “a counter-response to territorial aggression by nasal-using Straits Salish speakers such as Lummi, Klallam, and Samish” (Miller 2014:249). Thompson & Thompson (1972) stated that the denasalization of /m/ and /n/ resulted from “intimate relationships with adjacent languages having voiced [oral] stops in those positions.

> “The model must either itself have lacked nasals…, or it must have presented an extensive voiced stop system. The influence would appear to operate most strongly on a language in which a voiced stop set was already developing as the result of internal dynamics. The obvious case where precisely this seems to have happened is Puget Sound Salish [i.e., Lushootseed].” (Thompson & Thompson 1972:449).

However, as Thompson & Thompson noted, the source of the influence “is unfortunately less clear” (1972:449). None of these explanations appear to address the problem of whether traces of nasality could be observed for voiced stops at the phonetic level.

As will be shown in Section 8.4, acoustic evidence reveals instances of partial (weak) nasality for voiced stops in specific prosodic positions, suggesting that denasalization may have occurred due to the interaction between low-level phonetic implementations and higher-level prosodic information. In what follows, I will discuss evidence of denasalization in other languages. There are two languages where denasalization has been clearly documented in the literature. These two languages are Twana (which is another Central Salish language that is closely related to Lushootseed) and Korean, which is an unrelated language that is not a part of the linguistic area (or Sprachbund) that defines this feature but has nevertheless been extensively documented in the phonetics literature on denasalization.

### 8.3.1 *Denasalization in Twana*

Like Lushootseed, the neighboring language Twana (which is also Coast Salish) has undergone denasalization, where nasal stops became voiced oral stops. In Drachman's (1969) dissertation on Twana phonology, he proposed that denasalization was developed through low-level phonetic implementations. Drachman observed that there were many instances of denasalization in word-initial and non-initial (utterance-medial) environments. Drachman also proposed that the development of denasalization in word-initial and non-initial (utterance-medial) environments had its own separate development. Drachman emphasized the importance of the length (i.e., duration) of the consonant closure for denasalization to occur. Drachman also predicted that utterance-initial nasals became pre-nasalized voiced stops, which would eventually denasalize entirely. Drachman stated that the "raising" of the velum was in anticipation of the non-nasality of the following segment (e.g., an oral vowel), which Drachman believed led to the denasalization of nasal stops in word-initial position. Citing Bjork (1961) and Fritzell (1963), Drachman stated that the supraglottal closure duration of the segment was shorter within an utterance (i.e., utterance-medial position), which would lead to the opening time of the nasopharyngeal port sharply curtailed.

However, there appears to be some problems with Drachman's analysis of denasalization in Twana. It appeared Drachman misinterpreted the findings of Bjork and Fritzell. Bjork (1961) didn't find what Drachman proposed to be evidence for denasalization in utterance-medial positions (nor did Bjork report this in his paper). Moreover, Fritzell (1963) in fact found a decrease in activity of the levator veli palitini muscle in utterance medial position, suggesting that the velum must've been lowered in those positions. This directly contradicts Drachman's hypothesis that the opening of the velopharyngeal port was sharply curtailed in utterance-medial position. However, there was one noteworthy finding from Fritzell's (1963) paper that suggests the possible mechanisms underlying denasalization in certain prosodic environments. In his paper, Fritzell (1963) conducted an electromyographic study to measure the action potential of the muscles responsible for raising and lowering the velum (i.e., levator veli palitini and tensor veli palitini muscles, respectively) in the production of nasal sounds. Fritzell found that in words beginning with a nasal sound, the action potential of the levator veli palitini was increased just prior to the acoustic signal of nasality for most of the time (like oral stops). This suggests that the velum was raised prior to the acoustic signal of nasality. As we will see later (based on evidence from Korean), there is a strong tendency for nasal segments to weaken (or show losses) in similar prosodic environments.

Another problem with Drachman's analysis is that Drachman did not discuss how this feature was potentially diffused to and from neighboring languages in the linguistic area, which (as mentioned in the introduction) was a well-known feature that occurred in some parts of the Pacific Northwest area. The question of whether the feature was borrowed from Lushootseed, or if Lushootseed borrowed the feature from Twana, is unclear.

### 8.3.2 *Denasalization in Korean*

Korean is a language that is spoken in the Korean peninsula of East Asia. Although Korean is not linguistically related to Lushootseed[6] (i.e., it is not part of the Salish family, nor does it belong to the same linguistic area as Lushootseed), denasalization has nevertheless been well attested in the language. Denasalization in Korean has also been examined extensively in the phonetic literature.

[6] Korean belongs to the Koreanic family, which includes Korean spoken in the mainland and Cheju Korean.

In Korean, denasalization primarily occurs in specific prosodic positions. It has been shown that denasalization occurs primarily in domain-initial positions (Cho & Keating 2001, Yoshida 2008, Kim 2011, Ahn 2013, Jang et al. 2018). Domain-initial positions refer to segments that occur initially at certain prosodic boundaries (for example, the initial position of focus contrasts or word-initial position). According to Cho & Keating, “the stronger the prosodic boundary, the more extreme the articulatory gesture, possibly nearer to the consonant target” (2001:178). This phenomenon has often been referred to as ‘domain-initial strengthening’, where consonants are pronounced with longer and stronger closures in the initial position of certain prosodic domains (Cho & Keating 2001, Keating et al. 2004). This suggests that boundaries associated with higher-level prosodic units are more likely to cause denasaliazation than are boundaries associated with relatively lower-level prosodic units.

In Kim’s (2011) dissertation, Kim used an acoustic and aerodynamic approach to study denasalization in word-initial position in Korean. Kim also conducted a perceptual study examining native listeners’ vs. non-native listeners’ perception of denasalized forms in Korean. One of the major findings was that although denasalization was present, native listeners perceived the sounds as nasal regardless of the acoustic and aerodynamic outcomes. However, non-native (English) listeners perceived the denasalized variants as voiced oral stops. Another major finding was that there were more instances of partial denasalization (prenasalized stops) in word-initial position than complete denasalization (where nasal stops were realized as voiced stops). Kim also found that, for instances where nasal stops were partially denasalized, the nasal airflow was considerably weaker than fully nasalized segments. Kim also reported that denasalization was more prominent for alveolar nasals in domain-initial positions than for bilabial nasals (as in the case of Lushootseed (see Section 8.2)). Moreover, non-native (English) listeners were more likely to perceive the alveolar nasals as denasalized (98%) than the bilabial nasals (70%).

Ahn (2013) and Yoshida (2008) examined the relationship between nasality and the duration of the stop closure. Ahn found evidence of nasality decreasing when the duration of the nasal stop was shorter. Moreover, Ahn found that this appeared to be the case in word-initial position, suggesting that nasality decreased in word-initial position in Korean. Corroborating the findings of Kim (2011), Ahn found that alveolar nasals had shorter duration and were more frequently devoiced than bilabial nasal stops. Yoshida (2008) made a similar observation. However, Yoshida stated that “denasalization” was actually “nasality weakening”, which was dependent on “segment duration adjustment related to prosody” (2008:21). According to Ohala & Ohala (1993) (cited by Yoshida), denasalization “has a function of reducing the acoustic distortion by nasal coupling” (1993:230).

In a related study, Jang et al. (2018) examined the role of focus and prosodic boundaries on coarticulatory vowel nasalization in Korean. They found that vowel nasalization was greatly reduced under focus. They also found that focus-induced reduction of vowel nasalization was more robust word-initially than IP-initially, showing an interaction between focus and prosodic boundary (it should be noted that there was some nasal weakening in IP-initial position as well, despite not being as robust as word-initial position).

In all these studies, domain-initial nasals were often produced with weak nasality or sometimes with no nasality (and sometimes, though rarely, domain-initial devoicing) (Ahn 2013; Yoshida 2008; Kim 2011; Yoo 2015; Cho & Keating 2001). As was observed by Yoshida (2008) and Kim (2011), most instances of denasalization in domain-initial position were realized with partial (or weak) nasality, where the nasal stops were often realized as postoralized (i.e., m > mb, n > nd) stops. As mentioned in Section 8.3.1 (for Twana), Fritzell (1963) found that in words beginning with a nasal consonant, the action potential of the levator veli palitini muscle increased just prior to the acoustic signal of nasality for most of the time (like oral stops). This would be consistent with the idea that nasality has the potential to decrease in those positions, where the action of raising the velum prior to the acoustic signal of nasality would perseverate into the articulatory adjustment needed for the production of nasality. This would suggest that the weakening of nasality can be expected in domain-initial position.

Going back go Fritzell's (1963) study, we can also note that the activity of the levator veli palitini muscle during speech differs from its activity during vegetative breathing (i.e., unconscious, automatic breathing at rest). The normal state of the levator veli palitini is relaxed and the velopharyngeal port is open during vegetative breathing. It takes the activation of this muscle to make an oral sound (vowel or consonant) or during swallowing. However, as Fritzell showed, the "speech ready posture", which happens just before we start to make speech sounds (exclusively), includes closing the velopharyngeal port, even if the first sound in the word is a nasal.

However, unlike Korean (where denasalization was found in domain-initial positions), denasalization in Lushootseed occurred in all prosodic positions (as will be shown in Section 8.4, evidence of domain-initial strengthening may still provide important insights on denasalization in Lushootseed based on acoustic evidence from recordings of Lushootseed elders). There were some words in Gibbs' *Dictionary of the Niskwali* that showed the interchangeable use of voiced stops and nasal stops in word-final position (e.g., *si-āb', si-ām'* 'a chief' (transcribed as /siʔab/ in the IPA)). This suggests that denasalization occurred in other environments that were not always domain-initial.

Domain-initial strengthening has nevertheless been attested for non-nasal approximants in other Salish and neighboring languages. According to Swadesh (1952), /j/ is realized as [d͡ʒ] and /w/ is realized as [gʷ] word-initially (and initially in stressed syllables) in Quinault. Moreover, it has been observed that in Klallam, */j/ and */w/ developed to */d͡ʒ/ and */gʷ/ respectively in word-initial positions, which later became devoiced into /t͡ʃ/ and /kʷ/ (Swadesh 1952, Thompson & Thompson 1972). An exact parallel could be observed for the neighboring non-Salish language Chemakum (Swadesh 1955:60). This suggests that fortition (or strengthening) in domain-initial position was a well attested phenomenon in other Salish (and neighboring) languages.

## 8.4 ANALYSIS

To investigate the nasality of stops in Lushootseed, I conducted an acoustic analysis of voiced stops in Lushootseed. The research question is whether some nasality was present for the voiced stops /b/ and /d/ in Lushootseed. This study predicts that partial (or weak) nasality can be observed for the voiced stops /b/ and /d/ in Lushootseed, which becomes realized as prenasalized stops [mb] and [nd] respectively. This study also predicts that partial (weak) nasality can be observed in specific prosodic domains (i.e., domain-initial position). As will be shown in Section 8.4.2, the findings corroborate these predictions.

### 8.4.1 *Methods*

To investigate the presence/absence of nasality for voiced stops, I conducted a qualitative and quantitative analysis of voiced stops by listening for audible nasal murmur, inspecting spectrograms and waveforms, as well as measuring the amplitudes of the peaks corresponding to F1 and the extra pole zero pair above F1 (near 1000Hz) from a power spectrum for individual tokens of voiced stops in the corpus. Each token was categorized into three sets: Prenasalized [mb] and [nd], voiced oral stops [b] and [d], and the nasal stops [m] and [n]. Frequency components of the voiced stops /b/ and /d/ were compared with the nasal stops /m/ and /n/ from discourse style narrative, where the speaker was quoting Raven in the story “Five Brothers”. Prenasalized voiced stops [mb] and [nd] were compared with plain voiced stops [b] and [d] in different prosodic positions (domain-initial position vs. non-prominent-initial position or intervocalic position). Three of the recordings (from the speaker Annie Jack) that were used in the previous chapters were examined.

Nasals have the property of introducing extra pole zero pairs in the transfer function below and above frequencies of the first formant (Chen 1996, Fujimura & Lindqvist 1964, Lindqvist-Gauffin & Sundberg 1976, Dang & Honda 1994). The zeros are located near the peak of the first formant. The acoustic consequences of nasal coupling from the sinuses generally reduces the amplitude of F1 and increases the bandwidth of F1, as well as introducing peaks below F1 (near 250Hz) and above F1 (near 1000Hz). The peak above F1 (near 1000Hz) is associated with the nasal cavity with an opening of the velopharyngeal port at its posterior end (Stevens 2000:512). The frequency of this zero is a consequence of the side branch between the velopharyngeal opening and the point of closure in the oral cavity (Stevens 2000). However, there are other shunting cavities that are responsible for the introduction of these extra pole-zero pairs, which includes the sinus maxillares and the sinus frontales (Lindqvist-Gauffin & Sundberg 1976).

In this study, the amplitudes of the peaks corresponding to F1 and the extra pole zero pair above F1 (near 1000Hz) was measured from a power spectrum. The amplitude of the peak corresponding to the extra pole zero pair above F1 (near 1000Hz) was labeled P1, whereas the amplitude of F1 was labeled A1. The difference between A1 and P1 (i.e., A1-P1) was also calculated to determine the degree of nasality for the prenasalized and nasalized variants. The smaller the difference, the greater amount of nasality. Conversely, the greater the difference, the smaller amount of nasality. P1 was also used to determine the presence/absence of a nasal murmur in voiced stops. Figure 8.1 is a power spectrum illustrating the locations of amplitudes A1 and P1 for the prenasalized variant [mb].

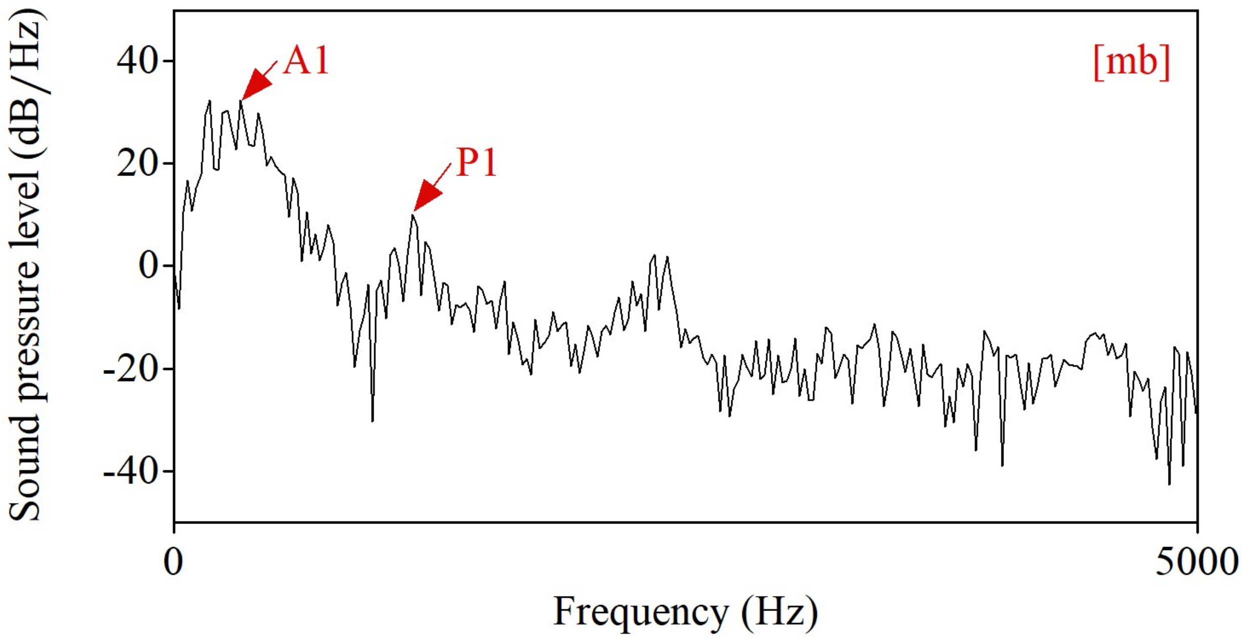



**Figure 8.1** Power spectrum illustrating amplitudes A1 and P1 for the prenasalized variant [mb].

Amplitudes A1 and P1 were compared between each token of [b d], [mb nd], and [m n], where the nasals [m n] were analyzed from the speaker using nasals over voiced stops to imitate Raven in the story “Five Brothers”.

The percentage of voiced stops that were prenasalized from the recordings was calculated. To determine the level of “prominence” of the word-initial syllable containing the initial voiced stops, the average duration of the syllable containing the voiced stops were compared between words initialized with prenasalized voiced stops and words initialized with plain voiced stops. Voiced stops that occurred word-finally or in clusters with other voiceless obstruents were excluded from the analysis because voiced stops were usually devoiced (with minimal voice leakage) in those positions (see Chapter 4 for more details).

### 8.4.2 *Findings*

From the recordings, there were a few instances of partial (weak) nasality (in the form of prenasalization) for the voiced stops /b/ and /d/ in word-initial position. There were visible formant structures (though faint) along the upper frequency range in the spectrogram. This can be observed in Figure 8.2 for the voiced alveolar stop /d/ (realized as [nd]) and Figure 8.3 for the voiced bilabial stop /b/ (realized as [mb]).

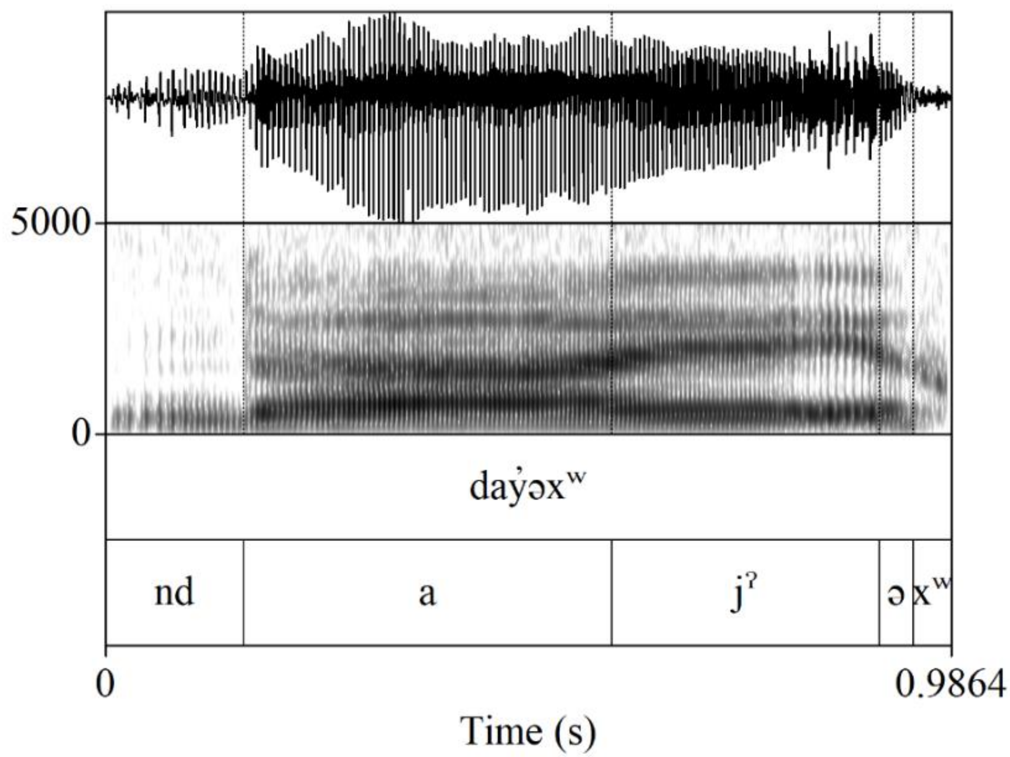



**Figure 8.2** Prenasalized alveolar stop [nd] in word-initial position under focus.

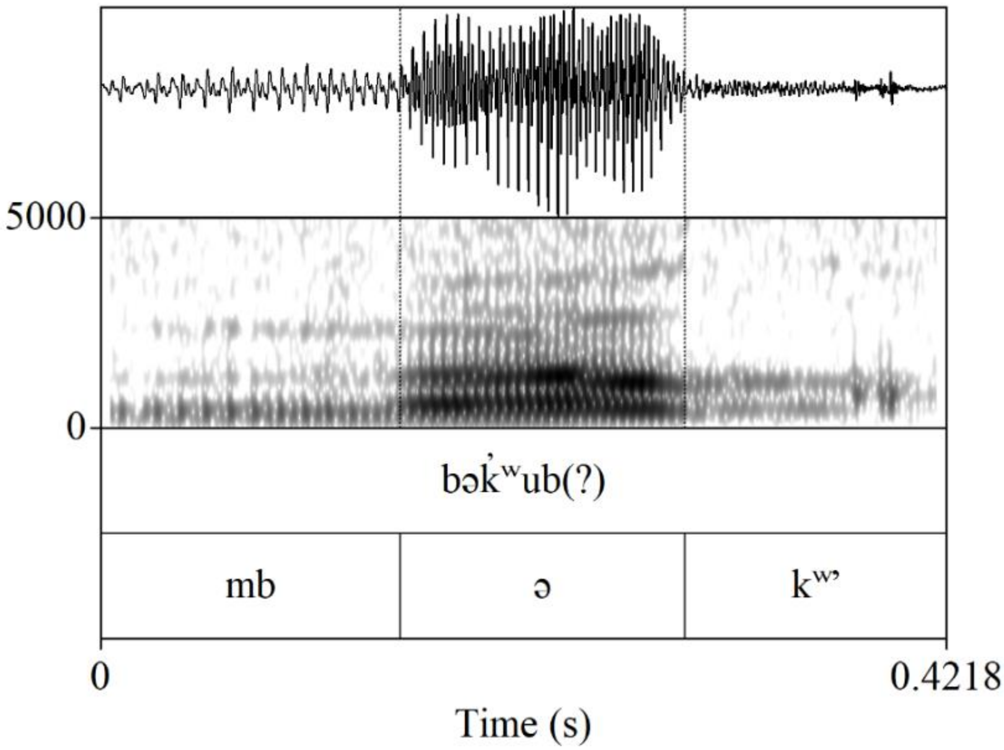



**Figure 8.3** Prenasalized bilabial stop [mb] in word-initial position.

Moreover, as shown in Figure 8.2 and Figure 8.3, the nasality for the bilabial stop appeared to be greater than the nasality of the alveolar stop. This was observed in general, where the amplitude of nasal murmur for the bilabial stop tended to be greater than the alveolar stop. This was apparent based on the visible formant structures in the mid and upper frequency range for the bilabial stop, which was more intense for the bilabial stop than the alveolar stop. It should be noted that the magnitude of the voicing component (which was the visible formant structure at the lowest frequency range) was much greater than the faint upper frequency components, suggesting that these voiced stops were strongly voiced. Moreover, the amplitude of the voicing component in the waveform gradually decreased throughout the closure, suggesting that these were voiced stops (see Chapter 6 for more details on voiced stops). It should be noted that P1 was used to determine the presence/absence of nasality for the voiced stops. In some instances, upper formant structures around 2000~4000Hz were present for the voiced bilabial stop [b] in intervocalic position. As discussed in Chapter 4, voiced stops /b/ tend to be realized as voiced bilabial fricatives [β] in intervocalic position. The amplitude P1 (which was always near 1000Hz) was never present for the voiced bilabial stops /b/ in intervocalic position. This suggests that voiced stops were not nasalized in intervocalic position.

There were 68 voiced bilabial stops /b/ and 50 voiced alveolar stops /d/ that were produced by the speaker in these recordings. For the voiced bilabial stops /b/, 19 occurred word-initially and 49 occurred intervocalically. For the voiced alveolar stops /d/, 13 occurred word-initially and 37 occurred intervocalically. Of the 19 word-initial voiced bilabial stops in these recordings, approximately 66% (12/19) were realized with partial (weak) nasality (i.e., realized as prenasalized voiced bilabial stops [mb]). For the word-initial voiced alveolar stops, 53% (7/13) were realized with partial (weak) nasality (i.e., realized as prenasalized voiced alveolar stops [nd]). In other words, 12 of the 19 word-initial voiced bilabial stops /b/ and 7 of the 13 word-initial voiced alveolar stops /d/ were realized with partial (weak) nasality.

It should be noted that partial (weak) nasality occurred only in domain-initial position. There was no evidence of partial (weak) nasality in intervocalic position. Of the 32 word-initial voiced stops, 12 word-initial voiced stops (6 bilabial and 6 alveolar) were not partially nasalized. However, these 12 voiced stops did not occur in prosodically prominent positions (these occurred initially in unstressed syllables). This suggests that voiced stops cannot show partial (weak) nasality in intervocalic position or non-prominent positions (moreover, there was no evidence of partial (weak) nasality in word-final position). This suggests that partial (weak) nasality was limited to prosodically strong domains. This can be observed in Figure 8.4, where the voiced bilabial stop /b/ was realized as [b] (i.e., it was not prenasalized). The word-initial voiced bilabial stop [b] in Figure 8.4 occurred in an unstressed syllable. This suggests that prenasalization could only be observed in prosodically strong domains.

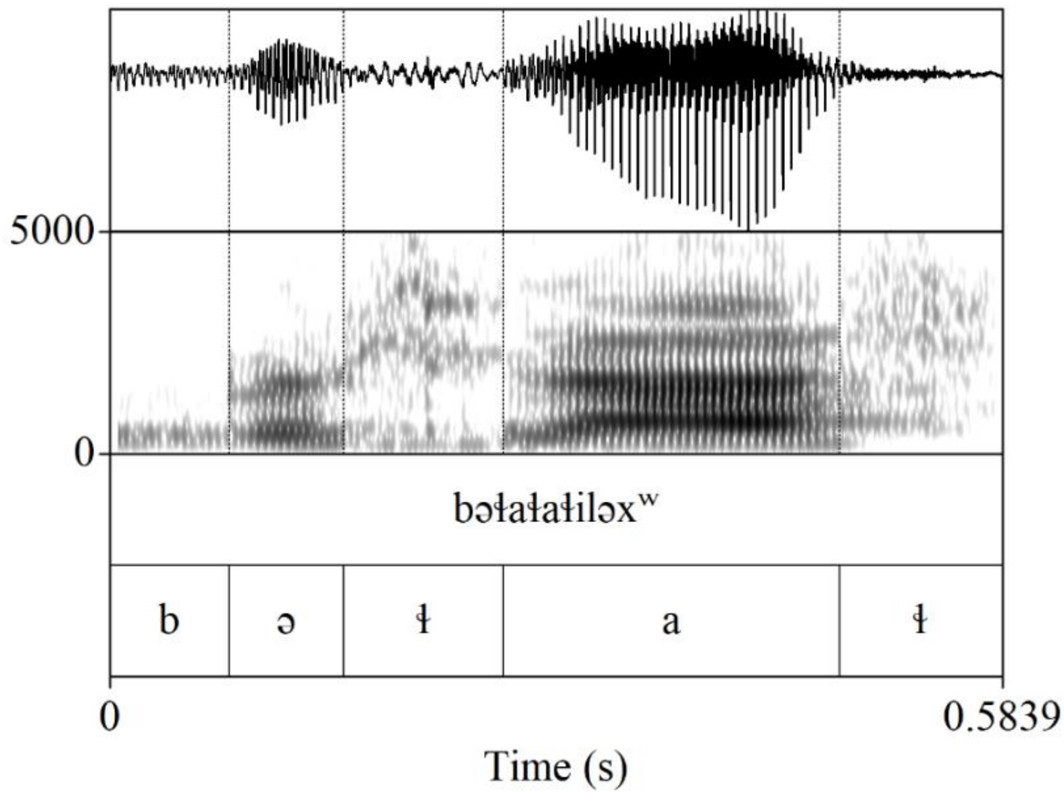



**Figure 8.4** Voiced bilabial stop [b] in word-initial position.

Table 8.1 summarizes the number of observations for /b/ and /d/ in word-initial (prenasalized and voiced) and intervocalic position that was discussed above.

**Table 8.1** Number of observations for /b/ and /d/ in word-initial (prenasalized and voiced) and intervocalic position.

| Consonant | Word-initial | | Intervocalic | Total |
|---|---|---|---|---|
| | Prenasalized | Voiced | | |
| [b] | 12 (63%) | 7 (36%) | 49 | 68 |
| [d] | 7 (54%) | 6 (46%) | 37 | 50 |

(1) is an IP-notation of the word-form from Figure 8.3, where the word /bək'ʷub/ 'plunder' (realized as [mbək'ʷub]) occurred in domain-initial position (see Chapter 10 for more information on the prosodic structure of Lushootseed).

(1) <PAUSE> [$_{IP}$ [$_{AP}$ mbək̓ʷub] [$_{AP}$ ʔəsstab] [$_{AP}$ tuʔusil]] <PAUSE>
‘He plundered the things and dived’

Most instances where voiced stops were prenasalized (as in [nd] and [mb]) occurred when the word was produced under focus and/or at the beginning of phrases that was preceded by a pause. This was typically characterized by greater duration, F0, and intensity throughout the utterance. Table 8.2 shows the average duration of vowels preceded by voiced stops in word-initial position for the prenasalized variants and the plain voiced stop variants.

**Table 8.2** Average duration of vowels preceded by voiced stops in word-initial position for the prenasalized variants and plain voiced stop variants.

| | Prenasalized (ms) | Voiced (ms) |
|---|---|---|
| /b/ | 211ms | 98ms |
| /d/ | 326ms | 102ms |

As Table 8.2 summarizes, the average duration of the syllable containing the word-initial prenasalized variants was much greater (2~3x greater) than the syllable containing the word-initial plain voiced stop variants. This suggests that prenasalized variants occurred initially in prosodically prominent positions (i.e., domain-initial positions).

There was also evidence of voiced stop devoicing in word-initial position. However, instances of voiced stop devoicing in word-initial position was rare. There were only two instances of devoicing for the voiced alveolar stop /d/ in word-initial position from the data. There were no instances of devoicing for the voiced bilabial stop /b/ in word-initial position. Devoicing of the voiced alveolar stop /d/ can be observed in Figure 8.5, where the voiced alveolar stop /d/ was realized as devoiced [d̥].

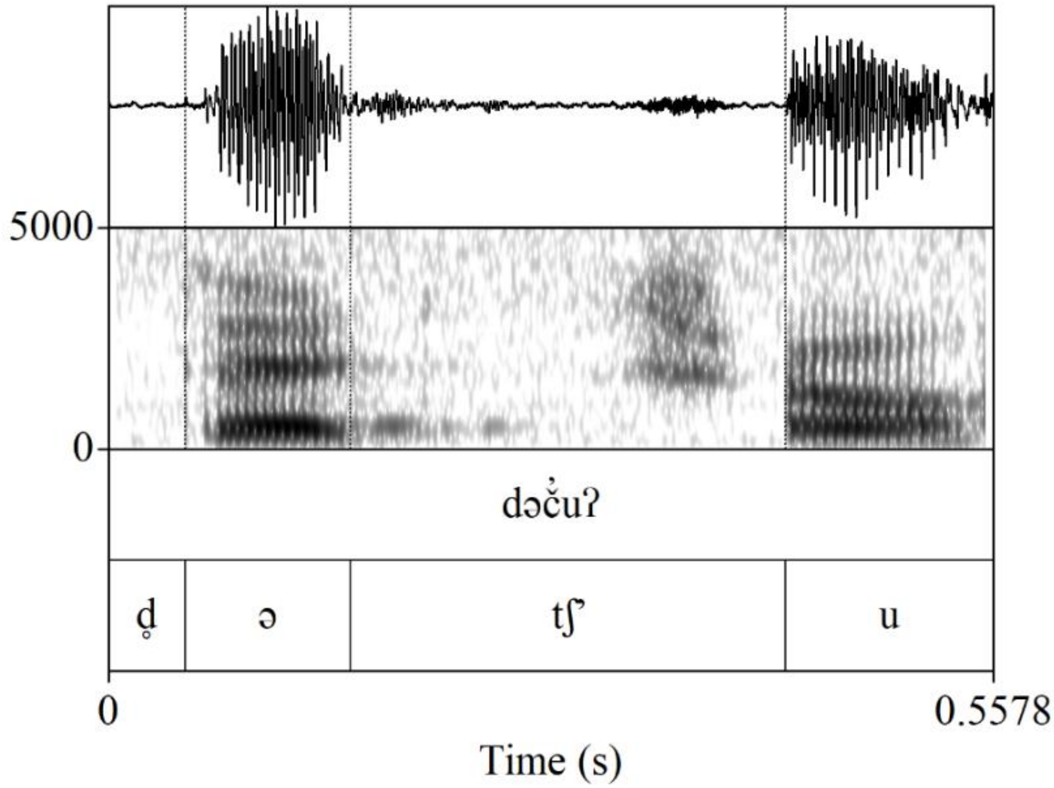



**Figure 8.5** Voiced alveolar stop /d/ devoiced [d̥] in word-initial position.

Figure 8.6 is a waveform and spectrogram of the Lushootseed word /mimuʔan/ ‘small’. As Figure 8.6 illustrates, fully nasalized stops [m] and [n] was present in the word /mimuʔan/ ‘small, little’. The nasality of the word-final alveolar nasal [n] was breathy, which obscured measures of A1 and P1.

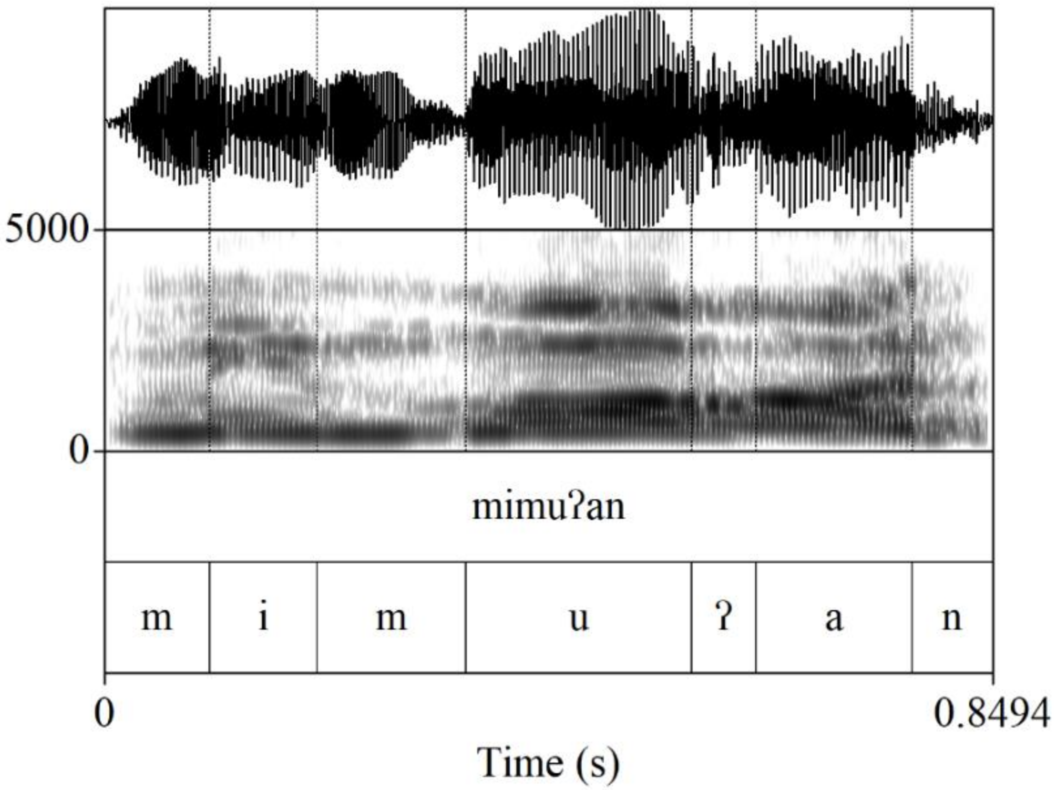



**Figure 8.6** Word /mimuʔan/ 'small, little' in Lushootseed.

The amplitudes of A1 and P1 for the stops [b d], [mb nd] and [m n] are summarized in Table 8.3. As Table 8.3 summarizes, A1 and P1 for the prenasalized variant [mb] and [nd] was considerably lower than [m], suggesting that the prenasalized variants were produced with a weaker nasal airflow than fully nasalized stops. The A1 of the prenasalized variants [mb nd] was not that different from the voiced stops [b d]. However, A1 for the prenasalized variants [mb nd] was 7.1 dB and 4.3 dB less than the nasal [m n] respectively. Moreover, amplitude P1 for the fully nasalized stops [m n] were considerably greater than P1 of the prenasalized variants. P1 was not calculated for [b] and [d] because it was not present (this is expected for voiced stops, which do not introduce an extra pole zero pair near F1). Moreover, the difference between A1 and P1 was much greater for the prenasalized variants [mb nd] than the fully nasalized stops [m n], which suggests that there was weaker nasal airflow for the prenasalized variants.

**Table 8.3** Average amplitudes A1 and P1 for word-initial voiced stop [b d], prenasalized [mb nd], and bilabial nasal stop [m n].

| Segment | *N* | A1 (in dB) | P1 (in dB) | A1-P1 |
|---|---|---|---|---|
| [b] | 6 | 31.4 dB | N/A | N/A |
| [d] | 4 | 31.6 dB | N/A | N/A |
| [mb] | 12 | 32.3 dB | 10.7 dB | 21.6 |
| [nd] | 6 | 33.6 dB | 6.7 dB | 26.9 |
| [m] | 6 | 39.4 dB | 26.1 dB | 13.3 |
| [n] | 6 | 37.9 dB | 24.3 dB | 13.4 |

Another observation worth noting in Table 8.3 is the amplitude P1 for the prenasalized variants, where P1 for [nd] is 4 dB lower than [mb]. This suggests that alveolar [nd] is characterized as having weaker nasal airflow when compared to the bilabial [mb].

### 8.4.3 *Interpretation of findings*

Partial (weak) nasality (in the form of prenasalization) occurred exclusively in domain-initial positions. This could be interpreted as voicing *enhancement* in prosodically strong environments (Wetzels & Nevins 2018). Voiced stops are characterized by a low-frequency noise during the constricted interval. When voiced stops are partially nasalized (in the form of prenasalization), the low-frequency amplitude of the sound is increased by preventing a buildup of intraoral pressure during a portion of the closure interval (Stevens et al. 1986:439). This enhances the audibility of the low-frequency noise that is characteristic of voiced stops. Moreover, a slight lowering of the velum would prevent a build-up of intraoral pressure during a portion of the voicing interval, making it easier for speakers to produce voicing during the articulatory closure of the stop.

The partial nasality of voiced stops in prosodic domain-initial position may have been used as a cue to signal voice enhancement in the class of oral stops in Lushootseed. In other words, speakers may have started perceiving weakened nasals as voiced stops. Because the weakening of nasality occurred in prosodically strong environments (via domain-initial position), the perception of these sounds as being voiced stops may have been perceptually salient in those environments. This may have led the underlying representation of nasals to become completely denasalized because of the perceptual salience of weakened nasals as voiced stops in prosodically strong boundaries. This may explain why nasals have denasalized to voiced stops in other prosodic environments as well: These segments were no longer represented as “nasals” due to the perceptual salience of weakened nasals as voiced stops in prosodically strong boundaries. The weakened nasality in domain-initial position was likely used in Lushootseed to enhance the voicing contrast, which became a part of the underlying representation of voiced stops in Lushootseed. This is further supported by Wetzels & Nevins (2018), who stated that partial (weak) nasality in domain-initial position is evidence of enhancing the voicing contrast in the class of oral stops (see Section 8.5.1 for more discussion on the phonological representation of voiced stops in Lushootseed).

It should be noted that amplitude P1 for the prenasalized alveolar variant [nd] is considerably smaller than the prenasalized bilabial [mb]. Moreover, only the voiced alveolar stop /d/ is sometimes devoiced in prosodic domain-initial position. This may corroborate Kim (2011), where the alveolar place of articulation tends to show less nasal airflow and are sometimes devoiced in prosodic domain-initial position. This may also corroborate Lonsdale (2021), where the sound change */n/ > /d/ was more prevalent than the bilabials */m/ > /b/. Because /d/ had a smaller P1 and sometimes devoiced in prosodic domain-initial position, it is possible that the perception of /d/ as voiced was perceptually more salient during the sound change from */n/ > /d/ than */m/ > /b/, where /b/ is never devoiced in prosodic domain-initial position.

## 8.5 Discussion

Based on the hypothesis given above, evidence of partial (weak) nasality in domain-initial position suggests the partial (weak) nasality of voiced stops were used to enhance the voicing contrast in

Lushootseed. However, there are other problems that need to be addressed. For example, there are questions concerning the phonological representation of voiced stops in Lushootseed. Moreover, there is the problem of how denasalization occurred in other neighboring languages that have also undergone this sound change. There is also the question of whether nasals in Lushootseed are contrastive, and whether the use of nasals in certain styles of speech would be evidence for contrastive nasals in the language. In this section, I discuss (1) the phonological representation of voiced stops in Lushootseed, (2) other problems that need to be addressed, (3) the use of nasals in certain styles of speech, (4) whether nasals are contrastive in Lushootseed, and (5) accounting for other voiced obstruents.

### 8.5.1 *Phonological representation of voiced stops in Lushootseed*

There are two conflicting views on the underlying (phonological) representation of voiced stops in Lushootseed. One view is that voiced stops in Lushootseed pattern with sonorants (Urbanczyk 1996, Rice 1993). Here, I will be referring to this view as the 'sonorant alignment' hypothesis. According to Keren Rice (1993), there are languages whose voiced stops pattern with sonorants. In fact, under this view, voiced stops do not have an underlying [voiced] feature in these languages. Rather, languages whose voiced stops pattern with sonorants have a 'sonorant voicing' [SV] feature, which allows voiced stops to alternate with other sonorants such as nasals. This can be observed in *Sahtúot'į̨nę̨ kədə́*, an Athabaskan language spoken in northern Canada. As the *Sahtúot'į̨nę̨ kədə́* example in (2) shows, the oral stops in the imperfective stem form alternates with the nasal stops in the perfective stem.

(2) *Sahtúot'įnę kədə́*[7]

a. [-de] 'win (imperfective)'
[-nõ] 'win (perfective)'
b. [-be] 'swim (imperfective)'
[-mĩ] 'swim (perfective)' (Rice 1993:322)

According to Rice (1993), voiced stops in these languages do not contrast from nasals (instead, voiced stops pattern with sonorants in these languages). According to Urbanczyk (1996), Lushootseed is one of these languages. Evidence that Urbanczyk gives comes from data on root-initial clusters in Lushootseed. Urbanczyk found that there were no root-initial clusters containing voiced obstruents or sonorants, suggesting that voiced obstruents behaved like sonorants.

There are several problems with the sonorant alignment hypothesis. One problem is that the sonorant alignment hypothesis does not provide evidence for the expected direction of change (or the motivation for the change) (i.e., where nasals became voiced stops). Based on Urbancyzk's work, there was only evidence for how voiced obstruents might pattern with sonorants. However, this itself does not provide evidence for denasalization. One problem with Urbancyzk's evidence for sonorant alignment is that voiced stops not occurring in root-initial clusters may simply be an artifact of the fact that voiced stops were once sonorants (i.e., nasals), which could not occur in root-initial clusters prior to the denasalization shift because these were nasal stops and not oral stops. In other words, voiced stops not occurring in root-initial clusters may simply be evidence that these stops were reflexes of nasals, which were underlyingly sonorants prior to the denasalization shift. However, this would not be direct evidence of voiced stops patterning with sonorants in today's Lushootseed (i.e., synchronic, post-denasalization Lushootseed). It could be interpreted as simply being an artifact of the fact that voiced stops were once sonorants (i.e., nasal stops) prior to the denasalization shift, which could not occur in root-initial clusters (in other

[7] Also called "Bearlake Slave" (Rice 1993).

words, it may be an inherited phonotactic restriction). Sonorant alignment does not provide evidence for the direction of change (i.e., from nasals to voiced stops), nor does it provide evidence for what may have phonetically motivated the sound change.

It is also worth noting that there was evidence of voiced obstruents patterning with voiceless obstruents in Lushootseed. For example, sonorants in Lushootseed (especially lateral approximants and labio-velar approximants) tend to laryngealize (via creaky voicing) in reduplicated stems. In some stems that contain a syllable-final sonorant, the sonorant consonant becomes laryngealized in the reduplicant syllable. However, like voiceless stops, voiced obstruents do not laryngealize in reduplicant syllables. This is shown in (3) for the CVC+ reduplicant, which functions as the distributive reduplication (distributive reduplication signals plurality or a verbal designation to more than one object in Lushootseed). As (3) shows, voiced obstruents pattern closely with voiceless obstruents because the voiced stop /b/ in /jubil/ ‹yubil› 'starve' does not laryngealize in the reduplicant syllable /jub~jubil/ ‹yub~yubil› 'many starves'. This contrasts from the sonorant /l/ in /stulək$^{w}$/, which laryngealizes in the reduplicated stem /stul$^{ʔ}$~tulək$^{w}$/ ‹stul̓~tulək$^{w}$› 'rivers'.

| (3) | Stem | DIST~Stem |
|---|---|---|
| Sonorant | stulək$^{w}$ 'river' | stul$^{ʔ}$~tulək$^{w}$ 'rivers' |
| Voiceless | tupud 'pound (TR)' | tup~tupud 'pound many (TR)' |
| Voiced | jubil 'starve' | jub~jubil 'many starves' |

Evidence of voiced obstruents patterning with voiceless obstruents based on data from reduplication in Lushootseed has also been noted by Botma (2004).

Another strong evidence against the sonorant alignment hypothesis is the realization of the voiced alveolar stop /d/ in domain-initial position. As discussed in Section 8.4.2, the voiced alveolar stop /d/ are sometimes devoiced [d̥] in word-initial position. Moreover, as discussed in Chapter 6, voiced dorsal stops /g/ and /g$^{w}$/ are always devoiced in word-initial position. The devoicing of these stops in word-initial position may suggest that voiced stops pattern with obstruents and not sonorants.

Another problem with the sonorant alignment hypothesis is that, in Rice's (1993) [SV] model, the expected direction of change would (diachronically) be from voiced stops to nasals: */d/>/n/, */b/>/m/. Based on evidence from Athabaskan languages, voiced stops become realized as nasals in certain stems. This suggests that the expected direction of change for voiced stops that are underlyingly sonorants would be to shift into a segment that is produced with more sonority (like nasals) to "enhance" the sonority of those segments. However, in Lushootseed, the direction of change was underlyingly from nasals to voiced stops: */n/>/d/, */m/>/b/. The sonorant alignment hypothesis does not directly address the problem of why the direction (or expected direction) of change went from nasals to voiced stops.

Advocates of the sonorant alignment hypothesis argue that denasalization may be evidence of sonorant alignment. However, proponents of this view have not addressed how sonorant alignment would be evidence for denasalization. The evidence that was proposed for sonorant alignment does not predict denasalization. In other words, it is unlikely that nasals became voiced stops based on the evidence proposed for sonorant alignment. This statement would, in fact, be contradictory to the proposal that there was an expected direction of change from nasals to voiced stops.

Because nasal stops shifted to voiced oral stops in Lushootseed, an account needs to address how a system of sonorants shifted to segments that became less like sonorants. In other words, an account needs to address how nasals in Lushootseed historically became more like obstruents and less like sonorants. The strongest evidence for voiced stops being underlyingly obstruents comes from the current phonetic data, where there were instances of partial nasality for voiced stops in prosodic domain-initial position.

According to Wetzels & Nevins (2018), prenasalization of voiced stops in prosodic domain-initial position is evidence of voice *enhancement*, where the partially nasalized portion that emerges on voiced stops is a way of enhancing the voicing contrast in the class of oral stops (Wetzels & Nevins 2018:841). In other words, prenasalization in domain-initial position is a form of *enhancement* of voiced stops, which is a strategy for *hypervoicing* obstruents. The reason why prenasalization was used in those positions was likely because it cued enhancement of a voicing contrast for these stops. This would signal a voicing contrast, which suggests that a [voiced] feature (and not an [SV] feature) was underlyingly present for these consonants. Although /b d/ being realized as [mb nd] would make the stops more sonorant-like (phonetically), this is a synchronic process that is used to enhance the underlying [voice] feature, which suggests that these stops are underlyingly obstruents. In other words, the prenasalization of voiced stops is distinct from the diachronic denasalization process discussed above. The evidence here contrasts strongly from the views of Rice (1993) and Urbancyzk (1996), who stated that Lushootseed underlyingly patterns voiced stops with sonorants and that voiced stops do not have a [voice] feature but instead has an [SV] feature. Because prenasalization occurred in prosodic domain-initial position and never intervocalically, the underlying representation of voicing was strong for these consonants.

Proponents of the sonorant alignment hypothesis may argue that it is possible to interpret the partial (weak) nasality of voiced stops as evidence of sonorant alignment. Because voiced stops were partially nasalized in domain-initial position, speakers may have perceived the voiced stops more like sonorants (i.e., it may have been used to "enhance" the sonority of these segments). This cannot be the case because, if this were true, then the opposite direction of change (diachronically) would be expected (i.e., voiced stops to nasals, as in */b/>/m/ and */d/>/n/). If voiced stops were underlyingly sonorants, then prenasalization would be evidence of voiced stops diachronically shifting into something that was more sonorant (i.e., nasals) due to the enhancement of sonority to those segments. In fact, this kind of shift (where voiced stops shifted to nasals, with an intermediate step of prenasalization) has been observed in other languages such as Malay, where historically prenasalized stops shifted to fully nasalized stops (Ladefoged & Maddieson 1996). However, in Lushootseed, the diachronic shift did not occur in this direction. In fact, it went from nasals to voiced stops (i.e., */m n/ > /b d/). This would suggest that the kind of sound change that occurred in the language may have been due to fortition (or strengthening) of these segments. As mentioned above, the prenasalization of voiced stops in Lushootseed would be evidence of voice enhancement, where the prenasal portion is a way of enhancing the voicing contrast in the class of oral stops. Contrary to the views of Rice (1993), this would suggest that a [voiced] feature (and not an [SV] feature) was present in the class of Lushootseed voiced stops. Under this view, voiced stops in Lushootseed should phonologically be represented as an obstruent and not a sonorant.

Under this view, voiced stops are underlyingly obstruents in Lushootseed. This suggests that the underlying sonority of nasals have become lost (historically) over time. Under this hypothesis, nasal stops may have strengthened to voiced oral stops. The weakening of nasality resulting in the complex stops being reanalyzed as /b d/ rather than /m n/ was likely because the prosodic positions that it occurred in were perceptually salient. Because they became partially (weakened) nasal segments in perceptually salient environments, the partial (weakened) nasal airflow of these segments likely became used to “enhance” the perceptibility of a voicing contrast for these stops in Lushootseed. This may have led speakers to perceive nasal stops as voiced oral stops in Lushootseed. This was also what most likely motivated the partial (weak) nasality of voiced stops in domain-initial position to be used in the language. This was what may have motivated the denasalization shift to occur from a phonetic and phonological point of view.

To summarize, there are two conflicting views concerning the underlying (phonological) representation of voiced stops in Lushootseed. One view argues that voiced stops in Lushootseed patterns with sonorants (Rice 1993, Urbancyzk 1996). Under this view, voiced stops do not have a [voiced] feature, but (instead) have what Rice calls a ‘Sonorant Voicing’ [SV] feature. The other view (the view that I adopt) is that voiced stops are underlyingly obstruents (and not sonorants) in Lushootseed (Botma 2004). Based on evidence of partial (weak) nasality in prosodic domain-initial position, the phonetic findings strongly point out that voiced stops are underlyingly obstruents (and not sonorants) in Lushootseed. This suggests that voiced stops in Lushootseed have a [voiced] feature (and not an [SV] feature) that is underlyingly present in the language.

### 8.5.2 *Questions concerning the linguistic area*

Despite the efforts of this chapter to address how denasalization may have occurred in Lushootseed, there are other questions that need to be addressed. One of these questions involves the distribution of this feature in languages across the Pacific Northwest area. As mentioned in the introduction, denasalization was an areal feature that affected some languages in the Pacific Northwest. These languages include two Central Salish languages (i.e., Lushootseed and Twana) and a few non-Salish languages (i.e., Quileute (Chemakuan), Makah and Nitinat (Wakashan)). The question remains: how did denasalization become a feature for these languages? According to Haas (1969), the feature was most likely diffused into Nitinat and Makah due to areal pressure from neighboring Salish languages. If the hypothesis proposed in this paper is correct (that denasalization is both phonetically and phonologically motivated), then how was this shift diffused into other (non-Salish) languages?

It was possible that the fortition of nasals to voiced stops was prominent in languages like Lushootseed, Twana, Quileute, Makah, and Nitinat because domain-initial strengthening itself was a prominent feature in the linguistic area. As mentioned in Section 8.3.2, neighboring languages such as Quinault and Klallam do, in fact, show evidence of domain-initial strengthening of non-nasal approximants as both a synchronic (in the case of Quinault) and diachronic (in the case of Klallam) source (Swadesh 1952, Thompson & Thompson 1972). Although denasalization did not occur in Quinault and Klallam, evidence of domain-initial strengthening did occur in these two languages. This phenomenon must have been diffused into neighboring languages around the linguistic area, which included Twana, Lushootseed, Quileute, and Makah. It was in those languages where the mechanism of domain-initial strengthening became used for nasal stops, which subsequently led these segments to become denasalized.

There are also questions to be raised concerning the interchangeable use of nasals and voiced stops during the 19$^{th}$-century. Although the interchangeable use of nasals and voiced stops has been documented for languages that underwent denasalization, it appears that this feature was also widely distributed across other Pacific Northwest languages during this period. Sapir (1915) documented a few words where voiced stops were used in place of nasals in Comox. There were also earlier records from Boas on the interchangeable use of nasals and voiced stops in other Pacific Northwest languages that were noted by Kinkade (1985), where only two instances of voiced stops and nasals were being used interchangeably in his Klallam materials. Boas also described the production of sounds in Lower Chinook, where he stated that labial "sonants" (i.e., voiced stops, approximants, and nasals) involved "a semiclosure of the nose and weak lip-closure, which is therefore intermediate between b, m, and w, with prevalent m character" (Boas 1911:565). There were records of Quinault during 1897 (by Livingston Farrand) showing a few instances of *d* where *n* would be expected (Kinkade 1985:479). However, instances where voiced stops and nasals were used interchangeably was never found in Squamish and Northern Straits, where these two languages have contrastive nasals in their phonemic inventory. This leads to the question of why only a subset of those Pacific Northwest languages underwent denasalization, whereas the others that also showed evidence of the interchangeable use of nasals and voiced stops did not undergo this shift and settled on nasals.

To address this problem, there may be evidence of a typological split across languages in the Pacific Northwest. It could be the case that domain-initial strengthening was a prominent feature in a subset of languages in the Pacific Northwest (which includes languages that have undergone denasalization), whereas the other subset of languages was unlikely to show a contrast between voiced obstruents and sonorants (e.g., Squamish, Northern Straits, and Comox, which are languages that have contrastive nasal stops in their phonemic inventory). The strongest evidence for a typological split could be observed when we compare the current findings with data from Comox. In Comox, there is evidence of voiced obstruents becoming laryngealized (like sonorants) in reduplicated syllables (Mellesmoen 2018). There is also evidence of voiced obstruents alternating with sonorants in Comox. This contrasts strongly from the current findings in Lushootseed, where voiced obstruents do not laryngealize in reduplicated syllables. Moreover, voiced stops sometimes devoice in word-initial position (as shown in Section 8.4.2, voiced alveolar stops /d/ were sometimes devoiced [d̥] in word-initial position). As discussed in Chapter 6, voiced velar and labiovelar stops /g/ and /gʷ/ are often devoiced in word-initial position (especially when preceded by a pause). The data from Comox and the current data from Lushootseed may provide evidence for why only a subset of the languages that showed the interchangeable use of nasals and voiced stops underwent denasalization. The distribution of languages that provides evidence of domain-initial strengthening were more-or-less contiguous in the linguistic area. It included the southernmost Central Salish languages (i.e., Lushootseed, Twana, and (diachronically) Klallam); a Tsamosan Salish language (i.e., Quinault) that falls further south and west from those Central Salish languages; and the non-Salish languages Quileute, Makah, and (diachronically) Chemakum. However, languages north past these areas (which includes Squamish, Northern Straits, Halkomelem, and Comox-Sliammon) utilized a system that did not contrast voiced obstruents from sonorants. This suggests that there may have been a typological split between languages where domain-initial strengthening was a prominent feature in the linguistic area and languages where domain-initial strengthening would not be expected because of the lack of a contrast between voiced obstruents and sonorants in those languages.

Another problem is the lack of social variables in the data. If the sound change was phonetically and phonologically motivated, then which social groups were leading this sound change? How did this sound change become widely distributed across speakers of different social groups in Lushootseed? There were no accounts of the social groups that used voiced stops and nasals interchangeably in the 19$^{th}$-century. It was possible that certain age groups during the 19$^{th}$-century used voiced stops in place of nasals. For instance, younger speakers during the 19$^{th}$-century might have used voiced oral stops, whereas older speakers were using nasals. This kind of apparent time data has never been recorded in 19$^{th}$-century literature on Lushootseed. This hypothesis is mere speculation on the social groups that were leading this phonetically (and phonologically) motivated sound change. Because there were missing social variables in the literature, an understanding of denasalization cannot be fully attained with 100% accuracy.

### 8.5.3 *The use of nasals in certain styles of speech*

In Lushootseed, when speakers were quoting or imitating animals in Salish myths, nasals were used in place of voiced oral stops. However, this was most likely due to changes in speech style that require some modulation of the vocal tract (where this modulation is not phonologically or linguistically significant) because nasalization was present throughout entire utterances requiring voicing (which included vowels and approximants, not just the voiced obstruents) during instances of quoting/imitating animals in Salish myths. Evidence of speech styles that require some modulation of the vocal tract can be found across languages.

Cross-linguistically, there are various stylistic ways of speaking, where speakers could modify their vocal tracts in such a way that could imitate certain figures or stereotype certain qualities of a character. Japanese (especially in Japanese animation) speakers often pharyngealize an entire utterance to imitate a certain figure of “masculinity”, which can also be used to convey (stereotypically) “unintelligence” or a “villain” of that character (Teshikawara 2004). Pharyngealization is not a contrastive feature in Japanese. Nevertheless, speakers can use pharyngealization in this way to imitate, convey, and/or stereotype certain qualities of a character. In English, children sometimes use nasality throughout entire utterances (sometimes even nasalizing voiced obstruents) to imitate (or “stereotype”) the femininity of characters (Cartei et al. 2019). Something similar may be happening in Lushootseed, except speakers were using nasality instead of “pharyngealization” (as in Japanese) to quote/imitate animals in Salish myths. The question becomes “why” speakers chose to use nasality as a voice modulation for quoting or imitating animals in Salish myths. This might due to the speakers’ recognition of the use of nasality as an archaic form of speaking, which was how the ancient animals from the Salish myths spoke.

Regardless, these kinds of voice modulations are common across languages and should not be treated as evidence for contrastive nasals in the language.

It has also been stated in the literature that adult speakers use nasality throughout the utterance when speaking endearingly to children (Hilbert & Hess 1976, Hess 1982). It is possible that denasalization may have been due to hypercorrecting the speech of adults who were speaking endearingly to children. As the children grew older, children may have hypercorrected nasal stops to voiced stops to “signify” that they were no longer children to speak endearingly towards. However, this is mere speculation on the denasalization shift in Lushootseed. Whether denasalization was a feature that emerged due to the hypercorrection of speech from children becoming adults cannot be determined from the current data.

### 8.5.4 *Nasal contrast in Lushootseed*

The only evidence of contrastive nasals in Lushootseed can be observed in the word /mimuʔan/ ‘small, little’. As mentioned in Section 8.2, it was possible that the word was borrowed from a neighboring Central Salish language. Nevertheless, evidence from borrowing may not preclude evidence of contrastive nasal stops in Lushootseed. In most cases, the sounds of a word from the donor language becomes changed to conform to native sounds and phonetic constraints of the borrowing language. This process is known as *phoneme substitution*, where a foreign sound in borrowed words that do not exist in the receiving language is replaced by the nearest phonetic equivalent in the borrowing language (Campbell 2020:65). In fact, phoneme substitutions of borrowed words have been found in Lushootseed, where the nasal stops were replaced with oral voiced stops in a few English loans. For example, this could be observed in the word /blas/ ‘molasses’, which was borrowed from the English word ‘molasses’. This could also be observed in the word /pastəd/ ‘white person’, which was borrowed from the English word ‘Boston’. If this were to be the case, then, by phoneme substitution, the word /mimuʔan/ ‘small, little’ should have been borrowed in its denasalized form, as in /bibuʔad/, because the nearest phonetic equivalent to the nasals were the voiced oral stops. However, because the word was not borrowed in this manner (i.e., the nasals were retained), this may suggest that nasals were underlyingly contrastive in Lushootseed because no phoneme substitution of the nasal stops took place. It could be suspected that the word /mimuʔan/ ‘small, little’ was borrowed later (i.e., post-denasalization shift). However, the word did appear as far back as Gibbs’ 1872 dictionary of Nisqually, where it was transcribed as *mi-mān* ‘small’. This suggests that the word may have been a part of the Lushootseed lexicon even prior to the denasalization shift. This would suggest that speakers may have contrasted nasals from voiced stops, and only a few words (such as /mimuʔan/ ‘small, little’) retained its nasals because the nasals in those words were (apparently) useful for contrasting words. This may further suggest that voiced stops do not pattern with sonorants because there was an underlying contrast between nasals and voiced stops.

Another piece of evidence for a nasal contrast could be found in some Lushootseed proper names. For example, the speaker Ruth Shelton’s indigenous name was /siastənu/, which contained the alveolar nasal stop /n/. Other proper names include /t͡ʃuχiləm/ ‹čux̌iləm› for the speaker Stan Jones (Bates et al. 1994:379). Speakers in Lushootseed may have been aware of a contrast between nasal stops and oral stops. Although nasal stops were denasalized for almost all Lushootseed words that contained it, speakers may have still been aware of a contrast between nasal stops and oral stops. This may have led speakers to use nasal stops for certain naming conventions (such as proper names).

However, it was possible that speakers were aware of a nasal contrast because speakers at the time knew how to speak English as a second language, which contrasts nasals from voiced stops. Second language perceptions of nasals may have been very strong for these speakers. In other words, a speakers' awareness of a nasal contrast may not be evidence of an actual nasal contrast in Lushootseed because speakers were fully aware of a nasal contrast from their second language. Nevertheless, this does not explain why the nasals in the word /mimuʔan/ 'small, little' were retained in Lushootseed. In other words, it is difficult to determine whether there was a nasal contrast in Lushootseed.

### 8.5.5 *Other voiced obstruents*

There are other voiced obstruents that contrast in Lushootseed. These include /g/, /$g^{w}$/, /d͡ʒ/ ‹ǰ›, and /d͡z/ ‹$d^{z}$›. Most other Salish languages do not contrast these voiced obstruents. However, the origins of these stops could be inferred based on their distribution in words. There are two positions in a word where the surface realization of these voiced obstruents can occur in Lushootseed: word-initially and intervocalically. These voiced obstruents rarely occur word-finally (i.e., they can never occur word-finally as a surface realization). These voiced obstruents can occur at the end of bound roots. However, these roots are bound morphemes and must combine with another morpheme that is initialized with a vowel. The occurrence of voiced obstruents /$g^{w}$/ and /d͡ʒ/ in word-initial position can be explained as follows: In word-initial position, these two voiced obstruents are reflexes of the approximants */w/ and */j/ respectively, which became obstruents due to domain-initial strengthening. As mentioned earlier, domain-initial strengthening for these approximants has been attested in other Salish languages such as Quinault, where /w/ is realized as [$g^{w}$] and /j/ is realized as [d͡ʒ] in domain-initial position (Swadesh 1952, Thompson & Thompson 1972). In fact, this is the most common type of phonological fortition according to a typological survey by Easterday & Bybee (2019). This suggests that the obstruent variants of those approximants have phonologized into the Lushootseed phonemic inventory.

However, it is difficult to identify what the voiced velar stop /g/ was a reflex of in Lushootseed. The voiced velar stop [g] occurred very rarely in the data. There are only a small number of words that begin with the voiced velar stop /g/ in Lushootseed. Acoustic evidence showed that the voiced velar stop /g/ in Lushootseed is devoiced [g̊] in word-initial position (see Chapter 6 for more details). More research (such as comparative analyses) needs to be done on the voiced velar stop /g/ to determine what it was a reflex of in Lushootseed in an earlier stage of the language.

It is possible to identify what /d͡z/ is a reflex of in Lushootseed. When compared with Klallam, cognates of words beginning with /d͡z/ in Lushootseed appear to be words that begin with /t͡ʃ/ in Klallam. For example, the cognate of the word /d͡zaq'/ ‹dᶻaq̓› 'fall' in Lushootseed is /t͡ʃaq'/ ‹čaq̓› 'fall' in Klallam. As mentioned in the end of Section 8.3.2, Klallam has historically undergone domain-initial strengthening of */j/>*/d͡ʒ/, which later devoiced into /t͡ʃ/. This intermediate step of */d͡ʒ/ in Klallam may provide some clues to the historical development of /d͡z/ in Lushootseed. In Lushootseed, */d͡ʒ/ may have shifted to /d͡z/ through fronting. In other words, the direction of change may have been from */j/>*/d͡ʒ/>/d͡z/ for those words containing /d͡z/ in Lushootseed, where */d͡ʒ/ has fronted to /d͡z/. However, there was no evidence from the conditioning environment that appeared to have motivated fronting. It's possible that /d͡z/ developed separately from /d͡ʒ/, though there is no clear evidence for this development from the conditioning environment. However, fronting has also been observed for the voiceless post-alveolar fricative /ʃ/ ‹š› across dialects in Lushootseed. For example, the word for 'sibling-in-law' in the Southern dialect is /t͡ʃ'əbəʃ/ ‹č̓əbəš› 'sibling-in-law', whereas in the Northern Lushootseed dialect it is /t͡ʃ'əbas/ ‹č̓əbas› 'sibling-in-law'. Further evidence of /d͡z/ being a reflex of */j/ can be observed in Squamish, where the word for 'fall' (which is /d͡zaq'/ ‹dᶻaq̓› in Lushootseed) is /jaq̓/

‹yak̲’› ‘fall’ in Squamish. This provides further evidence of a typological split across Pacific Northwest languages, where Pacific Northwest languages that showed domain-initial strengthening (i.e., Lushootseed, Twana, Klallam, Quinault, Quileute, Makah, and Chemakum) split from languages north past these languages, which did not undergo domain-initial strengthening because of the phonological representation of sonorants in those languages.

## 8.6 CONCLUSION

In this chapter, I addressed the question of whether phonetic nasality (as opposed to phonological nasality) was present in Lushootseed. I conducted a qualitative and quantitative acoustic analysis of voiced stops in Lushootseed. The evidence showed that voiced stops were partially (weakly) nasalized in domain-initial position. I also used the evidence of partial (weak) nasality in Lushootseed to address some problems on denasalization in the language. For example, the current evidence showed that voiced stops have an underlying [voice] feature, which is contrary to the views of Rice (1993) and Urbanczyk (1996). Although there are other issues on denasalization that has yet to be addressed, the current findings is not only a first step towards addressing some problems concerning the phonetic and phonological representation of nasality and voiced stops in Lushootseed, but it is also the most detailed account of the presence of phonetic nasality and the phonological status of voiced stops in Lushootseed.

# Chapter 9. ACOUSTIC PROPERTIES OF LARYNGEALIZED SONORANTS AND GLOTTAL STOPS

## 9.1 OVERVIEW

In this chapter, I cover laryngealized sonorants and glottal stops in Lushootseed. Laryngealization (which comes in the form of creaky voice) can be observed for laryngealized sonorants and glottal stops (see Chapter 6 for more details on the creaky voiced onset of ejectives). Like most Salish languages, Lushootseed is known for having a set of laryngealized sonorants (also called "glottalized resonants" in Salish linguistics) in its phonemic inventory. Laryngealized sonorants are typologically rare and are said to be found most frequently in languages with obstruents that involve a glottalic airstream mechanism (i.e., ejectives and/or implosive) (Maddieson 1984:116). The three laryngealized sonorants of Lushootseed, the palatal /jˀ/ ‹y̓›, labio-velar /wˀ/ ‹w̓›, and the lateral alveolar /lˀ/ ‹l̓›, are realized with creaky voicing and are realized as post-glottalization (see Section 9.4 and 9.5 for more details).

Early documentation of Lushootseed (and other Salish languages) did not recognize laryngealized sonorants as a class of segments (Efrat 1978, Mitchell 1968). For example, some of the work done by anthropologists Colin Tweddell (1947, 1950) and Warren Snyder (1957, 1968) transcribed laryngealized sonorants as a sequence of an approximant and a glottal stop. Laryngealized sonorants weren't present in the transcription of Lushootseed sounds until the mid-late 20th-century, where they were recognized and transcribed as contrastive sounds by the linguist Thom Hess (1967, 1976). Today, second language learners are well aware of this class of segments.

In this chapter, I examine laryngealized sonorants in Lushootseed. In Section 9.2, I discuss the physiological mechanisms and acoutic properties of creaky voicing and glottal stops, the types of creaky voicing observed in the data. In Section 9.3, I discuss the distribution of laryngealized sonorants in Lushootseed using data from the Lushootseed dictionary (Bates et al. 1994). Section 9.4 describes the acoustic attributes of laryngealized sonorants in Lushootseed using six acoustic measures: jitter, spectral tilt, fundamental frequency (f0), and intensity. In Section 9.5, I discuss implications of the diachronic status of laryngealized sonorants in Lushootseed and the larger Salish family in light of the acoustic measures. Section 9.6 concludes with a summary.

## 9.2 PHYSIOLOGY AND ACOUSTICS OF CREAKY VOICING AND GLOTTAL STOPS

The term "creaky voice" refers to a number of different kinds of voice production (Keating et al. 2015). Previous work described creaky voice as having several acoustic and physiological characteristics (Laver 1994; Keating et al. 2015). These include the following: Low subglottal pressure and glottal flow (Murry 1969, Murry & Brown 1971, McGlone 1967, Monsen & Engebretson 1977); slack, thick, and medial compression of the vocal folds, with a small length of the ligamental glottis vibrating (Ladefoged 1971, 2001); ventricular incursion, where the ventricular folds contact the upper surface of the vocal folds, subsequently increasing the effective mass (but not the tension) of the folds, which dampens the airflow through the glottis (Hollien et al. 1966; Moore 1971); longitudinal shortening of the vocal folds; aryepiglottal-epiglottal constriction, where the aryepiglottal folds pulls the cuneiform cartilages closer to the surface of the epiglottis (Lindqvist-Gauffin 1969, 1972; Esling & Harris 2005; Edmondson & Esling 2006; Esling et al. 2005; Lindblom 2009); low fundamental frequency (f0) and irregular glottal pulses; as well as irregular amplitude, low Open Quotient, skewed glottal pulses, and low spectral tilt (Childers & Lee 1991, Gobl & Ni Chasaide 2010, Klatt & Klatt 1990). Keating et al. (2015) reported that there are many types of creaky voicing, each showing some variability to the properties described above. These types include the canonical creaky voice, vocal fry, pulse doubling, aperiodic voice, non-constricted creak, and tense/pressed voice.

The canonical type of creaky voicing is characterized by three patterns: (1) low rate of vocal fold vibration; (2) irregular glottal pulses; and (3) constricted glottis, with the posterior portions of the vocal folds held together and the anterior (ligamental) portions vibrating (Ladefoged 1971:14-15). Each glottal pulse in the waveform is spaced widely apart and at irregular intervals. This type of creaky voicing occurs quite frequently in laryngealized sonorants in Lushootseed. This is illustrated in Figure 9.1, where the laryngealized lateral approximant /lˀ/ shows properties of canonical creaky voice.

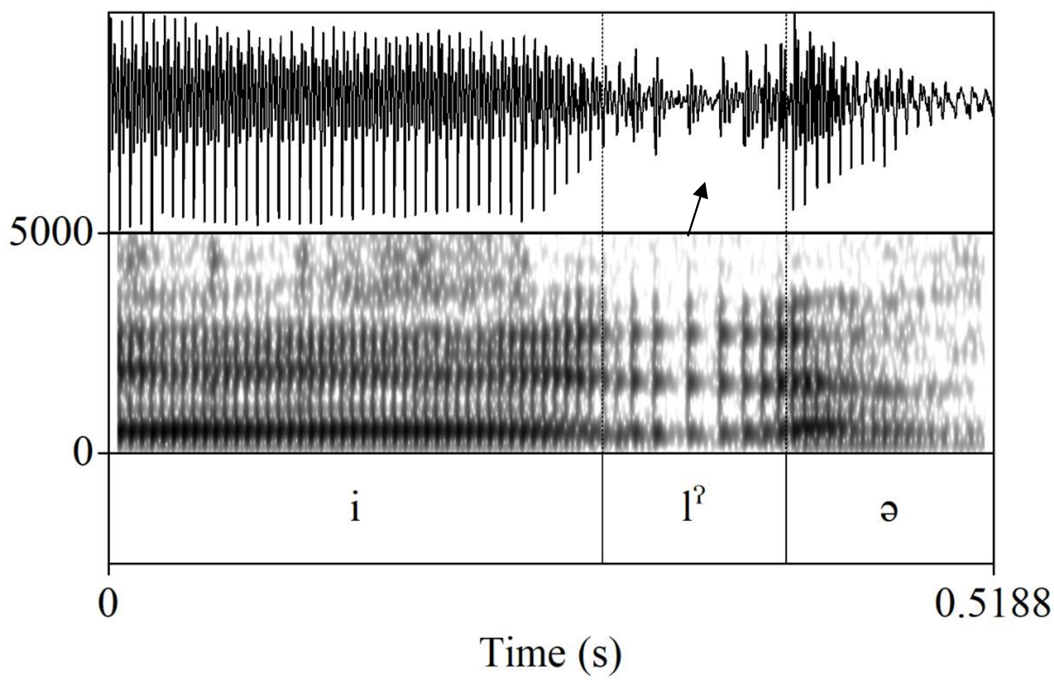



**Figure 9.1** Waveform and spectrogram of the canonical creaky voice for the laryngealized lateral approximant /lˀ/ in the word /ʔəbilˀəxʷ/ 'if now'. From the speaker Annie Jack. The arrow points to the interval that illustrates canonical creaky voice.

Another type of creaky voicing is known as "pulse doubling" or "pitch doubling". It is also known as "diplophonia" (Hong & Kim 1999, Imaizumi & Gauffin 1991) and "dicrotic dysphonia"

(Hollien et al. 1966, Moore & von Leden 1958) in the clinical literature. In such instances, there is "a vibrating pattern in which the vocal cords separate twice in quick succession and then approximate firmly in a relatively long closed phase" (Moore & von Leden 1958:235). Although this type of creaky voicing shows irregular glottal pulses and a constricted glottis (like the canonical creaky voice), f0 is not necessarily lowered (Keating et al. 2015:2). This type of creaky voicing shows alternating longer and shorter pulses. It occurred only a few times in one recording of the speaker Annie Jack. An example of pulse doubling can be observed in the waveform in Figure 9.2.

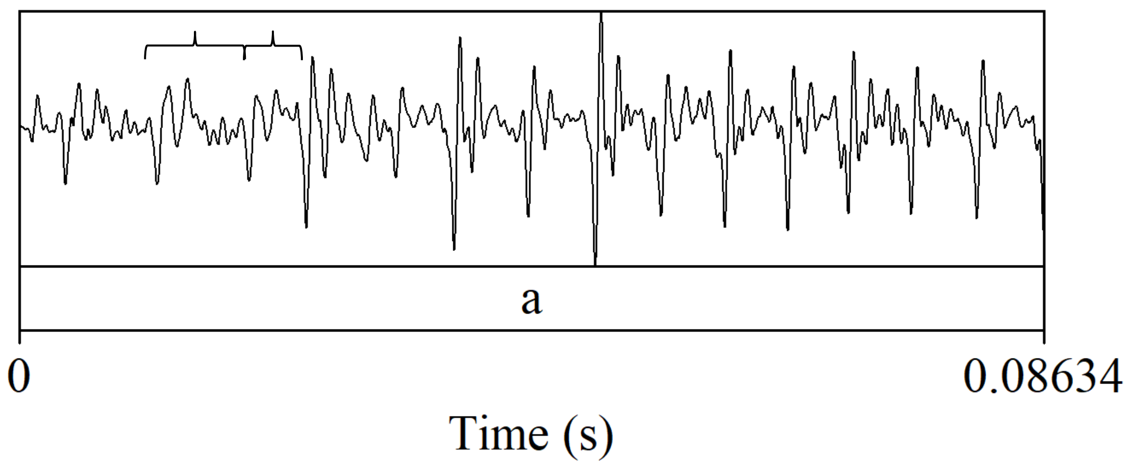



**Figure 9.2** Waveform of pulse doubling, taken from the vowel /a/ from the Lushootseed speaker Annie Jack. Brackets mark the intervals of alternating longer and shorter pulses.

As mentioned above, pulse doubling occurred only a few times in one recording of Annie Jack. However, it was not always realized on phonologically contrastive glottalized segments (i.e., glottal stops, laryngealized sonorants, and/or ejectives). It occurred as an epiphenomenon for only two instances of the vowel /a/ in one recording. For this reason, pulse doubling should not be interpreted as a phonologically contrastive type of creaky voice in Lushootseed.

Another type of creaky voice that occurs in Lushootseed is "aperiodic voice", which is defined as f0 irregularity that is "taken to the extreme – vocal fold vibration is so irregular that there is no periodicity" (Keating et al. 2015:2). This can often be observed in laryngealized sonorants that are followed by an obstruent (usually a fricative). Figure 9.3 illustrates this kind of creaky voicing, where the interval labelled AV (aperiodic voice) shows extreme aperiodicity towards the end of its interval.

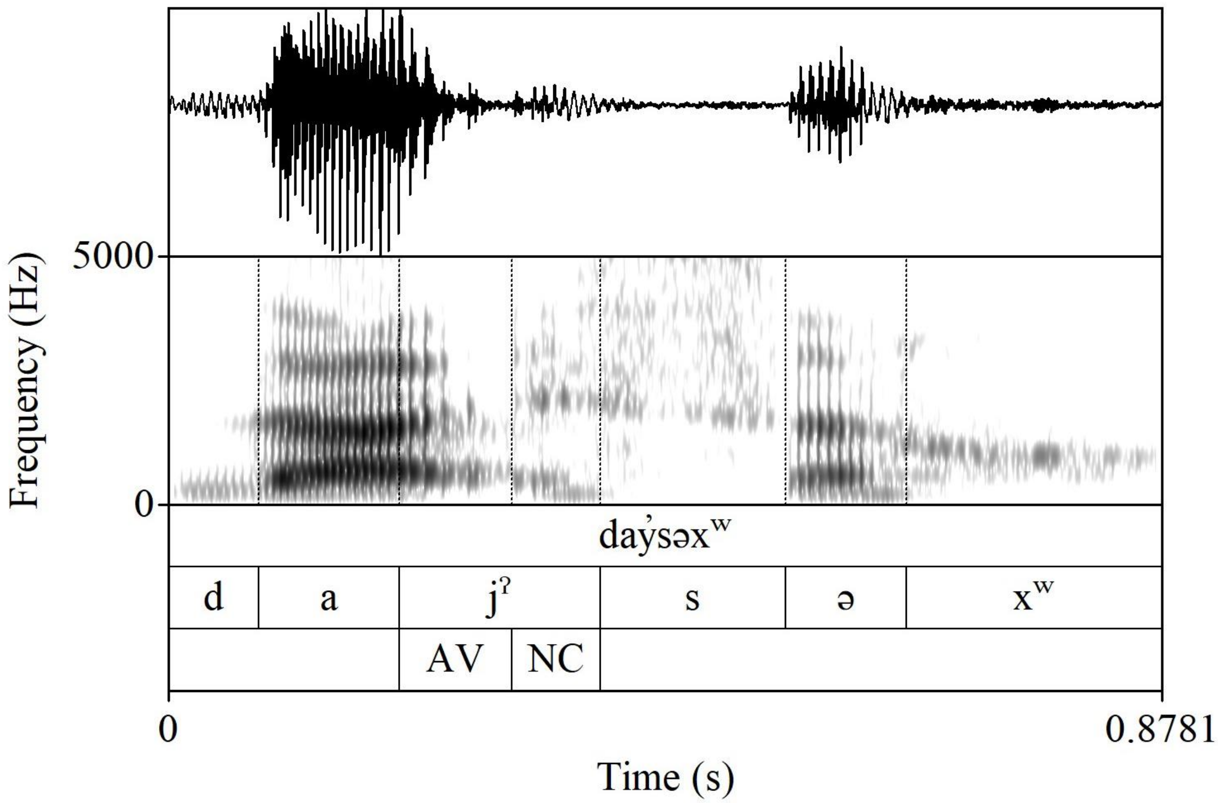



**Figure 9.3** Waveform and spectrogram of the word *day̓səxʷ* 'only, uniquely him(?) now' illustrating the periods of AV (aperiodic voice) and NC (nonconstricted creak).

However, Figure 9.3 also illustrates another type of creaky voicing in laryngealized sonorants: "Nonconstricted Creak" (labelled NC). In nonconstricted creak, although there is a low f0 (like canonical creaky voice) and irregular pulses, the glottis is spreading, not constricted (unlike canonical creaky voicing or aperiodic voice, where the vocal folds are tightly adducted, causing a drop in airflow through the glottis). This leads to an increase in airflow through the glottis. As Figure 9.3 illustrates, NC is preceded by a brief AV interval and is followed by the voiceless alveolar fricative [s]. The brief period of NC may have been due to the glottis spreading in anticipation of the following voiceless fricative (which involves a spread glottis).

Other types of creaky voicing include "vocal fry" and "tense/pressed voice" (Keating et al. 2015; Stevens 2000). However, these types of creaky voicing occurred rarely or (like pulse doubling) occurred as an epiphenomenon in the data. Although "vocal fry" (where there is a constricted glottis, low f0, and a high dampening of the pulses, but is not necessarily irregular (Keating et al. 2015:3)) occurred a few times in the recordings (sometimes at the end of an Intonational Phrase), it did not occur (or occurred rarely) on phonologically contrastive glottalized segments.

Glottal stops are made by holding the vocal cords tightly together, preventing air from passing through the glottis (Ladefoged 2001:48). Laver (1994:187-188, 206) defines a glottal stop as a maintained complete glottal closure. Glottal stops also occur during coughing (Ladefoged 2001:48). Like creaky voicing, glottal stops are often realized with an adduction of the arytenoid cartilages, medial compression of the vocal folds, a partial adduction of the ventricular folds, ventricular incursion, and a moderate narrowing of the laryngeal vestibule[8] through its epilaryngeal sphincter mechanism (Esling 1996:72-63, 1999:358-369; Esling & Harris 2005:358; Harris 1999, 2001; Garellik 2013).

Like the production of creaky voicing, the ventricular folds are adducted and comes into contact with the vocal folds (also known as ventricular incursion) for glottal stops, which dampens the airflow through the glottis (Fujimura & Sawashima 1971, Roach 1979, Harris 2001, Hollien et al. 1966, Moore 1971, Lindqvist-Gauffin 1969, Esling et al. 2005b). The inferior surfaces of the ventricular folds come into contact with the superior surfaces of the vocal folds, which creates an

[8] The laryngeal vestibule is defined as the supraglottal cavity of the larynx that extends from the ventricle of the larynx upwards through the aditus larynges (Zemlin 1998:117).

unusually thick, compact structure prior to the initiation of voicing (Hollien et al 1966:247). The lateral cricoarytenoid (LTA) and thyroarytenoid (TA) muscles are contracted to prevent air from passing through the glottis during a full glottal stop closure (Hirose 1997). However, in connected speech, glottal stops are seldom realized with a fully closed glottis (Ladefoged & Maddieson 1996, Esling & Harris 2005). According to Ladefoged & Maddieson, "glottal stops are apt to fall short of complete closure, especially in intervocalic positions. In place of a true stop, a *very compressed form of creaky voice or some less extreme form of stiff phonation may be superimposed on the vocalic stream*." (Ladefoged & Maddieson 1996:75, emphasis added). This is illustrated in Figure 9.4, where the intervocalic glottal stop in the Lushootseed word /ʔuʔəɬəd/ 's/he ate' is "creaky voiced". This suggests that glottal stops have the tendency to be realized with creaky voicing.

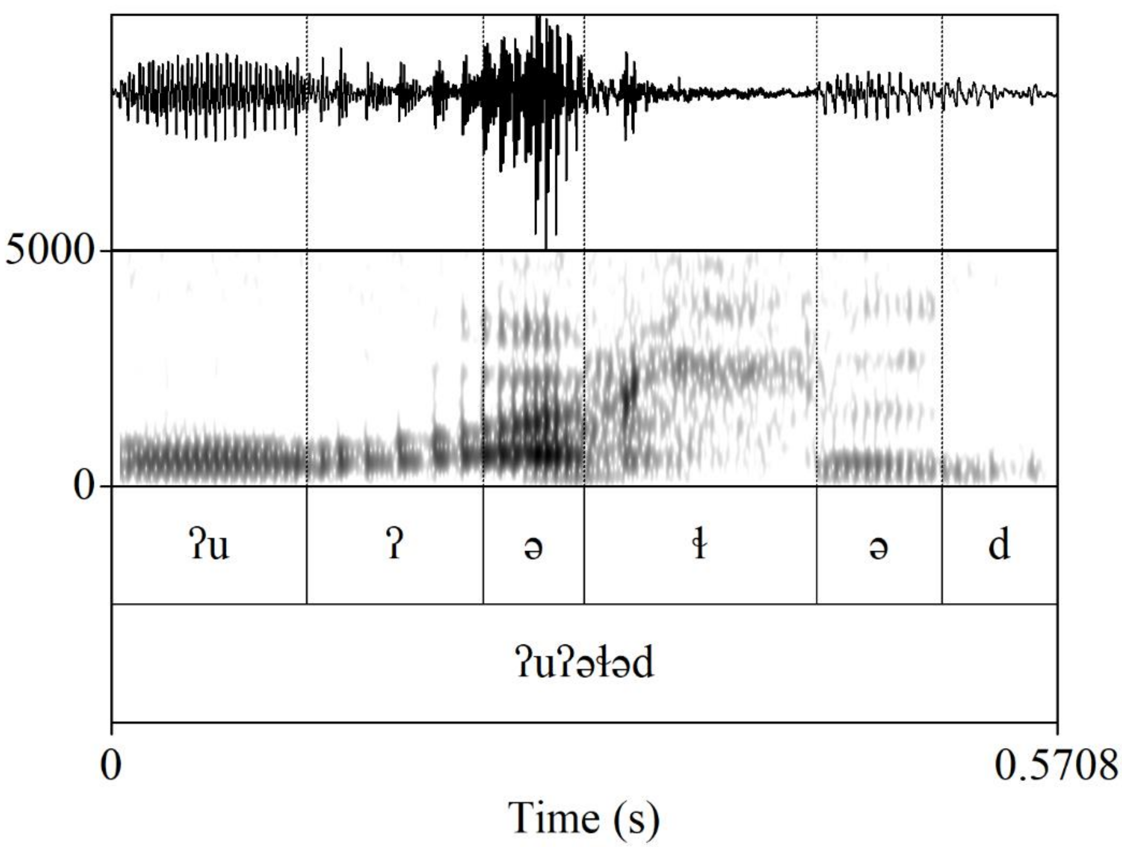



**Figure 9.4** Creaky voicing of the glottal stop /ʔ/ in intervocalic position, from the word /ʔuʔəɬəd/ 's/he ate'.

It is also important to note that, as illustrated in Figure 9.4, glottal stops were realized with canonical type of creaky voicing in Lushootseed.

The acoustic and physiological mechanism behind glottal stops is important to understanding the diachronic status of laryngealized segments, where laryngealized segments have historically phonologized from adjacent glottal stops in other languages (Silverman 1995; Kuang 2011, 2012; Garallek 2013). According to Silverman (1995), laryngealized phonation was derived historically from glottal stop lenition in the Popolocan language Mazatec. This has also occurred in checked syllables (where glottal stops occur in syllable-final position) in Yi languages (Kuang 2011, 2012). This suggests that laryngealization is often historically derived from glottal stops (Garallek 2013).

## 9.3 Distribution of Laryngealized Sonorants in Lushootseed

Laryngealized sonorants can occur only in word-medial and syllable-final (coda) position in Lushootseed. The data that was used to analyze the distribution of laryngealized sonorants comes from the Lushootseed dictionary (Bates et al. 1994) and the Metcalf recordings. Based on the data, there were no instances of laryngealized sonorants occuring in word-initial position. In the Lushootseed dictionary, there were many entries that included "alternative" transcriptions of words that involved a laryngealized sonorant. Most of these alternative transcriptions involved a plain sonorant that was adjacent to a glottal stop /ʔ/. There were some words in the Lushootseed dictionary where the laryngealized sonorant consonant was alternatively transcribed as a vowel adjacent to a glottal stop(s). These words include the following:

| (1) **Transcription** | **Alternative** |
|---|---|
| a. /ʔəjˀ/ ‹ʔəy̓› ‘find’ | ‹ʔiʔ› |
| b. /t͡ʃʼawˀ/ ‹č̓aw̓› ‘smelt’ | ‹č̓aʔuʔ› |
| c. /dəwˀajus/ ‹dəw̓ayus› ‘fermented salmon eggs’ | ‹duʔayus› |
| d. /k’ələwˀ/ ‹k̓ələw̓› ‘a greedy person’ | ‹k̓əluʔ› |

It is unknown if the alternative transcriptions of the words in (1) were produced in the manner they were transcribed by the observer. Moreover, it is unknown if speakers preferred one of the two forms of transcription for these words.

There were a few instances where the alternative transcription of a word involved a glottal stop preceding an approximant. This is observed in the word /ʔajˀəd/ ‹ʔay̓əd›, ‘companion, same sex friend, a pal’, which was alternatively transcribed as ‹ʔaʔyəd›. However, there were many entries where the word was alternatively transcribed as having a post-vocalic glottal stop (i.e., a glottal stop proceeding the approximant). This can be observed in (2), where each word includes an alternative transcription of a glottal stop following the approximant segment.

| (2) **Transcription** | **Alternative** |
|---|---|
| a. /t͡s’xʷajˀs/ ‹c̓xʷay̓s› ‘blinded’ | ‹c̓əxʷayʔs› |
| b. /t͡ʃʼawəjˀ/ ‹č̓awəy̓› ‘seashell’ | ‹č̓awəyʔ› |
| c. /dawˀ/ ‹daw̓› ‘just now’ | ‹dawʔ› |
| d. /dajˀ/ ‹day̓› ‘only, very’ | ‹dayʔ› |
| e. /hawˀ/ ‹haw̓› ‘hey!’ | ‹hawʔ› |
| f. /hədiwˀ/ ‹hədiw̓› ‘be inside house’ | ‹hədiwʔ› |
| g. /kajˀkajˀ/ ‹kay̓kay̓› ‘bluejay’ | ‹skayʔkay› |
| h. /k’ələwˀ/ ‹k̓ələw̓› ‘a greedy person’ | ‹k̓ələwʔ› |

i. /p’uajˀ/ ‹p̓uay̓› ‘flounder’ ‹p̓uayʔ›

j. /jəhawˀ/ ‹yəhaw̓› ‘proceed’ ‹yawʔ, hawʔ›

There were also a few entries where the alternative transcription included a non-laryngealized (plain, modal voiced) approximant. This can be observed in (3), where the words were alternatively transcribed as plain (non-laryngealized) approximants.

| (3) **Transcription** | **Alternative** |
|---|---|
| a. /t͡ʃ’əwˀit/ ‹č̓əw̓it› ‘endowed with many abilities’ | ‹č̓əwit› |
| b. /q’jˀuq’ʷ/ ‹q̓y̓uq̓ʷ› ‘throat’ | ‹q̓əyuq̓ʷ, q̓iyuq̓ʷ› |
| c. /sajˀ/ ‹say̓› ‘nervous, fidgety’ | ‹say› |
| d. /tilˀχi/ ‹til̓x̌i› ‘later on’ | ‹tiləx̌i› |
| e. /jəjˀduʔ/ ‹yəy̓duʔ› ‘swing’ | ‹yəyduʔ› |

Whether the laryngealized sonorants of these words with alternative transcriptions were realized as fully modal voiced approximants or some other type of creaky voicing (such as the ones described by Keating et al. (2015)) cannot be determined based on the current data.

There were more words in the data that were transcribed as laryngealized sonorants with no alternative transcriptions. There were 28 unique entries of words containing the laryngealized lateral approximant /lˀ/ ‹l̓›, 33 unique entries of words containing the laryngealized labio-velar approximant /wˀ/ ‹w̓›, and 15 unique entries of words containing laryngealized palatal approximants /jˀ/ ‹y̓›. These were entries that did not include an alternative transcription of a segment adjacent to a glottal stop.

Another predictable pattern of laryngealization was in reduplication. This often occurred in CVC+ reduplications, where the syllable-final approximant in the reduplicant syllable is laryngealized. However, this occurred mostly for roots ending with the lateral approximant /l/. The labio-velar approximant /w/ was laryngealized in other types of reduplications not discussed here (it also occurred rarely in reduplicated stems). There were no instances of the palatal approximant /j/ ‹y› being laryngealized in CVC+ reduplicants. Instances of the lateral approximant /l/ being laryngealized in CVC+ reduplicants can be observed in (4), where the reduplicant syllable contains a laryngealized approximant in syllable-final position.

| (4) **Root** | **CVC+ Reduplicant** |
|---|---|
| a. /t͡ʃalat͡s/ ‹čalac› ‘chase me’ | ‹čal̓~čalac› ‘(many) chasing me’ |
| b. /t͡sil/ ‹cil› ‘support from beneath’ | ‹cil̓~cil› ‘dished up’ |
| c. /qaləp/ ‘unmarried’ | ‹qal̓~qaləp› ‘[they] unmarried’ |
| d. /saliʔ/ ‘two’ | ‹sal̓~saliʔ› ‘two by two’ |

As (4) shows, laryngealization occurred on the syllable-final approximant in the reduplicant syllable. This suggests that the laryngealization of some approximants is morpho-phonologically predictable from reduplication. It is also possible to observe a glottalized-glottalized pattern where the laryngealized sonorant may be copied in a +VC reduplicant syllable (Hess 1967, Mellesmoen & Urbanczyk 2021). This can be observed in the word /dajˀ~ajˀ/ ‹day̓~ay̓› ‘alone’, derived from the root /dajˀ/ ‹day̓› ‘only’ (Hess 1967:66). According to Mellesmoen & Urbanczyk (2021:255-257), the glottalized-glottalized pattern in reduplicated syllables is common across Salish languages, where it has been observed in nine Salish languages.

Overall, some laryngealized sonorants are morpho-phonologically predictable in reduplicated structures. The alternative transcriptions of laryngealized sonorants may provide evidence that speakers did not differentiate laryngealized sonorants from either plain sonorants that were adjacent to a glottal stop or plain sonorants in general. This provides important implications on the diachronic status of laryngealized sonorants in Lushootseed (discussed further in Section 9.5).

## 9.4 ACOUSTIC ANALYSIS OF LARYNGEALIZED SONORANTS

### 9.4.1 *Methods*

In this chapter, I compare the acoustic characteristics of laryngealized sonorants /jˀ wˀ lˀ/ ‹y̓ w̓ l̓› with plain (i.e., modal voiced) sonorants /j w l/ ‹y w l› in Lushootseed. Data comes from recordings of the speaker Annie Jack. Five acoustic measures were used in the comparison: Jitter, spectral tilt, fundamental frequency (f0), intensity, and Cepstral Peak Prominence (CPP). Each acoustic measure was taken from a 46.5ms window from the approximate midpoint of each segment.

Jitter is the variation in the duration of successive fundamental frequency cycles (Gordon & Ladefoged 2001). The mean percent jitter ratio was calculated by taking the average absolute difference between consecutive pulses divided by the average period and multiplied by 100 (Koike 1973). Jitter tends to be higher during creaky phonation than other phonation types (Belotel-Grenié & Grenié 2004, Gordon & Ladefoged 2001, Javkin & Maddieson 1983, Kirk et al. 1993). As we will see in Section 9.4.2, the mean percent jitter ratio is greater for laryngealized sonorants than plain sonorants.

f0 was also measured through a power spectrum, where the frequency of the first harmonic was measured. Intensity was also measured as Decibels of Sound Pressure Level (dB SPL), which was calculated from 20 times the log (base 10) of RMS energy (RMS energy was calculated from the absolute amplitude values in a frame and is divided by the duration of the frame). As will be shown in Section 9.4.2, f0 and intensity is lower for laryngealized sonorants than plain sonorants.

Spectral tilt was also measured, which was calculated by taking the amplitude difference between the first harmonic and second harmonic, H1-H2. A Fast Fourier Transform (FFT) power spectrum was used to measure the amplitudes of the harmonics. The windowed signal was zero-padded (using Hamming) to minimize aliasing. According to Keating et al. (2015:4), spectral tilt (H1-H2) reflects glottal constriction, with a lower value indicating greater constriction. As we will see in Section 9.4.2, the spectral tilt for laryngealized sonorants was lower than plain sonorants. It has been shown that spectral tilt can be affected by differences in the first formant of the segment (Ladefoged et al. 1988). Because this study analyzes three different places of articulation for the sonorant segments, comparisons were made within place of articulation.

Another measurement that's been used to characterize different voice qualities is Cepstral Peak Prominence (CPP), which takes the peak "rahmonic" (an anagram of "harmonic") from a cepstrum (an anagram of "spectrum"), which is computed from a Fourier transform of the logarithm of its power spectrum from a sound wave (Watt et al. 2017; Fraile & Godino-Llorente 2014). Creaky voicing is characterized with low CPP when compared to modal voice (Keating et al. 2015; Fraile & Godino-Llorente 2014). In this study, I measured CPP from the most prominent peak "rahmonic" (in dB) of a cepstrum. CPP can be affected by differences in recording environments, such as varying types of background noises, as well as the distance a microphone is placed from a speaker's mouth (van der Woerd et al. 2020; Grillo et al. 2016). Because of the very nature of these recordings, it is uncertain (and unlikely) that the speaker was placed at a fixed distance from the microphone the entire time she was recorded. Moreover, each recording had their own amount of background noise, which could affect CPP. To resolve this problem, a smoothed CPP with a voicing activity detection (VAD) algorithm was used in Praat (Murray et al. 2022; Watt et al. 2017; Kim et al. 2021; Kitayama et al. 2020; Lowell & Hylkema 2015).

### 9.4.2 *Results*

Laryngealized sonorants are produced as the canonical creaky voice (discussed in Section 9.2). This is illustrated in Figure 9.5, where the laryngealized palatal approximant /jˀ/ in the word /dajˀiləxʷ/ ‹daẏiləxʷ› ‘become only’ was realized as the canonical type of creaky voicing.

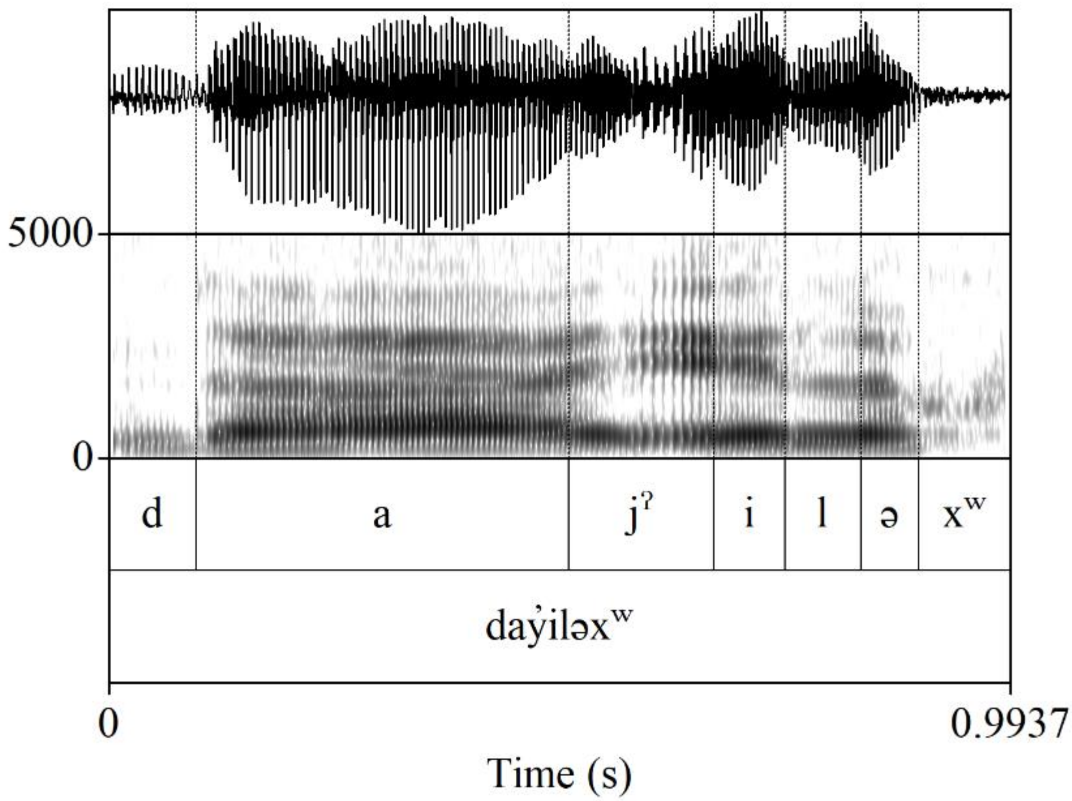



**Figure 9.5** Waveform and spectrogram of the word dajˀiləxʷ/ ‹daẏiləxʷ› ‘become only’.

Figure 9.5 illustrates the canonical creaky voicing that is characteristic of laryngealized sonorants in Lushootseed. This is also observed for the laryngealized lateral approximant /lˀ/ ‹l̓› and the laryngealized labio-velar approximant /wˀ/ ‹ẇ›. However, there are many instances where the creaky voicing of laryngealized sonorants is lost in connected (spontaneous) speech, especially when the speaker is producing words (containing laryngealized sonorants) at a high speech rate.

Table 9.1 summarizes the average jitter, f0, intensity, spectral tilt (H1-H2), and CPP of the laryngealized sonorants /jˀ wˀ lˀ/ ‹ẏ ẇ l̓› and the plain sonorants /j w l/ ‹y w l›.

**Table 9.1** Average jitter, f0 (in Hz), intensity (in dB), spectral tilt (absolute H1–H2), and CPP (in dB) for the laryngealized sonorants /jˀ wˀ lˀ/ ‹y̓ w̓ l̓› and plain sonorants /j w l/ ‹y w l›.

| **Segment** | ***N*** | **Jitter** | **f0 (Hz)** | **Intensity (dB)** | **\|H1-H2\|** | **CPP (in dB)** |
|---|---|---|---|---|---|---|
| /jˀ/ ‹y̓› | 6 | 11.4% | 114.32 | 61.5 | 2.97 | 3.49 |
| /j/ ‹y› | 6 | 0.7% | 167.82 | 67.43 | 10.02 | 10.84 |
| /wˀ/ ‹w̓› | 3 | 11.34% | 100.68 | 58.6 | 1.9 | 3.7 |
| /w/ | 7 | 0.76% | 173.29 | 69.72 | 9.8 | 9.71 |
| /lˀ/ ‹l̓› | 6 | 11.45% | 124.16 | 60.39 | 2.32 | 3.84 |
| /l/ | 8 | 0.67% | 147.43 | 71.86 | 2.79 | 7.33 |

As summarized in Table 9.1, jitter is greater for the laryngealized sonorants /jˀ wˀ lˀ/ ‹y̓ w̓ l̓› than the plain sonorants /j w l/ ‹y w l›. As predicted, the fundamental frequency (f0) and intensity is lower for the laryngealized sonorants /jˀ wˀ lˀ/ ‹y̓ w̓ l̓› than the plain sonorants /j w l/ ‹y w l›. Moreover, CPP is lower for the laryngealized sonorants than the plain sonorants. However, there are some noticeable differences in measures of spectral tilt (H1-H2) between the different places of articulation from the data.

The spectral tilt for laryngealized palatals and laryngealized labio-velar approximants /jˀ wˀ/ ‹y̓ w̓› is (as predicted) smaller than the spectral tilt for the corresponding plain approximants /j w/ ‹y w› respectively in terms of absolute values. However, in the case of the lateral place of articulation, the laryngealized lateral approximant /lˀ/ ‹l̓› has an approximately similar spectral tilt as the plain lateral approximant /l/. The spectral tilt for the laryngealized lateral approximant /lˀ/ ‹l̓› is about the same as /l/.

Overall, the acoustic measures that appeared to reliably predict (and differentiate) laryngealized sonorants from plain (modal voiced) sonorants in Lushootseed is jitter, f0, intensity, and CPP. Spectral tilt is also a reliable measure to differentiate plain from laryngealized sonorants for two places of articulation (i.e., the palatal and labio-velar), but not for the lateral place of articulation. There are clear acoustical differences between the laryngealized sonorants and plain sonorants.

## 9.5 DIACHRONIC STATUS OF LARYNGEALIZED SONORANTS

Although the historical "source" of laryngealized sonorants in Lushootseed (and, in general, Coast Salish) is unknown, it is possible to make some inferences on the diachronic status of this class of segments based on data from hyperarticulation from prosodic focus. As Figure 9.6 illustrates, creaky voicing occurred relatively late in the total duration of the underlying laryngealized palatal approximant when the speaker, Annie Jack, added focus (and hyperarticulated) the word /dajˀəxʷ/ ‹day̓əxʷ› 'only now'.

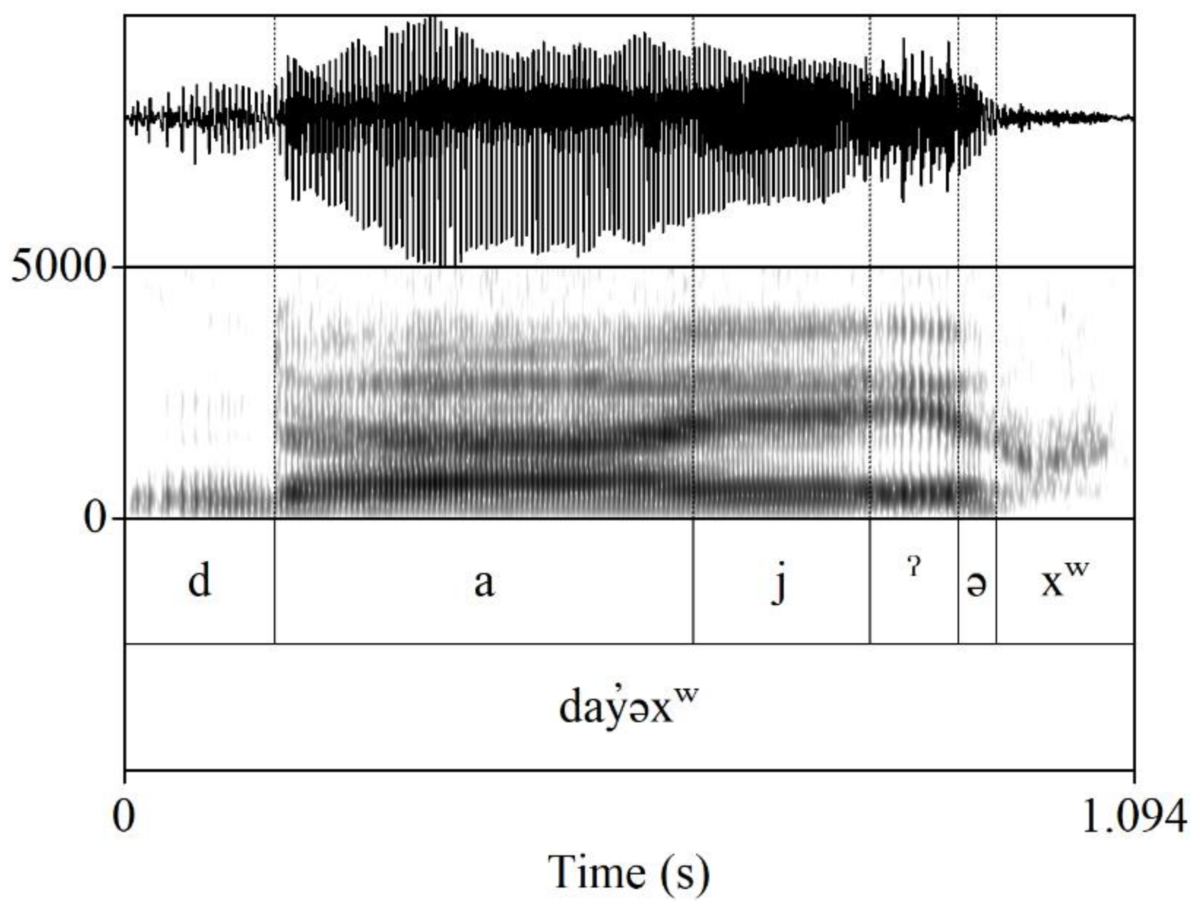



**Figure 9.6** Waveform and spectrogram of the word /dajˀəxʷ/ ‹day̓əxʷ› 'only now', illustrating the relatively late realization of creaky voicing on the laryngealized approximant.

Figure 9.6 illustrates the hyperarticulation of the word /dajˀəxʷ/ ‹day̓əxʷ› 'only now', which was produced with a duration of approximately 1 second. This word was produced under prosodic focus, where the duration of the vowel and the laryngealized sonorant was considerably long. As mentioned in Section 9.3, there were many laryngealized sonorants that involved an alternative transcription. These alternative transcriptions involved a sonorant segment that was adjacent to a glottal stop. In fact, there were many words in the Lushootseed dictionary where a laryngealized approximant was alternatively transcribed as an approximant with a post-vocalic glottal stop. Because laryngealization occurred relatively late in the production of the laryngealized approximant /jˀ/ in the hyperarticulated word /dajˀəxʷ/ ‹day̓əxʷ› ‘only now’ in Figure 9.6, the speaker may have “perceived” laryngealization as a feature that occurred late in the production of an approximant gesture (like post-vocalic glottal stops). From this, it could be speculated that laryngealized sonorants were historically derived from some sonorant segment that was adjacent to a glottal stop.

Laryngealized sonorants may have originated from pre-/post-vocalic glottal stops. This suggests that laryngealized sonorants were unlikely to be a part of the proto-Salish (or pre-proto-Salish) inventory. As mentioned in Section 9.3, the strongest evidence for this comes from the number of alternative transcriptions of words containing laryngealized sonorants in Lushootseed, where the alternative transcriptions involved a glottal stop adjacent to a sonorant segment. In the Lushootseed dictionary (Bates et al. 1994), there were a number of entries that included laryngealized sonorants and sonorants adjacent to a glottal stop as an alternative transcription. The words in (2) contains laryngealized sonorants that were alternatively transcribed with a sonorant adjacent to a glottal stop from the Lushootseed dictionary.

In connected (spontaneous) speech the coarticulation of creaky voicing onto approximants from pre- or post-vocalic (and/or intervocalic) glottal stops may have phonologized into laryngealized sonorants. As mentioned in Section 9.2, glottal stops are seldom realized with a full glottal closure in connected speech. It is often realized as a "very compressed form of creaky voicing" (Ladefoged & Maddieson 1996:75). Because glottal stops in general tend not to be realized with a full closure of the glottis in intervocalic and/or pre- or post-vocalic position (it tends to be creaky voiced), this suggests that the laryngeal setting of glottal stops in connected (spontaneous) speech involved creaky voicing, which may have perseverated or anticipatorily coarticulated to the adjacent sonorant segment. As mentioned in Sections 9.2 and 9.4, both glottal stops and laryngealized sonorants were realized with canonical creaky voicing. This may suggest that the laryngeal setting of these two segments are historically related. Speakers of languages that have developed out of Proto-Salish (or pre-Proto-Salish) may have started perceiving the laryngealization of sonorants from adjacent glottal stops as a single segment because the laryngealization of the glottal stop likely occurred throughout the entire duration of the approximant gesture during rapid (spontaneous) utterances, which contrasts from careful hyperarticulated speech (as shown in Figure 9.6).

Diachronic laryngealization is not uncommon in the world's languages. As mentioned in Section 9.2, laryngealized phonation was derived historically from glottal stop lenition in the Popolocan language Mazatec (Silverman 1995). This has also occurred in checked syllables (where glottal stops occur in syllable-final position) in Yi languages (Kuang 2011, 2012). This suggests that laryngealization is often historically derived from glottal stops (Garallek 2013). Because laryngealized sonorants show the same type of creaky voicing as glottal stops in intervocalic position, it wouldn't be surprising if the two classes of segments (i.e., glottal stops and laryngealized sonorants) were historically related.

Although there is a wide distribution of larygnealized sonorants in Salish languages, not all Salish languages (or dialects of some of these languages) contrast laryngealized sonorants. For example, some of the Tsamosan Salish languages (see Chapter 1 for more details on the Salish language family) do not contrast laryngealized sonorants (according to Mellesmoen & Urbanczyk (2021), laryngealization of approximants can occur in reduplicated syllabes in some of the Tsamosan Salish languages, where the pattern of laryngealization is similar to the laryngealization of approximants in Lushootseed reduplicated stems (discussed in 9.3); however, the laryngealized forms of these approximants itself are not used contrastively in some of these languages and are represented as post-vocalic glottal stops (Kinkade 1963)). Moreover, according to Donna Gerdts (personal communication), not all dialects of Halkomelem (which is a Coast Salish language like Lushootseed) contrast laryngealized sonorants. It is also worth noting that not all neighboring non-Salish languages in the linguistic area contrast laryngealized sonorants (for example, Makah and Quileute do not have a set of larygnealized sonorants in their phonemic inventory). This is good reason to suspect that larygnealized sonorants were not a part of the proto-Salish (or pre-proto-Salish) inventory and was instead derived from the laryngealization of sonorants from adjacent glottal stops.

## 9.6 CONCLUSION

In this chapter, I characterize the acoustic and physiological correlates of laryngealized sonorants and glottal stops in Lushootseed. In Section 9.2, I discuss creaky voicing, the types of creaky voice observed in Lushootseed, and how glottal stops are realized as a compressed form of canonical creaky voice in Lushootseed. In Section 9.3, I discuss the distribution of laryngealized sonorants in Lushootseed using data from the Lushootseed dictionary (Bates et al. 1994). In Section 9.4, I conduct an acoustic analysis of laryngealized sonorants in Lushootseed. There are several acoustic measures that can be used to dinstinguish laryngealized sonorants from plain sonorants. The findings showed that jitter, f0, intensity, and CPP are reliable measures that differentiates laryngealized sonorants from plain sonorants in Lushootseed. Although spectral tilt is also a reliable measure, it did not appear to be reliable for the lateral place of articulation, as the difference is too small for laterals. In Section 9.5, I discuss the diachronic status of laryngealized sonorants in Lushootseed, where I propose that laryngealized sonorants historically derived from sonorants adjacent to glottal stops.

Acoustic evidence showed that laryngealized sonorants are often produced with canonical creaky voicing. Glottal stops in intervocalic position are also realized with canonical creaky voicing. Because many alternative transcriptions of words containing a laryngealized sonorant were transcribed as sonorants adjacent to a glottal stop, and because laryngealization occurred relatively late in the production of a laryngealized sonorant in hyperarticulated speech (as illustrated in Figure 9.6), this may suggest that laryngealized sonorants may be historically derived from the lenition of an adjacent glottal stop, which are typically realized as creaky voiced in connected (spontaneous) speech.

# Chapter 10. LUSHOOTSEED SUPRASEGMENTALS: STRESS, INTONATION, AND LUT-TOBI

## 10.1 INTRODUCTION

In this chapter, I cover two suprasegmental features in Lushootseed: stress and intonation. The study of stress in Lushootseed has been well documented (Hess 1977, Urbanczyk 1996). Urbanczyk (1996) documented the pattern of stress that occurs in the Northern dialect of Lushootseed, where she characterized the relationship between vowel quality and metrical prominence in Lushootseed words. Moreover, dialectal differences in the realization of stress in Lushootseed have been well documented by Hess (1977), who characterized phonological and lexical differences between the Northern and Southern dialects. There are also lexical differences in the placement of stress (Bates et al. 1994). In Section 10.2, I summarize these findings by characterizing the patterns of word-level stress in Lushootseed.

The prosodic (stress and intonational structure, as well as the organization of words into phonological phrases and constituents) structure of Lushootseed has also been well documented (Beck 1996, 1999; Beck & Bennett 1998, 2007). However, a formal system of transcribing Lushootseed intonation has not been established. In Section 10.3, I provide the first ToBI labelling system for transcribing Lushootseed intonation. I call the Lushootseed ToBI model "lut-ToBI". This model is grounded on the works of Beck and colleagues (Beck 1996, 1999; Beck & Bennett 1998, 2007) with a few modifications to the model proposed by Beck and colleagues (see Section 10.3.1 for more details). The goal of Section 10.3 is to characterize the pattern of intonation in Lushootseed sentences. Moreover, differences in intonational contour between *yes-no* questions and declarative sentences have not been documented in Lushootseed. In Section 10.3, I compare the pattern of intonation between *yes-no* questions and declarative sentences in Lushootseed.

To transcribe suprasegmentals, I use the Lushootseed orthography for the transcription of words, which suffices for the purpose of this chapter. However, I transcribe stress by using the IPA labelling convention for primary stress (i.e., [ˈ]). The motivation for using orthography is to make it more accessible to readers who are not trained phoneticians but are nevertheless interested in studying the pattern of stress and intonation in Lushootseed (see Chapter 1 for more details on the Lushootseed orthography).

## 10.2 STRESS

### 10.2.1 *What is the acoustic correlate for stress in Lushootseed?*

Stress has often been an elusive topic in the acoustic phonetic literature. According to Lehiste (1970), "of the three suprasegmental features [quantity, tonal features, and stress], stress has for a long time been the most elusive one" (1970:106). The acoustic phonetic details that listeners use to tell stressed from unstressed syllables apart are not always consistent and vary across languages. While it's been argued that differences in pitch are the sole reliable cues that listeners use to make judgements about stress in isolated words (Fry 1958), subsequent research has found that there was significant variation between speakers in the use of pitch and other correlates of stress (e.g., Lieberman 1960). Others contend that syllable duration serves as the most reliable cue for telling stress apart, and not pitch (Crystal & House 1990). However, many phoneticians were critical of the idea that syllable duration alone serves as the most reliable cue for making judgements about stress (Lehiste 1977; Cutler 2005; Beckman 1982; Roach 1982; Jun 2005b; Dauer 1983). Many have also referred to *vowel reduction* as a major correlate of stress across the world's languages (Delattre 1969, Dauer 1983). However, there is considerable cross-linguistic differences in vowel reduction and other correlates of stress (Delattre 1969; den Os 1988; Koopmans-van Beinum 1980). The phonetic correlate of stress could be a combination of various factors that are not always mutually exclusive. According to Ladefoged (2005), stressed syllables may or may not have greater intensity or a higher pitch. However, speakers always use greater respiratory energy when producing stressed syllables at least in English (Ladefoged 2005:20).

From a psycholinguistic point of view, stress has a relative degree of *isochrony*, which is a perceptual tendency that allows listeners to isolate the rhythm of each syllable in isolated words (Fletcher 2013). To illustrate this, tap your finger to each syllable in the word *potato* /pəˈteɪɾoʊ/ as you say the word. Notice the timing between the first two taps, where the first tap (corresponding to the first syllable) quickly transitions to the timing of the second tap (corresponding to the second syllable). You may also notice that the second tap is held the longest and/or is tapped the hardest, suggesting that it is the stressed syllable. The timing of each tap (as well as the relative "intensity" of each tap) will correspond to one's subjective judgement of the inter-stress rhythm for each syllable (Fletcher 2013). Such levels of isochrony, however, may vary across languages. Patterns of stress in languages like English are relatively easy to tell apart; however, determining the location of stress in languages like Indonesian (Odé 1994; Ebing 1994; Laksman 1994) or Korean (Jun 2003) is very difficult. In these latter languages, there is considerable disagreement about which syllable is labelled "stressed" or "unstressed".

Whether Lushootseed is a more "isochronous" language (like English) or not (like Indonesian or Korean) is difficult to determine without L1 speakers. However, there is good reason to suspect that Lushootseed is a more "isochronous" language. The pattern of stress in Lushootseed has been well documented in the literature (Hess 1977; Urbanczyk 1996). Moreover, based on my own impressionistic observations, it is relatively easy to tell apart which syllables were stressed and which ones weren't. Some of the acoustic phonetic correlates to stress in Lushootseed may be a mixture of duration, intensity, and vowel reduction. However, it should be noted that no one of these measures should serve as the sole basis for determining stressed syllables apart from unstressed syllables. For instance, although unstressed syllables tend to have a shorter duration than stressed syllables, there are a variety of factors that could affect syllable duration that isn't stress-related in Lushootseed (for example, the shortening of vowels when followed by a voiceless consonant in a stressed syllable; the lengthening of full vowels in some words; reduced prominence in discourse; etc…). One of the difficulties of measuring duration is that duration is affected by many factors other than stress, such as changes in speech rate and vowel duration differences in discourse structure. Pitch is not a reliable measure for stress. Stressed syllables and unstressed syllables can have the same pitch range in sentences (see Section 10.3 for more details). The only time a low or falling pitch contour can be observed is at the end of an utterance (even if the final syllable of the utterance is stressed) (see Section 10.3 for more details). Intensity can vary across utterances as well. Following Ladefoged (2005), stress is best interpreted as involving greater respiratory energy, and judgements over stress are highly isochronous.

Lushootseed data from the literature (Bates et al. 1994; Hess 1977; Urbanczyk 1996) is used to analyze the pattern of stress. Subjective judgements on the location of stress (based on experience working with these recordings, as well as knowledge of the morphological makeup of word-forms in Lushootseed) are also used to determine the location of stress in Lushootseed words. Acoustic data is used wherever there appears to be a significant pattern of stress in words. The acoustic measures that are examined are the *relative* duration and *relative* intensity of each syllable in a word.

### 10.2.2 *Location of primary stress in words*

Data for the analysis of stress in Lushootseed comes from Hess (1977), Urbanczyk (1996), and the Lushootseed dictionary (Bates et al. 1994). All the examples that follow come from these three sources.

In Lushootseed, there is at most one stressed syllable per word. Roots that are monosyllabic tend to be the location of primary stress in a word. This can be observed in the following examples, where each root (containing vowels /u i a ə/) are stressed when attached to the control transitive /-d/ (note the allomorphic insertion of a vowel on the control transitive, which has the same quality as the vowel of the root):

(1) a. ‹ʔu-ˈt̓uc̓-ud› ‘shot (TR)’
b. ‹ʔu-ˈč̓it̓-id› ‘chewed, gnawed (TR)’
c. ‹ʔu-ˈkʷaxʷ-ad› ‘helped (TR)’
d. ‹ʔu-ˈkʷəd-əd› ‘grabbed (TR)’

Although the root syllable containing the schwa /ə/ in (1) is stressed, it is not always the case that roots containing schwa /ə/ are stressed in every Lushootseed dialect. According to Hess (1977), there are dialectal differences to the location of stress in a word. (1) reflects the pattern that occurs in the Southern dialect. However, in the Northern dialect, the location of primary stress is on the first non-schwa syllable of a stem. This is observed in (2) and (2), where the location of stress in (2) is placed on the allomorphic insertion of the full vowel /a/ for the control transitive /-Vd/ when the root contains a schwa /ə/. More examples can be observed in (3), (4), and (5).

| | | |
|---|---|---|
| (2) | a. ‹ˈkʷəd-əd› ‘grab (TR)’ | (Southern Lushootseed) |
| | b. ‹kʷəd-ˈad› ‘grab (TR)’ | (Northern Lushootseed) |
| (3) | a. ‹ˈtəyil› ‘to go upstream’ | (Southern Lushootseed) |
| | b. ‹təˈyil› ‘to go upstream’ | (Northern Lushootseed) |
| (4) | a. ‹ˈdəč̓uʔ› ‘one’ | (Southern Lushootseed) |
| | b. ‹dəˈč̓uʔ› ‘one’ | (Northern Lushootseed) |

(5) a. ‹ˈčəg$^{w}$əš› ‘wife’ (Southern Lushootseed)
b. ‹čəˈg$^{w}$as› ‘wife’ (Northern Lushootseed)

According to Hess (1977), stress tends to fall on the penultimate syllable in the Southern dialect. Hess gives the following examples to show the penultimate stress pattern in the Southern dialect:

(6) a.‹ˈg$^{w}$ədbix$^{w}$› ‘blackberry’
b. ‹g$^{w}$ədˈbix$^{w}$-ac› ‘blackberry bush’

(7) a.‹ˈstəg$^{w}$ad› ‘salmonberry’
b. ‹stəˈg$^{w}$ad-ac› ‘salmonberry bush’

(8) a.‹ˈst̓ək̓$^{w}$əb› ‘stick’
b. ‹st̓(ə)ˈk̓$^{w}$ab-šəd› ‘shoe’

Hess (1977) also provides examples of some Southern Lushootseed words that do not fit the penultimate stress pattern above. Four of these words include the following:

(9) a. ‹st’iˈx$^{w}$ibx̌› ‘red huckleberry’ (Southern Lushootseed)
b. ‹ˈst̓ix$^{w}$ib› ‘red huckleberry’ (Northern Lushootseed)

(10) a. ‹st’əˈq̓ax$^{w}$› ‘beaver’ (Southern Lushootseed)
b. ‹ˈst’əqax$^{w}$› (Northern Lushootseed)

What is worth noting here is the contrast between the Southern dialect and Northern dialect, shown in (9) and (10). Although the Northern Lushootseed words (i.e., (9) and (10)) use the northern stress pattern, they also show the stress placement expected in Southern Lushootseed words (where the stress is placed on the first syllable of a root).

There are also differences in the placement of stress when a lexical suffix (i.e., a suffix “with a relatively concrete meaning” (Bates et al. 1994:xix)) is present. When the first syllable of a lexical suffix contains a full vowel, then that syllable will usually be stressed when the monosyllabic root (that it attaches to) contains a schwa. This is also observed for monosyllabic lexical suffixes, where the lexical suffix that contains a full vowel is stressed. This is observed in both dialects of Lushootseed. The root syllable containing the schwa becomes unstressed, and sometimes the schwa is deleted if the root syllable contains a voiceless consonant in syllable-final position. (11) shows falling on the lexical suffix *-ič* 'cover, surface' (note that the schwa in the parenthesis indicates that the schwa is deleted).

(11) a. ‹dəˈgʷ-ič› 'middle of house, road, rope, pile of things'
b. ‹k̓ʷ(ə)ˈɬ-ič› 'spilled on top of'

However, when a lexical suffix combines with a root containing a full vowel, the syllable containing the root will usually bear primary stress. This can be observed in (12).

(12) a. ‹ˈdᶻaq̓-ič› 'tree falls on someone/something'
b. ‹ˈx̌ʷil-ič› 'kneel'

The above data is consistent with Urbanczyk (1996), who analyzed the location of primary stress as falling on the first full vowel of a stem[9] in the Northern dialect. However, this is not always the case for every word in Lushootseed. For instance, when the root *ʔuq̓ʷ* 'pull out, unplug' (which contains the full vowel /u/) attaches to the lexical suffix *-ucid* 'doorway, body of water, language', the first syllable of the lexical suffix (i.e., containing the full vowel /u/) becomes stressed, as shown in (13).

(13) ‹ʔuˈq̓ʷ-ucid› 'open doorway' (LD 243)

Moreover, the data from (3), (4), and (5) shows that the first syllable containing a schwa can be the location of primary stress in the Southern dialect. Factors that determine the location of primary stress of a stem can be word-dependent (as shown in (13)) or dialect specific (as shown in the Southern Lushootseed examples in (3), (4), and (5)). (13) also illustrates a penultimate stress pattern that is consistent with examples (6)-(8).

[9] A stem can be analyzed as a root, a root bounded by a morpheme (e.g., *təy-il* 'run-INCH', where the root *təy-* 'run' is bounded to *-il* INCH), or a root combined with a lexical suffix.

Urbanczyk (1996) observed that there is a preference for stress to fall "on the more sonorous vowel /a/" (1996:137). Urbanczyk observed that when /a/ is initial, stress is initial "in virtually every stem. However, when /a/ is second, stress is peninitial in about half the stems, showing that initial stress is forgone in order to stress /a/" (1996:137). However, again, there are dialectal differences and word-specific differences in the location of stress for a root + lexical suffix stem. This is observed for the root *č̓it* 'near', which shows differences in the location of stress of a stem when combined with a lexical suffix beginning with /a/, as shown in (14) and (15).

(14) *Dialectal differences*:
a.‹ˈč̓it-abac› 'near side' (Northern Lushootseed)
b. ‹č̓iˈt-abac› 'near side' (Southern Lushootseed)

(15) *Word-specific differences*:
a. ‹č̓iˈt-alap› 'near foot/let'
b. ‹ˈč̓it-alus› 'surprised' (lit. 'near eyed')

As (14) and (15) show, stress does not necessarily fall on the first /a/ of a stem in Lushootseed. The location of primary stress for these stems are either dialect-specific or word-specific, where some lexical suffixes pulls the stress from the root, whereas others don't.

When the first syllable of a lexical suffix contains a schwa /ə/ and the root it attaches to also contains a schwa /ə/, primary stress falls on the first syllable of the stem (i.e., the root syllable containing the schwa) in both dialects. This is observed in (16), where the lexical suffix *-əldiʔ* 'ear, side of head' is attached to the root *x̌əɬ* 'sick'.

(16) ‹ˈx̌əɬ-əldiʔ› 'earache'

In short, word-level stress is predictable in Lushootseed. However, there are dialect-specific and word-specific differences that are not always predictable in a stem. This can be observed from a set of root + lexical suffix stems, which can show unique placements of stress in a word.

### 10.2.3 *Reducible /a/*

There are a set of monosyllabic roots that contain an open central vowel /a/ that is reduced to the schwa [ə] when followed by a suffix that begins with a full vowel. In fact, it is quite common for the open central vowel /a/ to reduce to [ə] in Lushootseed. Examples of /a/ being reduced to a schwa include the following:

(17) a. ‹c̓aʔkʷ› 'wash' + ‹-ulč› 'dish' → ‹c̓əˈgʷulč› 'wash dishes'
b. ‹c̓aʔkʷ› 'wash' + ‹-ačiʔ› 'hands' → ‹c̓əˈgʷačiʔ› 'wash hands'
c. ‹čaʔkʷ› 'seaward' + ‹-alatxʷ› 'house' → ‹čəˈgʷalatxʷ› 'outside the house'
d. ‹čad› 'where' + ‹-ał› 'class membership' → ‹čəˈdał› 'which is the biggest, smallest'
e. ‹dᶻakʷ› 'shake' + ‹-ab› MD → ‹dᶻəˈkʷab› 'wag (tail)'
f. ‹gʷah› 'accompany' + ‹-adad› LEX → ‹gʷəˈładad› 'accompany one (in particular)'

However, there appear to be dialect specific differences in the placement of stress for some of these words. In one recording of the Southern Lushootseed speaker Annie Jack, the first syllable in the word ˈ*c̓agʷ-ači-b=əxʷ* 'wash hands now (md)' was the location of primary stress. Figure 10.1 is a waveform and spectrogram showing that the syllable nucleus (i.e., the vowel) of the first syllable had greater duration than the other vowels in the utterance, suggesting that this was the stressed syllable.

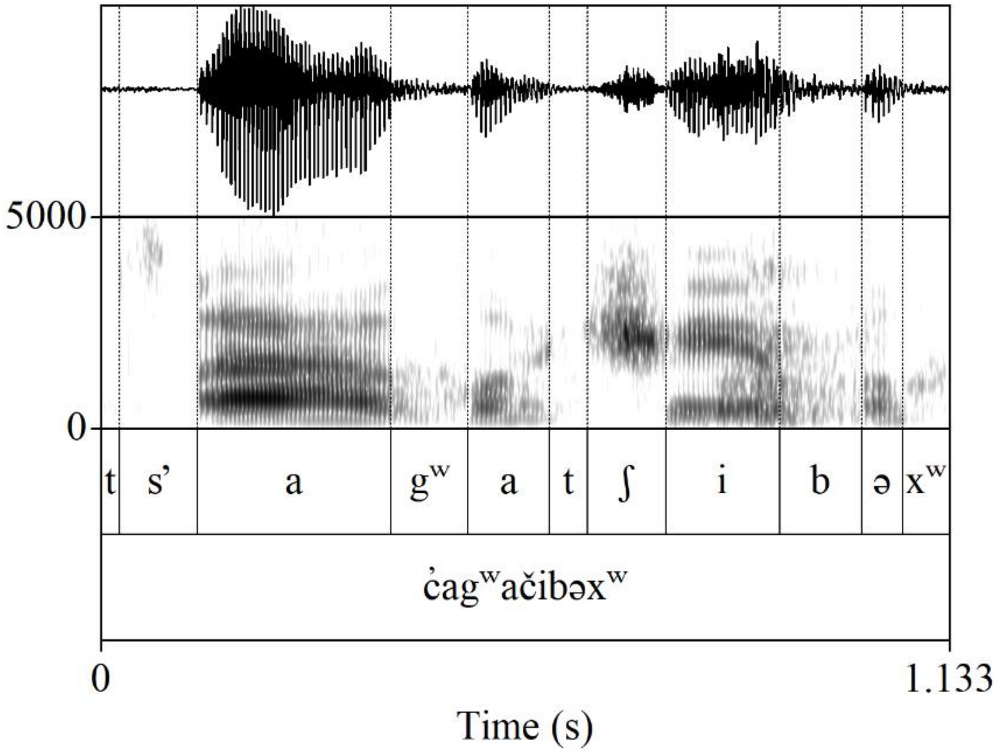



**Figure 10.1** Waveform and spectrogram of the word ˈ*ċagʷ-ači-b=əxʷ* ‘wash hands now (md)’, where the first /a/ in the word had the longest duration.

It is worth noting that in Figure 10.1, the duration of the third vowel /i/ was not quite as long as the first /a/ in the word. However, the duration of this vowel was longer than the preceding and following unstressed vowels (i.e., the second /a/ and the last vowel /ə/). This may suggest that the third vowel /i/ was secondarily stressed in the word. In other words, it is possible that, for some words with three or more syllables, there are secondarily stressed syllables and that Lushootseed is not restricted to the levels of primary stressed syllables and unstressed syllables.

### 10.2.4 *Discussion*

To summarize, determining the location of stress is predictable across word-forms in Lushootseed. However, there are a few dialect-specific and word-specific differences that are not readily predictable based on the morphological composition of a word alone. Although there is a general tendency for the first full vowel of a stem to be stressed, this isn't the case for every word and every dialect in Lushootseed. This is particularly observed in roots combined with a lexical suffix. Although the first full vowel of a root + lexical suffix stem is usually the location of primary stress, there are a few dialect-specific and word-specific differences that does not always follow this pattern. Overall, understanding the location of primary stress in a word is important for characterizing the prosodic structure of Lushootseed because the stressed syllable of a word determines the location of a pitch accent in the language, which is discussed in the next section.

## 10.3 Prosody, Intonation, and lut-ToBI

Tones and Break Indices (ToBI) is the most well-known system of annotation for the prosodic structure of languages (Jun 2022). The goal of ToBI is to transcribe the phonological properties of intonation ("tones") and the perceived disjuncture between words ("break indices"). Together, these properties represent the prosodic structure of an utterance. In this section, I present a ToBI model for annotating intonation in Lushootseed. The proposed ToBI model for Lushootseed is called "lut-ToBI" (based on ISO 639-3: lut)[10], following the tradition in the ToBI literature.

The proposed model adopts an autosegmental-metrical (AM) approach, which was first developed to analyze English intonational structure (Pierrehumbert 1980; Pierrehumbert & Hirschberg 1990; Beckman & Hirschberg 1994; Silverman et al. 1992; Ladd 2008). The AM approach was subsequently developed for other languages, such as Japanese (Beckman & Pierrehumbert 1986; Pierrehumbert & Beckman 1988; Campbell 1996, 1997; Venditti 1995,

[10] Although I present a formal system of transcribing intonation in Lushootseed, I do not claim that this system should be viewed as set-in-stone. There are other problems that needs to be addressed (see Section 10.3.4 for a discussion on these issues), which may require a few revisions of the current lut-ToBI system in the future. Regardless, I do believe that the current system is an important first step towards developing a formal system of transcribing intonation and classifying the prosodic structure of Lushootseed.

2005), Korean (Jun 1993, 1998, 2000, 2005a), French (Jun & Fougeron 1995), and many others (Gussenhoven 2005; Arvaniti & Baltazani 2005; Godjevac 2005; Gordon 2005).

The prosodic structure (i.e., stress and intonational structure, as well as the organization of words into phonological phrases and constituents) of Lushootseed has been well documented (Beck 1996, 1999; Beck & Bennett 1998, 2007). Beck and colleagues (Beck 1996, 1999; Beck & Bennett 1998, 2007) characterized the demarcation of intonational phrases (IPs) and phonological paragraphs as declination contours, which are phonological markers of episodic structure in discourse. According to Beck & Bennett, the phonological paragraphs "are demarcated by extra-high f0 reset and contain sub-paragraphs, consisting of multiple phonological utterances U" (1998:11) (where the phonological utterance U is a level higher than the intonational phrase and is marked at the level of syntax as opposed to the phonology (Nespor & Vogel 1986)). Beck (1996, 1999) also characterized phonological words W and clitics C as being marked by word-level stress, where the prosodically prominent (stressed) syllable is the head of a phonological word W, whereas a morphologically free base that is unstressed is marked as a clitic C.

Although the prosodic structure of Lushootseed has been documented, a ToBI system for transcribing Lushootseed intonation has not been developed. In this chapter, I develop the first ToBI labelling system for transcribing intonation in Lushootseed. The labeling conventions in this study are grounded on the works of Beck and colleagues. However, there are a few modifications that need to be made to Beck's prosodic model of Lushootseed. This is further discussed in the next section. In Section 10.3.2, I describe the ToBI tiers for transcribing Lushootseed intonation, which includes a Word Tier, Tone Tier, Break Indices Tier, and Miscellaneous Tier. In Section 10.3.3, I analyze two recordings: one recording of connected *spontaneous* speech, and the other careful *elicited* speech. These two styles of speech are analyzed to cover as much of the intonational structure as possible. Section 10.3.4 concludes with a summary of this study and a discussion of some outstanding questions.

### 10.3.1 *Lushootseed prosodic organization*

A phonological model of Lushootseed intonation was proposed by Beck and colleagues (Beck 1996, 1999; Beck & Bennett 1998, 2007). However, their analysis is not within the autosegmental-metrical approach to intonation. For instance, it assumes that phonological words and clitics cannot be grouped into a higher level of constituency that is still lower than the IP (i.e., an Accentual Phrase (AP)). Moreover, it assumes that there are no tonal units in the intonational structure of a contour that can be marked "categorically" (i.e., into a set of H and L tones in the intonational contour). There were also some important differences between my analysis and Beck's (1999) analysis of the prosodic structure of words in Lushootseed. For example, Beck classified adverbs (i.e., adverbial auxiliaries) as clitics. However, acoustic evidence showed that these forms were prominent, suggesting that they contained a phrasal nucleus. The nuclear syllable of these forms showed greater overall duration and intensity than the clitics. This can be observed in Figure 10.2 for the adverbial auxiliary /dajˀəxʷ/ ‹daỷəxʷ› 'only now' (where Beck would analyze this as an unstressed syllable and as a clitic with no phrasal nucleus), where the total duration of the entire word alone was approximately 1 second long (the root ‹daỷ› 'only' was approximately 800ms).

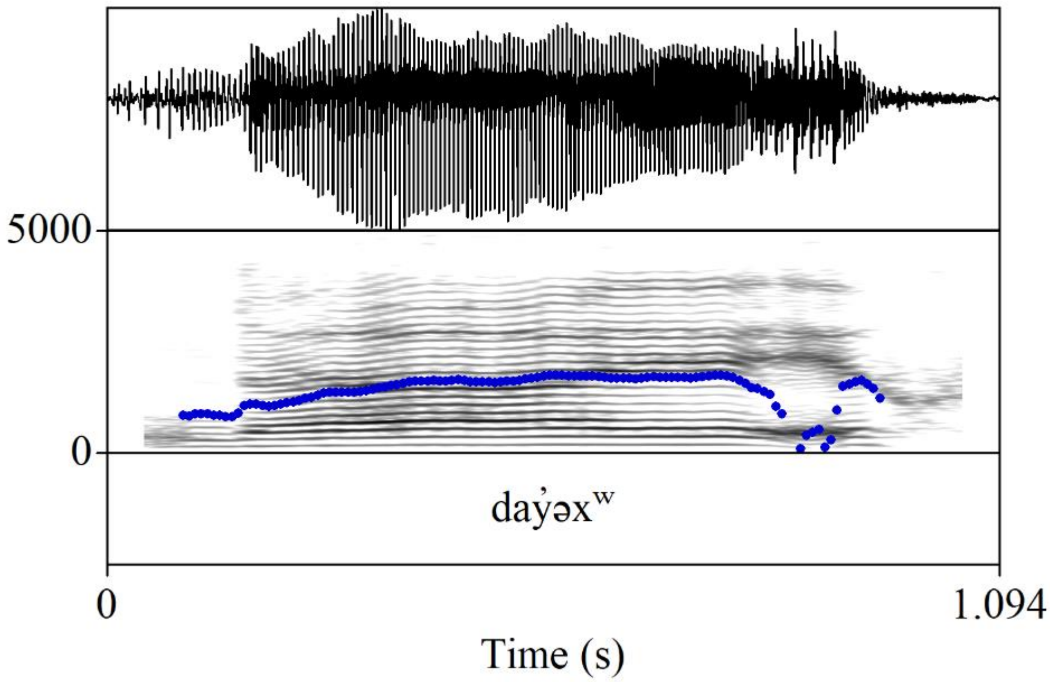



**Figure 10.2** Waveform and spectrogram (with pitch contours plotted) of the word /dajˀəxʷ/ ‹day̓əxʷ› 'only now'.

Moreover, Beck and colleagues observed phonological paragraphs as being demarcated by the pitch range of each f0 contour. However, in the system I develop here, phonological paragraphs are demarcated by pauses that separate IP's. The distinct pitch ranges between declination contours that are *not* separated by pauses are interpreted here as intermediate phrases that belong to the same phonological paragraph. This is because there are systematic dependencies in the pragmatic meaning between two (or more) of these declination contours that are not separated by pauses, which should be interpreted as intermediate phrases (iP) falling within the same prosodic domain (see Section 10.3.3.2 for more details), and that the phonological paragraph is just an IP. For these reasons, some aspects of Beck's model need to be modified to account for all types of prosodic units in Lushootseed.

The model proposed for Lushootseed here is hierarchically organized. It consists of an Intonational Phrase (IP) that contains one or more Accentual Phrases (AP). Each AP can be broken down into a set of Phonological Words (W) and Phonological Clitics (C), which occur on the same level but are mutually exclusive from one another. A distinct feature of W is that it is built around a phrasal nucleus (i.e., the head of an AP), which figures most "prominently" (i.e., due to W containing a stressed syllable) in the AP. The W functions as the head of an AP. Forms that do not figure as "prominent" (i.e., unstressed free morphemes such as oblique prepositions or determiners) are described here as Phonological Clitics (C). Cs must combine with a head, which is the W of an AP. Some Cs are mobile (Davis 2000), particularly pronominal clitics in Lushootseed. The following structure illustrates the position of Cs in relation to the Ws in a sample IP structure:

(18) {{{ W }}$_{AP}$ {C C { W }}$_{AP}$ {{ W }}$_{AP}$}$_{IP}$
‹łałliləxʷ ʔə tsiił sčətxʷəd čəgʷəš›
'Bear's wife lives there now' (AJ/Elk & Bear)

Following Beck (1999), each phonological word is interpreted here as the phrasal nucleus because it functions as the head of an AP. Phonological clitics (C) and phonological words (W) are defined in terms of their prominence, where prominence is determined by word-level stress. Clitics are elements of an AP that are not prominent and cannot serve as the phrasal nucleus. This would apply to forms that are unstressed (e.g., the oblique /ʔə/ and determiners). Sometimes, there are robust acoustic cues that mark clitics, such as shorter duration, reduction of vowel quality, and lowered intensity. On the other hand, the phonological word W must be a "word" that contains a "prominent" (i.e., stressed or metrically strong) syllable. The prominent syllable is the location of primary stress of a word, which will often show a relatively heightened intensity and a relatively longer duration. Cs combine with Ws to form an AP. Each AP must contain a single phrasal nucleus, which is identified here as the phonological word W (some APs are comprised of only one W).

IPs can be identified based on three acoustic features: (1) long pauses (actual pauses in the acoustic signal) between IPs; (2) distinct pitch ranges; and (3) distinct declinations. As we will see in Section 10.3.3.2, all IPs in Lushootseed can be identified as declination contours, where distinct pragmatic meanings can be inferred based on their pitch ranges. It is possible to observe breaks between distinct declinations as having no subjective sense of pause. This is possible when the f0 declination contours have distinct pitch ranges. In such cases, the two declinations are said to belong to the same phonological paragraph, which is a larger unit that can be defined as the IP (see Section 3.3.2 for more details).

According to Beck & Bennett (2007), the prosodic “grouping” of phrases can be organized into a higher level of constituency, which is known as the phonological paragraph. Following Ladd (1988), Beck & Bennett states that f0 declinations are the principal diagnostic for prosodic constituents (Beck & Bennett 2007:11). Two (or more) successions of f0 declination marks two (or more) intermediate phrases that belong to a higher level of prosodic constituency known as the phonological paragraph. In this study, phonological paragraphs are analyzed as successions of intermediate phrase(s) (i.e., iP) (marked with distinct declinations) with no subjective sense of “pauses” between them. Two iPs that are grouped into a single phonological paragraph (which I define here as an IP) are marked with a break index of 3 (see Section 10.3.2.3 for more details on break indices). Each intermediate phrase has distinct pitch ranges (which I discuss in more detail in Section 10.3.3.2), which are identified here as cues towards transitioning into different phrases that mark distinct pragmatic meanings across iPs.

### 10.3.2 *ToBI Tiers*

Based on the prosodic structure of Lushootseed, a formal system of annotating this structure can be established. In this section, I discuss each tier used for the lut-ToBI model. The tiers for the lut-

ToBI model include the Word Tier, Tone Tier, Break Indices Tier, and Miscellaneous Tier. Each tier plays an important role in characterizing the prosodic structure of Lushootseed discourse. The ToBI labelling system follows the guidelines and conventions described by Jun (2022).

#### 10.3.2.1 Word Tier

The Word Tier marks intervals between words, where words are labeled in each interval. The words are transcribed using the Lushootseed orthography. However, if one chooses to use this system of labelling, they may also choose to transcribe the words using the conventional IPA. It is advised that no other system of transcribing the words other than the Lushootseed orthography or the IPA is used. The Lushootseed orthography, which uses the Americanist IPA, is highly accurate in mapping graphemes to phonemes. It is also uncontroversial because it is the traditional system used by the indigenous language community. When transcribing time-aligned words in the Word Tier, the software Praat is used in this study.

#### 10.3.2.2 Tone Tier

Following the AM model of intonational phonology, the tone labels mark the salient f0 points (marked as either high (H) or low (L) tones) that occur within an intonation contour. When the tone is marked on an intonationally prominent syllable (because it is metrically strong), it is called the pitch accent (marked with a star [*], e.g., H*). A pitch accent is applied only for syllables that have primary stress. When the tone is associated with the edge of a prosodic unit, it is called a boundary tone (marked with a percent symbol %, e.g., L%). I have identified the following tones for the Tone Tier:

- **H***: High pitch accented tone. This occurs at the beginning of an intonational phrase (i.e., the stressed syllable of the first AP) and is usually the tone that is marked on the stressed (nuclear) syllable of the final AP when the final AP's W contains more than one syllable. It can be defined as either a relatively high pitch (f0) or a rising f0 contour.
- **H^***: Upstep high tone. This occurs at the beginning of an intermediate phrase and its pitch range is higher than the overall pitch range of the previous intermediate phrase (see Section 10.3.3.2 for evidence of this from "surprisal" intonation).
- **H**!*: Downstep high tone. This occurs at the beginning of an intermediate phrase (iP), where its pitch range is the same as the final L* of the previous iP and is the highest pitch accented syllable of its respective iP (see Section 10.3.3.2 for evidence in sustained repetition).
- **L***: Low pitch accented tone. This is sometimes transcribed on the final AP's nuclear syllable. However, it never falls on the nuclear syllable of AP's preceding the final AP. This tone is most frequently used when the final W is monosyllabic. It is defined as having a relatively low pitch (f0) contour.
- **L**!*: Downstep low tone. This occurs at the phrasal nucleus (prominent syllable) of the first W when it's not the first syllable of W. Its pitch range is lower than the pitch range of the final L* of the previous iP and the contour before it (i.e., unstressed syllables of W) (see Section 10.3.3.2 for evidence in verb repetition).
- **L**-: Low intermediate phrase (iP) edge tone. This occurs at the end of iPs (within a phonological paragraph, or IP). L- usually means that the pitch contour remains "unchanged" at the edge of an iP, though it can also show a low or falling pitch contour. This tone is marked with a break index of 3 (see the next section for more details).

- **L%**: Low boundary tone that marks the end of a phonological paragraph (or an IP) with one or more iPs. This tone is labelled at the end of an IP that is followed by a strong subjective sense of pause. L% is typically a low or falling pitch contour. This tone is marked with a break index of 4.

An example of some of these tones can be observed in Figure 10.3 (for sentence (19)), where the tones H*, L*, and L-L% are labelled in the tone tier.

| | | |
|---|---|---|
| (19) ʔu-ƛ̓a-čup | ti | spicx̌ʷ[11] |
| PFV-go.to.place-firewood | DET | spicx̌ʷ |

‘spicx̌ʷ went to fetch for firewood’ (AJ/spicx̌ʷ 00:02.7)

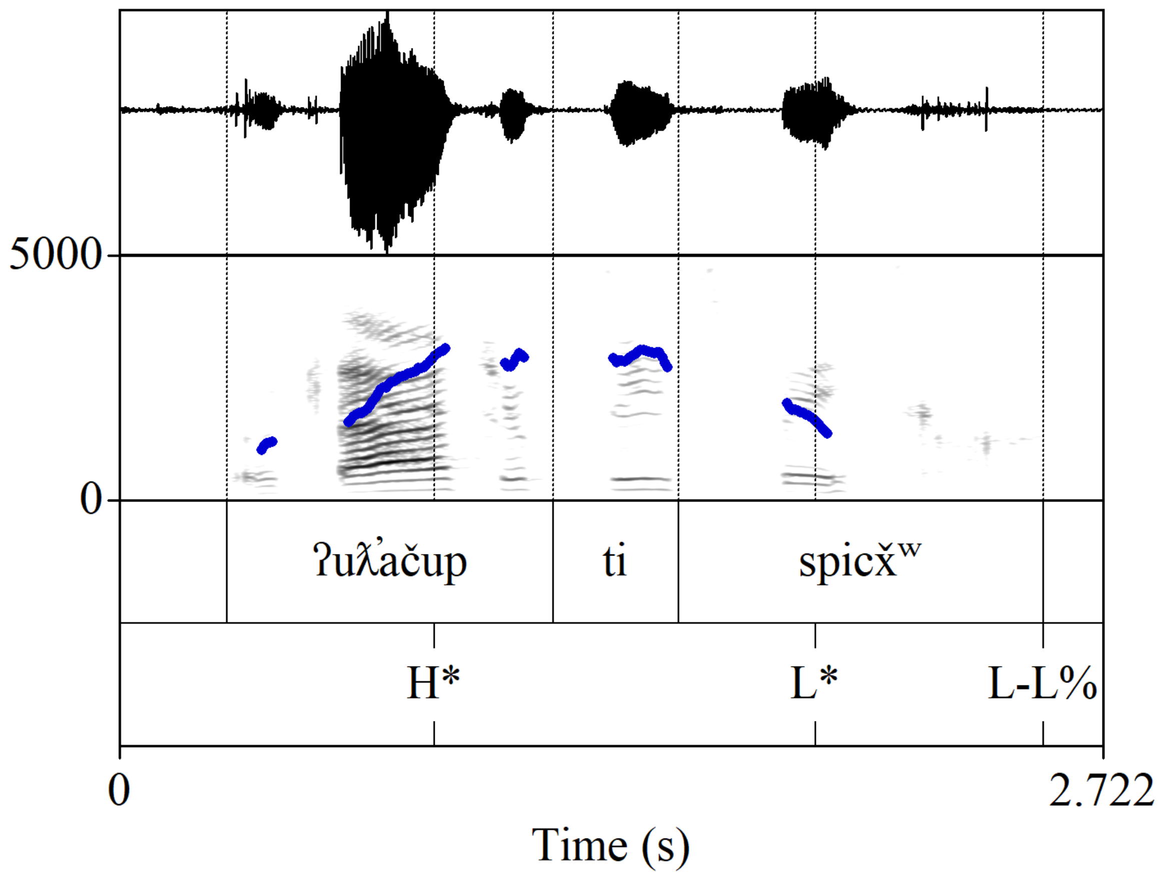



**Figure 10.3** Example of tone labels in the tone tier in Lushootseed.

[11] According to the Lushootseed dictionary, *spicx̌ʷ* is the myth name for *sx̌ʷəx̌ʷiʔ*, which is an unidentified small bird.

It should be noted that the pitch accented tones (i.e., H* and L*) are marked exclusively on the nuclear (stressed) syllable of a phonological word. It is never marked on a phonological clitic or an unstressed syllable (clitics or unstressed syllables are not labelled with a tone marker). For cases of uncertain tonal events, a question mark "?" is placed next to the tone label.

#### 10.3.2.3 Break Indices Tier

The prosodic organization of words and phrases are marked with break indices. Each break index is labelled at the edge of phonological clitics, words, and phrases. In general, the higher the break index, the higher "level" of constituency the word/phrasal domain it's associated with[12]. The following break indices are used for the lut-ToBI model:

0: For cases of clear phonetic marks of 'clitic' groups. These are used for breaks between clitics.

1: A perceived disjuncture between the edge of a phonological clitic C and a phonological word W.

2: The right-most edge of an AP.

3: Perceived disjuncture between intermediate phrases with no apparent pauses between them (sometimes, this can be marked by conjunctions separating clauses (as in *gʷəl* "and")). This is used for demarcating two or more intermediate phrases within the same phonological paragraph. The associated tone label is L-.

4: Perceived disjuncture that is followed by a strong of pause (separated by an actual pause or separated by a comma). This break index is used for separating IPs, which can contain one (or more) iP. The associated tone label is L%.

---

[12] Here, I define each "domain" as phonological levels proposed in Nespor & Vogel's (1986:16) hierarchy of prosodic constituency. The following is an interpretation of the prosodic hierarchy that was proposed by Nespor & Vogel:
Intonational Phrases (phonological paragraph) > Intermediate Phrases > Accentual Phrases > Word > Clitic

For the break index 3, this can occur if two distinct declination patterns are observed between separate iPs. If there is no “falling” intonation after the accentual phrase (which may precede a conjunction), this must be marked with 2. Break index 3 can also be used when two iPs are separated by distinct pitch ranges (this is especially true when the final AP is followed by a discourse marker). It should be noted that two (or more) iP’s that are separated by a break index of 3 are interpreted as belonging to the same phonological paragraph (or IP), which is a level higher than iPs. However, when two (or more) IPs are separated by a break index of 4, this is interpreted as IPs belonging to separate phonological paragraphs.

The diacritic ‘p’ is analogous to the ‘p’ used by Jun (2005) in Korean ToBI (K-ToBI). This diacritic is used for breaks 1 and 2 (i.e., 1p and 2p), which marks abrupt cut offs (or pauses) between words with a break index of 1 or 2. Abrupt cut offs (or pauses) can happen when the speaker hesitates between phonological clitics and words. When there is an abrupt cut off between syllables within a word (e.g., *ləs… č̓iq̓ʷil*), the diacritic ‘p’ is not used because it does not indicate a break between word forms. Instead, ‹silence› is labelled in the miscellaneous tier (see Section 10.3.2.4 for more details). This is contrasted from the pause that occurs after IPs or phonological paragraphs, which are pauses that are not caused by a speaker’s hesitation between Cs and Ws (in such instances, when the IP or paragraph is followed by a pause, it is marked with a break index of 4).

The diacritic ‘2d’ is used for discourse markers. Discourse markers are used to mark the onset of a new intonational phrase. These can come in the form *ʔu*…, *ʔa*…, *huy*…, etc…. Discourse markers have their own nuclear pitch accent, which is separate from the accentual phrases that follow. For this reason, discourse markers are interpreted as belonging to their own accentual phrase, which should be separated with a break index of 2. Discourse markers can also be used on accented syllables of an AP. In this case, ‹discourse› is labelled in the miscellaneous tier during these intervals. These markers can be thought of as marking a focus contrast.

It is also worth noting that a break index of 4 does not necessarily fall on the final AP. It may fall at the end of a clitic form, so long as it forms the boundary of an intonational phrase (or phonological paragraph). For example, this can be observed in *$g^w$ələ cutəbəx$^w$ ti* ‘and she/he said this’, organized as follows:

(20) {{ C { W }}$_{AP}$ C}$_{IP}$
‹$g^w$ələ cutəbəx$^w$ ti›
‘and she/he said this’ (AJ/Elk & Bear 02:33.67)

Figure 10.4 illustrates the ToBI transcription of the structure in (20).

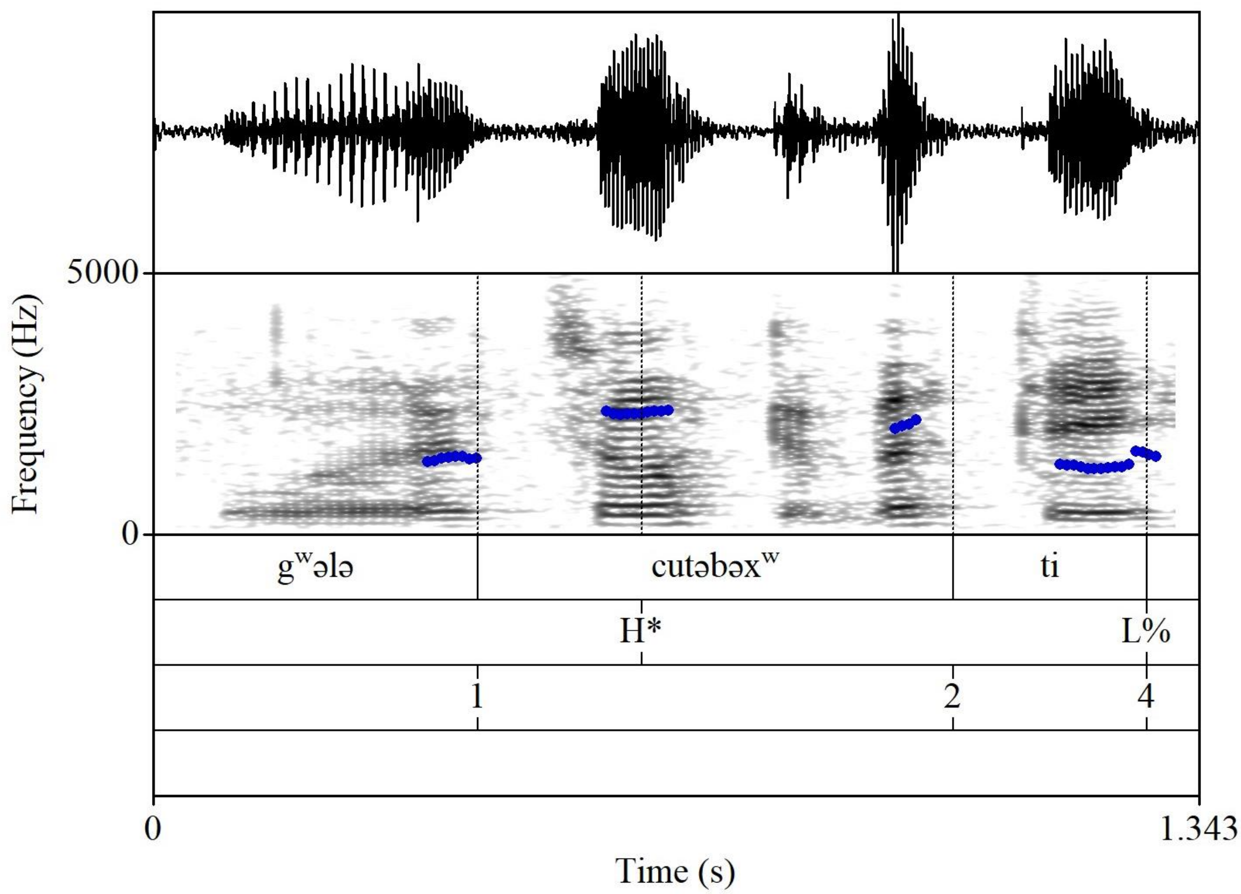



**Figure 10.4** ToBI transcription of example (20) *$g^w$ələ cutəbəx$^w$ ti* ‘and she/he said this’.

The only evidence for why the final C should be marked with a break index of 4 is the L-L% followed by a pause. The example in (20) suggests that IPs can end with either an AP or a C. This suggests that clitics must fall within a phrasal domain – i.e., the APs or IPs of the utterance.

When there is a falling intonation at the end of the IP, this indicates a separate declination from the IPs that precede or follow this form. It can also occupy a distinct pitch range, suggesting that it belongs to its own IP. However, at the end of each IP utterance (when it is followed by a pause), the break index 4 is marked at the boundary of the utterance to mark the end of the IP or phonological paragraph.

#### 10.3.2.4 Miscellaneous Tier

The miscellaneous tier is used for any comments on speech (e.g., silence, audible breath, laughter, disfluencies) that is desired by transcription groups. One transcription convention when labelling pauses in the miscellaneous tier is ‹silence›. When there is a pause between syllables of the same word to signify different types of repetitions, these are not marked with a break index 1p or 2p. Instead, the mark ‹silence› is labelled in the miscellaneous tier for this interval. Whenever the accented syllable of a phonological word W is a focus, it is labelled ‹discourse› to denote that the syllable itself functions as a discourse marker.

The miscellaneous tier can also be used when there are no apparent breaks between words. For example, in the phrase *gʷəl ləcutəbəxʷ* “and he said (PASS)”, there is no apparent “break” between *gʷəl* “and” and *ləcutəbəxʷ* “he said (PASS)” because the lateral approximant at the end of *gʷəl* and the beginning of *lə-* are realized with no break between the word forms (these are the same lateral approximants realized in the utterance). Another example is in deletion of the vowel in an open determiner (i.e., a determiner that is an open syllable) (see Chapter 11 for more information on allomorphs in Lushootseed), where the initial consonant of the determiner becomes the onset of the following word that is initialized with the morpheme *ad-* 'you POSS', as in *t(i) ad-sč̓istxʷ* 'your husband'. Although there are two 'words' in this phrase (i.e., the phonological clitic *ti* 'this' and the phonological word *ad-sč̓istxʷ* 'your husband'), there is no break between the words as the vowel in the determiner is deleted and the initial alveolar stop /t/ in the determiner becomes the onset of the following word initialized with *ad-* 'you (poss.)'. When this happens, ‹no break between words› (or simply ‹no break›) can be labelled in the miscellaneous tier.

### 10.3.3 *Analysis*

#### 10.3.3.1 Methods

In this section, I analyze two types of recordings for the annotation of lut-ToBI: (1) recordings of connected *spontaneous* speech, which comes from narratives of traditional Salish myths; and (2) careful *elicited* speech, which comes from recordings of lesson materials that were used for second language teaching. The purpose of (1) is to characterize the relationship between iPs, phonological paragraphs (or IPs), and pragmatic meanings of each prosodic unit in Lushootseed discourse. The purpose of (2) is to characterize differences in intonational contours for different types of sentences (e.g., *yes-no* questions and *wh*-questions vs. declaratives).

Two speakers were examined: (1) Annie Jack for the recording of connected *spontaneous* speech, and (2) Louis George for the recording of careful *elicited* speech. The recording of Annie Jack (Southern Lushootseed speaker) comes from a traditional Salish myths "Elk and Bear" and "spicx̌ʷ". The recordings of Louis George came from lesson materials that were recorded by Thom Hess in the 1970's for Northern Lushootseed. These recordings are publicly available through http://lushootseedresearch.org. These recordings were used to accompany Hess and Hilberts' introductory textbook to Northern Lushootseed (Hess & Hilbert 1976).

Each recording was analyzed using a waveform, spectrogram, and pitch tracker. A narrowband spectrogram was used by setting the window length (in the spectrogram setting) to 30ms. The pitch range was set from 100Hz (minimum) to 400Hz (maximum). The analysis method that was used in the pitch setting was autocorrelation.

#### 10.3.3.2 Connected spontaneous speech

The labeling convention of lut-ToBI provides insight on how the pattern of intonation works in Lushootseed discourse. As it turns out, Lushootseed makes minimal use of intonation. Unlike English or Korean (where different sentence types or pragmatic "meanings" can be inferred from differences in intonation contour), only one type of intonational contour occurs in these Lushootseed recordings: f0 declination (HL%). The only way speakers can convey distinct "pragmatic meanings" is by producing each declination with distinct pitch ranges across intermediate and intonational phrases. However, the pattern of intonation itself (i.e., the contour that defines the pattern) is always the same: Every intonational phrase can be identified as f0 declination.

According to Beck & Bennett (2007), an intonational phrase IP is marked by a gradual fall in f0 from the beginning to the end of an utterance. However, the current data illustrates that the fall in intonation is usually observed on the final syllable (or sometimes the penultimate syllable) at the edge of an intonational phrase. The falling intonation is often rapid (or "abrupt"), and it often marks the end of a phonological phrase (either iP or IP). As Figure 10.5 illustrates, it is possible to draw a straight line (dashed red) that connects the maximum pitch values of each accented syllable, which is followed by a short fall at the end of the IP.

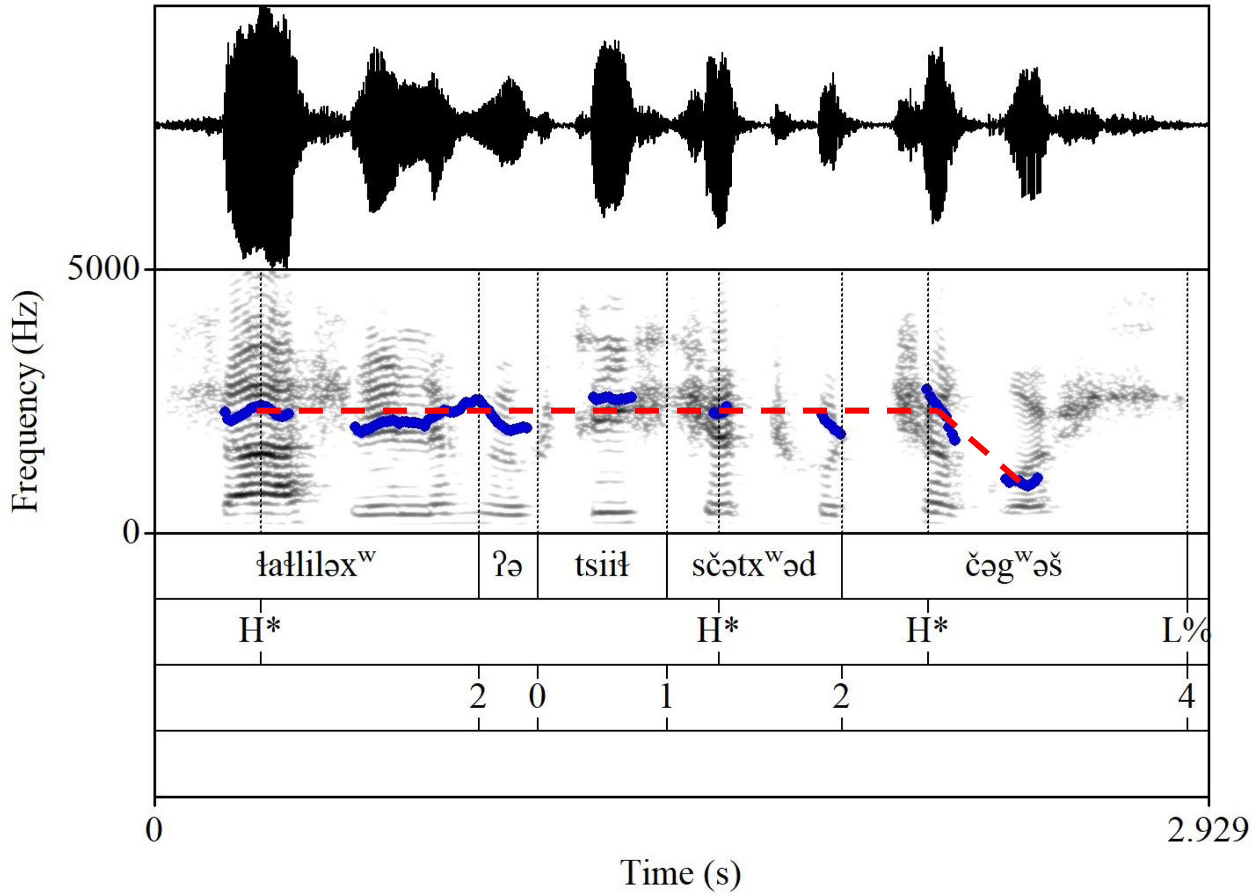



**Figure 10.5** Example of f0 declination for an IP in Lushootseed.

According to Hargus (personal communication), this kind of intonational pattern can also be observed in Yakima Sahaptin (where a straight line can be drawn to connect the maximum pitch values of each accented syllable of an IP). However, Hargus also notes that a boundary low is not always observed in all declaratives in Sahaptin (Hargus & Beavert 2014).

Two intermediate phrases that are grouped into a single phonological paragraph (which I define here as an IP) are marked with a break index of 3. Each intermediate phrases has distinct pitch ranges. This can be observed in Figure 10.6, where the two intermediate phrases (separated by a break index of 3) have distinct pitch ranges. As Figure 10.6 illustrates, the iP that follows the break index of 3 (which forms the sentence *ʔu... ʔəsč̓učɬaʔ* ‘oh! It is just small leaves!’) has a higher pitch range (transcribed as H^*) than the iP preceding it (which forms the sentence *huy c̓ibiq̓idəxʷ gʷəl labtxʷəxʷ* ‘Then she scratched it and looked at it’) (see (21) for an example of these two sentences in IGT).

| | | | | | | |
|---|---|---|---|---|---|---|
| (21) | huy | c̓ibiq̓-id=əxʷ | gʷəl | lab-txʷ=əxʷ. | ʔu... | ʔəs-č̓u~č̓łaʔ |
| | then | scratch-TR=now | and | see-CAUS=now. | Oh | STAT-DIM~leaves |

‘Then she scratched it and looked at it. Oh! It is just small leaves!’ (AJ/Elk & Bear 33)

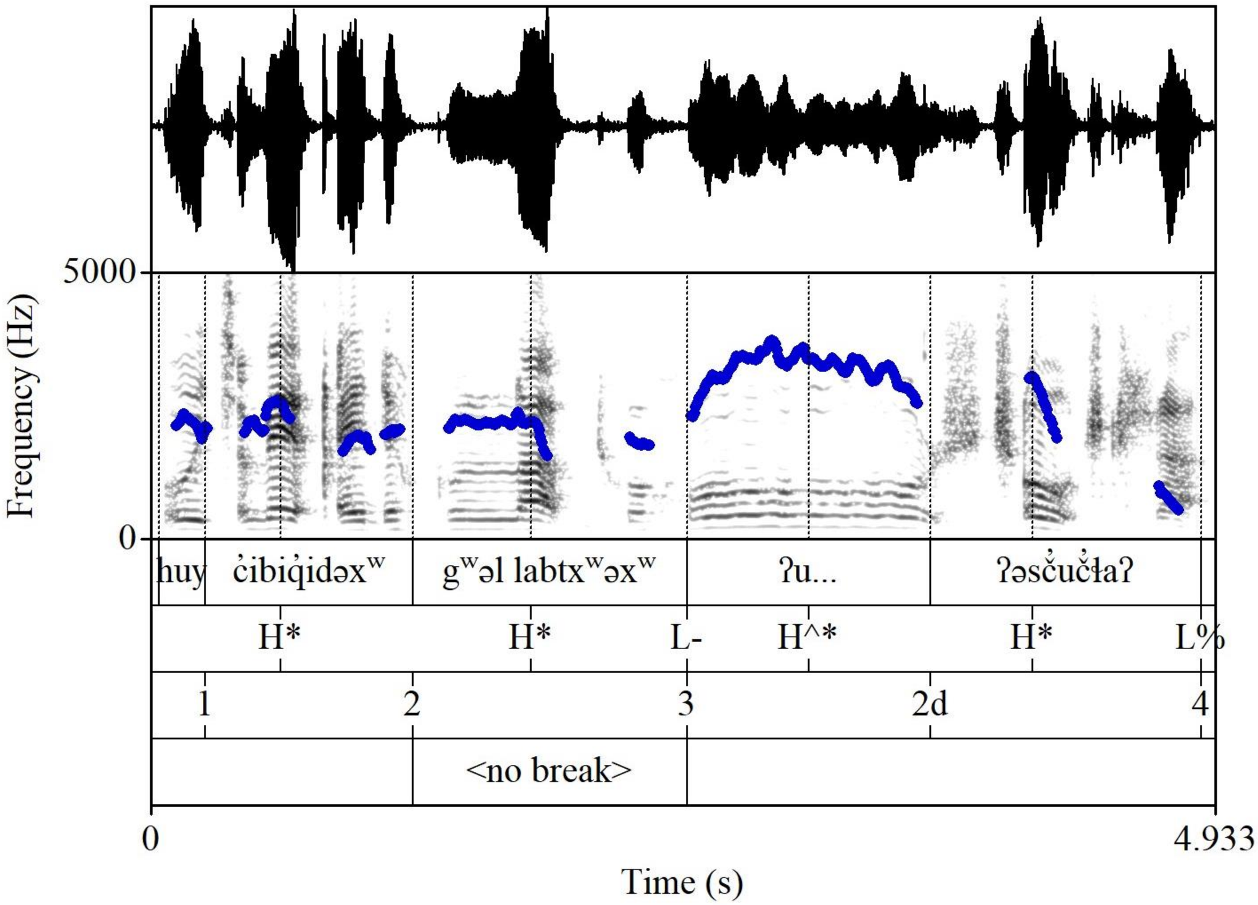



**Figure 10.6** Distinct pitch contours for two iPs (separated by a break index of 3).

The first iP in Figure 10.6 has an edge tone (labelled L-) that doesn’t necessarily fall along the intonation contour (i.e., it marks an “unchanged” intonation contour). On the other hand, the second iP (i.e., the last iP of the phonological paragraph) has a steeply falling intonation at the very edge of the intonation contour. When there is a steeply falling intonation contour at the very edge of an utterance, this usually signifies the end of an intonational phrase. On the other hand, an "unchanged" edge contour signifies "continuation" – that is, there is no cessation of the utterance by a pause, and it is followed by an iP.

Because two iPs of the same intonational phrase (IP) show distinct pitch ranges, pragmatic meanings can be inferred based on the distinct pitch ranges of each iP. For instance, it is often the case that in two successive iPs, if the f0 declination of the second iP has a higher pitch range than the first iP, the speaker (or the character narrated by the speaker in the discourse) may express "surprise" based on information given from the first iP. This can be observed in Figure 10.7, where the latter sentence (i.e., the domain of the second iP, separated by a break index of 3) *ʔuləḱʷədəxʷ čəxʷ tiił ʔəsčí̓q̓ʷil* 'you ate something that is dirty' has a higher pitch range than the former sentence (i.e., the domain of the first iP) *ƛ̓uc̓agʷačibəxʷ siʔab čəxʷə ƛ̓uʔəłəd ʔə qahał* 'you, noble one, usually wash your hands and you usually eat a lot'.

| | | | | |
|---|---|---|---|---|
| (22) ƛ̓u-c̓agʷ-ači-b=əxʷ | siʔab | čəxʷə=ƛ̓u-ʔəłəd | ʔə | qahał. |
| HAB-wash-hand-MD=now | noble | 2SG.SBJ.CONJ=HAB-eat | OBL | a.lot |
| ʔu-ləḱʷ-əd=əxʷ=čəxʷ | tiił | ʔəs-čí̓q̓ʷ-il | | |
| PFV-eat-TR=now=2SG.SBJ | DET | STAT-rotten-INCH | | |

'you, noble one, would wash your hand and would eat a lot. You ate something that is dirty!'

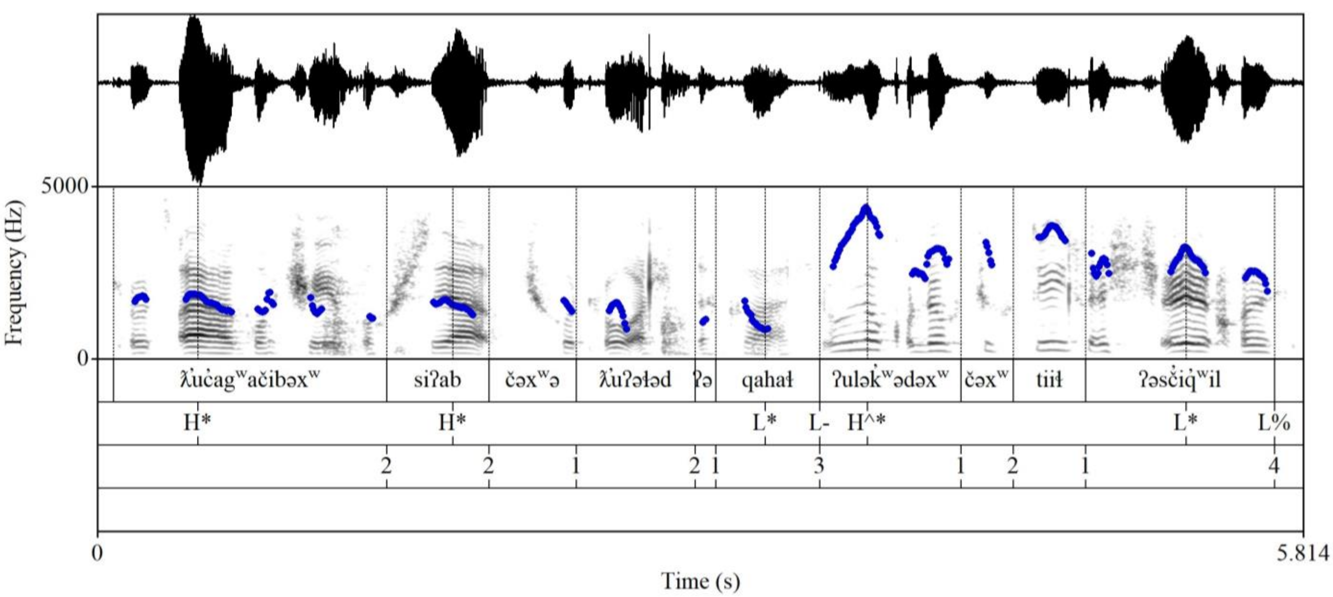



**Figure 10.7** Two IPs (separated with a break index of 3), where the second IP (following the break index 3) expresses "surprise" given the information from the preceding sentence.

In Figure 10.7, the higher pitch range in the latter sentence expresses "surprise" based on information from the preceding sentence (that is to say, it is surprising that the individual ate something that is dirty because that person usually stays "clean" and "healthy", based on the information given from the previous sentence). The two iPs in Figure 10.7 belong to the same phonological paragraph (or IP) because there is no subjective sense of pause between the two iPs. Moreover, there are certain "dependencies" in pragmatic meanings between the two iPs, which can be inferred if the two iPs fall on the same phonological paragraph. It expresses a level of "antecedents", where the iP that follows the break index of 3 is dependent on the meaning of the iP preceding it. It is for this reason that the two iPs are interpreted as falling within the same prosodic domain (i.e., a larger unit that can be called the phonological paragraph, or IP).

Rhetorical repetition plays an important role in marking discourse events and narration. They are marked by differences in pitch ranges of intonational contours across intermediate and intonational phrases. There are several kinds of rhetorical repetitions in Lushootseed. Here, I look at three of these: Verb Repetition, Sustained Repetition, and Elaboration Diacope (where the term "diacope" means words/phrases that are repeated in discourse/narratives). An example of verb repetition can be observed in Figure 10.8, where the speaker repeats the verb *ɬəx̌ub* 'hunt' (see (23) for the IGT of the sentence). As Figure 10.8 illustrates, there is a series of downsteps (transcribed as "!" on the pitch accented syllables) for the verb *ɬəx̌ub* 'hunt', where the speaker repeats the verb to emphasize the habitual act (marked by the habitual aspect *ƛ̓u-* HAB) of hunting. Downsteps can also be observed on the pitch accented syllable of the repeated word(s), whereas the pitch range of the syllables preceding the pitch accented syllables (in the same word) occupies the same pitch range as the pitch accented syllable of the preceding iP (demarcated with the break index 3). The pitch ranges of these syllables can be observed in Figure 10.8, where the red lines are connected by the pitch peaks relative to the pitch accented syllable.

(23) ƛ̓u-łəx̌ub tiił kʷagʷičəd. ʔu-łəx̌ub. ʔu-łəx̌ub.
HAB-hunt DET elk PFV-hunt PFV-hunt
'The elk always hunted. He hunted. He hunted.'

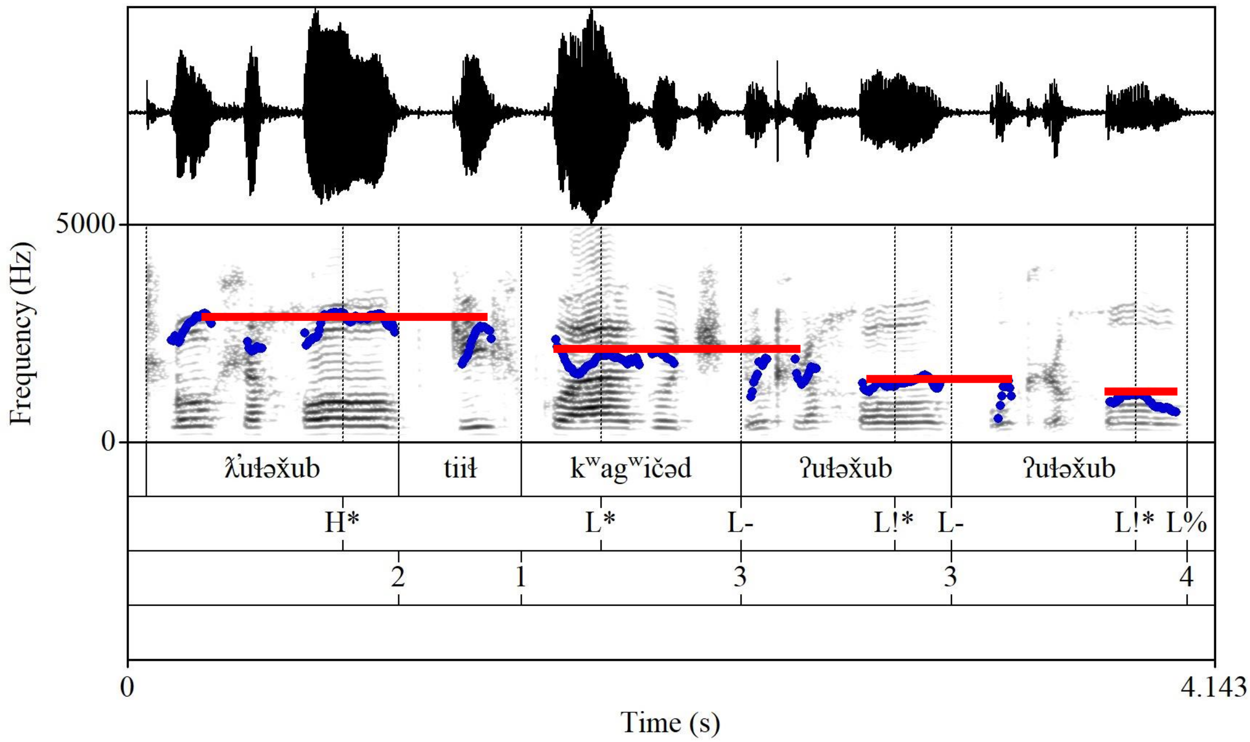



**Figure 10.8** Example of verb repetition with a series of downsteps (transcribed as L!*). Red lines marks the level of pitch range.

Another kind of repetition is known as *sustained repetition*. Here, the intonation contour is "sustained" (i.e., the pitch range across each repeated word remains unchanged) throughout the repeated utterance and is followed by a phrase that closes the sentence (evident from the falling contour at the end of the intonational phrase). This can be observed in Figure 10.9, where the pitch range of the final pitch accented syllable in the first iP (i.e., *huy tuʔəłtxʷəxʷ ʔə kʷi stab* 'Then she fed her something') is sustained (remains unchanged) throughout the following iPs. It should be noted that, because the pitch accent of the second iP (i.e., the phrase *gʷəl tuwələx̌ʷil* 'and she grew stronger’) is in the same pitch range as the final pitch accented syllable of the previous iP (i.e., in the word *stab* ‘something’), the tone for the pitch accented syllable of the second iP is labelled H because it is the highest tone within its respective iP. This contrasts from verb repetition (as illustrated in the previous example, Figure 10.8), where the pitch range of the pitch accented syllable gets lower relative to the pitch accent of the previous iPs.

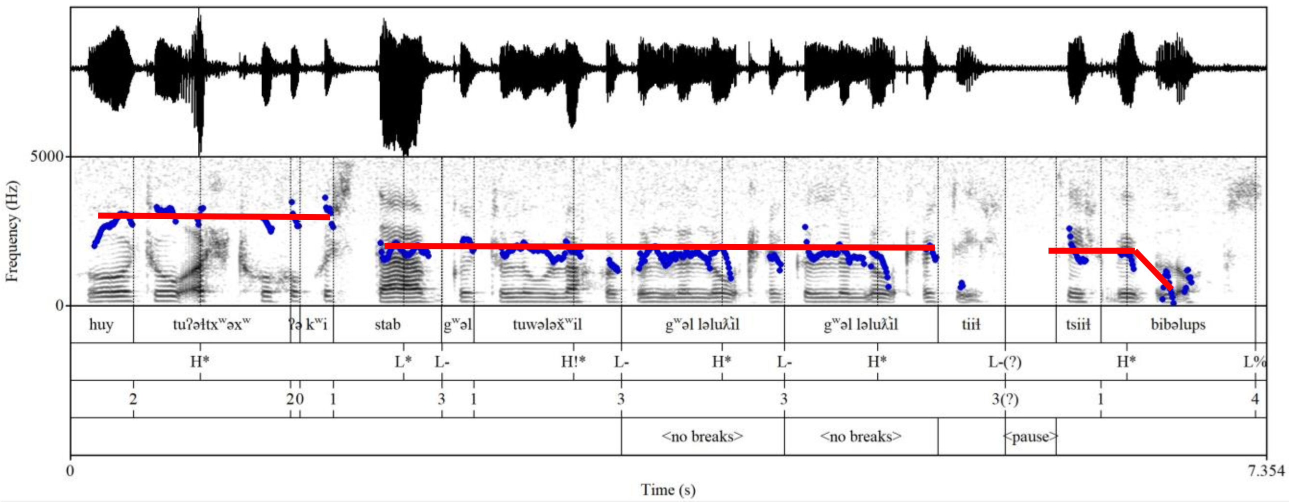



**Figure 10.9** Example of sustained repetition, where the pitch range of the repeated phrase *gʷəl ləluƛ̓il* ‘and getting older’ remains the same across iPs (marked with a break index of 3). Red lines marks the level of pitch range.

In sustained repetition, the repeated words/phrases signifies a “continual act/state”. The example in Figure 10.9 illustrates that the repetition of the phrase *gʷəl ləluƛ̓il* ‘and getting older’ means that she (i.e., the little raccoon) is getting older and older (that is, *bibəlup-s* ‘her little raccoon’ is continually getting older). Because the pitch range of the repeated words/phrases occupies the same pitch range as the second iP *gʷəl tuwələx̌ʷil* ‘and she’s gotten stronger’, the repetition of *gʷəl ləluƛ̓il* ‘and getting older’ can be said to be included in the shared semantic domain (or “space”) that coincides with the raccoons “continual development” (i.e., getting stronger and older). This is dependent on the “thing” (from the word *stab* ‘something’) that is being fed to the raccoon, where the pitch range of the word *stab* ‘something’ sets off the sustained pitch range of the following iPs.

"Elaboration diacope" is used to refer to the repetition of a word that introduces an elaboration (Gerdts 2018), where the word that is repeated is being "elaborated" in more detail once introduced in the new IP. In elaboration diacope, an IP ends with a word W, followed by a pause, and then followed by another IP that starts with the repeated W. This can be observed in Figure 10.10, where the first IP ends with the word *ǰač̓əxʷ* 'river rises now' and the following IP (preceded by a pause) begins with the same (repeated) word *ǰač̓əxʷ* 'river rises now'. The IGT in (24) shows that the elaboration of the repeated word *ǰač̓əxʷ* 'river rises now' is used to provide more detail (or context) to the event denoted by that word in the preceding IP (i.e., before the pause).

(24) huy gʷəl ǰač̓=əxʷ. ǰač̓=əxʷ ti swatixʷtəd…
then and river.rises=now river.rises=now DET land
'Then the river rises. The rising river floods the land…'

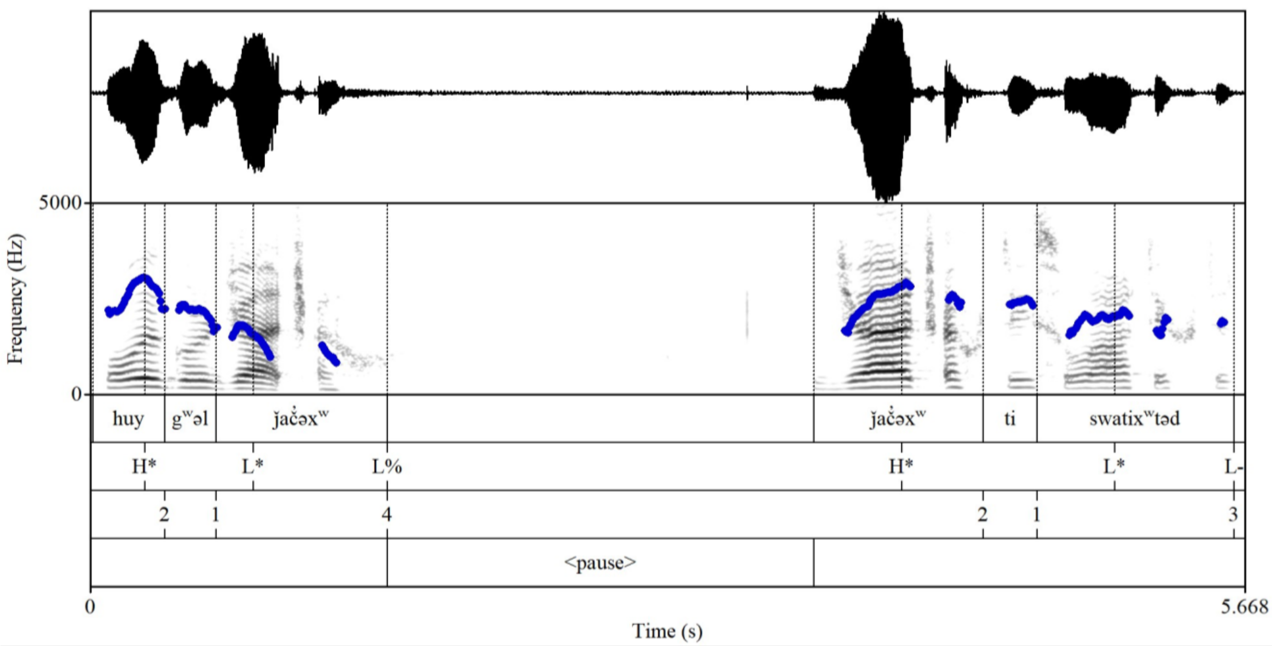



**Figure 10.10** Example of elaboration diacope, which shows the repetition of the word *ǰač̓əxʷ* 'river rises now'.

As Figure 10.10 illustrates, the pitch contour of *ǰač̓əxʷ* ‘river rises now’ in the first IP (which ends with a break index of 4) has a steep falling contour (marked with a pitch accent L*), which is the default pattern that occurs at the end of IPs. This is followed by a pause, which is subsequently followed by the second IP that begins with the (repeated) word *ǰač̓əxʷ*. Here, the word *ǰač̓əxʷ* ‘river rises now’ is being elaborated in more detail by providing it context, where the event of “river rising” is flooding *swatixʷtəd* ‘land’. In the second IP, the word *ǰač̓əxʷ* ‘river rises now’ (which forms the beginning of the second IP) has a high pitch accented syllable (marked as H*) that remains steady until it reaches the end of the iP (i.e., the final pitch accented syllable of the iP).

#### 10.3.3.3 Careful elicited speech

In careful *elicited* speech, there were three types of sentences that were produced by the speaker: Interrogative *yes-no* questions, *wh*-questions, and declarative responses to the interrogative *yes-no* and *wh*-questions. The intonational contours for interrogative *yes-no* questions and declarative responses were the same: Both were realized with a declination pattern. This can be observed in Figure 10.11, where the interrogative *yes-no* question (Figure 10.11a) and the declarative response (Figure 10.11b) showed declination patterns.

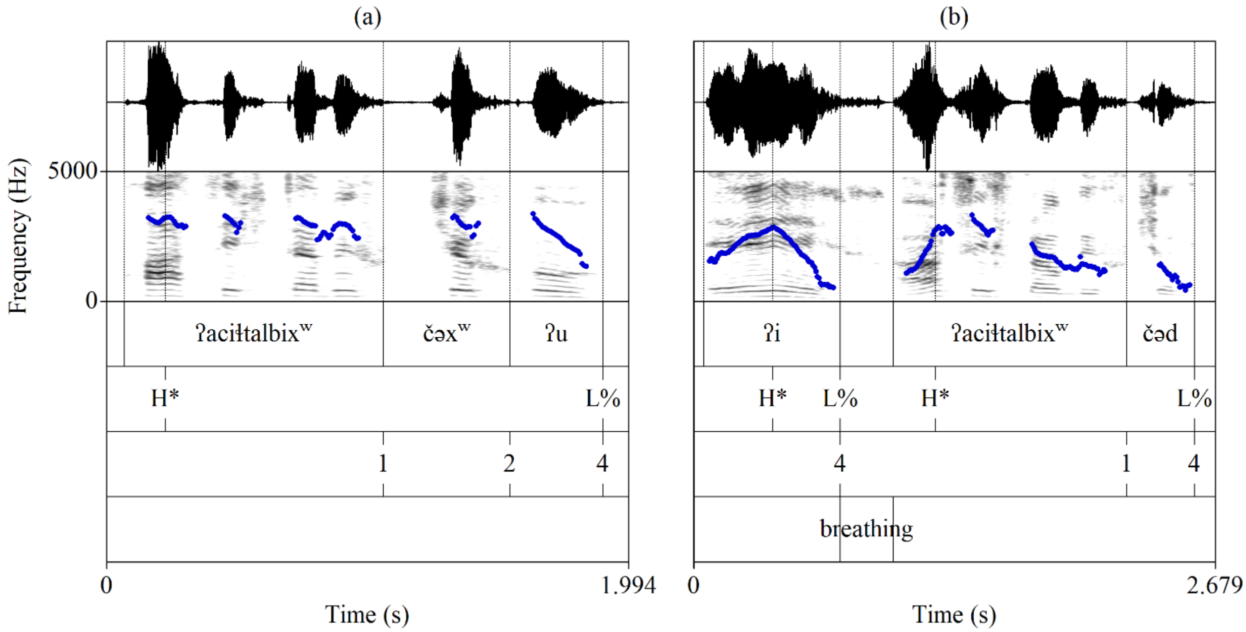



**Figure 10.11** f0 contour for (a) the interrogative *yes-no* question *ʔaciłtalbixʷ čəxʷ ʔu* 'Are you a Native American?', and (b) the declarative response *ʔi. ʔaciłtalbixʷ čəd* 'Yes. I am Native American.'

However, the interrogative *yes-no* question in Figure 10.11a appeared to have a higher pitch range than the declarative response in Figure 10.11b. This is consistent with Jacobs (2007) work on the Salish language Squamish, where there was a higher pitch range for *yes-no* questions than declaratives (despite both sentence types being realized with a declination pattern). However, the differences in pitch range between these two sentence types might be superficial at best. As we have seen in Section 10.3.3.2, speakers can adjust their pitch range to express different kinds of pragmatic meanings across IPs (such as "surprise"). A higher pitch range does not necessarily imply that the sentence is an interrogative. Speakers can utilize a higher pitch range to convey various pragmatic meanings (such as "surprise") that doesn't necessarily mark the sentence as an interrogative *yes-no* question. The most important cue for differentiating interrogative *yes-no* questions from declaratives appears to be the use of the question particle *ʔu*. The morphological marking of *yes-no* questions (via the question particle *ʔu*) appeared to play a more significant role in differentiating the two sentence types than changes in pitch range across utterances.

It is also worth noting that the pitch contour for the word *ʔi* ‘yes’ has a rising-falling pattern. However, it is uncertain if the rising-falling pattern is indicative of a declarative response to a *yes-no* question. As the labelling convention in Figure 10.11b illustrates, the peak of the intonation contour could be interpreted as a high (H*) pitch accent (where an intonational “rise” is simply a H*, as discussed in Section 10.3.2.2), which is followed by a falling pitch contour at the end of the utterance (which could be marked with an L-L%, which, as discussed in Section 10.3.2.2, can be used to label a low or “falling” intonation contour). The word *ʔi* ‘yes’ is marked with a break index of 4 because it is followed by a pause, which marks the end of the IP (for this reason, L-L% is marked in the Tone Tier at this boundary).

Like the comparison between interrogative *yes-no* questions and declarative responses, *wh*-questions and declarative responses has the same pattern of intonational contour: Namely, f0 declination. This can be observed in Figure 10.12, where the *wh*-question (Figure 10.12a) and the declarative response (Figure 10.12b) showed declination patterns, where the *wh*-question is marked by the *wh*-word *stab* ‘what’.

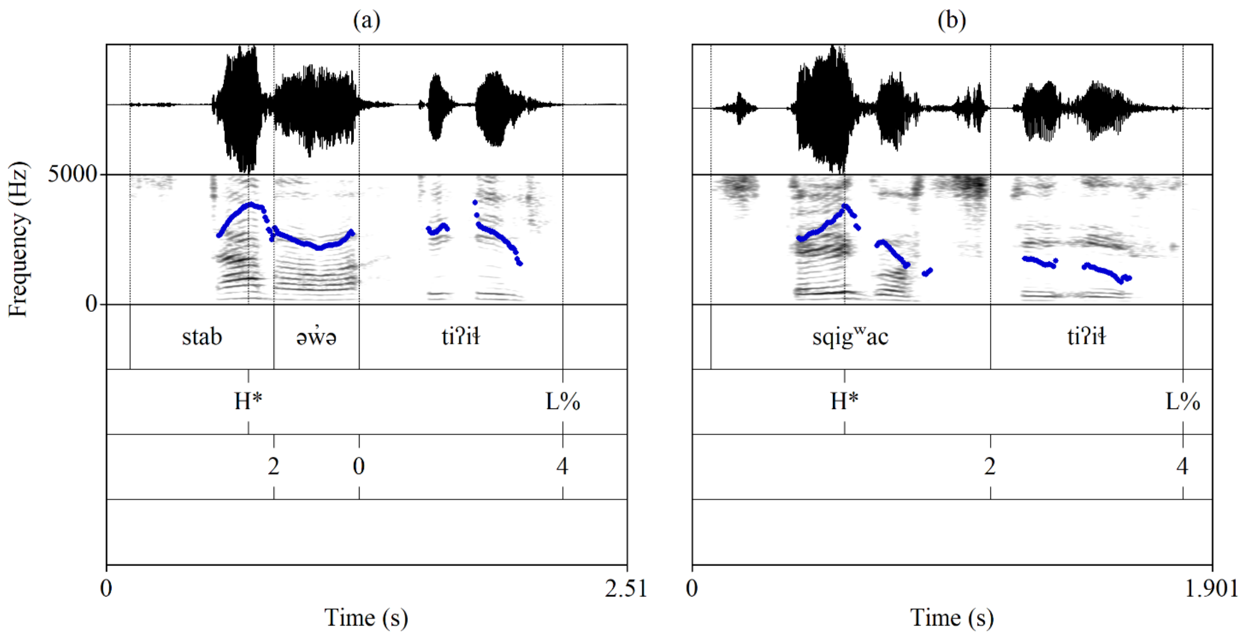



**Figure 10.12** f0 contour for (a) *wh*-question *stab əw̓ə tiʔiɬ* 'what is that', and (b) declarative response *sqigʷac tiʔiɬ* 'that is a deer'.

It should be noted that the pitch range for the distal demonstrative *tiʔiɬ* at the end of the two sentences showed distinct pitch ranges, where the pitch range in *tiʔiɬ* in the *wh-question* (Figure 10.12a) had a relatively higher pitch range than *tiʔiɬ* in the declarative response (Figure 10.12b). However, like the situation of *yes-no* questions (discussed above), pitch range doesn't appear to be a significant factor in differentiating interrogative *wh*-questions from declarative sentences. The most important factor appeared to be the position of the *wh*-word *stab* 'what', which occurs at the beginning of a sentence to signify that it is a *wh*-question.

### 10.3.4 *Discussion*

In this paper, I provided a model for transcribing intonation in Lushootseed. The labelling convention was grounded on the works of Beck and colleagues (Beck 1996, 1999; Beck & Bennett 1998, 2007) with a few modifications to their system. The evidence showed that intonational contours in Lushootseed were always the same: Every IP could be identified as f0 declination.

Distinct pragmatic meanings across iPs could be inferred based on their distinct pitch ranges. Although sentence types (i.e., the difference between interrogatives and declaratives) showed the same type of intonation contour (both were characterized as f0 declinations), there was a tendency for *yes-no* and *wh*-questions to show a higher pitch range than declarative sentences in careful elicitation speech. Although this model is a first step towards transcribing intonation in Lushootseed, there are a few problems that will require future investigation.

One problem is the lack transcribing lut-ToBI for connected spontaneous speech of the Northern dialect. It is unknown if the patterns observed from the Southern dialect could also be observed in the Northern dialect. Another problem is that a comparison between *yes-no*/*wh*-questions and declaratives was not observed in connected spontaneous speech. There were no instances of *yes-no* questions in the recording of connected spontaneous speech. Whether this pattern occurs in connected spontaneous speech or not cannot be determined based on the current evidence alone. Moreover, it is uncertain whether the intonation of *yes-no* questions and declaratives differs between the Northern and Southern dialects. For this reason, future investigation may require an in-depth analysis of *yes-no* questions and declaratives in connected spontaneous speech and across dialects of Lushootseed.

In this study, a few types of discourse marking cues (based on information from changes in pitch range) (across iPs) were examined: Namely, the change in pitch range to convey the pragmatic meaning of “surprise” (as illustrated in Figure 7) and the intonation contours of rhetorical repetitions such as verb repetition, sustained repetition, and elaboration diacope. There are many ways of utilizing pitch ranges across iPs to convey distinct pragmatic meanings in Lushootseed, especially during repetitions. And there are many types of repetitions that was not examined in this study. Future investigation will require a more careful analysis of the intonational structure of rhetorical repetitions.

## 10.4 Conclusion

In this chapter, I covered stress and intonation in Lushootseed. Although there is no fixed acoustic correlate to stress in Lushootseed, stress can be identified based on the relative duration and relative intensity of each syllable in a word. Word-level stress in Lushootseed is predictable; however, there are dialect-specific and lexical-specific differences that may not always conform to the common types of stress patterns in the language. An understanding of word-level stress is important for the transcription of intonation in Lushootseed because the location of primary stress in a word determines the location of a pitch accent. The pattern of intonation in Lushootseed is simple because there is only one type of intonational contour that occurs across utterances: f0 declination. Speakers use distinct pitch ranges across each f0 declination to convey distinct pragmatic meanings. The intonation contour for *yes-no* and *wh*-questions was the same as declarative sentences: Both sentence types were characterized by f0 declination. Although the pitch range for *yes-no* and *wh*-questions was relatively higher than declaratives, the most important cue that speakers use to differentiate the two sentence types apart is the question particle *ʔu* to mark *yes-no* questions and the position of the *wh*-word in the sentence.

# PART 3. MORPHOLOGY

# Chapter 11. OVERVIEW OF LUSHOOTSEED MORPHOLOGY

## 11.1 INTRODUCTION

In this chapter, I provide a brief introduction to Lushootseed morphology. I begin this chapter (Section 11.2) by situating Lushootseed in current morphological typology. In Section 11.3, I discuss words and word forms, word order vs morphology, and general position restrictions. In Section 11.4, I discuss allomorphic variations using data from primary and secondary sources. In Section 11.5, I provide information about two common patterns of reduplication. In Section 11.6, I cover conjunctions and the negation marker *xʷiʔ* in Lushootseed.

## 11.2 TYPOLOGICAL CLASSIFICATION OF LUSHOOTSEED MORPHOLOGY

The question of whether Lushootseed can be classified as either agglutinative or fusional, or whether the language can be classified as either analytic (isolating), synthetic, or polysynthetic, has not been addressed in the literature. According to Lonsdale (personal communication), Lushootseed can be classified as some (synthetic) combination of fusional and agglutinative. Quantitative approaches towards classifying the morphological typology of different languages have been used in the past (Greenberg 1959, Haspelmath 1993, Haspelmath & Sims 2010, Fortescue 1984, Payne 2017). However, a quantitative approach towards classifying Lushootseed morphology has yet to be conducted. In this section, I provide the first quantitative approach towards classifying Lushootseed morphology by calculating the degree of synthesis and degree of fusion from stories told by two speakers (one Southern and one Northern): Three stories from the Southern Lushootseed speaker Annie Jack (AJ) and two stories from the Northern Lushootseed speaker Susie Sampson Peters (SSP).

To determine the degree of synthesis, a synthesis index was calculated by dividing the number of morphemes M by the number of words W per sentence (based on Greenberg (1959), Payne (2017), and Haspelmath & Sims (2010) equation for calculating the degree of synthesis). Moreover, the average M/W ratio per-sentence was calculated. The M/W ratio was used to determine whether the language is (or close to) either analytic, synthetic, or polysynthetic. Using Payne's (2017) index, if the average M/W ratio is in the range of $1 \leq M/W < 2$, the level of synthesis should be classified as *analytic* (or *isolating*). If the M/W ratio is in the range of $2 \leq M/W < 3$, the level of synthesis should be classified as *synthetic*. If the M/W ratio is $M/W \geq 3$, the level of synthesis should be classified as polysynthetic. Figure 11.1 is a continuum that illustrates the index of synthesis (adapted from Payne (2017)).

| $1 < M/W < 2$ | $2 \leq M/W < 3$ | $3 \leq M/W$ |
|---|---|---|
| Analytic | Synthetic | Polysynthetic |

**Figure 11.1** Index of synthesis (i.e., M/W). Adapted from Payne (2017:86).

Table 11.1 shows the average M/W ratio per-sentence for the two speakers.

**Table 11.1** Average M/W ratio for the speakers AJ and SSP.

| **Speaker** | ***N*** | **Average M/W** | **SD** |
|---|---|---|---|
| AD | 124 | 2.01 | 0.63 |
| SSP | 127 | 2.3 | 0.72 |

Note: *N* = number of observed sentences, SD = standard deviation

As Table 11.1 summarizes, the average M/W ratio for SSP was slightly greater than for AJ. This may suggest that there was a greater degree of synthesis in the Northern dialect than the Southern dialect. Regardless, the average M/W ratio for each speaker fell within the range of $2 \leq M/W < 3$, classifying the language as synthetic.

The degree of fusion (i.e., whether a language is agglutinative or fusional) is more difficult to quantify. An agglutinative language has been defined as “a language in which almost all words are formed by concatenation of morphemes” (Haspelmath & Sims 2010:319). The junctures between morphemes are clear, and there is no purely morphophonemic[13] variation (Payne 2017:87). On the other hand, a fusional language has been defined as a language “that makes a fair amount of use of morphology, but in which there is not usually a one-to-one correspondence between morphs and meanings” (Haspelmath & Sims 2010:329). Payne (2017) states that a highly fusional language is “one in which morpheme junctures are difficult to determine” (Payne 2017:87).

Words that involve suppletive morphology, allomorphic variation, and cumulative expressions (which are morphemes that express two or more grammatical meanings that would otherwise be expected to be expressed separately (Haspelmath & Sims 2010:64)), are generally classified as “fusional”. An index of fusion can be calculated by dividing the number of fusional morpheme junctures (Fj) by the total number of morpheme junctures (J) (which includes Fj). According to Payne, this is more difficult to quantify because there are many ways that words can be formed in response to variations in grammatical categories. In this study, I count a morphological element as Fj if there is an allomorphic variation, suppletive allomorphs, and/or a cumulative expression. For example, the subject clitic *=čəd* is a cumulative expression because it specifies more than one grammatical meaning: Namely, person (i.e., 1st-person), number (i.e., singular), and argument (i.e., subject) (in other words, it has three fusional junctures, namely these grammatical meanings). Examples of allomorphic variations can be observed in Section 11.4. An example of a suppletive allomorph is the distinction between *č̓ač̓aš* ‘child’ and *wiw̓suʔ* ‘children’,

[13] Morphophonemic variation here means “allomorphic” variation that applies only to certain morphemes, using Payne’s terminology (Payne 2017:93).

where the two allomorphs are not pronounced similarly (suppletive allomorphs of this kind would count one fusional juncture). All other morphological junctures (including Fj's) are counted as J, which include affixation, reduplication, morphological clitics, and compounding. Figure 11.2 is a continuum that illustrates the index of fusion (adapted from Payne (2017)). According to Payne, the cutoff for when a language can be classified as fusional or agglutinative is .5.

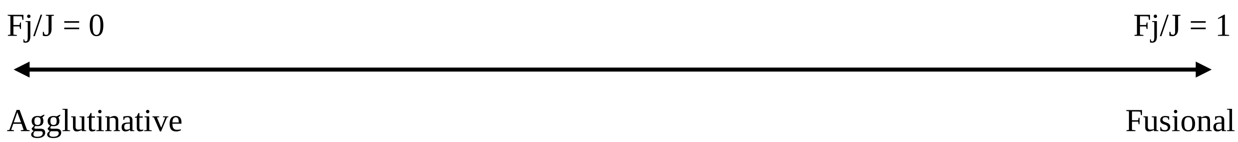



**Figure 11.2** Index of fusion (i.e., Fj/J). Adapted from Payne (2017:87).

Table 11.2 summarizes the Fj/J ratio for the two speakers.

**Table 11.2** Fj/J ratio for the two speakers AJ and SSP.

| **Speaker** | **Fj** | **J** | **FJ/J** |
|---|---|---|---|
| AJ | 82 | 220 | .37 |
| SSP | 95 | 233 | .41 |

As Table 11.2 summarizes, the Fj/J ratios for the two speakers were quite similar. Although the Fj/J ratio is less than .5, the ratios for the two speakers were not as low as languages that are generally classified as agglutinative, such as Turkish (Haspelmath & Sims 2010, Greenberg 1959) or Korean (Sohn 1999), which are languages that are well known to be agglutinative. The index may be consistent with Lonsdale (personal communication), who stated that Lushootseed can be classified as mostly agglutinative with some fusional morpheme junctures.

To summarize, Lushootseed can be classified as synthetic and a combination of fusional and agglutinative. Although the index of fusion shows that the Fj/J ratio in Lushootseed was less than .5, there were many cumulative expressions and allomorphic variations in the data, which brought it further away from being classified as a canonical agglutinative language (such as

Turkish or Korean). Therefore, Lushootseed is best classified as synthetic and a combination of fusional and agglutinative. This supports Lonsdale's (personal communication) observations.

## 11.3 BACKGROUND OF LUSHOOTSEED MORPHOSYNTAX

### 11.3.1 *Word order and argument restrictions*

The general word order in Lushootseed is Verb-Subject-Object (VSO). In transitive clauses, two overt DPs cannot occur in Lushootseed (Davis & Matthewson 2009). The subject in transitive clauses is always pronominal and occurs to the left of the object. Subjects and objects are usually distinguished morphologically. Subjects usually occur as pronominal clitics and objects can be marked as pronominal suffixes (see Chapter 12 for more details on pronominal morphology in Lushootseed). Objects can also occur as overt DPs (i.e., a noun headed by a determiner), while some phrases can occur as oblique phrases (i.e., a DP headed by an oblique *ʔə*, which occurs as implied AGENTS in passive constructions, implied PATIENTS in middle and dative applicative constructions, or DPs headed by a locative preposition *ʔal* 'in, on, at', *dxʷʔal* 'to, towards', *tul̓al* 'from' (see Chapter 14 for more details)). Subjects can also occur as overt DPs in middle constructions. The following are examples of overt DPs used for subjects in middle constructions (1) and objects in transitive's respectively (2).

| | | | |
|---|---|---|---|
| (1) q̓il-əb | ti | kaw̓qs | |
| load-MD | DET | raven | |
| 'Raven loaded up his belongings' | | | (SSP/Nobility 168) |

| | | | |
|---|---|---|---|
| (2) bə-lə-xʷəc-əd=čəd | tiʔəʔ | d-s-č̓ayəp | |
| ADD-PROG-remove.clothes-TR=1SG.SBJ | PROX | 1SG.POSS-NMLZ-skirt | |
| 'I removed my skirt' | | | (SSP/Training 2) |

### 11.3.2 *Verb roots*

The verb word is built around a root, which is either free or bound. It has been suggested that all verb roots are *intransitive* in Salish languages (Davis & Matthewson 2009, Thompson &

Thompson 1992). Verb roots may be classified as either *unaccusative* (also known in Salish linguistics as non-control intransitives) or *unergative* (control intransitives). Unaccusatives are intransitive predicates that have a single THEME argument. Unergatives are intransitive predicates with a single AGENT argument. The term “control” comes from conceptualizing the AGENT as a “controller”, or entity with volition, involved in the event (Thompson & Thompson 1992). The term “control” can apply to both transitives and intransitives. In this section, I describe each type of verb root (i.e., unaccusative and unergative) in Lushootseed.

#### 11.3.2.1 Unaccusatives (non-control intransitives)

Some verb roots that are *unaccusative* are listed in (3). As (3) shows, all these verb roots are monosyllabic and CVC.

(3) *q̓ax̌ʷ* ‘freeze’; *k̓ʷas* ‘burn body, roast, barbeque’; *ǰiq̓* ‘immerse, soak’; *q̓ʷuʔ* ‘gather’; *dᶻax̌* ‘move, shake’; *ƛ̓ax̌ʷ* ‘grow’; *ƛ̓ax̌* ‘feel cold’; *ƛ̓iq̓* ‘adhere, stick’; *k̓ʷəɬ* ‘spill, pour’; *qʷib* ‘prepare’; *huy* ‘do, make, prepare something’; *hud* ‘burn, fire’; *ʔix̌ʷ* ‘throw away’; *q̓ʷəl* ‘cook, bake’; *ɬič̓* ‘cut’; *q̓əč* ‘bent, crooked’; *tuč̓* ‘shoot’

A simple sentence exemplifying one of these verb roots is shown in (4).

(4) ʔu-tuč̓=čəd
PFV-get.shot=1SG.SBJ
‘I got shot’ (LD 241)

The structure in (4) can be distinguished from passives (see Chapter 14 for further discussion on passive forming *-b* and valency-changing operators in Lushootseed). Unaccusative verb roots can also be classified as non-control intransitives because the core argument for these verbs is not in control of the event denoted by the verb. Thus, (4) cannot mean “I shot”. Unlike passives, sentences containing unaccusatives such as (4) cannot contain an oblique object (marked by *ʔə*), which implies an AGENT. However, unaccusatives can license oblique INSTRUMENTS (or natural forces), as shown in (5) (note that *sx̌ədiʔac* ‘devil’s club’ is a kind of plant, which suggests that the oblique argument is a kind of natural force):

(5) ʔu-caq̓=čəd ʔə tiʔəʔ sx̌ədiʔac
PFV-be.jappbed=1SG.SBJ OBL PROX devil.club
'I got stuck by the devil's club' ('the devil's club unintentionally stick me') (LD 43)

The licensing of oblique INSTRUMENTs (or natural forces) with unaccusatives is a common cross-linguistic phenomenon (Alexiadou et al. 2005). For example, natural forces can be licensed with anticausatives in English (e.g., *the vase broke from the pressure*, where *the pressure* is the implied argument (i.e., natural force)).

#### 11.3.2.2 Unergatives (control intransitives)

Some verb roots that may be described as *unergative* are listed in (6):

(6) *ʔəɬəd* 'eat'; *šuɬ* 'see'; *ɬalil* 'land ashore'; *q$^{w}$ic* 'travel downstream'; *ʔəy̓/ʔi* 'find'; *ʔibəš* 'walk'; *təlawil* 'run'; *yayus* 'work'; *təyil* 'travel upriver'; *k$^{w}$il* 'pick berries'; *təč* 'roll off, tumble down'

According to the Lushootseed dictionary (Bates et al. 1994), the verbs in (6) are classified as "AGENT-backgrounding", where the subject of an unergative is the semantic AGENT. The verbs in (6) may also be described as *control intransitives* (Thompson 1985), where the core argument has control (or volition) of the event, an AGENT-like characteristic.

### 11.3.3 *Position class restrictions in verbs*

Verbal affixes to roots are rigidly ordered with respect to each other. Table 11.3 shows the broad positional restrictions of verbal affixes in relation to the verb root. Only one other prefix (other than the complementizer) can occur between the rightmost TAM prefix and the verb root, *dx$^{w}$*- 'towards'.

**Table 11.3** Broad positional restrictions of verbal affixes to the root

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| TAM | COMP | TAM (STAT/PERF) | *dx$^{w}$*- | ROOT | VAL | pron.-suffix | pron.-clitic |

Note: VAL = valency-changing suffix, pron. = pronominal, COMP = complementizer, STAT = stative, PERF = perfective, TAM = Tense-Aspect-Mood prefix

In Chapter 13 and Chapter 14, I cover the position class of TAM prefixes and valency-changing suffixes in more detail.

## 11.4 ALLOMORPHIC VARIATIONS IN LUSHOOTSEED

There are several kinds of allomorphs in Lushootseed. Allomorphs are readily transcribed in the Lushootseed alphabet, which is a common convention that was first adopted by Thom Hess and Vi Hilbert in their transcriptions of Lushootseed discourse. In this section, I cover all allomorphic variations in Lushootseed.

When any of the following Tense-Aspect-Mood (TAM) prefixes, *tu-* PST, *łu-* FUT/IRR, *ƛ̓u-* HAB, *bə-* ADD, *lə-* PROG, or *gʷə-* SBJV, combines with the stative aspect *ʔəs-* STAT, the surface realization of the form involves the deletion of the vowels in these TAM prefixes and the deletion of the initial glottal stop [ʔ] in the stative aspect *ʔəs-*. An open central vowel [a] is inserted in place of the deletion site, yielding the following surface realizations:

(7) *tu-* + *ʔəs-* → *tas-*
*łu-* + *ʔəs-* → *łas-*
*ƛ̓u-* + *ʔəs-* → *ƛ̓as-*
*bə-* + *ʔəs-* → *bas-*
*lə-* + *ʔəs-* → *las-*
*gʷə-* + *ʔəs-* → *gʷas-*

The surface realization of these expressions is a monosyllabic prefix that is attached to the following verb root. Another kind of allomorph that occurs in Lushootseed is when the prefix *dxʷ-* 'contained' is preceded by the stative aspect *ʔəs-*, which forms *ʔəxʷ-*.

Other types of allomorphic variations can be observed in the set of valency-changing operators in Lushootseed (see Chapter 14 for more information on valency-changing operators). There are a few allomorphic variations in the control transitive *-d*. One of these variations is a vowel harmony that involves the insertion of a vowel on the control transitive *-d* (as in *-Vd*). The form of the transitive suffix is partly fixed when it attaches to monosyllabic roots, where the quality of the inserted vowel is in harmony with the vowel quality of the root that *-d* combines with. This can be observed in (8):

(8) *t̓uc̓* 'shoot' + *-d* TR → *t̓uc̓-**ud*** 'shoot (TR)'
*č̓it̓* 'chew' + *-d* TR → *č̓it̓-**id*** 'chew (TR)'
*kʷaxʷ* 'help' + *-d* TR → *kʷaxʷ-**ad*** 'help (TR)'
*kʷəd* 'grab, take' + *-d* TR → *kʷəd-**əd*** 'grab, take (TR)'

However, this occurs only if the verb root is monosyllabic (most verb roots are monosyllabic in Lushootseed). The insertion of a vowel does not occur on verb roots that have more than one syllable. For example, when the control transitive *-d* combines with the verb root *gʷəlal-* 'kill', no vowel is inserted and the stem is simply realized as *gʷəlal-d* 'kill (TR)'.

When the control transitive *-d* combines with the passive (middle) *-b*, the control transitive *-d* becomes realized as voiceless *-t*. This can be observed when comparing (9) and (10):

(9) ʔu-t̓uc̓-ud ti d-čaləs
PFV-shoot-TR DET 1SG.POSS-hand
'He shot my hand' (AJ/Fly 49)

(10) ʔu-t̓uc̓-ut-əb=čəd ʔə tiił s-bək̓ʷił
PFV-shoot-TR-PASS=1SG.SBJ OBL DIST NMLZ-foundling.child
'I was shot by the foundling child' (AJ/Fly 49)

As (10) shows, the surface realization of the control transitive *-d* involves devoicing (i.e., realized as *-t* [d̥]). (9) further illustrates the allomorphic insertion of the vowel *u*, which "agrees" with the vowel quality in the root *t̓uc̓* 'shoot'. Another allomorphic variation that is observed in (9) is the insertion of the schwa [ə] with the passive (middle) *-b*, which usually occurs for the control transitive *-d*.

The control transitive *-d* is also realized as devoiced *-t* (or [d̥] in the IPA) when combined with the 1st- or 2nd-person object suffix, *-s* and *-sid* respectively. This form is subsequently realized as the voiceless alveolar affricate /t͡s/ ‹c›. In the Lushootseed orthography, the form *-d* + *-s/-sid* is transcribed with *-c/-cid* (i.e., the voiceless alveolar affricate in /-t͡s/ and /-t͡sid/). This can be observed in (11), where the control transitive *-d* is devoiced when followed by the 2nd-person singular object suffix *-sid*. As (11) shows, the surface realization of the form *-t-sid* is transcribed (in the orthography) as the voiceless alveolar affricate *-c*, as in *-cid*.

(11) ʔut̓uc̓ucid ʔu
ʔu-t̓uc̓-ut-sid ʔu
PFV-shoot-TR-2SG.OBJ Q
'did s/he shoot (at) you?' (TH 43)

Another type of allomorphic variation is observed for the lack-of-control transitive *-dxʷ* and causative *-txʷ*, which are realized as *-du* and *-tu* respectively when followed by the passive (middle) *-b* or the 1st- and 2nd-person object suffixes *-bš* (SG)/*-buɬ* (PL) and *-bicid* (SG)/*-buɬəd* (PL)[14] respectively. This can be observed in (13) (compared with (12)), where the causative *-txʷ* is realized as [tu] when followed by *-bš* (1SG.OBJ):

(12) ʔux̌ʷ-txʷ tiʔəʔ kʷagʷičəd
go-CAUS PROX elk
'She took the elk' (lit. 'She caused the elk to go') (SSP/Flood 155)

(13) ʔu-ʔux̌ʷ-tu-bš ti č̓ač̓aš
PFV-go-CAUS-1SG.OBJ DET child
'The boy took me' (TH 42)

Another type of allomorphic variation is observed for the allative applicative *-c*. The allative applicative *-c* is realized as [-s] when combined with a word that ends with *-il* (INCH). The allative applicative (realized as [-s]) takes the position of the lateral approximant in the morpheme *-il*. This can be observed in (15) (compared with (14)), where the allative applicative is realized as [-s] and takes the position of the lateral approximant in the verb *ɬčil* 'arrive'.

(14) ʔux̌ʷ-c=əxʷ tiʔəʔ bədaʔ-s
go-ALTV=now PROX child-3.POSS
'She went after her son' (SSP/No legs 207)

---

[14] Note that *-bš* and *-bicid* differs from *-s* and *-sid*, where the former set occurs only with the valency-changing operators *-dxʷ* and *-txʷ*, whereas the latter set occurs only with the control transitive *-d*.

(15) bə-łči(l)-s tiʔəʔ cədił x̌alabac
ADD-arrive-ALTV PROX FOC x̌alabac
'he came to this place called x̌alabac' (SSP/paq̓ʷ 189)

The Lushootseed dictionary (Bates et al. 1994) did not analyze -*s* as a variant of -*c*. However, the example that the dictionary gave for -*s* (i.e., *təlawi-s* 'run after someone or something', which is derived from the root *təlawil* 'run') suggests that the derived form functions identically to the operator -*c* (e.g. *ʔux̌ʷ-c* 'go after someone or something', which is derived from the root *ʔux̌ʷ* 'go'). For this reason, -*s* can be analyzed as a variant of -*c*.

Another type of allomorphic variation can be observed in roots ending in a voiceless labiovelar stop [kʷ], voiceless post-alveolar affricate [t͡ʃ] ‹č›, or voiceless alveolar affricate [t͡s] ‹c›. (16)-(18) lists roots where root final [kʷ], [t͡ʃ] and [t͡s] alternate with [gʷ], [d͡ʒ] ‹ǰ› and [d͡z] ‹dᶻ›, respectively, when combined with a vowel-initial morpheme.

(16) *Stem-final C with voice alternation for the labio-velar stop [kʷ]~[gʷ]*
*cukʷ* 'it is only' + *-ał* (ordinal suffix) → *cugʷał* 'be the last'
*c̓aʔkʷ* 'wash' + *-Vd* (TR) → *c̓agʷad* 'wash (TR)'
*čaʔkʷ* 'located toward the water' + *-Vd* (TR) → *čagʷad* 'take some to the water'
*dəkʷ* 'inside something' + *-Vd* (TR) → *dəgʷəd* 'put something inside'
*dikʷ* 'advise, train, teach' + *-Vd* (TR) → *digʷid* 'to advice/teach/train someone'
*haʔkʷ* 'long (temporal)' + *=əxʷ* 'now' → *hagʷəxʷ* '(it was for) a long time'
*hikʷ* 'big, large, great' + *=əxʷ* 'now' → *higʷəxʷ* '(This time it is) big, large'
*ƛ̓akʷ* 'stitch' + *-Vd* (TR) → *ƛ̓agʷad* 'stitch (TR)'
*qaʔkʷ* 'rest' + *=əxʷ* 'now' → *qagʷəxʷ* 'rest up now'
*q̓ikʷ* 'come partly into view' + *-Vd* (TR) → *qigʷəd* 'appear (TR)'
*šikʷ* 'emerge from water' + *-Vd* (TR) → *šigʷid* 'emerge something from water'
*takʷ* 'buy' + *=əxʷ* (TR) → *tagʷəxʷ* 'buy now'
*tukʷ* 'immerse, soak thoroughly' + *-us* 'face' → *tugʷus* 'soak face thoroughly'
*t̓ukʷ* 'measure, figure out' + *-Vd* (TR) → *t̓ugʷud* 'measure (TR)'

(17) *Stem-final C with voice alternation for the post-alveolar affricate [tʃ]~[dʒ]*
*təč* 'roll, roll off, fall off' + *-Vd* (TR) → *təǰəd* 'roll (TR)'

(18) *Stem-final C with voice alternation for the alveolar affricate [ts]~[dz]*
*čac* 'hid' + *-il* (INCH) → *čadᶻil* 'become hidden'
*č̓adᶻac* 'inherit' + *-əb* (MD) → *č̓adᶻadᶻəb* 'inherit (MD)'
*gʷəc* 'be born' + *-adad* (LEX) → *gʷədᶻadad* 'teachings of one's ancestors'
*haac* 'long, tall' + *-ap* 'bottom, buttocks' → *hadᶻap* 'long-hipped'
*qʷac* 'yellow' + *-il* (INCH) → *qʷadᶻil* 'yellowish'
*šic* 'rub, file' + *-us* 'face' → *šidᶻus* 'rub on the cutting edge'

*tac* ‘dance’ + -*Vd* (TR) → *tadᶻəd* ‘(what a mother bird does to attract attention away from her babies)’
*x̌əc* ‘afraid, scared’ + =*əxʷ* ‘now’ → *x̌ədᶻaxʷ* ‘afraid now’
*x̌ʷəc* ‘strong or tart taste’ + -*əb* (MD) → (*dxʷ*-)*x̌ʷədᶻəb* ‘strong/tart tasting’

However, there are several roots that end with [kʷ], [t͡ʃ] and [t͡s] that do not show this kind of alternation. (19)-(21) lists roots (ending with [kʷ], [t͡ʃ] and [t͡s]) that do not show this alternation.

(19) *No voicing alternation for root-final voiceless labiovelar stop [kʷ]*
*bikʷ* ‘give slack’ + -*Vd* (TR) → *bikʷid* ‘give slack (TR)’
*cikʷ* ‘move, jerk’ + -*Vd* (TR) → *cikʷid* ‘move, jerk something’
*dukʷ* ‘change, transform’ + -*Vd* (TR) → *dukʷud* ‘change, transform (TR)’
*dᶻakʷ* ‘shake, rock’ + -*Vd* (TR) → *dᶻakʷad* ‘shake, rock something’
*təkʷ* ‘silent(?)’ + -*adiʔ* ‘ear, sides’ → *tkʷadiʔ* ‘deaf’
*t̓akʷ* ‘dry’ + -*il* (INCH) → *t̓akʷil* ‘gone dry’
*xʷikʷ* ‘scrape, rub hard’ + -*Vd* (TR) → *xʷikʷid* ‘scrape, rub hard something’
*x̌ʷikʷ* ‘blaze, set fire’ + -*Vd* (TR) → *x̌ʷikʷid* ‘blaze up, set fire something’

(20) *No voicing alternation for root-final voiceless postalveolar affricate [t͡ʃ] ‹č›*
*b̓əč* ‘fall down’ + -*Vd* (TR) → *b̓əčəd* ‘put something down’
*k̓ʷəč* ‘wild’ + -*a-cut* (LEX-REFL) → *k̓ʷəčacut* ‘it became wild’
*pač* ‘set something out’ + -*Vd* (TR) → *pačad* ‘set something out (TR)’
*q̓əč* ‘bent, crooked’ + -*Vd* (TR) → *q̓əčəd* ‘to bend’
*t̓əč* ‘extend’ + -*Vd* (TR) → *t̓əčəd* ‘to extend (to someone)’
*x̌əč* ‘mind, inner thoughts’ + -*Vd* (TR) → *x̌əčəd* ‘count something’

(21) *No voicing alternation for root-final voiceless alveolar affricate [t͡s] ‹c›*
*čəc* ‘red’ + -*il* (inch) → *čcil* ‘become red, reddish’
*čic* ‘blowing hard’ + =*əxʷ* ‘now’ → *čicəxʷ* ‘blowing hard now’
*pic* ‘downward, descend’ + -*Vd* (TR) → *picid* ‘take downward’
*qac* ‘lighten, let up’ + -*Vd* (TR) → *qacad* ‘lighten the (canoe) load’
*qʷəc* ‘slide, slip’ + -*Vd* (TR) → *qʷəcəd* ‘slide it’
*xʷac* ‘carry’ + -*Vd* (TR) → *xʷacad* ‘carry a canoe’
*xʷəc* ‘take clothes off’ + -*Vd* (TR) → *xʷəcəd* ‘take clothes off (TR)’
*x̌əc* ‘pull out, extract’ + -*Vd* (TR) → *x̌əcəd* ‘to pull something out’

It is possible to interpret the alternation in (16)-(18) as the output of a neutralizing rule because /kʷ/ and /gʷ/, /t͡ʃ/ and /d͡ʒ/, and /t͡s/ and /d͡z/, respectively, are contrastive in the language. In other words, the segments [kʷ] and [gʷ], [t͡ʃ] and [d͡ʒ], and [t͡s] and [d͡z] may be neutralized to [kʷ], [t͡ʃ], and [t͡s] respectively in coda position, and the underlying form of the roots in (16)-(18) contains a root-final /gʷ/, /d͡ʒ/ and /d͡z/. In other words, root-final /gʷ/, /d͡ʒ/ and /d͡z/ may be realized as voiceless in coda position for the set of roots in (16)-(18). Further evidence for devoicing in coda position comes from roots in (16)-(18) that are followed by an obstruent-initial morpheme. Even when the following obstruent is voiced, these root-final consonants are still realized as voiceless. This can be observed for the root *čaʔkʷ* ‘located toward the water, seaward’ (from (16)), where [kʷ] is voiceless when followed by the lack-of-control transitive *-dxʷ,* as in *čaʔkʷ-dxʷ* ‘manage to get something or someone down to the water or out to sea’. Recall in (16) that [kʷ] in *čaʔkʷ* ‘located toward the water, seaward’ is realized as voiced when followed by a vowel-initial morpheme, as in *čagʷ-ad* ‘take someone or something to the water’. This suggests that root-final /gʷ/, /d͡ʒ/ and /d͡z/ are realized as voiceless in coda position.

However, there is a very small number of roots that underlyingly end with /gʷ/ and /d͡z/ ‹dᶻ› in Lushootseed (however, there are no roots that are finalized with /d͡ʒ/ ‹ǰ› in Lushootseed). These roots are listed in (22) (for the voiced labiovelar stop /gʷ/) and (23) (for the voiced alveolar affricate /d͡z/ ‹dᶻ›).

(22) *Roots finalized with /gʷ/*

| | | |
|---|---|---|
| *ʔugʷ* ‘advice’ + *-us* ‘face’ | → | *ʔugʷus* ‘give directions, show, demonstrate’ |
| *tiꞌgʷ* ‘thank, pray’ + *-Vd* TR | → | *tiꞌgʷid* ‘to thank someone’ |

(23) *Roots finalized with /d͡z/ ‹dᶻ›*

| | | |
|---|---|---|
| *x̌ʷadᶻ* ‘injure, hurt, annihilate’ + *-Vd* TR | → | *x̌ʷadᶻad* ‘wipe out a village’ |

The roots ending in voiced /gʷ/ and /d͡z/ ‹dᶻ› are very rare and have only ever been documented as being followed by a vowel-initial morpheme. These did not occur anywhere in coda position or when followed by an obstruent-initial morpheme in the corpus, so there is no strong evidence that these roots are finalized with voiced variants in their underlying representation.[15] The lack of evidence of these roots occuring in word-final position (or being followed by an obstruent) does

[15] If the roots in (22) and (23) have final consonants that are underlyingly voiced, then there might be a three-way voicing contrast between the roots in (16)-(18), (19)-(21), and (22)-(23). The following lists the possible phonological specification of these stem-final consonants (using the labiovelar place of articulation as an example):

| **Stem-final C** | **Phonological Specification** | **Frequency** |
|---|---|---|
| V[kʷ]#, V[kʷ]-V | [-voiced] | fairly large |
| V[kʷ]#, V[gʷ]-V | [0voiced] | fairly large (except [d͡ʒ]) |
| V[gʷ]#, V[gʷ]-V | [+voiced] | three roots total |

not preclude the possibility that these root-final consonants can be realized as voiceless in those positions. For this reason, it is still possible to analyze this pattern as a neutralizing rule, where roots finalized with voiced /gʷ/, /d͡ʒ/ and /d͡z/ are realized as voiceless [kʷ], [t͡ʃ] and [t͡s] respectively in coda position.

More allomorphic variation can be observed in the set of "open morphemes", which are monosyllabic morphemes that are open syllables (i.e., syllables that end with a vowel), bound or free. When these morphemes are followed by the 2nd singular possessive prefix *ad*- 2SG.POSS, the vowel of the open morpheme is deleted, and the initial consonant of the open morpheme resyllabifies as the onset of the following *ad*- prefix. This can be observed for the determiner's *ti* and *kʷi* (see Chapter 15 for more details on determiners in Lushootseed), as well as the TAM prefixes *tu*- PST, *łu*- FUT, *ƛ̓u*- HAB, *bə*- ADD, *lə*- PROG, *gʷə*- SBJV.[16] (24) and (25) are examples of sentences that show this allomorphic variation, where the vowels in the open morpheme (in parenthesis) is deleted and the initial consonant of that morpheme becomes resyllabified as the onset of the following *ad*- (2SG.POSS).

(24) lə-x̌i~x̌əd=əxʷ　　six　　t(i)　　ad-suq̓ʷaʔ　　kʷ(i)
PROG-DIM~how=now　　as.usual　　DET　　2SG.POSS-younger.brother　　HYP
ad-səxʷ-ʔu-yabuk̓ʷ-txʷ
2SG.POSS-COMP-PFV-fight-CAUS
'Now what is your younger brother doing that you should be quarreling with him?!'
(AJ/Fly 49)

(25) ƛ̓u-x̌id=čəxʷ　　ʔal　　kʷi　　ƛ̓(u)-ad-s-hud.
HAB-how=2SG.SBJ　　when　　HYP　　HAB-2SG.POSS-NMLZ-burn
'What do you habitually do when you burn?'　　(AJ/Fly 51)

In summary, several morphemes exhibit allomorphy in Lushootseed. The stative aspect *ʔəs*- can take on several forms in relation to the preceding and/or following affix. Moreover, there

[16] It should be noted that this is sometimes transcribed in the Lushootseed orthography, where the vowel of the open morpheme that is deleted is enclosed in parentheses.

are several allomorphs for the set of valency-changing operators in Lushootseed. In this section, I also examined voice alternations in roots ending in [kʷ], [t͡ʃ] and [t͡s]. Finally, there is an allomorph for the set of open morphemes, where the vowel of the open morpheme is deleted, and the initial consonant of that morpheme becomes resyllabified as the onset of the following *ad-* (2SG.POSS) prefix.

## 11.5 Basic Patterns of Reduplication

There are many types of reduplication in Lushootseed. Two of the most common patterns of reduplication (i.e., diminutive reduplication and distributive reduplication) will be covered here. For a more extensive description of patterns of reduplication in Lushootseed, see Urbanczyk (1996).

### 11.5.1 *Diminutive reduplication*

Diminutive reduplication is a type of partial reduplication that derives the meaning "smallness, diminished action, endearment" (Bates et al. 1994:xvii). For example, when diminutive reduplication is used on the root *č̓əƛ̓aʔ* 'rock', it derives the form *č̓i~č̓əƛ̓aʔ*, which means 'little rock, pebble'. There are several forms that a diminutive reduplicant can take when applied to a root/stem. This usually depends on the quality of the first vowel of a root/stem.

The diminutive reduplicant tends to be Ci+ when the first vowel of a root/stem is the schwa /ə/. Table 11.4 lists a few examples of stems that contain the schwa /ə/ as the first vowel and the reduplicant form Ci+.

**Table 11.4** Stems containing the schwa /ə/ (vowel highlighted in red) and the reduplicant form Ci+. (Note: vowels in parentheses indicates that the vowel is deleted)

| Stem | Translation | Reduplicant Ci+ | Translation |
|---|---|---|---|
| sqʷəbay̓ | dog | sqʷi~qʷəbay̓ | small dog, puppy |
| sčətxʷəd | bear | sči~čətxʷəd | small bear, cub |
| šəgʷɬ | path, road | ši~šəgʷɬ | short road, shortcut |
| bəščəb | mink | bi~bəščəb | small mink |
| təlawil | run | ti~təlawil | jog, run a little |
| ʔəɬəd | eat | ʔi~ʔ(ə)ɬəd | eat a little, nibble |
| ƛ̓əxʷay̓ | dog salmon | ƛ̓i~ƛ̓(ə)xʷay̓ | dog salmon hatchling |

In other cases, the diminutive reduplication is the CV+√C∅ form (note: I use the square root symbol √ to mark the first syllable of a *root/stem*, as is the norm in the Lushootseed literature), which applies only if the first vowel of the root/stem is a full vowel /a i u/. The first vowel of the root/stem becomes deleted (or sometimes reduced to the schwa [ə]) once it is copied (i.e, CV+√CV → CV+√C∅). Table 11.5 lists words that show this form of diminutive reduplication.

**Table 11.5** Form CV+√C∅, where the first syllable of the root/stem contains the full vowel /a i u/ and the vowel in the root/stem is deleted.

| Vowel | Stem | Translation | Reduplicant CV+√C∅ | Translation |
|---|---|---|---|---|
| a | kʷagʷičəd | elk | kʷa~√kʷgʷičəd | small elk, baby elk (?) |
| a | č̓axʷ | to club, hit with a stick | č̓a~√č̓xʷ | lightly hit with a stick |
| i | stiqayuʔ | wolf | sti~√tqayuʔ | baby wolf |
| i | t̓isəd | arrow | t̓i~√t̓səd | small projectile |
| u | stuq̓ʷub | cough | stu~√tq̓ʷub | cough a little |
| u | stuləkʷ | river | stu~√tləkʷ | creek |

According to Urbanczyk (1996), the CV+√C∅ form occurs most frequently when the first vowel of a root/stem contains the open central vowel /a/. Based on data from Urbanczyk, the first vowel /a/ in a root/stem accounts for approximately 53% of stems that undergo this form of reduplication (where the first vowel of the root/stem gets deleted). This suggests that there is a stronger preference for vowel syncope to occur when the first vowel of a root/stem is /a/.

Another form of diminutive reduplication that occurs less frequently is CV+ *without* the deletion of the first vowel of the root/stem (i.e., CV+√CV). This can be observed for the word *q̓ilbid* ‘canoe’, which takes on the form *q̓i~√q̓ilbid* ‘small canoe’ in the reduplicant form. Another form of reduplication that occur less frequently is CVʔ+. This can be observed for the word *čaləš* ‘hand, arm’, which takes on the form *čaʔ~√čaləš* ‘small hand, small arm’ in the reduplicant form. Like the CV+√C∅ form described above, these other forms of reduplication (i.e., CV+√CV and CVʔ+) occurs only when the first syllable of the root/stem is a full vowel /a i u/. There is one additional form of diminutive reduplication that occurs in one word in the current data: Cə+. This form occurs in the word *qaʔ* ‘a lot’, taking on the form *qə~qaʔ* ‘few’.

In general, the diminutive reduplicant form Ci+ can be interpreted as an allomorph of the other forms (i.e., CV+√C∅, CV+, CVʔ+, Cə+) because the environment that Ci+ occurs in is more restricted (it only occurs when the first vowel of the stem is a schwa /ə/). Other forms of diminutive reduplication occur when the first vowel of the stem is a full vowel /a i u/, which has a wider distribution than the Ci+ form.

### 11.5.2 *Distributive reduplication*

Distributive reduplication is a type of partial reduplication that derives the meaning “items are distributed about, plural” (Bates et al. 1994:xvii). The form that this reduplication takes is CVC+, where the first syllable of the root/stem is copied. When the distributive reduplicant is applied to noun stems, the distributive reduplicant functions as a plural. This can be observed in the reduplicated form *q̓ʷəl̓~q̓ʷəladiʔ* ‘ears’, which comes from the stem *q̓ʷəladiʔ* ‘ear’. (As discussed in Chapter 10, when the first syllable of a stem ends with a lateral approximant, the lateral approximant at the end of the reduplicant (copied) syllable is often laryngealized. The laryngealization of lateral approximants occurs quite readily in distributive reduplication).

When the distributive reduplicant is used on a verbal (or verb-like) stem, the meaning of the reduplicated stem can vary. For example, when the distributive reduplicant is used on the speech act predicate *cut* ‘say, talk’, as in *cut~cut*, the meaning of the form becomes either “several talking” or “one person talking or saying something repeatedly” (Bates et al. 1994:48). Another example is when the distributive reduplicant is used on the verb root *č̓axʷ* ‘to club, hit with a stick’, as in *č̓axʷ~č̓axʷ*, which forms the meaning ‘beat someone with a stick or club’. The meaning of *č̓axʷ* ‘to *hit* with a stick’ becomes *č̓axʷ~č̓axʷ* ‘to *beat* with a stick’, where the meaning of the reduplicant form (i.e., ‘to *beat* with a stick’) can be thought of as repeatedly striking someone violently with a stick or a club. The meaning of the distributive reduplicant on verb roots/stems can denote actions that are carried out repeatedly (or many times) or the action is done (or distributed) across many individuals.

The distributive reduplicant can also derive a sense of “continuity”, which can be observed when the distributive reduplicant is used on a verb of motion, such as *dᶻək̓ʷ* ‘travel, wander’, as in *dᶻək̓ʷ~dᶻək̓ʷ*, which forms the meaning ‘wander about continually’. When the distributive reduplicant is used on the verb of motion *ʔibəš* ‘walk’, as in *ʔib~ʔibəš*, the meaning of the form becomes ‘walk all about, pace back and forth, walk without achieving (or often even having) a destination’. The meaning of ‘walk without achieving a destination’ and ‘pace back and forth’ can give a sense of “continuity”, as there is no clear destination to be reached in the act of walking.

## 11.6 Some Functional Free Morphemes

### 11.6.1 *Lushootseed conjunctions*

There are two types of conjunctions in Lushootseed: (1) Conjunctions that are used to connect DPs, and (2) conjunctions that are used to connect clauses. The first type of conjunction is *yəxʷ/ʔi* ‘and’ (*yəxʷ* is used in the Southern dialect, whereas *ʔi* is used in the Northern dialect). *yəxʷ/ʔi* is most frequently used to connect DPs together. This can be observed in (26) and (27), where (26) illustrates the conjunction *yəxʷ* 'and' used in the Southern dialect, and (27) illustrates the conjunction *ʔi* 'and' used in the Northern dialect:

| | | | | | | |
|---|---|---|---|---|---|---|
| (26) | ʔəs-łəł-lil | tiił | kaykay | yəxʷ | tsiił | kayəʔ-s |
| | STAT-live-INCH | DET | Bluejay | and | DET | grandma-3.POSS |

'Blue Jay and his grandmother were living there' (AJ Bluejay/41)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (27) | huy | lək̓ʷ-əd=axʷ | tiʔəʔ | ləpəskʷi | ʔi | tiʔəʔ | kupi |
| | then | eat-TR=now | DET | hardtack | and | DET | coffee |

'Then he ate this hardtack and this coffee' (RS History/8)

This type of conjunction also has the meaning of 'too, also', which can be observed in (28).

| | | | | | |
|---|---|---|---|---|---|
| (28) | dił | s-xʷiʔxʷiʔ-s=həlgʷəʔ | ʔi | tiʔił | qʷsyuʔ |
| | CLEFT | COMP-hunt-3.POSS=3PL.SBJ | and | DET | porpoise |

'Porpoise too is what they hunt'

The second type of conjunction is *gʷəl* 'and, but', which is used to "introduce sentences in long narratives" (Bates et al. 1994:100). An example of *gʷəl* being used can be observed in (29), (30), and (31), where the conjunction *gʷəl* is used to introduce new clauses in the narrative.

(29) qa ʔi tiił s-xʷiʔxʷiʔ-s=həlgʷəʔ gʷəl
a.lot also DET NMLZ-hunt-3.POSS=3PL.SBJ and
łu-bə-čagʷ-c-əb=həlgʷəʔ tiił dᶻəgʷəʔ gʷəl
IRR-ADD-seaward-ALTV-PASS=3PL.SBJ DET monster and
tu-bə-lə-lək̓ʷ-t-əb=həlgʷəʔ gʷəl bək̓ʷ-il
PST-ADD-PROG-eat-TR-PASS=3PL.SBJ and all-INCH
'They had also foraged a lot and then [unsuspectingly] the monster came to the water for them and ate them and they were all gone' (AJ/Raccoon 37)

| | | | |
|---|---|---|---|
| (30) | kʷəd-əd=əxʷ | gʷəl | t̓uk̓ʷ-txʷ=əxʷ |
| | take-TR=now | and | go.home-CAUS=now |

'Now she took her and took her home' (AJ/Raccoon 37)

(31) łalil-txʷ gʷəl ʔu-ʔəł-txʷ gʷəl ʔu-ʔəł-txʷ tiʔəʔ
to.land-CAUS and PFV-eat-CAUS and PFV-eat-CAUS DET
tu-dxʷ-q̓ixʷ
PST-permeate-upriver
'He invited them all to land and he fed them and he fed those coming from upriver' (SSP/Training 13)

As (29), (30), and (31) shows, the conjunction *gʷəl* 'and' is used to connect new clauses. It can also be used with the set of emphatic pronouns when speakers are giving introductions, which derives a cleft structure (see Chapter 12 for more details and examples).

### 11.6.2 *Negation xʷiʔ*

Like other Salish languages, the negation marker *xʷiʔ* in Lushootseed forms the head of a main clause (Matthewson 1996). Unlike languages such as English (which has a negative determiner "no"), Lushootseed does not have negative determiners. Negative elements in Lushootseed (and other Salish languages) function as the main predicate, where they occur clause-initially and are followed by a subordinate clause. This can be observed in (32)-(36), where the negation marker *xʷiʔ* occurs at the beginning of a clause and is followed by a subordinate clause.

(32) xʷiʔ gʷə-ad-s-ʔab-ši-d
NEG SBJV-2SG.POSS-COMP-extend-DAT-TR
' "Don't give it to them" ' (AJ/Bluejay 41)

(33) xʷiʔ=əxʷ kʷi dəč̓uʔ ƛ̓u-s-qʷad-c=əxʷ
NEG=now HYP one HAB-COMP-remain-ALTV=now
'Now not one was left' (AJ/Raccoon 37)

(34) xʷiʔ kʷi ad-s-dᶻalqʷ-us-bi-d tiʔiɬ
NEG HYP 2SG.POSS-COMP-turn.around-head-REL-TR DIST
ad-s-ʔəs-čəbaʔ
2SG.POSS-COMP-STAT-backpack
' "Do not look over your shoulder at what you have on your back!" ' (ML/Pheasant 45)

(35) xʷiʔ lə-pišpiš tiʔiɬ
NEG PROG-cat DIST
'that is not a cat' (LD 134)

(36) xʷiʔ lə-ad-swatixʷtəd
NEG PROG-2SG.POSS-land
' "it is not your land" ' (SSP/Memories 22)

According to Matthewson (1996), negatives cannot adjoin to DP's or appear within a DP in Salish languages. Negation markers can only occur as the head of a main clause, and there is no evidence of a negative determiner in Lushootseed or any Salish language.

## 11.7 Conclusion

In this chapter, I provided a brief background of Lushootseed morphology. Based on the data discussed in Section 11.2, Lushootseed can be classified as synthetic and some combination of fusional and agglutinative. Section 11.3 briefly covered the morphosyntax of Lushootseed, which included a discussion of (1) the most common type of word-ordering in Lushootseed (i.e., Verb-Subject-Object), (2) verb roots in Lushootseed, and (3) the broad positional restrictions of verbal affixation in Lushootseed. In Section 11.4, I discuss allomorphs in Lushootseed. This section provides the first analysis of the [$k^w$]~[$g^w$] alternation. Section 11.5 covered two types of reduplications in Lushootseed (which are the most common and most recurring types of reduplications in the language): Diminutive reduplication and distributive reduplication. Section 11.6 covered free functional morphemes in Lushootseed, which covers conjunctions and negation *xʷiʔ*. There there are two types of conjunctions: (1) conjunctions used to connect DPs, and (2) conjunctions used to connect clauses. The negation marker *xʷiʔ* is used as the head of a main clause, and how Lushootseed (as in other Salish languages) does not have negative determiners.

# Chapter 12. PRONOMINAL MORPHOLOGY IN LUSHOOTSEED

## 12.1 INTRODUCTION

In this chapter, I give a descriptive overview of pronominal morphology in Lushootseed, where I cover the set of pronominal subject clitics (Section 12.2), pronominal object suffixes (Section 12.3), pronominal possessive affixes (Section 12.4), and independent pronouns (Section 12.5). There have been a few accounts on Lushootseed pronominals in the past (Hess & Hilbert 1995ab, Hukari 1976). However, there has yet to be an extensive account on the set of independent pronouns in Lushootseed. The goal of this chapter is to characterize each of the pronouns (especially independent pronouns) in Lushootseed. The data that is used for this chapter comes from the Lushootseed dictionary (Bates et al. 1994), as well as primary (Hilbert 1995, 2000, 2005) and other secondary (Hess 1995) sources.

## 12.2 PRONOMINAL SUBJECT CLITICS

As mentioned in Chapter 11, pronominal subjects are clitics in Lushootseed. Table 12.1 shows the list of pronominal subject clitics in Lushootseed.

**Table 12.1** Pronominal clitics in Lushootseed.

| | Singular | Plural |
|---|---|---|
| 1st | *=čəd* | *=čəɬ* |
| 2nd | *=čəxʷ* | *=čələp* |
| 3rd | Ø | *=həlgʷə* |

In transitive clauses, subjects are always marked as pronominal clitics. Pronominal clitics are enclitics that are found in second syntactic position. Subject clitics combine with a verbal predicate (i.e., verbal constituent) when the verbal predicate is the first word of a sentence. However, when adverbial auxiliaries are present, pronominal clitics combine with the auxiliary, as shown in (7) and (8). As (7) shows, the first singular subject clitic *=čəd* is attached to the verb *liɬʔaluʔxʷ* ‘referring to’. However, (8) shows that when the adverbial auxiliary *x̌ʷul̓* ‘just’ is the first word of the sentence, the first singular subject clitic *=čəd* attaches to the auxiliary.

(7) liɬʔaluʔxʷ=čəd tiʔiɬ luƛ̓~luƛ̓
referring.to=1SG.SBJ DIST PL~elder
I am referring to the elders
‘I mean the real elders of old’ (SSP/Training 10)

(8) x̌ʷul̓=čəd liɬʔaluʔxʷ tiʔiɬ ʔaciɬtalbixʷ
just=1SG.SBJ referring.to DIST Native.American
‘I am just referring to the old Native American tradition’ (SSP/Training 10)

Pronominal subject clitics can also function as conjunctions that are used to introduce new clauses. This form of clitic functions cumulatively as both a pronominal subject and a conjunction. When the pronominal subject clitic is used as a conjunction, a schwa /ə/ is inserted at the end of the clitic and the clitic becomes a proclitic, which combines with the predicate that follows. This can be observed in (9) and (10), where the pronominal subject clitic (highlighted in red) combines with the host (i.e., the verbal predicate) that is positioned to the right of it.

(9) t̓uc̓-ut-s čəxʷə=gʷəlal-d tə d-čaləš
shoot-TR-1SG.OBJ 2SG.SBJ.CONJ=kill-TR DET 1SG.POSS-hand
‘Shoot me and you hurt my hand’ (AJ/Fly 49)

(10) ɬu-ʔuləx̌-əd=čəxʷ ti, čəxʷə=t̓uk̓ʷ-txʷ čəɬə=q̓əlsəd
FUT-gather-TR=2SG.SBJ DET 2SG.SBJ.CONJ=go.home-CAUS 1PL.SBJ.CONJ=steam
čəɬə=ʔəɬəd
1PL.SBJ.CONJ=eat
‘You will gather this, and you will bring it home and we will steam it and we will eat it’
(AJ/Elk 33)

The type of conjunction here functions the same as *gʷəl* ‘and, but’ (see Chapter 11 for more details), except it also functions cumulatively as a pronominal subject.

## 12.3 PRONOMINAL OBJECT SUFFIXES

Table 12.2 shows the list of pronominal object suffixes in Lushootseed. Unlike the subject marking morphemes (which are clitics), pronominal objects are marked as verbal suffixes.

**Table 12.2** Pronominal object suffixes in Lushootseed

| | singular | plural |
|---|---|---|
| 1st | *-s/-bš* | *-buɬ* |
| 2nd | *-sid/-bicid* | *-buɬəd* |
| 3rd | *-Ø* | |

The allomorphs *-bš* and *-bicid* occur with the lack-of-control transitive *-dxʷ*, causative *-txʷ* and allative applicative *-c*/*-s*. This is observed in (12), where the 1st-singular object *-bš* combines with the causative *-txʷ* (realized as [-tu]).

(11) ʔu-ʔux̌ʷ-tu-bš ti č̓ač̓aš
PFV-go-CAUS-1SG.OBJ DET child
'The boy took me' (TH 42)

In addition to the forms in Table 2, there are some portmanteau morphemes involving pronominal objects. The 1st- and 2nd-person object suffixes *-s* and *-sid* combines with the control transitive *-d* (underlyingly *-t*, as in *-t-s* and *-t-sid*) to be realized as *-c* and *-cid* respectively. This is observed in (12), where the form *-cid* comes from the underlying form *-t-sid*.

(12) ʔut̓uc̓ucid ʔu
ʔu-t̓uc̓-ut-sid ʔu
PFV-shoot-TR-2SG.OBJ Q
'did s/he shoot (at) you' (TH 43)

It should be noted that *-bš* and *-bicid* differs from *-s* and *-sid*, where the former set occurs only with the valency-changing operators *-dxʷ*, *-txʷ*, and *-c*, whereas the latter set occurs only with the control transitive *-d*.

It should be noted that pronominal object suffixes always function as direct objects in the clause. This is because pronominal object suffixes can only combine with the set of transitivizers in Lushootseed (see Chapter 14 for more details).

## 12.4 Pronominal Possessive Affixes

Table 12.3 lists the set of pronominal possessive affixes in Lushootseed.

**Table 12.3** Pronominal possessive affixes.

| | singular | plural |
|---|---|---|
| 1$^{st}$ | *d-* | *-čəɬ* |
| 2$^{nd}$ | *ad-* | *-ləp* |
| 3$^{rd}$ | *-s* | |

An example of a pronominal possessive affix can be observed in (13), where the 1$^{st}$ singular possessive prefix *d-* combines with the word *čaləš* 'hand' to form the meaning 'my hand'.

| | | | | |
|---|---|---|---|---|
| (13) ʔu… | t̓uc̓-ut-s | ʔal | tə | d-čaləš |
| oh… | shoot-TR-1SG.OBJ | on | det | 1SG.POSS-hand |

'Oh, shoot me on my hand' (AJ/Fly 49)

As (13) shows, the pronominal argument of *d-* functions as the possessor of the word *čaləš* 'hand'.

Pronominal possessive affixes function as *agents* when combined with a subordinate predicate (i.e., predicates that function as the head of a subordinate clause) (subordinate predicates can also be called "complements" in Lushootseed (Bates et al. 1994:xviii)). Note that subordinate predicates are marked by the complementizers *s-*, *səxʷ-* (which means "device for" (Bates et al. 1994:203)), or *dəxʷ-* (which means "reason for" (Bates et al. 1994:81)). This can be observed in (14), where the 1$^{st}$ singular possessive prefix *d-* functions as the semantic *agent* when combined with the subordinate predicate *s-t̓uc̓-ut-sid* 'COMP shoot you' (the subordination of the verb *t̓uc̓* 'shoot' is marked by the complementizer *s-*).

(14) ʔu... xʷiʔ kʷi d-s-tu̓c̓-ut-sid
oh… NEG HYP 1SG.POSS-COMP-shoot-TR-2SG.OBJ
'Oh, I will not shoot you' (lit. 'Oh, not my shooting you') (AJ/Fly 49)

It should be noted that, as shown in (14), negation *xʷiʔ* functions as the head of a clause, where the predicate that it modifies is subordinate (see Chapter 11 for more details on the function of the negation marker *xʷiʔ* in Lushootseed).

## 12.5 INDEPENDENT PRONOUNS

Table 12.4 is a list of independent pronouns in Lushootseed.

**Table 12.4** Independent pronouns in Lushootseed

| | Singular | Plural |
|---|---|---|
| 1st | *ʔəca* | *dibəɬ* |
| 2nd | *dəgʷiʔ* | *gʷəlapuʔ* |
| 3rd | *cədiɬ* | *caadiɬ* |

In Lushootseed, independent pronouns are used in situations which emphasize a pronoun, such as in "clefts" that are focus-inducing to the pronominal subject. This can be observed in (15), where the translation of the sentence is a cleft.

(15) ʔəca kʷi ɬu-kʷəd-at-əb
1SG.EMPH HYP FUT-take-TR-PASS
'I am the one who will be taken' (LD 10)

Sometimes, independent pronouns can occur with an overt cleft marker *diɬ*, where the occurrence of *diɬ* is redundant with the use of the independent pronoun. This can be observed in (16), which shows the same focus-inducing cleft structure as (15).

(16) diɬ ʔəca ti hay-dxʷ
CLEFT 1SG.EMPH DET know-LTR
'I am the one who knows it' (LD 10)

According to Davis (2022), independent pronouns in Salish languages occupy the focus position of a cleft (either covertly as in (15) or overtly as in (16)).

The independent pronoun can also be used to mark a focus-induced structure when speakers are introducing themselves (or others). This occurs when the independent pronoun is followed by the clausal conjunction *gʷəl* ‘and, but’ (see Chapter 11 for more details), which is subsequently followed by a noun that is not headed by a determiner. In such instances, the noun that follows the clausal conjunction *gʷəl* ‘and, but’ functions as a predicate, where it is not headed by a determiner and can modify a DP that follows. In such instances, independent pronouns are interpreted as focus-inducing. This can be observed in (17) and (18), where the noun *sduhubš* ‘Snohomish’ and *bədəʔ* ‘child’ is predicative.

(17) ʔəca gʷəl sduhubš
1SG.EMPH and Snohomish
‘I am Snohomish’ (LD 10)

(18) ʔəcə gʷəl bədəʔ kʷi Jack Stuck
1SG.EMPH and child DET Jack Stuck
‘I am the child of Jack Stuck’ (AJ/Message)

The predicative status of the nouns following the clausal conjunction *gʷəl* is strongly apparent in (18), where the noun *bədəʔ* ‘child’ heads the following object DP *kʷi Jack Stuck* ‘DET Jack Stuck’ (where only predicates in Lushootseed can head object DPs). Moreover, word forms that immediately follow the clausal conjunction *gʷəl* are often predicates because clausal conjunctions in Lushootseed can only introduce new clauses (in other words, the word that follows will usually be a clausal predicate) (as discussed in Chapter 11, *gʷəl* should be contrasted from the conjunction *yəxʷ/ʔi* ‘and’, where the latter is used to combine DPs and not clauses). For this reason, nouns that follow the clausal conjunction *gʷəl* must be interpreted as clausal predicates.

The 3rd-person independent pronoun *cədiɬ* can also be used to modify a noun stem, which adds focus to the person or thing denoted by the noun. This can be observed in (19) and (20), where the independent pronoun *cədiɬ* combines with the noun *kʷagʷičəd* to add an element of focus on the noun. However, in such instances, the noun still belongs to a DP (unlike the focus contrast used in (17) and (18)) because it is headed by the determiners *tiił* in (19) and *tiʔəʔ* in (20).

(19) ʔəs-pač tiił cədił kʷagʷičəd
STAT-laid.out DIST 3SG.EMPH elk
‘ “That elk is laid out” ’ (ML/Pheasant 39)

(20) bə-łči(l)-s tiʔəʔ cədił x̌alabac
ADD-arrive-ALTV PROX 3SG.EMPH x̌alabac
‘he came to this place called x̌alabac’ (SSP/paq̓ʷ 189)

This kind of focus-induced phrase (i.e., where *cədił* modifies the noun) has been observed only for 3rd-person arguments. There was no evidence of the 1st- or 2nd-person independent pronouns being contained in an overt DP structure (i.e., a noun headed by an overt determiner) (see Chapter 15 for more details on determiners in Lushootseed).

## 12.6 Conclusion

In this chapter, I covered pronominal morphology in Lushootseed. Pronominal subjects are clitics, which can also function cumulatively as a conjunction when introducing a new clause. Pronominal objects are marked as suffixes that occur at the end of a verbal predicate and are always direct objects. Possessive pronouns are affixes in Lushootseed, which can function as agents when combined with subordinate predicates. Independent pronouns are focus-inducing markers that can form a cleft sentence.

# Chapter 13. TENSE-ASPECT-MOOD PREFIXES

## 13.1 INTRODUCTION

In this chapter, I discuss the set of Tense-Aspect-Mood (TAM) prefixes in Lushootseed. TAM are marked as prefixes in Lushootseed. There are no TAM suffixes. Table 13.1 lists the set of TAM prefixes in Lushootseed.

**Table 13.1** TAM prefixes in Lushootseed

| Tense | Aspect | Mood |
|---|---|---|
| *tu-* past (PST) | *ƛ̓u-* habitual (HAB) | *gʷə-* subjunctive (SBJV) |
| *łu-* future (FUT) | *bə-* additive (ADD) | |
| | *lə-* progressive (PROG) | |
| | *ʔu-* perfective (PFV) | |
| | *ʔəs-* stative (STAT) | |

TAM prefixes *tu-*, *łu-*, *ƛ̓u-*, *bə-*, *lə-*, and *gʷə-* can combine with a verb stem or a noun stem. This may suggest that these forms are clitics rather than prefixes because of the freedom of host selection (Haspelmath & Sims 2010) – that is, a clitic can occur with hosts of various syntactic categories. However, it is possible that there is no clear distinction between noun and verb morphemes at an abstract level in Lushootseed. Moreover, they do not show the same kind of movement restrictions that pronominal clitics do in Lushootseed (see Chapter 12 for more details). According to Davis (2000), morphemes are identified as clitics in Salish languages if they follow the Clitic Mobility Criterion – that is, if a bound morpheme occupies a variable position relative to a given predicate (i.e., a verbal root/stem or auxiliary in Lushootseed), it is a clitic; otherwise, it is an affix (Davis 2000:502). Following this criterion, I treat the TAM prefixes *tu-*, *łu-*, *ƛ̓u-*, *bə-*, *lə-*, and *gʷə-* as prefixes in Lushootseed.[17]

[17] Moreover, these morphemes have often been treated as prefixes among educators who teach the language to students and children (Tami Hohn, personal communication).

In this chapter, I characterize each TAM prefix in Lushootseed, providing examples of their use in Interlinear Glossed Texts (IGTs) throughout. In Section 13.2, I discuss the past tense *tu-* and future tense *łu-*. In Section 13.3, I discuss the aspect prefixes *ƛ̓u-*, *bə-*, *lə-*, *ʔu-*, and *ʔəs-*. In Section 13.4, I discuss subjunctive mood *gʷə-*. Finally, in Section 13.5, I provide the first analysis of position class restrictions on TAM prefixes in Lushootseed (note that the TAM prefixes in Table 13.1 are not interpreted as a statement of their order with respect to each other), where I argue that the position class restrictions of TAM prefixes are due to their unique phonological shapes.

## 13.2 TENSE IN LUSHOOTSEED

There are two tense markers in Lushootseed: Past tense *tu-* and future tense *łu-*. According to Bates (1999, 2002) and Bates & Hess (2001), these tense markers can be used as a type of "relative tense", where a situation can be located on a timeline with reference to either the moment of speech (i.e., a *speech event*) or a time established within a discourse (i.e., a *situation time*) (Bates & Hess 2001:25).

### 13.2.1 *Past tense tu-*

In Lushootseed, the past tense *tu-* is used to denote a verbal event or state occurring in the past. According to Hess (1967), the past tense *tu-* is often used to mean that the verb took place in the remote past. However, there are many examples from primary sources suggesting that the past event (denoted by the verb) did not necessarily take place remotely. Examples of the past tense *tu-* can be observed in (1)-(4).

(1) tu-cəwəł=əxʷ=həlgʷəʔ
PST-hungry=now=3PL.SBJ
'They were hungry now' (AJ/Raccoon 37)

(2) huy tu-ʔəɬ-txʷ=əxʷ ʔə kʷi s-tab
then PST-eat-CAUS=now OBL HYP NMLZ-thing
‘Then she fed her something’ (AJ/Raccoon 37)

(3) tu-ʔəx̌id=əxʷ kʷi ad-ʔal~ʔalš
PST-what.happen=now HYP 2SG.POSS-PL~cross.sex.sibling
‘ “What have your brothers done?” ’ (ML/Brothers 80)

(4) tu-ɬčil siʔab
PST-arrive noble
‘ “They (i.e., brothers) arrived, sir” ’ (ML/Brothers 80)

According to Bates (2002), the past tense *tu-* can mark an event prior to the moment of speech inside a narrative. This can be observed in (4), where the use of *tu-* refers to the arrival of the brothers just prior to the speech event, as indicated by being enclosed in quotes “…”.

When the past tense *tu-* attaches to a noun stem, the object/entity denoted by the noun is said to have existed in the past. The past tense *tu-* used on the noun stem sometimes agrees with the past tense *tu-* used on the verb/predicate stem. This is shown in (5), where the past tense *tu-* that is attached to the noun stem *bad-s* ‘his father’ agrees with the past tense *tu-* that is attached to the predicate *gʷəlal-t-əb* ‘killed (PASS)’.

(5) tu-gʷəlal-t-əb kʷi tu-bad-s
PST-kill-TR-PASS HYP PST-father-3.POSS
‘His father was killed (murdered)’ (SSP/Training 4)

As (5) shows, when the past tense *tu-* combines with the noun *bad* ‘father’, the literal meaning of *bad* ‘father’ becomes ‘deceased father’. Moreover, sentence (5) shows that there is a tense agreement between the verbal predicate and the noun stem. However, the tense used on the verb/predicate stem does not always need to cooccur with the past tense *tu-* used on the noun. This can be observed in (6), where there is no past tense *tu-* on the verb stem *gʷəƛ̕udswiliq̓ʷid* ‘I come crying to…’.

(6) xʷiʔ gʷə-ƛ̕u-d-s-wiliq̓ʷ-id tsi tu-d-sk̓ʷuy
NEG SBJV-HAB-1SG.POSS-COMP-ask-TR DET.F PST-1SG.POSS-mother
‘Never once did I come crying to my mother’ (SSP/Training 2)

As (6) shows, the tense on the verbal predicate *ƛ̓u-* HAB does not agree with the past tense on the noun stem (highlighted in red). This suggests that the past tense marker can combine with nouns in the absence of a tense agreement with the verbal predicate.

### 13.2.2 *Future tense łu-*

The prefix *łu-* can function as either the future tense or an irrealis, which can be defined as "future; anticipated, expected or possible event" (Bates et al. 1994:147). According to Bates & Hess (2001), the future tense can function similarly to the future tense in English, where the future tense marks a situation referred to in the discourse but occurring at a subsequent time ($t_2$ in (7)). (7) shows a graphic representation of Bates (1999) and Bates & Hess (2001) presentation of this relation in Lushootseed narrative, which is modelled after Smith (1992).

(7) Future in face-to-face discourse, adapted from Bates (1999) and Bates & Hess (2001)

| | | |
|---|---|---|
| Time | $t_1$--------------------------------$t_2$-----> | |
| | speech event | situation time (future) |

An example of the future tense employed in this manner can be observed in (8), where the act of 'butchering the elk' and 'taking it home' is marked in the future from the speech event.

| | | | | |
|---|---|---|---|---|
| (8) | łu-k̓ʷič̓-id=čəł | tiʔił | kʷagʷičəd | čəxʷa=łu-t̓uk̓ʷ-txʷ |
| | FUT-butcher-TR=1PL.SBJ | DIST | elk | 2SG.SBJ.CONJ=FUT-go.home-CAUS |

' "We will butcher that elk and you will take it home" ' (ML/Pheasant 40)

However, Bates & Hess (2001) note that the future *łu-* can also be used to refer to the *relative* future, which marks a situation subsequent to some reference time determined in the discourse (for example, the general setting of a narrative in myth time) yet is still previous to the storytelling event (2001:27). This can be observed in (9), which is a graphic representation adapted from Bates & Hess (2001) that presents the relationship of time points for the relative future tense. As (9) illustrates, the situation time $t_2$ is used for the *relative* future, which is subsequent to the reference time $t_1$.

(9) Relative future

Time $t_1$--------------------------$t_2$------------------------$t_3$------->

reference time situation time (future) speech event

An example of a sentence that uses the future tense *łu-* to mark the relative future can be observed in (10), where the English translation uses "the perfect construction to render the event setting up the condition for the predicate marked with Lushootseed relative tense" (Bates & Hess 2001:34).

(10) huy=čələp łu-kʷaxʷ-du-bš=əxʷ
then=2PL.SBJ FUT-help-LTR-1SG.OBJ=now
'You folks will then have helped me now!' (B&H 34)

The future tense *łu-* can also function as an "irrealis", which means that the event (denoted by the verb) is "expected in the future or, at least, that it might occur. At the moment of speaking, however, the event or state has not become a reality" (Hess 1995:62). This can be observed in (11), where the future tense *łu-* is translated into English with *would*.

(11) ʔu-t̓ək̓-ačiʔ-d=čəd łu-gʷəƛ̓alad-s=əxʷ
PFV-slap-hand-TR=1SG.SBJ FUT-stop-3.POSS=now
'I slapped his hand so he would stop' (B&H 28)

As (11) shows, the future tense *łu-* can have a modal meaning (as indicated by the English translation), where the event is 'expected, anticipated, or might occur'.

## 13.3 Aspect in Lushootseed

### 13.3.1 *Habitual ƛ̓u-*

The habitual aspect *ƛ̓u-* is used to denote a “habitual action or state; generally, usually” (Bates et al. 1994:155). Examples of the habitual aspect *ƛ̓u-* can be observed in (12)-(15), which translates to ‘usually, always, ever’ in the English translation.

(12) ƛ̓u-kʷəd-yi-t-əb=čəd ʔə tiʔił səpləl, mimaʔən
HAB-take-DAT-TR-PASS=1SG.SBJ OBL DIST bread small
‘A little bit of bread was usually given to me, a small portion’ (SSP/Training 1)

(13) tiʔəʔ ƛ̓u-hikʷ hikʷ ƛ̓u-hədu
PROX HAB-big big HAB-humpback.salmon
‘These humpback salmons were usually very large’ (SSP/Training 8)

(14) ƛ̓u-ʔəs-tagʷ=əxʷ tiʔił d-bi~bəd~bədaʔ
HAB-STAT-hungry=now DIST 1SG.POSS-DIM~DISTR~offspring
‘ “My little children always go hungry” ’ (ML/Pheasant 41)

(15) p̓aƛ̓aƛ̓=čəd tux̌ʷ ƛ̓u-ʔibəš
worthless=1SG.SBJ just HAB-walk
‘ “I’m only ever wandering around” ’ (ML/Pheasant 38)

When the negation marker *xʷiʔ* is used with the habitual aspect *ƛ̓u-*, the meaning of the form becomes ‘never’. This can be observed in (16), where the habitual aspect *ƛ̓u-* means ‘never’ in the presence of the negation marker *xʷiʔ*.

(16) xʷiʔ gʷə-ƛ̓u-d-səxʷ-ʔəs-šuu-c
NEG SBJV-HAB-1SG.POSS-COMP-STAT-see-ALTV
‘I have never even seen her before’ (SSP/Training 6)

The habitual aspect *ƛ̓u-* has also been translated in English as “would”, though it describes a habitual state/condition designated by the event (denoted by the verb). This can be observed in (17), where habitual *ƛ̓u-* is translated into English with “would”:

(17) xʷiʔ lə-haʔkʷ čəda=ƛ̓u-dxʷ-s-cut-t-əb,
NEG PROG-long.time 1SG.SBJ.CONJ=HAB-permeate-COMP-say-TR-PASS
“ʔu p̓aƛ̓aƛ̓ dxʷʔal ʔəca”
oh worthless to 1SG.EMPH
‘After a short time I would think, “Oh, that is unimportant to me” ’ (SSP/Memories 15)

### 13.3.2 *Additive/repetitive bə-*

The additive/repetitive aspect *bə-* means "again, anew (of actions or states); additional, another (of nouns)" (Bates et al. 1994:34). It often translates to 'again' or '(do action) some more' in English. This can be observed in (18)-(21).

(18) bə-qʷib-id
ADD-prepare-TR
'He fixes it some more' (ML/Brothers 90)

(19) bə-kiis gʷəl bə-ʔux̌ʷ
ADD-stand and ADD-go
'He stands up again and walks some more' (ML/Pheasant 47)

(20) bə-huy-txʷ
ADD-made-CAUS
'He works on it some more' (ML/Brothers 90)

(21) bə-łčil-txʷ-yi-t-əb ʔə tiʔəʔ ʔal~ʔalš ʔə tiʔəʔ
ADD-arrive-CAUS-DAT-TR-PASS OBL PROX PL~cross.sex.sibling OBL PROX
s-ʔəłəd ƛ̓u-s-huy-s kʷi ƛ̓u-s-q̓ʷəl-d-s=həlgʷə
NMLZ-eat HAB-COMP-do-3.POSS HYP HAB-COMP-cook-TR-3.POSS=3PL.SBJ
'Again she is brought food by her brothers that they have finished cooking'
(ML/Brothers 82)

The additive *bə-* can also denote a state of "reoccurrence" based on the quality of an argument. This can be observed in (22), where the additive *bə-* combines with the predicate stem *ʔəs-ʔistə* 'STAT-be.like' to denote the "reoccurrence" of a quality onto an argument modified by the predicate.

(22) ƛ̓al̓=əxʷ bə-ʔəs-ʔistə tsiʔił
also=now ADD-STAT-be.like DIST.F
'It is also the same with her.' (ML/Brothers 80)

As (22) shows, when the additive *bə-* combines with the predicate stem *ʔəs-ʔistə* 'STAT-be.like', the expression gives a sense of a "reoccurrence" (or "sameness") in the quality of a character.

### 13.3.3 *Progressive (imperfective) lə-*

According to Bates (1999), the progressive (imperfective) aspect *lə-* indicates that an “action is ongoing, non-circumscribed, continuous, developing; acts are performed in a series or performed while moving from one place to another; action happens gradually” (1999:1). Examples of the progressive aspect *lə-* being used in sentences can be observed in (23)-(26).

(23) lə-ʔux̌ʷ
PROG-go
‘He is going’ (ML/Pheasant 35)

(24) x̌ʷul̓ lə-ʔibəš
just PROG-walk
‘He is just traveling’ (ML/Pheasant 35)

(25) lə-ʔuluɬ tə ʔiišəd-s gʷəl lə-ɬalil-txʷ
PROG-canoe DET friend-3.POSS and PROG-land-CAUS
‘When their friends were canoeing, they had them land…’ (SSP/Training 12)

(26) ʔux̌ʷ=əxʷ lə-ɬiɬt̓iʔac̓=əxʷ
go=now PROG-fish=now
‘Now she went line fishing’ (AJ/Raccoon 37)

As (23)-(26) shows, the progressive aspect *lə-* in Lushootseed functions similarly to the English present participle suffix *-ing*. When *lə-* combines with the stative aspect *ʔəs-*, the meaning of the form becomes “condition or state continues through time or space” (Bates 1999:1).

The progressive *lə-* can appear on nouns when preceded by the negation *xʷiʔ* in negation expressions to negate the descriptive condition (denoted by the noun) of a referent. This can be observed in (27) and (28). In (27) the progressive *lə-* combines with the noun *pišpiš* ‘cat’ and is preceded by the negation marker *xʷiʔ* to denote that it (i.e., some referent) is not a cat.

(27) xʷiʔ lə-pišpiš tiʔiɬ
NEG PROG-cat DIST
‘that is not a cat’ (LD 134)

(28) xʷiʔ lə-ad-swatixʷtəd
NEG PROG-2SG.POSS-land
‘ “it is not your land” ’ (SSP/Memories 22)

In the Skagit dialect (which is a part of the Northern Lushootseed dialect), there is another prefix, *ləcu-*, that functions very similarly with the progressive *lə-*. An example of the contrast between *ləcu-* and *lə-* can be observed in (29) and (30), where *ləcu-* is used in (29) and the progressive *lə-* is used in (30) (both from the Upper Skagit speaker Susie Sampson Peters).

| | | | | | | |
|---|---|---|---|---|---|---|
| (29) | x̌ʷul̓ | p̓aƛ̓aƛ̓ | ləcu-gʷad~gʷad | tiʔił | caadił | ləcu-gʷaa~gʷad |
| | just | worthless | PROG-DISTR~talk | DIST | 3PL.EMPH | PROG-AUG~talk |
| | ‘It was merely gossip spoken by those who were talking’ | | | | | (SSP/Memories 30) |

| | | | |
|---|---|---|---|
| (30) | x̌ac̓-ič-s | gʷəl | lə-gʷə~gʷad-tu-bš |
| | cover-1SG.OBJ-3 | and | PROG-DIM-talk-CAUS-1SG.OBJ |
| | ‘She covered me, then she was speaking (talking) to me’ | | (SSP/Training 6) |

As the examples in (29) and (30) shows, it was difficult to identify any differences in the meanings of the forms *ləcu-* and *lə-* when combined with reduplicant variants of the root *gʷad* ‘talk’. According to the Lushootseed dictionary, the form *ləcu-* means “continuous action [like the progressive *lə-*], an event or activity happens in one place, a verb of movement happens habitually or regularly” (Bates et al. 1994:135). Hess & Hilbert (1976:101-102) defined the prefix *ləcu-* as “regular repetition”. This may suggest that there are some subtle differences in the semantics of *ləcu-* and *lə-* (i.e., in the case of *ləcu-*, the action happens in one place, and that the movement happens habitually or regularly; whereas for *lə-* acts are performed while moving from one place to another), though there are also similarities (i.e., the fact that both *ləcu-* and *lə-* can denote a ‘continuous action’).

### 13.3.4 *Perfective ʔu-*

The perfective aspect presents an event that is viewed as a whole, which includes its starting point and its end point (Comrie 1976, Smith 1992). In Lushootseed, the perfective aspect functions in this way, where it is defined as “an action… viewed as a whole, in its entirety; an action or state is finite” (Bates et al. 1994:19). According to Hess (1967), the perfective aspect *ʔu-* is a completive marker, where a change has been affected and is now complete (Hess 1967:25). Examples of the perfective aspect can be observed in (31)-(35).

(31) ʔu-q̓il tiʔiɬ yuʔ~yubəč
PFV-land DIST DIM~butterfly
'That small butterfly landed' (SSP/Training 5)

(32) ʔu-bəč-alq ʔə tsiʔəʔ sqigʷac
PFV-down-game OBL DIST.F deer
'They have brought down Deer' (ML/Changer 222)

(33) gʷəl ʔu-p̓aʔad
and PFV-try
'(and) he tried it' (ML/Changer 221)

(34) təɬ tiʔiɬ dəxʷ-ʔu-cut~cut-s
truly DIST COMP-PFV-DISTR~say-3.POSS
'It was true what (Raven) was saying' (ML/Changer 221)

(35) ʔu-dᶻix̌-ič ʔal tiʔəʔ tu-s-ʔu-šəɬ-s hud
PFV-broken-covering at PROX PST-COMP-PFV-make-3.POSS wood
tu-s-ʔu-ƛ̓a~ƛ̓(a)-čup-s
PST-COMP-PFV-DISTR~go-fire-3.POSS
'It collapsed on top of him when he was gathering wood for firewood' (ML/Changer 221)

According to Hess & Hilbert (1976, 1995), *ʔu-* cannot occur with stative *ʔəs-* and progressive *lə-* and *ləcu-*, which they define as imperfective markers. This is expected, as the perfective is semantically incompatible with imperfective (as we will see in Section 5, however, the perfective *ʔu-* competes for the same position as the stative aspect *ʔəs-* and not *lə-*).

### 13.3.5 *Stative ʔəs-*

The stative aspect *ʔəs-* means that the condition or state (denoted by the predicate) exists (Bates et al. 1994:13). Examples of the stative aspect *ʔəs-* can be observed in (36)-(40). In the case of (38), the stative aspect *ʔəs-* is used to denote that the implied 3rd-singular subject "he" is in the state of lifting his pant legs (which is the literal meaning of (38)).

(36) ʔəs-xʷak̓ʷil
STAT-tired
'He is tired' (LD 250)

(37) ʔəs-hiił=čəd ʔə tiʔəʔ d-s-šud-ubicid
STAT-glad=1SG.SBJ OBL PROX 1SG.POSS-COMP-see-2SG.OBJ
'I'm glad to see you' (LD 109)

(38) ʔəs-q̓is~q̓is-aq
STAT-DISTR~expose-forked
'He lifts his pant legs' (SSP/Star child 69)

(39) ʔəs-x̌ʷuq̓dis ʔə tiʔəʔ s-qi~qəlikʷ-s
STAT-pinned OBL PROX NMLZ-DIM~blanket-3.POSS
'She has a little blanket pinned around her' (SSP/Star child 48)

(40) stab tiʔił ad-s-ʔəs-ʔəladᶻ-iʔł
what DIST 2SG.POSS-COMP-STAT-care.for-child
' "What is it that you are taking care of?" ' (SSP/Star child 58)

In each of these examples, the stative aspect *ʔəs-* is used to characterize the condition/state that the argument is in.

## 13.4 Mood *gʷə-* in Lushootseed

There is only one mood prefix in Lushootseed: Subjunctive *gʷə-*. According to the Lushootseed dictionary, the subjunctive *gʷə-* has been defined as "if, maybe, might… inflectional subjunctive prefix expressing doubt, (events) contrary to fact; appearing on any lexical category functioning as predicates or complements [i.e., subordinate predicates]" (Bates et al. 1994:95). There is some semantic overlap between the subjunctive *gʷə-* and the future *łu-*, where (as discussed in Section 13.2.2) the future tense *łu-* can have a "modal" meaning (where it can mean "expected in the future or, at least, that it might occur" (Hess 1995:62)) (as we will see in Section 13.5, *gʷə-* and *łu-* can cooccur in a word neighbor each other in the templatic slots for TAM prefixes). The use of the subjunctive under this definition can be observed in (40), where the subjunctive *gʷə-* corresponds to the meaning of 'might' in the English translation.

(40) gʷə-ƛ̓u-łil-t-əb kʷədaʔ tsiʔəʔ ʔə ti
SBJV-HAB-give.food-TR-PASS PTCL PROX.F OBL DET
ʔalš-s čəda=łu-ʔəład
cross.sex.sibling-3.POSS 1SG.SBJ.CONJ=FUT-eat
' "She might be given a little food by her brothers and I will eat" ' (ML/Brothers 81)

The subjunctive *gʷə-* also has a propositional meaning, which expresses "desire" or a modal/imperative function to the meaning of the expression. The English translation is usually "should be" or "must" when the subjunctive *gʷə-* is used in this manner. This can be observed in (41) and (42), where the subjunctive *gʷə-* is used to derive the meaning of "should be" or "must" in the English translation (semantically, it has denotes deontic necessity).

(41) gʷə-ʔu-daʔ-at-əb dᶻəł[18] gʷə-cədił-s kʷi gʷə-ʔu-ʔatəbəd-s
SBJV-PFV-name-TR-PASS PTCL SBJV-3SG.EMPH-3 HYP SBJV-PFV-die-3.POSS
' "He should be named if he is the one who has died" ' (ML/Changer 220)

(42) ʔu gʷə-dxʷ-cut-əb tiʔəʔ luƛ̓
oh SBJV-to-say-MD PROX old.man
'Oh, the old man must think' (ML/Brothers 81)

In Lushootseed, subordinate clauses are headed by a determiner (see Chapter 16 for more details). When the subjunctive *gʷə-* is attached to a subordinate predicate (i.e., the predicate that is the head of a subordinate clause), the determiner that modifies the subordinate predicate is the hypothetical determiner *kʷi* (see Chapter 15 for more details on determiners in Lushootseed). This can be observed in (43) and (44), where the hypothetical determiner *kʷi* modifies subordinate predicates headed by the subjunctive *gʷə-*.

(43) dił kʷi gʷə-s-ʔəs-č̓uxʷil ʔə tiʔił s-ʔəład
CLEFT HYP SBJV-COMP-STAT-grease OBL DIST NMLZ-food
'They would have been greasy from the food' (ML/Brothers 79)

(44) gʷəl ʔəx̌id=əxʷ kʷi gʷə-d-s-ʔu-huy-ud dxʷ-ʔatəbəd
and how=now HYP SBJV-1SG.POSS-COMP-PFV-do-TR to-die
tiʔił s-ʔəład-s=həlgʷəʔ
DIST NMLZ-food-3.POSS=3PL
' "Then how could their food kill me?" ' (RS/History 9)

[18] The predicate particle *dᶻəł* roughly means "it would seem, it must be that" (Bates et al. 1994:89)

Like subordinate clauses, when the subjunctive *gʷə-* combines with a noun stem, the head determiner is the hypothetical determiner *kʷi*. When the subjunctive *gʷə-* combines with the noun stem, it expresses a level of uncertainty that the object (denoted by the noun stem) exists, that the existence of the object is a mere possibility, or that the object does not exist yet. This can be observed in (45), where the subjunctive *gʷə-* combines with the noun stem *sʔəɬəd* 'food' to mean that the food that is being searched for may or may not exist yet.

(45) ʔu-gʷəč̓-əb ʔə kʷi gʷə-s-ʔəɬəd-s
PFV-search-MD OBL HYP SBJV-NMLZ-eat-3.POSS
'It looks for food' (RS/History 11)

When the negation *xʷiʔ* modifies a verb complement (i.e., a subordinate predicate), either (a) the subjunctive *gʷə-* is attached to the verb complement (i.e., the subordinate predicate that is headed by the negation *xʷiʔ*), as shown in (46)-(48); (b) the subordinate predicate is headed by the hypothetical determiner *kʷi*, as shown in (49); or (c) both, as shown in (50)-(51). In the case of (c) (as shown in examples (50)-(51)), the use of the hypothetical determiner *kʷi* is in concord with the subjunctive *gʷə-* in negation expressions. As (46)-(49) shows, the subordinate predicate could be modified by either *gʷə-* or the hypothetical determiner *kʷi*.

(46) xʷiʔ gʷə-s-huy-dxʷ-s
NEG SBJV-COMP-do-LTR-3.POSS
'He can't do it' (ML/Pheasant 60)

(47) xʷiʔ gʷə-s-ʔəs-hay-dxʷ-čəɬ
NEG SBJV-COMP-STAT-know-LTR-1PL.POSS
' "We don't know" ' (ML/Brothers 81)

(48) xʷiʔ gʷə-s-cut-s x̌ʷul̓ab ʔə tiʔiɬ sgʷəlub
NEG SBJV-COMP-say-3.POSS same.way OBL DIST pheasant
'He does not say as Pheasant does' (ML/Pheasant 58)

(49) ʔu... xʷiʔ kʷi d-s-t̓uc̓-ut-sid
oh… NEG HYP 1SG.POSS-COMP-shoot-TR-2SG.OBJ
'Oh, I will not shoot you' (AJ/Fly 49)

| | | | | | |
|---|---|---|---|---|---|
| (50) gʷəl | xʷiʔ | kʷi | gʷə-d-s-ʔəs-hay-dxʷ | stab | tsiʔəʔ |
| and | NEG | HYP | SBJV-1SG.POSS-COMP-STAT-know-LTR | what | PROX.F |
| čəgʷas | ʔə | tiʔəʔ | sgʷəlub | | |
| wife | OBL | PROX | pheasant | | |

‘But I do not know who the wife of Pheasant was’ (ML/Pheasant 32)

| | | |
|---|---|---|
| (51) xʷiʔ | kʷi | gʷə-d-s-dᶻalq-us-bi-d |
| NEG | HYP | SBJV-1SG.POSS-COMP-turn-head-RA-TR |

‘ “I am not to look over my shoulder at it” ’ (ML/Pheasant 47)

## 13.5 Position Class Restrictions of TAM Prefixes

Positional restrictions can be stated for the TAM prefixes in Lushootseed. The future *łu-* (which means the event denoted by the verb is ‘expected, anticipated’ (Bates et al. 1994:147)) can be positioned to the left or right of the subjunctive *gʷə-* (which means the event denoted by the verb is a ‘possibility’), as shown in (72) and (73):

(72) *future > subjunctive*

| | | | |
|---|---|---|---|
| tux̌ʷ=čəxʷ | łu-gʷə-ʔuʔəd | čəda=łu-k̓ʷaʔ-əd | tiʔəʔ |
| just=2SG.SBJ | FUT-SBJV-agree | 1SG.SBJ.CONJ=IRR-release-TR | PROX |
| ad-s-ƛ̓alalič̓əʔ | | | |
| 2SG.POSS-NMLZ-clothes | | | |

‘Only if you agree will I release your clothing!’ (SSP/Sockeye 230)

(73) *subjunctive > future*

| | |
|---|---|
| xʷiʔ gʷə-łu-s-ʔux̌ʷ-s | dxʷ-q̓ixʷ-ucid |
| NEG SBJV-FUT-COMP-go-3.POSS | to-upstream-body.of.water |

‘She will not go upriver’ (SSP/Sockeye 237)

The subjunctive *gʷə-* precedes the habitual aspect *ƛ̓u-*, as shown in (74):

(74) *subjunctive > habitual*

| | |
|---|---|
| xʷiʔ gʷə-ƛ̓u-bə-s-ʔu-laʔ-tid-s | tul̓-čad |
| NEG SBJV-HAB-ADD-COMP-PFV-point.out-TR-3.POSS | from-where |

‘It is not explained where from’ (SSP/Star Child 108)

The habitual aspect *ƛ̓u-* precedes the (remote) past tense *tu-*, as shown in (75):

(75) *habitual > past tense*

| | |
|---|---|
| tux̌ʷ | ƛ̓u-tu-s-ʔu-gʷa~gʷəd |
| just | HAB-PST-COMP-PFV-DIM~talk |

‘It was only conversation’ (SSP/Memories 36)

The past tense *tu-* precedes the additive (repetitive) *bə-* and the additive (repetitive) *bə-* precedes the progressive (imperfective) *lə-*, as shown in (76):

(76) *past tense > additive (repetitive) > progressive (imperfective)*

tux̌ʷ=əxʷ=čəɬ　　tu-bə-lə-gʷiid-t-əb
just=now=1PL.SBJ　　PST-ADD-PROG-invite-TR-PASS
'We were invited (to the new house)'　　(SSP/Nolegs 218)

The progressive (imperfective) *lə-* precedes the stative aspect *ʔəs-*, as shown in (77):

(77) *progressive (imperfective) > stative*

ɬu-lə-ʔəs-ləx̌-əd　　tə　　swatixʷtid
IRR-PROG-STAT-light-TR　　DET　　world
'He is the one who will light the world'　　(SSP/Star Child 118)

There is no instance of the perfective *ʔu-* combining with the stative aspect *ʔəs-*. This suggests that the perfective *ʔu-* competes for the same position as the stative *ʔəs-*. This might be because of semantic reasons (*ʔu-* is finite whereas the stative aspect *ʔəs-* is non-finite). One might expect the perfective *ʔu-* to compete for the same position as the progressive (imperfective) *lə-* because perfectives cannot occur with imperfectives (perfectives and imperfectives have not been found to co-occur in the current data, which is expected because perfectives are the opposite of imperfectives). However, this is the wrong analysis. Evidence against this alternative analysis comes from the distribution of the complementizer *s-*. The complementizer *s-* (as well as complementizers *dəxʷ-* or *səxʷ-*) replaces the initial glottal stop /ʔ/ in the perfective and the stative aspect, as in *s-u-* (underlyingly *s-ʔu-*) and *s-əs-* (underlyingly *s-ʔəs-*) respectively. Examples of these can be observed in (78) and (79), which illustrates *s-u-* and *s-əs-* respectively.

(78) tux̌ʷ　　ƛ̓u-tu-s-ʔu-gʷa~gʷəd
just　　hab-pst-comp-pfv-dim~talk
'It was only conversation'　　(SSP/Memories 36)

(79) ʔa　　tiʔəʔ　　s-ʔəs-ƛ̓uq̓ʷ-agʷil-s=əlgʷəʔ
be.there　　PROX　　COMP-STAT-cram.in-RECP-3.POSS=3.PL
'There they get themselves into a very snug place'　　(ML/Brothers 181)

As (78) and (79) shows, only the perfective *ʔu-* and the stative *ʔəs-* are positioned to the right of the complementizer *s-*. Otherwise, the TAM prefix (including the progressive *lə-*) occurs to the left of the complementizer (as in *gʷə-s-*, *ƛ̓u-s-*, *bə-s-*, *lə-s-*, etc…). If the perfective *ʔu-* competed for the same position as the progressive (imperfective) *lə-*, then the perfective *ʔu-* would occupy a position to the left of the complementizer *s-* because the progressive (imperfective) also occupies a position to the left of the complementizer. However, it doesn't: The perfective *ʔu-* (like the stative *ʔəs-*) will always occupy a position to the right of the complementizer *s-*. For this reason, the perfective *ʔu-* competes for the same position as the stative aspect *ʔəs-*.

The sequence in (80) gives the relatively fixed positions of the TAM prefixes that were examined so far. Notice that the internal order of the TAM prefixes is predictable from their unique phonological shapes (cf. similar observations by Tuttle & Hargus (2004) for a different language family), where the TAM prefixes that occupy the same templatic slot are phonologically similar.

(80) *ɬu-~gʷə-* > *ɬu-/ƛ̓u-* > *tu-* > *bə-* > *lə-* > *s-* > *ʔu-* > VERB
*{ʔəs-}*
IRR~SBJV > IRR/HAB > PST > ADD > PROG > COMP > PERF/STAT > VERB

It should be noted that there was no evidence of the future *ɬu-* occurring with the habitual *ƛ̓u-*. This may suggest that *ɬu-* occupies the same templatic slot as *ƛ̓u-* in Lushootseed. The prefixes *ɬu-* and *ƛ̓u-* are very similar phonologically, where both are initialized with a lateral obstruent that involves a delayed release. According to Tuttle & Hargus, there are phonological constraints on the ordering of affixes in different languages. This follows the Principle of Templatic Attraction, where "prefixes of the same (or similar) form are attracted to adjacent positions or merge" (2004:87, attributed to Jeff Leer). Under this principle, phonologically similar affixes occupy the same position in the template. The evidence from Lushootseed further supports the idea that the relatively fixed ordering of TAM prefixes is predictable from their unique phonological shapes.

## 13.6 CONCLUSION

In this chapter, I covered each TAM prefixes in Lushootseed. There are two tense prefixes in Lushootseed: The past tense *tu-* and the future tense *łu-*. There are five aspectual prefixes in Lushootseed: (1) the habitual *ƛ̓u-*, (2) the additive/repetitive *bə-*, (3) the progressive *lə-*, (4) the perfective *ʔu-*, and (5) the stative *ʔəs-*. There is only one mood prefix in Lushootseed, which is the subjunctive mood *gʷə-*. Each of these prefixes have their own unique functions and can occur with different sentence structures in Lushootseed. The ordering restrictions of the TAM prefixes in Lushootseed seem to be predictable from their unique phonological shapes, where prefixes that occupy the same templatic slot share similar phonological features with each other.

# Chapter 14. EXAMINATION OF VALENCY-CHANGING OPERATORS IN LUSHOOTSEED

## 14.1 INTRODUCTION

In this chapter, I do a morphological analysis of valency-changing operators in Lushootseed. Valency refers to the semantic role of arguments expressed by the predicate. There are seven of these operators, as shown in Table 14.1.

**Table 14.1** Valency-changing operators in Lushootseed

| Operator | Function |
|---|---|
| *-d* | Control transitive (TR) |
| *-dx^w^* | Lack-of-control transitive (LTR) |
| *-tx^w^* | Causative (CAUS) |
| *-b* | Middle (MD), Passive (PASS) |
| *-bi* | Relational applicative (RA) |
| *-ši, -yi* | Dative applicative (DAT) |
| *-c, -s* | Allative applicative (ALTV) |

Valency-changing operators have been studied extensively in the Salish literature. There are many language-particular studies that will be cited later in this chapter. The valency-changing operators of Lushootseed have been studied extensively by Beck (1996, 2007), Barthmaier (2000), Hess and colleagues (1967, 1973, 1998), and Zahir (2019). Beck uses Cognitive Grammar (Langacker 1987, 1992) to represent the meaning of valency-changing suffixes in Lushootseed. In this framework, an interaction "chain" is used to construct an event model, which consists of a (for example) causative action chain with an "initiator" and an "end point".

Kroeber (1999) provides a comparative analysis of these operators across Salish languages, characterizing these operators as specifying transitivity, ditransitivity or intransitivity. The proto-Salish operators that Kroeber lists are as follows: Control transitive *-*t*, *-*nt*; Causative *-*stəw*; Noncontrol (lack-of-control) transitive *-*nəw*; a transitive *-*mit*, *-*mint*, which indicates that "the object is semantically not a fully affected patient, but rather the endpoint toward which motion is directed or entity concerning which some psychological reaction is experienced" (Kroeber 1999:30); ditransitive **-xit* (**-ɬt* for Southern Interior Salish); and intransitive **-(ə)m*, which is "used in most [Salish] languages to form antipassives" (Kroeber 1999:31). In antipassive constructions, the PATIENT/THEME is either absent or reduced to the oblique. Kroeber's analysis showed that Salish can construct AGENT demotion clauses, where the semantic AGENT is reduced to the oblique (as in implied AGENTs in passive constructions). Note that Salish languages generally make a distinction between two broad types of obliques: core obliques and noncore obliques. Core obliques includes PATIENTs of antipassive constructions, PATIENTs of ditransitives and AGENTs of AGENT demotion clauses. According to Kroeber, core obliques are "presumably subcategorized arguments of the clause predicates."

> … certainly the nature of the semantic relation (more exactly, the thematic relation…) that a core oblique bears to the clause predicate is dependent on the clause predicate, rather than being coded directly in the form of the core oblique itself. In most [Salish] languages, core obliques are prepositional phrases introduced by a general preposition (glossed 'Oblique') (Kroeber 1999:42-43).

Unlike core obliques, noncore obliques are not dependent on the clause predicate. Noncore obliques are mostly locatives, which tend to be coded in the noncore oblique itself. These form a small set of prepositions that roughly correspond to English *to, at, in, on*. Salish languages show similarities in argument structure realizations based on these valency-changing operators.

The primary question addressed here is whether and how valency-changing operators in Lushootseed depart from or support the framework of valency-changing operators in Salish languages as described by Kroeber (1999), where Kroeber analyzes the relationship between the semantic roles of core arguments/obliques with valency-changing operators. In this chapter, I investigate this question by describing each of the operators in Lushootseed, providing a formal characterization of the argument structure of different combinations of these operators. A second goal is to take a fresh look at the different analyses of valency-changing operators that have been proposed and decide which have the best fit to the data.

In Section 14.2, I exemplify and analyze each of the valency-changing operators and their status in the literature. Section 14.3 covers the complex combinations of valency-changing operators in Lushootseed. Section 14.4 covers the position class of valency-changing operators in Lushootseed. Finally (Section 14.5), I compare the current data with findings from other Salish languages.

## 14.2 SINGLE VALENCY-CHANGING OPERATORS

Valency-changing suffixes are common in Lushootseed and combines with verb roots. However, verb roots can occur on their own without combining with a valency-changing operator. For example, (1) and (2) illustrates the occurrence of a verb root without a valency-changing suffix.

(1) ʔu-t̓uc̓=čəd
PFV-shoot=1SG.SBJ
'I got shot' (LD 241)

(2) ʔu-caq̓=čəd ʔə tiʔəʔ sx̌ədiʔac
PFV-jab=1SG.SBJ OBL PROX devil.club
'I got stuck by the devil's club' ('the devil's club didn't intentionally stick me') (LD 43)

In this section, I survey the valency-changing suffixes in Lushootseed. For each suffix, I provide data establishing the function. Whenever possible, I have provided a pair of examples, one with the suffix in question and another without it, to establish the syntactic and semantic properties of the base to which the valency suffix attaches. Because Lushootseed is a closed corpus, I have not always been able to find a suitable pair of examples.

### 14.2.1 *Control transitive -d*

Control transitive -*d* has several allomorphs: [-d], [-Vd], and [-t]. [-Vd] is the result of inserting a vowel when -*d* is attached to the verb root. The quality of the vowel usually matches the vowel quality of the unaccusative root it attaches to, which is monosyllabic. For example, when the control transitive *-d* is attached to the root *t̓uc̓* 'shoot', the vowel that is inserted is [-u-], as in *t̓uc̓-ud*. The allomorph [-t] occurs when the passive (middle) *-b* is attached to the control transitive *-d* (see Section 14.3.1.1).

According to Beck (1996, 2007), *-d* causative adds an AGENT/initiator that causes a change of state. In this view, the change of state is expressed as the endpoint that corresponds to the trajectory of the root. For this reason, *-d* can express causation. Beck distinguishes internal causative *-d* from the external causative *-txʷ* (see Section 14.2.3). Beck states that the event is seen as a single process for the operator *-d*, where the "initiator participates directly, playing the semantic role of AGENT – hence, the term 'event-internal causative'" (Beck 1996:124). According to Zahir (2019), the operator *-d* expresses control, where the AGENT has "control over the event [denoted by the verb]". This operator transforms an intransitive clause into a transitive clause. According to the Lushootseed dictionary (Bates et al. 1994), the operator *-d* is a transitive suffix that "allows for a direct complement PATIENT, creating a PATIENT-oriented verb" (1994:xvi). In this view, the operator *-d* emphasizes the role of PATIENT more than the AGENT. This conflicts with Beck (1996, 2007) and Zahir (2019), who suggest that the operator *-d* adds an external argument of AGENT.

In Lushootseed, the control transitive *-d* assigns an external argument to form a transitive. The external argument must be pronominal. It assigns the semantic role of AGENT, which "does the event [denoted by the verb] with care and deliberateness" (Zahir, 2019). For example, compare (3) and (4). (3) contains a monovalent (one argument) verb that requires the subject to be PATIENT/THEME. On the other hand, (4) contains a bivalent (two argument) verb that assigns the role of AGENT to the subject and the role of THEME to the direct object (i.e., *ti d-čaləš* 'my hand').

(3) ʔu-ṭ'uc̓=čəd
PFV-shoot=1SG.SBJ
'I got shot' (LD 241)

(4) ʔu-ṭ'uc̓-ud ti d-čaləš
PFV-shoot-TR DET 1SG.POSS-hand
'He shot my hand' (AJ/Fly 49)

The following rule (using Haspelmath & Sim's (2010) notation for labelling argument assignments) shows the semantic role change posited when control transitive *-d* is added to a verb:

(5) V V-*d*

$$\begin{bmatrix} \text{SBJ} \\ | \\ \text{patient/theme}_x \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{agent} & \text{patient/theme}_x \end{bmatrix}$$

According to Levin and Rappaport-Hovav (1995), there are universally four classes of unaccusative verbs: VERBS OF EXISTENCE (e.g., *exist*, *endure*, *remain*), VERBS OF APPEARANCE (e.g., *appear*, *awake*, *emerge*), VERBS OF INHERENTLY DIRECTED MOTION (e.g., *arrive*, *come*, *go*, *enter*) and VERBS OF CHANGE-OF-STATE (e.g., *break*, *freeze*, *close*, *open*). The verbs that express a change of state "figure most prominently in the causative alternation".

> [There is] a fundamental division within the class of unaccusative verbs that is motivated with respect to the causative alternation.… (V)erbs of existence and verbs of appearance [and verbs of inherently directed motion], although bona fide unaccusatives, do not participate in the causative [transitive] alternation. This property is not characteristic of only English, but is typical of a variety of languages (1995:119)

In Lushootseed, the control *-d* can attach to VERBS OF CHANGE-OF-STATE to derive a transitive (causative) alternation, as shown in (6) and (7):

(6) ʔu-xʷəƛ̓ tə d-dᶻədis
PFV-break DET 1SG.POSS-tooth
'My tooth broke' (LD 251)

(7) xʷəƛ̓-əd=əxʷ tiʔəʔ qa sč̓ədᶻx̌
break-TR=now PROX a.lot nettle

‘He broke off a lot of nettles’ (LD 251)

Unlike English, Lushootseed can also form transitives from VERBS OF APPEARANCE. This is observed in (8) and (9), where control *-d* attaches to the verb *ƛ̓iq* ‘emerge’ to denote ‘take something or someone out’.

(8) ʔu-ƛ̓iq=čəd
PFV-emerge=1SG.SBJ
‘I emerged’ (LD 154)

(9) ʔu-ƛ̓iq-id tiʔəʔ t̓altəd
PFV-emerge-TR PROX knife
‘She took out the knife’ (LD 154)

Another pair of examples is given in (10) and (11), where control *-d* attaches to the verb *ʔa* ‘be there, be in existence’ (which is a VERB OF EXISTENCE) to denote ‘put something there’.

(10) didiʔɬuʔxʷ ʔu ʔa
still Q exist
‘Is it still there?’ (LD 1)

(11) lə-ʔah-əd
PROG-exist-TR
‘He put something there’ (‘He is putting something there’) (LD 1)

Although control *-d* cannot attach to VERBS OF INHERENTLY DIRECTED MOTION, the causative *-txʷ* can (see Section 14.2.3 for more details). The evidence above shows that the transitive (causative) alternation can apply not only for VERBS OF CHANGE-OF-STATE, but also VERBS OF APPEARANCE, VERBS OF EXISTENCE, and VERBS OF INHERNTLY DIRECTED MOTION (see Section 14.2.3), which is contrary to the predictions made by Levin and Rappaport-Hovav (1995).

### 14.2.2 *Lack-of-control transitive -dxʷ*

Beck (2007) characterizes the operator *-dxʷ* as “diminished control”. Consistent with the Lushootseed literature (Barthmaier 2000, Bates et al. 1996, Zahir 2019), this operator yields an AGENT that is “in less than complete control of the situation” (Beck 2007:56). Like the operator *-d*,

*-dxʷ* specifies a syntactic subject as AGENT and a direct object PATIENT. The operator is used to express the action as being performed accidentally or performed with some difficulty. The Lushootseed dictionary (Bates et al., 1994) also classifies the operator *-dxʷ* as expressing a lack of control, where the operator *-dxʷ* expresses the "lack of full control on the part of the AGENT" (Bates et al. 1994:xvi).

The lack-of-control transitive *-dxʷ* forms a transitive clause that introduces a semantic AGENT (i.e., an external argument) that either lacks full control of the event denoted by the verb (Barthmaier 2000, Bates et al. 1994, Beck 2007, Zahir 2019) or has no control altogether (as in INSTRUMENT or natural force) (see Section 14.3.1.2 for an example of *-dxʷ* licensing INSTRUMENT). Use of *-dxʷ* conveys that the AGENT "manages to, or accidently does the event" (Zahir 2019:44). This is shown in (13) (compared with (12), which shows the occurrence of the verb *lab* 'see, look' without a valency-changing suffix), where the word "happen" from the translation comes from the lack-of-control transitive *-dxʷ*. In (13), the AGENT happened to (accidently or coincidentally) see the place that was smoking.

| | | | | | | |
|---|---|---|---|---|---|---|
| (12) | ʔəs-x̌id | kʷ | ƛ̕u-s-ʔəs-lab | ʔə | kʷi | s-łəłaq |
| | STAT-how | HYP | HAB-COMP-STAT-see | OBL | HYP | NMLZ-thimbleberry |
| | How | does | it look | OBL | a | thimbleberry |

'How does a thimbleberry look?' (LD 133)

| | | | | | | |
|---|---|---|---|---|---|---|
| (13) | łəčil | dxʷʔal | tiił | tu-lab-dxʷ=əxʷ | tiił | ʔu-t̓iq̓ʷ-il |
| | arrive | to | DIST | PST-see-LTR=now | DIST | PFV-smoke-INCH |
| | He arrived to over there | | | he happened to see | over there | smoking |

'He arrived to where he happened to see smoke' (AJ/Bluejay 41)

In (13), if the control transitive *-d* replaced the lack-of-control transitive *-dxʷ*, then the AGENT would have deliberately (or intentionally) seen (or looked at) the place that was smoking (and was not accidental).

The following rule shows the semantic role changes when the lack-of-control transitive *-dxʷ* is added to a verb:

(14) V V-*dxʷ*

$$\begin{bmatrix} \text{SBJ} \\ | \\ \text{patient/theme} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{agent/instrument} & \text{patient/theme} \end{bmatrix}$$

### 14.2.3 *Causative -txʷ*

According to Beck (1996), *-txʷ* expresses an external causative, where the CAUSER/initiator is not a direct participant of the event. In this view, the CAUSER/initiator is “external” to the event denoted by the verb. According to Zahir (2019), the operator *-txʷ* is a causative, where the AGENT “causes the P(atient) to do the event” (Zahir 2019:45). This implies that the AGENT/CAUSER is not directly (or physically) involved in the execution of the caused event. According to the Lushootseed dictionary (Bates et al. 1996), the causative *-txʷ* forms a “causative transitive suffix” that creates a PATIENT-oriented verb stem.

The causative *-txʷ* forms *productive causation* (to distinguish it from Beck’s ‘internal causation’). Like control *-d*, the external argument must be pronominal when the causative *-txʷ* is attached to the verb. The difference between direct (internal) causation (as in (7)) and productive causation involves the role of the CAUSER. In direct (internal) causation, the causing event involves the direct/physical intervention of an external CAUSER, where the CAUSEE is PATIENT/THEME. However, in productive causation, the causing event does not involve the direct/physical intervention of an external CAUSER. In other words, the CAUSER does not get physically involved in the execution of the caused event (Shibatani & Pardeshi 2002). This is observed in (16) (compared with (15)) and (18) (compared with (17)), where the verbs ‘make’ and ‘have’ in the translation come from the causative *-txʷ*. (Note the contrast between [X prepared Y] and [X has Y prepared], where the latter forms productive causation). Because the CAUSEE is expressed as the direct object, the causative *-txʷ* forms a transitive.

| | | | | | | |
|---|---|---|---|---|---|---|
| (15) | ʔu-kʷəd | ti | ʔiɬkʷəlq | | | |
| | PFV-take | DET | some | | | |
| | ‘She took some (not all)’ | | | | | (LD 123) |
| (16) | ʔu-kʷəd-txʷ | | | | | |
| | PFV-take-CAUS | | | | | |
| | ‘He made someone take it’ | | | | | (LD 124) |
| (17) | ʔəs-qʷib=əxʷ=čəd | dxʷʔal | kʷi | d-s-ƛ̕a | | tawd |
| | STAT-prepare=now=1SG.SBJ | to | HYP | 1SG.POSS-COMP-go | | town |
| | ‘I’m getting ready to go to town’ | | | | | (LD 191) |
| (18) | ɬu-ʔəs-qʷib-txʷ=čəxʷ | | tiʔiɬ | ʔaciɬtalbixʷ | ɬu-q̓il-id=čəxʷ | |
| | FUT-STAT-prepare-CAUS=2SG.SBJ | | DIST | people | FUT-load-TR=2SG.SBJ | |
| | ‘You will have the people, whom you will board (load), prepared’ | | | | | (SSP/Flood 150) |

With *-txʷ*, the external CAUSER does not have direct influence over the caused event. For this reason, the causative *-txʷ* should be distinguished from control *-d* (see Section 14.2.1). The control *-d* forms direct (internal) causation, where the role of CAUSER and the role of AGENT may be the same because the event denoted by the verb involves the direct (or volitional) intervention of the external argument. In direct (internal) causation, there is a ‘spatiotemporal overlap’ between the causing event and the caused event (Shibatani & Pardeshi 2002). However, the causing event is distinct from the caused event in productive causation, which usually involves the CAUSER giving an oral direction/instruction to the CAUSEE. Another property of productive causation is that the CAUSEE can be AGENT. However, the CAUSEE is restricted to PATIENT/THEME in direct (internal) causation. This yields the following rule, which shows the semantic role assignments for the causative *-txʷ*:

(19)

$$\begin{array}{ccc} \text{V} & & \text{V-}\textit{tx}^{w} \\ \begin{bmatrix} \text{SBJ} \\ | \\ \text{patient/theme} \end{bmatrix} & \leftrightarrow & \begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{causer} & \text{causee/agent} \end{bmatrix} \end{array}$$

Productive causation can be formed through periphrastic constructions in English. Only a few roots can occur as productive causation without putting it in the periphrastic in English, such as the verbs *feed* and *show*.

Sometimes, there is a semantic interaction between causative *-txʷ* and the verb root, such as when *-txʷ* attaches to verbs of inherently directed motion (such as *ʔux̌ʷ* 'go'). In that case, the meaning becomes 'bring' or 'to take with someone' (Hess & Bates 1998), as shown in (21) (compared with (20)):

| | | | |
|---|---|---|---|
| (20) | ʔux̌ʷ=čəd | čuba | |
| | go=1SG.SBJ | go.upland | |
| | 'I went upland' | | (SSP/Training 10) |

| | | | | |
|---|---|---|---|---|
| (21) | ʔux̌ʷ-txʷ | tiʔəʔ | kʷagʷičəd | |
| | go-CAUS | PROX | elk | |
| | 'She took the elk' ('She caused the elk to go') | | | (SSP/Flood 155) |

However, this form is still a productive causative. Evidence for this comes from translations that correspond to productive causation (periphrastic in English) on motion verbs, as shown in (22):

(22) čubəʔ-s-txʷ=əxʷ
go.upland-3.OBJ-CAUS=now
'He had them climb upland' (SSP/Nobility 181)

Further evidence for this analysis comes from sentences that contain a directional phrase when the causative *-txʷ* is attached to a verb of motion, as shown in (23):

| | | | | | | |
|---|---|---|---|---|---|---|
| (23) | gʷəl | ʔux̌ʷ-tu-b | dxʷʔal | tiʔił | ʔa | |
| | and | go-CAUS-PASS | to | DIST | exist | |
| | and | they make him go | to | that | there | |
| | 'and they took him over there' ('and they made him go there') | | | | | (SSP/Memories 28) |

Directional phrases can only occur with verbs of motion. Motion verbs designate a "locative goal" as a canonical result of directional phrases rather than a change of state (Narasimhan et al, 1996). This suggests that the causative does not take away the verb's meaning as a motion verb. According to Zahir (2019), motion verbs can be perceived figuratively as 'take someone/something' when combined with the causative. For this reason, the meaning 'bring' or 'take with someone' is merely a surface representation of a true productive causation that is formed on motion verbs. In other words, the causative *-txʷ* forms productive causation on motion verbs, which suggests that the literal translation for (23) is 'and they CAUSED him to go to that place'.

Productive causation has also been observed in other Salish languages such as Halkomelem (Gerdts 1993). As the Halkomelem example shows (see (24)), the causative *-stəxʷ* is attached to a motion verb to derive productive causation whose figurative meaning is ‘to bring’.

(24) *Halkomelem*
ʔi cən ʔəmʔi-stəxʷ tᶿə swiwʔləs
AUX 1SBJ come-CAUS.3OBJ DET boy
‘I made the boy come’/ ‘I brought the boy’ (DG 9)

There are many roots that require the stative aspect *ʔəs-* to occur with the causative *-txʷ*. In these verbs, the CAUSER puts the CAUSEE in a state that the verb denotes. According to Beck (2007), the combination of the stative aspect *ʔəs-* and the causative *-txʷ* gives the reading ‘have X in the state of’. This structure can be observed in (18) above. (25) lists some of these roots.

(25) *xʷəc* ‘take clothes off’; *qʷib* ‘prepare’; *łid* ‘tie’; *kʷal* ‘weave’; *ƛ̓al* ‘wear (clothes)’; *ƛ̓akʷ* ‘stitch’; *ǰiq̓* ‘soak’; *taʔ* ‘put in position’

Some verbs that do not show the co-occurrence of stative aspect *ʔəs-* and causative *-txʷ* are the *control roots* (unergatives) listed in Chapter 11. In these verbs, the causative *-txʷ* derives productive causation where the CAUSEE is AGENT. This is observed in (26) and (27), where the word *feed* in the translation forms productive causation.

(26) łu-ʔəłəd=čəd ʔə tiʔəʔ sʔuladxʷ
FUT-eat=1SG.SBJ OBL PROX salmon
I will eat OBL this salmon
‘I will eat this salmon’ (LD 11)

(27) ʔu-ʔəł-txʷ ti ʔiišəd-s
PFV-eat-CAUS PROX friend-3.POSS
‘They fed their friends’ (SSP/Training 12)

### 14.2.4 *Middle -b*

Like unergatives (see Chapter 11), the middle *-b* (allomorph: [-əb]) forms *control intransitives*. Beck (2007) analyzes the operator *-b* as the “causative middle”, which creates an intransitive verb stem with some extra semantic feature. Using Cognitive Grammar, Beck (1996) states that the initiator is acting on something that is within its "possessive domain" — i.e., "the set of things in the initiator's possession or which the initiator can affect such that this action has some effect on the initiator or the initiator's interests" (Beck 1996:120). The endpoint is "unprofiled", although "the change effected in it by the initiator is" (Beck 1996:120). Beck cites Kemmer (1993), who suggests that middles characterize a degree of "self-interest" on the part of the AGENT/initiator. Kemmer distinguishes reflexives from middles, where reflexives assign two semantic roles (AGENT and PATIENT/BENEFICIARY) to the same entity, whereas the middle fails to show this distinction. Beck relates this idea to Cognitive Grammar, where "the causal factor… is construed as the will of the initiator" (Beck 1996:122).

The Lushootseed dictionary (Bates et al. 1994) analyzes the suffix *-b* as forming a large class of AGENT-oriented intransitive verb stems. According to the Lushootseed dictionary, "with Lexical stems it designates middle voice" (Bates et al. 1994:32). The dictionary also observed that the operator *-b* can combine with transitive suffixes (i.e. *-d, -dxʷ, -txʷ,* and *-c/-s*) to form a passive construction.

Zahir (2019) suggested that the middle *-b* has as its source a reflexive. Also citing Kemmer (1993), the middle *-b* "also occurs in many cases where the two semantic participant roles [AGENT and PATIENT] themselves are conflated into one and their distinction is less discernable" (Zahir 2019:75). However, Zahir observed that there are in fact a few verb stems that give a reflexive reading. This is observed in (28), where the middle form gives a reflexive reading.

(28) a. hədiw̓-b
inside.house-MD
'bring self inside a house/building'
b. hədiw̓-d
inside.house-TR
'bring someone/something inside a house/building' (ZZ 77)

In addition to this valency-changing function, the middle also appears to have a "verbalizing function", as shown in (29).

(29) a. kəpu
'coat'
b. kəpuu-b
coat-MD
'put coat on' (LD 119)

I also discuss lexicalized instances of -*b* below in Section 14.3.2.

The middle is also known for forming an antipassive construction in the Salish literature (Barthmaier 2000; Beck 2007; Gerdts & Hukari 1998, 2000, 2006; Kroeber 1999). According to Haspelmath & Sims (2010), antipassives are *deobjective*, where the PATIENT is "removed from [the] argument structure, or not linked to any element in function structure" (2010:325). Dixon (1994) states that the object PATIENT/THEME takes on a "peripheral function" (1994:146), which is marked by a non-core case, preposition, etc. According to Dixon, the object PATIENT/THEME can be omitted. In Lushootseed antipassive constructions, the object PATIENT/THEME is marked with an oblique *ʔə*. This is observed in (30), (31) and (32), where the oblique *ʔə* marks the PATIENT/THEME.

(30) ʔu-q̓ʷəl-b tsi sładayʔ ʔə tə bayac
PFV-bake-MD PROX.F woman OBL PROX meat
'The woman baked the meat' (ZZ 84)

(31) gʷəl łu-q̓ʷax̌ʷ-əb=həlgʷə ʔə ti kʷagʷičəd
and FUT-butcher-MD=3PL.SBJ OBL PROX elk
and they will butcher OBL the elk
'and they will butcher the elk' (SSP/Nobility 181)

(32) ʔu-c̓əb-əb=čəd ʔə tə stəgʷad
PFV-pick.berry-MD=1SG.SBJ OBL PROX salmon.berry
I picked OBL the salmon berry
'I picked salmonberries' (LD 51)

Antipassives are also formed from middles in other Salish languages such as Halkomelem (Gerdts & Hukari 1998), as shown in (33).

(33) *Halkomelem*

| | | | | |
|---|---|---|---|---|
| niʔ | q̓ʷəl-əm | ʔə | tᶿə | sce:łtən |
| AUX | bake-MD | OBL | DET | salmon |

‘He cooked/barbecued/bake the salmon’ (GH 52)

The following rule shows the semantic role assignments for antipassive *-b*:

(34) V V-*b* (antipassive)

$$\begin{bmatrix} \text{SBJ} \\ | \\ \text{patient} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & (\text{OBL}_{ʔə}) \\ | & | \\ \text{agent} & \text{patient} \end{bmatrix}$$

14.2.5 *Allative applicative -c*

The allative applicative -*c* attaches to verbs to derive a goal-oriented stem (Bates et al. 1994, Beck 2007, Zahir 2019). These applicatives attach most frequently to verbs of motion to specify the direct object as a locative goal. This is observed in (36) (compared with (35)), where the direct object is GOAL.

(35)

| | | |
|---|---|---|
| ʔux̌ʷ | tsiʔəʔ | šəbad-s |
| go | PROX.F | fish.trap-3.POSS |

‘The mother of the child goes to check her fish trap’ (SSP/Star Child 96)

(36)

| | | |
|---|---|---|
| ʔux̌ʷ-c=əxʷ | tiʔəʔ | bədaʔ-s |
| go-ALTV=now | PROX | child-3.POSS |
| go after | her | son |

‘She went after her son’ (SSP/Nolegs 207)

The following entry shows the semantic role assignments for the allative applicative -*c*:

(37) V V-*c*

$$\begin{bmatrix} \text{SBJ} \\ | \\ \text{patient/theme} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{agent} & \text{goal} \end{bmatrix}$$

When the verb ends in -*il*, the allative applicative -*c* is realized as [s] (Beck 2007, Zahir 2019). This is observed in (14), where the allative applicative is realized as [s] and takes the position of the lateral approximant in the verb *łčil* ‘arrive’.

(38) bə-łči(l)-s tiʔəʔ cədił x̌alabac
ADD-arrive-ALTV PROX 3SG.EMPH x̌alabac
'he came to this place called x̌alabac' (SSP/paq̓ʷ 189)

The Lushootseed dictionary (Bates et al. 1994) did not analyze *-s* as a variant of *-c*. However, the example that the dictionary gave for *-s* (i.e., *təlawi-s* 'run after someone or something', which is derived from the root *təlawil* 'run') suggests that the derived form functions identically to the operator *-c* (e.g. *ʔux̌ʷ-c* 'go after someone or something', which is derived from the root *ʔux̌ʷ* 'go'). For this reason, *-s* can be analyzed as a variant of *-c*.

The allative applicative *-c* can also attach to speech act predicates to specify the applied object as GOAL, as shown in (39) and (40).

(39) cuu-c=əxʷ=čəd tsiʔił diič̓uʔ
say-ALTV=now=1SG.SBJ DIST.F one
I said now to that one
'I said now to one of them' (SSP/Memories 20)

(40) huy gʷəd~gʷaa-c-əb=əxʷ tiʔəʔ ʔəs-xʷəlk̓ʷ
then DISTR~talk-ALTV-PASS=now PROX STAT-drunk
then they talked to the drunk
'Then they talked away to those who were drunk' (SSP/Memories 28)

This should contrast from the relational applicative *-bi*, which makes speech act predicates behave closer to psych predicates (see Section 14.3.6).

### 14.2.6 *Summary*

In this section, I provided data that showed the semantic role assignments for each of the valency-changing suffixes in Lushootseed. As Section 14.2.1 showed, the control transitive *-d* specifies an external AGENT that is in complete control of the event denoted by the verb. Unlike the predictions of Levin & Rappaport-Hovav (1995) (where only VERBS OF CHANGE-OF-STATE can participate in the causative alternation), the current data showed that transitives can be derived from other verbs that do not always express a change-of-state in Lushootseed. Section 14.2.2

showed that the lack-of-control transitive *-dxʷ* specifies an external argument that is in less than complete control of the event denoted by the verb. Section 14.2.3 showed that the causative *-txʷ* yields *productive causation*, where the external CAUSER does not get physically involved in the execution of the caused event (thus, the direct object can be interpreted as an AGENT that can be differentiated from the external CAUSER). Section 14.2.4 showed that the middle *-b* forms intransitive stems whose core argument is interpreted as the semantic AGENT. The middle *-b* can form antipassive constructions, where the semantic PATIENT is reduced to an oblique. Section 14.2.5 showed that the allative applicative *-c/-s* forms a goal-oriented stem where the direct object is assigned the semantic role of GOAL. In the next section, I cover the different combinations of valency-changing operators that's been observed from the data.

## 14.3 COMBINATIONS OF VALENCY-CHANGING OPERATORS

Other types of valence change (such as passives and applicative constructions) can be derived through the combination of more than one of the valency changing suffixes reviewed in Section 14.2. Moreover, there are other operators (i.e., the applicatives *-bi* and *-ši, -yi*) that require the control transitive *-d* to combine with them. In this section, I cover the complex combinations of valency-changing operators in Lushootseed and provide data establishing the functions of these complex combinations.

### 14.3.1 *Passivation*

The middle *-b* forms a passive when combined with the argument adding suffixes (i.e., control *-d*, lack-of-control *-dxʷ*, causative *-txʷ*, and allative applicative *-c/-s*). In this chapter, I gloss the middle as a passive (PASS) when combined with these suffixes (i.e., control *-d*, lack-of-control *-dxʷ*, causative -*txʷ*, and allative applicative -*c/-s*) in Lushootseed. This is to disambiguate instances where the middle occurs twice on the same root, as shown in Section 14.3.2.

#### 14.3.1.1 Control -*d* passives (-*t-əb*)

Passives are derived by attaching the passive (middle) -*b* to the control transitive -*d* (note: the control transitive -*d* is realized as [-t] when combined with the middle -*b*). In passives, the oblique morpheme *ʔə* marks the implied AGENT (like prepositional *by*-phrases in English passives). This is shown in (42), which can be compared with (4) (repeated here in (41)). In (42), the subject is PATIENT/THEME and the oblique (marked by *ʔə*) is AGENT.

| | | | | |
|---|---|---|---|---|
| (41) | ʔu-t̓uc̓-ud | ti | d-čaləš | |
| | PFV-shoot-TR | DET | 1SG.POSS-hand | |
| | ‘He shot my hand’ | | | (AJ/Fly 49) |
| (42) | ʔu-t̓uc̓-ut-əb=čəd | ʔə | tiiɬ | s-bək̓ʷiɬ |
| | PFV-shoot-TR-PASS=1SG.SBJ | OBL | DIST | NMLZ-foundling.child |
| | I was shot | by | the | foundling child |
| | ‘I was shot by the foundling child’ | | | (AJ/Fly 49) |

Here, the passive (middle) -*b* becomes a detransitivizer whose oblique object (marked by *ʔə*) is an adjunct. This yields the following rule for passive constructions:

(43) V-*d* V-*t-əb*

$$\begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{agent} & \text{patient} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & (\text{OBL}_{ʔə}) \\ | & | \\ \text{patient/theme} & \text{agent} \end{bmatrix}$$

#### 14.3.1.2 Lack-of-control -*dxʷ* passives (-*du-b*)

The passive (middle) -*b* can attach to the lack-of-control transitive -*dxʷ* to assign the semantic role of AGENT (or INSTRUMENT or natural force) to the oblique object (marked by *ʔə*). The lack-of-control transitive -*dxʷ* is realized as [du] when attached to the passive -*b*. This is shown in (44), where the INSTRUMENT (or natural force) is assigned to the oblique object (marked by *ʔə*):

(44)

| gʷəl | lə-ləx̌ʷ-us-du-b | ʔə | ti | č̓əƛ̓aʔ |
|---|---|---|---|---|
| and | PROG-cover-face-LTR-PASS | OBL | PROX | rock |

‘and rocks were placed to cover its face’ (lit. ‘and the face was covered by the rocks’)[19]
(SSP/Star Child 109)

This yields the following entry for passivized lack-of-control transitives:

(45) V-*dxʷ* ↔ V-*du-b*

| V-*dxʷ* | | ↔ | V-*du-b* | |
|---|---|---|---|---|
| SBJ | OBJ | | SBJ | (OBL$_{ʔə}$) |
| \| | \| | | \| | \| |
| agent/instrument | patient | | patient | agent/instrument |

14.3.1.3 Causative -*txʷ* passives (-*tu-b*)

The causative -*txʷ* can also be passivized and is realized as [tu] when followed by the passive (middle) -*b*. Causative -*txʷ* combined with the passive (middle) -*b* assigns the semantic role of CAUSER to the oblique object (marked by *ʔə*). In these constructions, a non-pronominal constituent can occupy the position of CAUSER. This is observed in (47) (compared with (46)), where the role CAUSER is assigned to the oblique object (marked by *ʔə*). When the passive (middle) -*b* is combined with the causative -*txʷ*, the CAUSEE is usually the THEME.

(46) tu-ʔa-txʷ=əxʷ=əlgʷəʔ
PST-exist-CAUS=now=3PL.SBJ
‘They had him there’ (LD 1)

(47)

| ʔa-tu-b | ʔə | tsi | d-ʔəpus | tiʔił | sgʷaʔ-s |
|---|---|---|---|---|---|
| exist-CAUS-PASS | OBL | DET.F | 1SG.POSS-aunt | DIST | ones.own-3.POSS |

‘My aunt brought out her (bartering things)’ (lit. ‘Her bartering things were brought out by my aunt) (SSP/Memories 21)

This yields the following rule for causative-passive -*tu-b*:

(48) V-*txʷ* ↔ V-*tu-b*

| V-*txʷ* | | ↔ | V-*tu-b* | |
|---|---|---|---|---|
| SBJ | OBJ | | SBJ | (OBL$_{ʔə}$) |
| \| | \| | | \| | \| |
| causer | causee/agent | | causee/theme | causer |

[19] Although I couldn’t find an example with just -*dxʷ* and not -*b* attaching to this root to justify the base of the rule in (44), this example illustrates how the external argument can be assigned the role of INSTRUMENT (or natural force) from the lack-of-control transitive -*dxʷ*

Unlike passivized forms such as (47) (where the CAUSER is oblique and the CAUSEE is the subject), the passive (middle) -*b* attaches to the causative -*txʷ* to mark an oblique THEME and an oblique agentive CAUSEE when attached to the root *ʔəɬəd* 'eat'. This is observed in (50) (compared with (27), repeated as (49)), where the first oblique *ʔə tiiɬ bayac* is THEME and the second oblique *ʔə tiiɬ x̌ax̌aʔ-s* is the agentive CAUSEE.

(49) ʔu-ʔəɬ-txʷ ti ʔiišəd-s
PFV-eat-CAUS PROX friend-3.POSS
'They fed their friends' (LD 11)

(50) ʔu-ʔəɬ-tu-b=əxʷ ʔə tiiɬ bayac ʔə tiiɬ x̌ax̌aʔ-s tiiɬ s-ləx̌il
PFV-eat-CAUS-PASS=now OBL DIST meat OBL DIST in.law-3.POSS DIST NMLZ-day
'Then Day fed his in-law some meat' ('in-law was fed meat by Day') (AJ/Fly 53)

This argument structure was observed only for the root *ʔəɬəd* 'eat'. The reason for this departure from other passivized causatives is unknown.

#### 14.3.1.4 Allative applicative -*c* passives (-*c-əb*)

The allative applicative can also combine with the passive (middle) -*b*. As shown in (52), when the passive (middle) -*b* attaches to the allative applicative, the subject *tiʔəʔ ad-bədaʔ* 'your child' is GOAL and the oblique object (marked by *ʔə*) is AGENT. This can be compared with (14) (repeated in (51)), where the verb *ɬčil* 'arrive' occurs with the allative applicative -*c* without the passive (recall that the allative applicative -*c* is realized as [-s] when the root ends in -*il*, as was shown in Section 14.2.5).

(51) bə-ɬči(l)-s tiʔəʔ cədiɬ x̌alabac
ADD-arrive-ALTV PROX FOC x̌alabac
'he came to this place called x̌alabac' (SSP/paq̓ʷ 189)

(52) ʔu-ɬči(l)-s-əb tiʔəʔ ad-bədaʔ ʔə ti s-ɬə~ɬadəyʔ
PFV-arrive-ALTV-PASS PROX 2SG.POSS-child OBL PROX NMLZ-DIM~lady
'Oh, some women came after your child' (lit. 'Your child was gone after by some women') (SSP/Star child 98)

This yields the following rule for the allative-passive -*c*-*əb*:

(53) V-*c* V-*c*-*əb*

$$\begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{agent} & \text{goal} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & (\text{OBL}_{ʔə}) \\ | & | \\ \text{goal} & \text{agent} \end{bmatrix}$$

### 14.3.2 *Middle-causative-passive -b-tu-b and lexicalized middles*

Unlike passives formed from middle -*b* (which follows the causative -*txʷ*, as seen in Section 14.3.1.3), the causative -*txʷ* can also follow the middle -*b*. These constructions are valency-increasing, where a direct object complement can be introduced. This is observed in (54) and (55), where the causative -*txʷ* attaches to the middle -*b* to form a bivalent (two argument) stem.

(54) ʔu-yəc-əb=čəd
PFV-inform-MD=1SG.SBJ
'I told' ('I informed') (LD 276)

| | | | |
|---|---|---|---|
| (55) łu-yəc-əb-txʷ=čəxʷ | ti | xʷiʔ | lə-haʔł |
| FUT-inform-MD-CAUS=2SG.SBJ | PROX | NEG | PROG-good |
| you will inform | the | no | good |

'You will tell the no good father' (lit. 'You will cause the no good (father) to be informed')
(SSP/Nolegs 214)

The following rule shows the semantic role assignments for the middle-causative sequence -*b*-*txʷ*:

(56) V-*b* V-*b*-*txʷ*

$$\begin{bmatrix} \text{SBJ} \\ | \\ \text{agent} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{causer} & \text{causee} \end{bmatrix}$$

Some scholars suggest that the passive-forming -*b* is the same as the middle -*b* (Barthmaier 2000, Zahir 2019). In this view, the passive described in Section 14.3.1 is formed by attaching the middle to a transitivizer (either control -*d*, lack-of-control -*dxʷ*, or causative -*txʷ*).[20] However, others distinguish passive -*b* and middle -*b* (Beck 2007). There appears to be a need to

[20] This view is also maintained for other Salish languages such as Halkomelem (Gerdts & Hukari 1996, 2000, 2006).

disambiguate passive-forming middles from middles that attach directly to the root because of constructions that require two middles to be suffixed to the same root, as shown in (57) where the passive *-b* attaches to the causative *-txʷ*. This is evidence of two *-b* suffixes occurring on the same root.

| | | | | |
|---|---|---|---|---|
| (57) q̓il-əb$_1$-tu-b$_2$ | tiʔiʔəʔ | ʔə | kʷi | tu-s-ʔəɬəd |
| load.up-MD-CAUS-PASS | PROX.PL | OBL | HYP | PST-NMLZ-eat |
| These people were made to be loaded | | with | the | food |

‘They loaded up these people with lots of food’ (lit. ‘These (people) were made to be loaded (on board) with food’) (SSP/Nolegs 216)

In (57), the *-b* glossed MIDDLE marks the demonstrative pronoun *tiʔiʔəʔ* as the core (subject) argument. The CAUSATIVE-PASSIVE suffix sequence marks the core argument as the CAUSEE in the relation, and the oblique (which is sensitive to the antipassive *-b$_1$*) becomes the PATIENT/THEME. This yields the following rule for the middle-causative-passive sequence:

(58) V-*b*-*txʷ* V-*b*-*tu*-*b*

$$\begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{causer} & \text{causee} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & \text{OBL}_{ʔə} \\ | & | \\ \text{causee} & \text{patient} \end{bmatrix}$$

According to the analysis underlying (57), the passive *-b$_2$* in (57) is not the same operator as the middle *-b$_1$* because the middle already occurs to the left of the causative. In this view, the same operator cannot occur twice. This view suggests that Lushootseed (and perhaps no Salish language) does not permit the same operator to occur more than once on the same root. The *-b$_2$* that attaches to the causative *-txʷ* is homophonous with the *-b$_1$* that directly attaches to the root.

Another possible analysis of (57) would be to analyze bimorphemic *q̓il-əb* as a single morpheme *q̓iləb* ‘to load up’. In other words, the middle *-b* is *lexicalized* in this verb. It’s true that there are some verb roots that cannot occur without the middle *-b*. In fact, according to Hess (1976), most middle forms are *lexicalized* in Lushootseed because there is no corresponding entry in the

Lushootseed dictionary that exists for these forms without the middle *-b* (Barthmaier, 2000, Bates et al., 1994). (59) lists the verbs that must occur with the middle *-b*.

(59) *t̓it̓əb* 'bathe'; *hiq̓ʷab* 'desire, attached'; *x̌ayəb* 'laugh'; *t̓ilib* 'sing'; *saxʷəb* 'run, jump'; *xʷuyub* 'sell'; *ʔušəb* 'pity'; *tuq̓ʷub* 'cough'; *p̓ix̌ʷəb* 'drip'; *č̓t̓usəb* 'shampoo hair'; *p̓usəb* 'float'; *x̌acəb* 'quarrel'; *t̓ičib* 'wade out, swim'; *qəlb* 'rain'

Under this analysis, the lexicalized forms in (59) are closer to control roots because these forms can act as independent bases (i.e., a single morpheme that affixes can attach to). For example, these forms show *control intransitivity*, as shown in (60).

(60) tu-xʷuyub=čəd
PST-sell=1SG.SBJ
'I sold' (SSP/Memories 20)

Kemmer (1993:22) also views the combination root + middle suffix as lexicalized. Barthmaier (2000) similarly analyzed the verb *saxʷ-əb* 'run, jump' as a lexicalized middle *saxʷəb*, as shown in (61) where *-b₂* is glossed as the middle and the form *saxʷəb* is treated as a single morpheme.

| (61) ʔu | ɬu-saxʷəb-tu-b₂ | ti | d-bədaʔ |
|---|---|---|---|
| Oh | FUT-run-CAUS-MD | PROX | 1SG.POSS-child |

'Oh, my son is going to be kidnapped' (PB 5)

This may suggest that *-b₂* in (57) and (61) are middles and not distinct passive morphemes. However, some of the 'lexicalized' forms in (59) (such as *xʷuyub* 'to sell') can also form antipassives, which is observed in (62). As (62) shows, the PATIENT/THEME (i.e., 'the salmon') is reduced to the oblique (marked by *ʔə*), suggesting that it's an antipassive construction. This suggests that the so-called fossilized middle in *xʷuyub* 'sell' is still analyzable as a root + suffix.

| (62) ƛ̓ub=čəxʷ | ʔu | ʔu-xʷuyub | ʔə | kʷi | tu-ad-sʔuladxʷ | tu-ʔəs-šab |
|---|---|---|---|---|---|---|
| okay=2SG.SBJ | Q | PFV-sell | OBL | HYP | PST-2SG.POSS-salmon | PST-STAT-dry |

'You decided to sell the salmon that you had dried?' (SSP/Memories 21)

The analysis of 'lexicalized' middles as roots is also problematic in other cases. For example, the form *q̓iləb* 'to load' in (57) is, in fact, not lexicalized because the root *q̓il* 'load' can occur without the middle *-b*. This is shown in (63), where the verb root *q̓il* 'load' can occur without the middle *-b*.

(63) tu-lə-ʔəs-q̓il=čəd
PST-PROG-STAT-load=1SG.SBJ
'I was riding on it' (LD 184)

(63) shows that the middle in the form *q̓iləb* 'to load' is morphologically complex. Moreover, the only other valency-changing operator that can attach to the right of a 'lexicalized' middle is the causative *-txʷ*. This suggests that the middle *-b* is still productive even if the root is bound to the middle (i.e., the so-called 'lexicalized' middles). Another strong piece of evidence for this comes from the antipassive use of middles in the so-called 'lexicalized' forms, as shown in (62). In other words, some of the lexicalized middles in (59) (such as *xʷuyub* 'sell') should not be analyzed as roots. Rather, they should be analyzed as stems that consists of a root bound to the middle *-b* (where the root and middle suffix can be analyzed separately, i.e., lexicalized but heteromorphemic). Stronger evidence of this comes from other Salish languages. The middle-causative-passive formation, such as the one observed in (57), is also observed in Halkomelem (Gerdts 1993). According to Gerdts, constructions such as (64) involve an antipassive (corresponds to *-əm₁*), causative (corresponds to *-st*), and passive (corresponds to *-əm₂*) representation. In these constructions, it appears the middle (antipassive *-əm₁*) is also productive.

(64) *Halkomelem*

| | | | | | | |
|---|---|---|---|---|---|---|
| ni | q̓ʷəl-əm₁-st-əm₂ | θə | słeniʔ | ʔə | tᶿə | səplil |
| AUX | bake-INTR-CAUS-INTR | DET | woman | OBL | DET | bread |

'The woman was made to bake the bread' (DG 11)

In this chapter, I adopt this approach by analyzing the middle *-b* separately from the root.

### 14.3.3 *Dative applicative -ši, -yi*

The realization of the dative applicative differs between the two dialects (Northern and Southern) of Lushootseed. The Southern dialect realizes the dative applicative as *-ši*, whereas the Northern dialect realizes the dative applicative as *-yi*. Regardless, *-ši* and *-yi* differ phonologically but exhibit the same morphosyntactic and semantic behavior.

In Lushootseed, dative applicatives must combine with control transitive *-d* to form a ditransitive verb stem. The dative applicative *-ši* assigns the semantic role of RECEIVER (or BENEFICIARY) to the direct object while the oblique (marked by *ʔə*) is assigned the role of PATIENT. This is the only way ditranstive sentences can be constructed in Lushootseed. As (65) shows, the dative applicative *-ši* attaches to the root *ʔab* 'extend' to form a recipient applicative.

| (65) | day̓=əxʷ | ʔəs-ʔab-ši-d | tə | s-qʷəb~qʷbayʔ-s | ʔə | tiiɬ | x̌ʷəs |
|---|---|---|---|---|---|---|---|
| | just=now | STAT-extend-DAT-TR | PROX | NMLZ-PL~dog-3.POSS | OBL | DIST | fat |

'Fat is just given to their dogs' ('They just give the fat to their dogs') (AJ/Bluejay 41)

This gives the following entry for dative applicative *-ši* (combined with control *-d*):

(66) V ↔ V-*ši-d*

$$\begin{bmatrix} \text{SBJ} \\ | \\ \text{patient} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & \text{OBJ} & (\text{OBL}_{ʔə}) \\ | & | & | \\ \text{agent} & \text{recipient/beneficiary} & \text{patient} \end{bmatrix}$$

In dative applicative constructions, the control transitive *-d* can also combine with the passive (middle) *-b*, as shown in (67). The non-passive form (as shown in (65)) specifies the subject as AGENT, the direct object as RECEIVER and the oblique (marked by *ʔə*) as PATIENT. However, as (67) shows, the subject *tsiiɬ č̓ač̓aš* 'the girl' is RECEIVER, the first oblique (marked by *ʔə*) is AGENT, and the second oblique (also marked by *ʔə*) is PATIENT.

| (67) | ʔab-ši-t-əb=əxʷ | tsiiɬ | č̓ač̓aš | ʔə | tsiiɬ | kayəʔ-s |
|---|---|---|---|---|---|---|
| | extend-DAT-TR-PASS=now | DIST.F | child | OBL | DIST.F | grandma-3.POSS |
| | ʔə | tiiɬ | t̓q̓ʷalšəd | | | |
| | OBL | DIST | tumpline | | | |

'The girl had been given a tumpline by her grandmother' (AJ/Bluejay 41)

This gives the following entry for passivized dative applicative *-ši-t-əb*:

(68) V-*ši-d* ↔ V-*ši-t-əb*

$$\begin{bmatrix} \text{SBJ} & \text{OBJ} & (\text{OBL}_{ʔə}) \\ | & | & | \\ \text{agent} & \text{recipient} & \text{patient} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & (\text{OBL}_{ʔə}) & (\text{OBL}_{ʔə}) \\ | & | & | \\ \text{recipient} & \text{agent} & \text{patient} \end{bmatrix}$$

The dative applicative can also form a benefactive. As (69) shows, the pronominal object *-c* (1SG.OBJ) that is the direct object of the sentence is assigned the role of BENEFICIARY. (69) also shows that the PATIENT (i.e., *the door* in the translation) is implied in dative applicative constructions.

| | | |
|---|---|---|
| (69) | dxʷ-gəq̓-yi-c | kia |
| | CTD-open-DAT-1SG.OBJ | grandma |
| | ‘Open (the door) for me, Grandmother’ | (SSP/Training 10) |

In general, when the dative applicative attaches to the root *ʔab* ‘extend’, it forms a recipient applicative. Beck (2007) and Zahir (2019) observed that when the dative applicative attaches to the root *kʷəd* ‘grab, take’, it forms a MALEFACTIVE. In these constructions, the action is done to the detriment of the applied argument, as shown in (70).

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (70) | ʔu-kʷəd-ši-t-əb=čəxʷ | ʔu | ʔə | tə | stubs | ʔə | tə | kəpu |
| | PFV-grab-DAT-TR-PASS=2SG.SBJ | Q | OBL | PROX | man | OBL | PROX | coat |
| | ‘Did the man take the coat from you?’ | | | | | | (LD 124) | |

However, most verb roots that combine with the dative applicative *-ši*, *-yi* forms the benefactive. This should contrast from the relational applicative *-bi* (see Section 14.3.6), which appears to assign various non-PATIENT roles to the core (direct object) argument.

### 14.3.4 *Causative-dative applicative -txʷ-yi/-ši-d*

As mentioned in Section 14.2.3, when the causative *-txʷ* attaches to a verb of motion, the meaning becomes ‘bring’ or ‘take with someone’. The dative applicative *-ši, -yi* can be attached to the causative *-txʷ*, where it adds an argument whose semantic role is RECEIVER/BENEFICIARY. This is observed in (71), where the direct object (‘her mother’) is RECEIVER and the PATIENT is implied.

| | | | | |
|---|---|---|---|---|
| (71) | gʷəl | ʔux̌ʷ-txʷ-yi-d | tsi | sk̓ʷuy-s |
| | and | go-CAUS-DAT-TR | PROX.F | mother-3.POSS |
| | ‘She brought it to her mother’ | | | (SSP/Star Child 114) |

This gives the following entry for the causative-dative sequence:

(72) V-*txʷ* V-*txʷ-yi-d*

$$\begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{causer} & \text{causee/agent} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & \text{OBJ} & (\text{OBL}_{\text{ʔə}}) \\ | & | & | \\ \text{causer} & \text{recipient/beneficiary} & \text{causee/patient} \end{bmatrix}$$

### 14.3.5 *Allative-dative applicative -c-yi/-ši-d*

As mentioned in Section 14.2.5, the allative applicative -*c* assigns the semantic role of GOAL to the direct object. The dative applicative -*ši, -yi* can attach to the allative applicative -*c*, and when it does, the direct object becomes SOURCE. This is observed in (73), where the direct object *tiʔiɬ səltup* ‘that marten’ is SOURCE.

(73) ɬu-ʔux̌ʷ-c-yi-d=čəd tiʔiɬ səltup
FUT-go-ALTV-DAT-TR=1SG.SBJ DIST marten
‘I shall go take from that marten’ (SSP/Sockeye 228)

The following entry shows the semantic role assignments for the allative-dative sequence:

(74) V-*c* V-*c-yi-d*

$$\begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{agent} & \text{goal} \end{bmatrix} \leftrightarrow \begin{bmatrix} \text{SBJ} & \text{OBJ} & (\text{OBL}_{\text{ʔə}}) \\ | & | & | \\ \text{agent} & \text{source} & \text{patient} \end{bmatrix}$$

### 14.3.6 *Relational applicative -bi*

Beck (2007) classifies *-bi* as the “middle applicative”. According to Beck, the middle applicative -*bi* assigns many semantic roles. The direct object takes on various roles other than PATIENT and the role varies from verb to verb. According to Zahir (2019), -*bi* is a “relativizer”. Zahir did not cover the relativizer -*bi* in detail. Zahir only stated that the control operator -*d* can attach to the relativizer -*bi*. The Lushootseed dictionary classifies -*bi* as a “secondary derivational suffix” (Bates et al. 1994:39), which is defined as “one of a small set of suffixes, expanding the set of transitive endings a given stem allows” (1994:xix).

In this chapter, I gloss this suffix "relational applicative" because the applied objects can have a variety of relationships with the event denoted by the verb in most Salish languages. For example, in Halkomelem the cognate suffix specifies the stimulus of a psychological predicate, the source of a verb of motion, the goal of a speech act predicate, the sufferer of an adversative, or even a benefactive of an intransitive (Gerdts & Kiyosawa 2003, 2005; Kiyosawa 2006). This term is also adapted from Thompson & Thompson (1992), where in Thompson Salish "the subject is moving or in relation to whom/which the action is accomplished" (1992:73).

#### 14.3.6.1 General relational applicative -bi

Like the dative applicative *-ši*, *-yi*, the relational applicative *-bi* must combine with the control transitive *-d* to form the verb stem. The relational applicative *-bi* has several roles. One of these roles is to specify a GOAL. (76) (compared with (75)) shows that the relational applicative *-bi* can attach to the verb *yayus* 'work' to form a GOAL-oriented stem, where the direct object *tiʔəʔ sʔabac* 'this Sumas' is GOAL.

(75) gʷə-yayus=čəd
SBJV-work=1SG.SBJ
'I can work' (LD 276)

(76) tu-yayus-bi-d tiʔəʔ sʔabac
PST-work-RA-TR PROX Sumas
'She worked on (making) this Sumas[21]' (SSP/Flood 156)

In Halkomelem (Gerdts & Kiyosawa 2003), the relational applicative *-meʔ-* (the cognate of Lushootseed *-bi*) attaches to the verb *ya:ys* 'work' (the cognate of Lushootseed *yayus* 'work') to form a benefactive, as shown in (77). In Lushootseed, the dative applicative *-ši*, *-yi* (see Section 14.3.3) forms the benefactive. Unlike Halkomelem, Lushootseed can derive a GOAL-oriented stem when the relational applicative *-bi* is attached to the verb *yayus* 'work'.

[21] In this translation, the speaker SSP was referring to the creation of the Sumas people. In the story she says the Sumas people were made from a flood that was caused by Thrush (depicted as a woman in this story)

(77) *Halkomelem*
   ya:ys   ‘work’
   ya:ys-meˀ-t   ‘work for him/her’   (GK 7)

The relational applicative can also derive new meanings to the predicate. The change in meaning suggests *-bi* is a derivational suffix. As (78) shows, the meaning of the root *taʔ* ‘put in position’ becomes ‘compressed’ with the addition of the relational applicative *-bi*.

(78) put=əxʷ   ʔəs-taʔ-bi-d   ti   tu-d-k̓ətuʔ
   just=now   STAT-put.in.position-RA-TR   PROX   PST-1SG.POSS-stomach
   just now   it compressed      my stomach
   ‘My stomach was compressed’   (SSP/Training 8)

The relational applicative can change the spatial profile of the root. When the relational applicative *-bi* attaches to verbs of location or direction such as *ʔałx̌ad* ‘located downstream’ and *gʷəd* ‘down’, the meaning of the expression becomes ‘below’, as shown in (79) and (80).

(79) ʔałx̌ad-bi-d   ʔə   Lyman   čəłə=łalil
   located.downstream-RA-TR   OBL   Lyman   1PL.SBJ.CONJ=land.ashore
   below   OBL   Lyman   we beached
   čəła=gʷax̌ʷ
   1PL.SBJ.CONJ=stroll
   and we walked
   ‘below Lyman we beached and walked’   (SSP/Memories 29)

(80) gʷəd-bi-d   ʔə   tiʔəʔ   xʷqəp̓ucid-s
   down-RA-TR   OBL   PROX   knee-3.POSS
   ‘Below his knee’   (SSP/Clothing 82)

The relational applicative can also change the temporal profile of the root. As (81) shows, the relational applicative *-bi* attaches to the ordinal *dᶻixʷ* ‘first’ to derive the meaning ‘before’.

(81) dᶻixʷ-bi-d   ʔə   July   tiʔił   s-wəliʔ   ʔə   tiʔił   d-səxʷ-studəq
   first-RA-TR   OBL   July   DIST   COMP-appear   OBL   DIST   1SG.POSS-COMP-slave
   before   OBL   July   was born   OBL   my belove son
   ‘It was just before July (4th) that my beloved son was born’   (SSP/Memories 23)

When changing the spatial or temporal profile of the root, the PATIENT argument that would otherwise be the direct object for verbs *below* or *before* in English (which does not have applicatives) become reduced to the oblique *ʔə* in Lushootseed, as shown in (79)-(81). This is expected from applicative constructions, which normally take a non-PATIENT argument as the direct object and the PATIENT argument as the oblique.

It has been observed that the applied object is *source* when the relational applicative is attached to verbs of motion in Halkomelem (Gerdts & Kiyosawa 2003), as shown in (82).

(82) *Halkomelem*

| | | |
|---|---|---|
| ɬəw̓ | 'run away' | |
| ɬəw̓-mə-t | 'run away from him/her' | (GK 7) |

However, there was no evidence of relational applicative *-bi* attaching to verbs of motion in the current Lushootseed data.

#### 14.3.6.2 Psych predicates

Most of the verbs that combine with the relational applicative *-bi* are psych predicates. (83) lists some of the psych predicates that can combine with the relational applicative *-bi*.

(83) *x̌əč* 'think, feel'; *x̌əc* 'fear'; *ʔušəb* 'pity'; *lax̌* 'remember'; *hiq̓ʷ-* '(emotionally) attached, desire'; *pətidgʷəs-* 'think, contemplate'; *ʔulus* 'respect'; *ǰuʔil* 'joy'; *hiiɬ* 'happy'.

According to Gerdts & Kiyosawa (2003), it is possible to express psychological events as an applicative construction. In Halkomelem, when the relational applicative *-meʔ* attaches to a psych predicate, the subject is EXPERIENCER and the direct object is STIMULUS. This is observed in (84), where the surface transitivity of the psych applicative is apparent from the presence of the transitive suffix.

(84) *Halkomelem*

| | | | | |
|---|---|---|---|---|
| ni | cən | siʔsiʔ-meʔ-t | kʷθə | sqʷəmey̓ |
| AUX | 1SBJ | frighten-RA-TR | DET | dog |

'I was frightened at the dog' (GK 339)

Beck (2007) also observed that in Lushootseed, most of the verbs that combines with the applicative *-bi* are roots that express a mental state or emotion, where the applied object is

STIMULUS and the subject is EXPERIENCER. This is shown in (86) (compared with (85)), where the direct object in (86) is STIMULUS.

(85) ʔəs-x̌əc=čəd
STAT-afraid=1SG.SBJ
'I'm afraid' (LD 260)

(86) ʔəs-x̌əc-bi-d=čəd tə sqʷəbayʔ
STAT-afraid-RA-TR=1SG.SBJ PROX dog
'I'm afraid of the dog' (LD 260)

This derives the following rule for relational applicative *-bi* on psych predicates:

(87)
$$V_{psych} \begin{bmatrix} \text{SBJ} \\ | \\ \text{experiencer} \end{bmatrix} \leftrightarrow V_{psych}\text{-}\textit{bi-d} \begin{bmatrix} \text{SBJ} & \text{OBJ} \\ | & | \\ \text{experiencer} & \text{stimulus} \end{bmatrix}$$

Psychological events can also be expressed in negation constructions, as shown in (88).

(88) xʷiʔ kʷi stab gʷə-ʔəs-x̌əc-bi-d=čəd
NEG HYP thing SBJV-STAT-afraid-RA-TR=1SG.SBJ
'Nothing could scare me' (SSP/Training 2)

The control transitive *-d* that attaches to the relational applicative *-bi* can also combine with the passive (middle) *-b*, which specifies the oblique object as EXPERIENCER and the subject as STIMULUS. This is shown in (89), where the oblique object (marked by *ʔə*) is EXPERIENCER and the subject that is the lexical DP *tiił x̌ʷubt* 'that paddle' is STIMULUS.

(89) pətidgʷəs-bi-t-əb ʔə tiił lə-dukʷ-alikʷ tiił x̌ʷubt
think-RA-TR-PASS OBL DIST PROG-change-REC DIST paddle
think about by the changer the paddle
'The one who was changing things directed his thoughts to the paddle' (lit. 'the paddle was thought about by the changer') (AJ/Fly 45)

According to Gerdts & Kiyosawa (2003), the applied object becomes GOAL when relational applicatives attach to speech act predicates in Salish languages. This is observed in Halkomelem, where the relational applicative *-meˀ-* attaches to the speech act verb *qʷal* 'speak', as shown in (90).

(90) *Halkomelem*

| | | |
|---|---|---|
| $q^w$al | 'speak' | |
| $q^w$əl-mə-t | 'lecture to, bawl him/her out' | (GK 7) |

However, in Lushootseed, speech act predicates behave closer to psych predicates when combined with the relational applicative *-bi*. This is shown in (91), where the relational applicative *-bi* attaches to the speech act predicate *cut* 'say' to denote 'think about'.

(91) cut-əbi-d=ə$x^w$
say-RA-TR=now
'She thought about it' (AJ/Elk 33)

In Lushootseed, the allative applicative *-c* attaches to speech act predicates to specify the applied object as GOAL (see Section 14.2.5).

### 14.3.7 *Summary*

This section showed that there are complex combinations of different valency-changing operators in Lushootseed. These combinations can derive a more complex argument structure. As Section 14.3.1 showed, the middle *-b* can combine with the transitivizers (*-d, -d*$x^w$*, -t*$x^w$*,* and *-c/-s*) to derive a passive. Section 14.3.2 showed that there can be more than one occurrence of the middle on a verb stem, where the middle *-b* can precede the causative *-t*$x^w$ and the causative *-t*$x^w$ can precede the passivizing middle *-b*. There I also argued that while some have analyzed root + middle as lexicalized middles, at least some are not monomorphemic roots, but still behave like middles. Section 14.3.6 and 14.3.3 showed that the relational applicative *-bi* and the dative applicative *-ši, -yi* must combine with the control transitive *-d* to form an applicative construction. Section 14.3.4 and 14.3.5 showed that the dative applicative *-ši, -yi* can also combine with the causative *-t*$x^w$ and allative applicative *-c/-s* to form a more complex argument structure. In the next section, I discuss the position class of these operators based on their combinatoric possibilities.

## 14.4 Positional Summary of Valency-changing Operators

As the previous section showed, valency-changing operators can combine with other valency-changing operators to derive a more complex argument structure. The combinatoric possibilities of these operators have important implications for the position class of these operators, as these combinations appear to occur in a strict order (for instance, the dative applicative *-ši*, *-yi* can only occur to the right of the causative *-txʷ*, but the causative cannot occur to the right of the dative applicative *-ši*, *-yi*). There is evidence of positional restrictions on the valency-changing operators, as summarized in (92) and illustrated below.

(92) VERB > *-b* > *-txʷ* {*-c*} > *-ši (-yi)* > *-bi* > *-d* > *-b*
VERB > MD > CAUS/ALTV > DAT.APPL > REL.APPL > TR > PASS

There was evidence of the middle *-b* preceding the causative *-txʷ* and the allative applicative *-c*. Moreover, the causative *-txʷ* and the allative applicative *-c* can precede the passive (middle) *-b*, as shown in (93) and (94):

(93) *middle > causative > passive*
ɬu-saxʷ-əb-tu-b
FUT-run-MD-CAUS-PASS
'He will be kidnapped or run off with' (SSP/Star Child 97)

(94) *middle > allative appl. > passive*
saxʷ-əb-is-əb ʔə kʷsi ʔadad kʷədiʔ stə
run-MD-ALTV-PASS OBL HYP.F magpie remote thing
'Magpie ran after that thing' (LD 200)

There was also evidence of the causative *-txʷ* and the allative applicative *-c* preceding the dative applicative *-ši*, *-yi*, as shown in (95) and (96). The causative *-txʷ* cannot occur with the allative applicative *-c* and they are analyzed as occurring in the same position class with respect to the verb stem.

(95) *causative > dative appl.*
ʔəƛ̓-txʷ-ši-c
come-CAUS-DAT-1SG.OBJ
'Bring it to me' (AJ/Bluejay 41)

(96) *allative appl. > dative appl.*
łu-ʔux̌ʷ-c-yi-d=čəd tiʔił səltup
FUT-go-ALTV-DAT-TR=1SG.SBJ DIST səltup
'I shall go take from that səltups' (SSP/Sockeye 228)

I have only been able to find one piece of evidence for the dative applicative *-yi* preceding the relational applicative *-bi*, as shown in (97):

(97) *dative appl. > relational appl. > transitive > passive*
ʔəs-x̌ic-əč-t-əb ʔə kʷi tubšədə
STAT-snatch-head-TR-PASS OBL HYP warrior
snatch (you) by the head OBL the warriors
gʷə-kʷəd-yi-bi-t-əb=əxʷ
SBJV-grab-DAT-RA-TR-PASS=now
if (they) come here to kidnap (you)
'Warriors will snatch you by the head if they come here to kidnap you'
(SSP/Nobility:161)

(97) also shows that the control transitive *-d* can attach to the applicative *-bi* and the passive *-b* can attach to the control transitive *-d*.

There are selectional restrictions on the kinds of combinations that can occur for each operator. For instance, there was no evidence of the dative applicative *-ši*, *-yi* occurring with the middle *-b* (i.e., the sequence V-*b*-*ši*-*d* has not been attested). Neither the causative *-txʷ* nor the allative applicative *-c* occurred with the relational applicative *-bi*. Moreover, neither the causative *-txʷ* nor the allative applicative *-c* occurred with the transitive *-d* unless the transitive is introduced by the dative applicative *-ši, -yi*. Although the lack-of-control transitive *-dxʷ* competes for the same position as the control transitive *-d* (because the two operators are transitive and semantically incompatible), there was no evidence of the lack-of-control transitive *-dxʷ* attaching directly to the applicatives and the causatives in the current data. Only the passive (middle) can attach to the lack-of-control transitive *-dxʷ*, where it is positioned to the right of *-dxʷ*. This suggests that the operators

*-d, -dx^w^, -tx^w^* and *-c* may compete for the same position when attached directly to the verb root. Table 14.2 lists unattested sequences of operators in current Lushootseed data. (98) describes the position of those operators that compete for the same position when attached directly to the verb root.

(98) VERB > *-d/-dxʷ/-txʷ/-c* > *-b*
VERB > TR/LTR/CAUS/ALTV > PASS

**Table 14.2** Unattested sequences of operators in the current Lushootseed data.

| Sequences | Operators |
|---|---|
| **V-dxʷ-bi* | *Lack-of-control transitive-Relational appl. |
| **V-txʷ-bi* | *Causative-Relational appl. |
| **V-c-bi* | *Allative appl.-Relational appl. |
| **V-dxʷ-d* | *Lack-of-control transitive-Control transitive |
| **V-txʷ-d* | *Causative-Control transitive |
| **V-c-d* | *Allative appl.-Control transitive |

Finally, the basis for the ordering restrictions on these suffixes is not explored here. It has been suggested that such ordering restrictions follow from semantic scope (Muysken 1981, 1986) or unique phonological shape (Tuttle & Hargus 2004). Most of the Lushootseed valency operators have unique phonological shapes, except for *-b* middle and *-b* passive, which do not occur in the same order (by my analysis), suggesting that phonological shape cannot be the whole story.

## 14.5 DISCUSSION

The current presentation of data from Lushootseed is mostly consistent with Kroeber's (1999) framework of valency-changing operators in Salish languages. Obliques can be distinguished as core obliques and non-core obliques in Lushootseed. Core obliques (marked by *ʔə*) marks AGENTs of passive constructions, PATIENTs of anti-passive constructions and PATIENTs of ditransitive constructions. Like Kroeber's analysis, noncore obliques are mostly locatives (includes *dxʷʔal* 'to, towards', *ʔal* 'at, in, on' and *tul̕ʔal* 'from') in Lushootseed. However, there are also combinations of operators that are not easily defined in Kroeber's framework. For example, RECEIVERS (or

BENEFICIARIES) of ditransitive predicates are not always direct objects. As (67) showed, subjects can also be RECEIVERS (or BENEFICIARIES) when the passive (middle) *-b* combines with the dative applicative *-ši/-yi*. Nonetheless, consistent with Kroeber's analysis of obliques, the PATIENT remains an oblique even when the dative applicative is passivized. According to Kroeber (1999), core obliques mark arguments that are licensed by the clause predicate. The question of whether these arguments are obligatory is uncertain. It is likely that obliques are universally adjuncts and are not obligatory to the verb stem. These are arguments that are optionally licensed by the valency-changing operator. It could be argued that the oblique PATIENT is obligatory in ditransitive predicates. However, a reanalysis of dative applicatives shows that these form high applicatives (Pyllkanen 2000), where the PATIENT is implied (and is therefore an adjunct). Analyzing PATIENTs as adjuncts in ditransitive predicates shows that there is no need to analyze a null 3rd-person pronoun where the PATIENT does not occur overtly.

Chapter 11 hypothesized that all verb roots are intransitive. This is consistent with observations made for other Salish languages (Davis 1997, 2000; Galloway 1997; Van Eijk 1997; Thompson 1985). Most of the verb roots in Lushootseed are unaccusative, while there is a small set of verbs that may be called unergative.

Applicative operations shift a non-object (e.g., indirect object or oblique object) to the direct object function (Haspelmath & Sims 2010). Although this is observed for the relational applicative *-bi* in Lushootseed, the relational applicative can also do the opposite (shift a direct object function to a non-object) for a small class of predicates such as verbs that specify location or direction and ordinal predicates. In these constructions, the spatial or temporal profile of the root is changed, and the object is marked with the oblique *ʔə*.

Like other Salish languages, the relational applicative *-bi* can specify a psychological event (EXPERIENCER-STIMULUS) when attached to psych predicates. However, relational applicatives can also specify psychological events on speech act predicates in Lushootseed. This does not occur in other Salish languages. In most Salish languages, the applied object becomes GOAL when the relational applicative attaches to speech act predicates (Kiyosawa 2006). However, as (91) showed, this does not occur in Lushootseed because speech act predicates behave closer to psych predicates when combined with the relational applicative *-bi*. The allative applicative *-c* specifies the applied object as GOAL when attached to speech act predicates.

For the dative applicative *-ši*/*-yi*, the argument PATIENT is marked by the oblique *ʔə* and is therefore implied. Because the PATIENT is an implied object (and is therefore an adjunct), the applied object bears no relation to the implied object. This suggests that dative applicatives take an event as its argument and introduces an individual (the applied object) that is thematically related to that event (Marantz 1993). According to Pyllkänen (2000), these constructions are called high applicatives and should be distinguished from low applicatives (found in English), where the latter forms double object constructions (such as *John baked Mary a cake*, where the BENEFICIARY *Mary* bears a strong relationship with the PATIENT *a cake*). High applicatives show no sensitivity to the implicitness or explicitness of the argument PATIENT because its meaning makes no reference to it.

Many Salish languages use different operators to distinguish the recipient applicative from the benefactive applicative. For example, in Halkomelem, *-as* forms 'recipient/dative' and *-łc* forms 'benefactive' (Kiyosawa 2006). Coeur d'Alene also distinguishes recipient applicatives from benefactive applicatives, where *-ši* forms benefactive applicative and *-tuł* forms dative (recipient) applicative (Doak 1997). In Nicola Lake Okanagan, *-xi* forms the benefactive and *-ł* indicates an action that is performed “to/on someone” (Hebert 1982:112-178). According to Beaumont (1985), Sechelt contrasts benefactive applicatives from malefactive applicatives. In Sechelt, *-emt* (benefactive) indicates an action that “works to the advantage of someone else”, whereas *-nit* (malefactive) indicates an action that “works to the disadvantage of someone else” (Beaumont 1985:102-112).

Like Lushootseed, some Salish languages use the same operator to form the recipient applicative and the benefactive applicative. In Klallam, *-si* forms a dative applicative and “creates a ditransitive stem with a recipient/beneficiary/source direct object and an implied patient” (Montler 1996). In Northern Straits, *-si* is ‘indirective’ and “the participant expressed in the object suffix is the goal rather than the patient of the predicate” (Montler 1986:8). In Lillooet, *-xit* “refers to an indirect object, i.e., a beneficiary or recipient, or the one from whom something is taken” (Van Eijk 1997:113-116). The benefactive and malefactive are represented by a single suffix *-ši* in Nooksack (Galloway 1997), which is also observed in Lushootseed.

Lexicalized middles have been analyzed as being heteromorphemic rather than being roots themselves. This is because the middle is still productive in the forms found in (59). Examples of their productive use comes from antipassive constructions such as (62), where the middle in these lexicalized forms still licenses an antipassive construction. Note that antipassive constructions can only be licensed by the productive use of middles. Moreover, no other operator besides the causative can attach to the right of a lexicalized middle, suggesting that these forms behave closer to middle constructions rather than control roots. This is made even more apparent from Table 14.2 because neither applicatives *-ši* nor *-bi* can attach to the middle of these lexicalized forms (notice, for instance, that the relational applicative *-bi* can attach to control roots, such as *yayus* ‘work’ (as shown in (76)) but not lexicalized middles such as *tiʔitəb* ‘bathe’. This is because applicatives such as *-bi* have not been attested to occur with middles). All this evidence points in favor of the view that lexicalized middles still make productive use of their middles, despite being fossilized to the root.

## 14.6 CONCLUSION

Lushootseed valency-changing operators are complex. This chapter showed that Lushootseed valency-changing operators can be broadly classified as (i) transitives (control, lack-of-control, and causative), (ii) applicatives (relational, dative, and allative) and (iii) middles (anti-passive and passive). Moreover, valency-changing operators can combine with other valency-changing operators to derive a complex argument structure. This chapter also attempted to describe the argument structure for these complex combinations in Lushootseed. More research needs to be done on combinations of operators in other Salish languages.

# Chapter 15. DETERMINERS AND NOMINAL MORPHOLOGY IN LUSHOOTSEED

## 15.1 INTRODUCTION

In this chapter, I discuss determiners and nominal morphology in Lushootseed. The function of determiners in Lushootseed has been briefly described by Hess (1967), Hess & Hilbert (1995), Matthewson (1996). Moreover, nominal morphology has been discussed in Hess's earlier works (Hilbert & Hess 1975) and elsewhere (Bates 2004). However, determiners and nominal morphology has not been analyzed extensively using data from primary sources (see Chapter 2 for more details on primary and secondary sources). The goal of this chapter is to analyze and describe determiners and nominal morphology using data from primary sources. In Section 15.2, I cover each determiner in Lushootseed by analyzing texts from primary and secondary sources. In Section 15.3, I provide a brief overview of nominal morphology in Lushootseed using data from primary and secondary sources.

## 15.2 DETERMINERS IN LUSHOOTSEED

In Lushootseed, determiners can be used to modify a noun (which appears in argument position) or can be used as the head of a subordinate predicate (which introduces a subordinate clause). Determiners can also mark gender in Lushootseed. According to Matthewson (1996), Salish languages lack quantifier determiners (such as the determiners *every* and *some* in English), as well as a lack of encoding of definiteness/indefiniteness and specificity. However, as we will see in the sections that follow, it is possible to evaluate Lushootseed determiners as encoding definiteness/indefiniteness and specificity.

### 15.2.1 *Determiners tiʔəʔ and ti*

There are dialectal differences in the use of determiners in Lushootseed. In the Northern Lushootseed dialect, there are two determiners that are used to differentiate the proximal demonstrative from the demonstrative used to designate a "unique reference" (Bates et al. 1994:224): The demonstratives *tiʔəʔ* PROX and *ti* SPEC (where the gloss SPEC means 'specifier', which functions like the English definite determiner *the*). Examples of demonstratives *tiʔəʔ* PROX and *ti* SPEC can be observed in (1) and (2), told by the Northern Lushootseed speaker Martha Lamont. According to Matthewson (1996), Salish determiners cannot encode specificity (or definiteness), although Salish determiners encode assertion of existence. However, as the Northern Lushootseed example in (2) shows, Lushootseed can clearly encode specificity (or definiteness) with the determiner *ti*, which is separate from the proximal demonstrative *tiʔəʔ*. As (1) and (2) shows, the proximal demonstrative *tiʔəʔ* is translated to the English proximal demonstrative *this*, whereas the specifier *ti* is translated to *the* in English, which may indicate that *ti* marks definiteness/specificity. However, this interpretation may not necessarily be the case. Without tests designed to disambiguate the possible interpretations, it is not possible to know with certainty that *ti* marks definiteness/specificity.

| | | | |
|---|---|---|---|
| (1) ƛ̓ub=čəd | ʔəs-ʔistə-b | ʔə | tiʔəʔ |
| well=1SG.SBJ | STAT-be.like-MD | OBL | PROX |

' "I had better be like this" ' (ML/Pheasant 47)

| | | | |
|---|---|---|---|
| (2) łu-gʷəx̌-al-iǰ-əd=čəł | tiʔəʔ | d-s-həliʔ-du-b | ʔə |
| FUT-untied-CNN-bundle-TR=1PL.SBJ | PROX | 1SG.POSS-NMLZ-alive-LTR-PASS | OBL |
| ti | sʔub~ʔubədiʔ | | |
| SPEC | DISTR~hunter | | |

' "We will unpack this with which I was aided by the hunters" ' (ML/Pheasant 48)

In the Southern Lushootseed dialect, however, the proximal demonstrative and the demonstrative used to designate a "unique referent" (i.e., the "specifier") is leveled to just *ti*. Examples of *ti* being used as a proximal demonstrative as well as to designate a "unique referent" can be observed in

(3) and (4), told by the Southern Lushootseed speaker Annie Jack. As (3) and (4) shows, the determiner *ti* can function as both the proximal demonstrative and the demonstrative used to designate a “unique referent” in Southern Lushootseed.

(3)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ʔəs-gʷəd-il=əxʷ | ti | ʔibac | ʔə | tsiił | lu~luƛ̓ | ʔə | tsiił |
| STAT-down-INCH=now | PROX | grandchild | OBL | DIST.F | DIM~old | OBL | DIST.F |
| haʔł | sładayʔ | | | | | | |
| good | lady | | | | | | |

‘This grandchild of the old woman was sitting. She was a good woman.’
(AJ/Bluejay 41)

(4)

| | | | | | |
|---|---|---|---|---|---|
| bə-lək̓ʷ-t-əb | tiił | ʔaciłtalbixʷ | ʔə | ti | dᶻəgʷəʔ |
| ADD-eat-TR-PASS | DIST | people | OBL | SPEC | monster |

‘Those people were eaten again by the monster’ (AJ/Raccoon 37)

The feminine marking of these two determiners is *tsiʔəʔ* and *tsi* (where *tsi* is produced as *sə* or *šə* when reduced, where *šə* is the reduced form of *tsi* that is used by Suquamish, Nisqually, and Squaxin Island speakers, and *sə* is the reduced form of *tsi* that is used everywhere else). Gender is associated with the noun that the determiner modifies. The infix -*s*- is inserted to mark the feminine gender of the determiner (indicated by angled brackets ‹s› in the IGT). Feminine determiners can either specify the gender of a non-gendered noun or it can agree with the gender of the noun. This can be observed in (5), where the feminine determiner *tsi* agrees with the gender of the feminine noun *kayəʔ* ‘grandma’.

(5)

| | | | | | | |
|---|---|---|---|---|---|---|
| t̓uk̓ʷ=əxʷ | t<s>i | | č̓ač̓aš | gʷələ | pus-ud | t<s>i |
| go.home=now | <F>DET | | child | and | throw-TR | <F>DET |
| kayəʔ-s | ʔə | tiił | t̓q̓ʷalšəd | | | |
| grandma-3.POSS | OBL | DIST | tumpline | | | |

‘The girl went home now, and then she threw the tumpline at her grandmother’
(AJ/Bluejay 43)

As (5) shows, the feminine determiner *tsi* agrees with the gender of the noun *kayəʔ* ‘grandma’, which is also feminine. However, (5) also shows that the feminine determiner *tsi* can be used to specify (and not agree with) the gender of the noun when the noun has no inherent gender, where the feminine determiner *tsi* combines with the non-gendered noun *č̓ač̓aš* ‘child’ to derive the meaning ‘the girl’.

### 15.2.2 *Distal determiner tiił*

The determiner *tiił* has been defined as a “distal adjectival demonstrative” (Bates et al. 1994:225). Like English *that*, *tiił* can be used to indicate the person or thing (denoted by the noun) that it modifies. Examples of *tiił* can be observed in (6) and (7), where the distal demonstrative *tiił* translates as English *that*.

| | | | | | | |
|---|---|---|---|---|---|---|
| (6) | gʷat | əw̓ə[22] | tiił | stubš | ʔal | tudiʔ |
| | who | PART | DIST | man | at | there |

‘who is that man over there?’ (H&H 10)

| | | | | |
|---|---|---|---|---|
| (7) | ʔəs-pač | tiił | cədił | kʷagʷičəd |
| | STAT-laid.out | DIST | 3SG.EMPH | elk |

‘ “That elk is laid out” ’ (ML/Pheasant 39)

The distal demonstrative *tiił* can also occur at the end of sentences. According to Hess & Hilbert (1995), when the distal demonstrative *tiił* occurs at the end of sentences, it adds “more emphasis to the statement” (1995:11). Moreover, when the distal demonstrative *tiił* occurs at the end of a sentence, a glottal stop [ʔ] is inserted between the vowels, as in *tiʔił*. This can be observed in the exchange (8), where the distal demonstrative *tiʔił* occurs at the end of sentence (8) and does not modify the preceding noun.

| | | | | | | |
|---|---|---|---|---|---|---|
| (8) a. | gʷat | əw̓ə | tiił | č̓ač̓aš | ʔal | tudiʔ |
| | who | PART | DIST | child | at | there |

‘Who is that child over there?’

| | | | |
|---|---|---|---|
| b. | dił | d-bədaʔ | tiʔił |
| | CLEFT | 1SG.POSS-child | DIST |

‘That is my son’ (H&H 10)

[22] The particle *əw̓ə* means “it seems” (Bates et al. 1994:93). It has been described as a predicate particle “expressing mild surprise, occurring most often in predicates, occasionally in complements” (1994:93).

Like the determiners *tiʔəʔ* and *ti* (see Section 2.1), the infix *-s-* is inserted to mark the feminine gender of the distal demonstrative, *tsiiɬ*. The feminine form of the distal demonstrative can also occur at the end of sentences. This can be observed in the exchange in (9), where the feminine form of the distal demonstrative tsiiɬ can modify the noun (9) and can occur at the end of the sentence (9).

| | | | | | | |
|---|---|---|---|---|---|---|
| (9) a. | gʷat | əw̓ə | t<s>iiɬ | sɬadəyʔ | ʔal | tudiʔ |
| | who | PART | <F>DIST | lady | at | there |
| | ‘Who is that woman over there?’ | | | | | |
| b. | diɬ | d-sk̓ʷuy | | t<s>iʔiɬ | | |
| | CLEFT | 1SG.POSS-mother | | <F>DIST | | |
| | ‘That woman is my mother’ | | | | | (H&H 10) |

Overall, the distal demonstrative *tiiɬ* functions very similarly to the English distal demonstrative *that*. Moreover, *tiiɬ* can occur in positions where *ti* and *tiʔəʔ* are expected. It should be noted that there are a few dialectal differences in the realization of *tiiɬ* in Lushootseed. In Southern Lushootseed, when the distal demonstrative modifies a word (i.e., a noun or a subordinate predicate), it is realized as *tiiɬ*; however, in the Northern dialect, when the distal demonstrative is modifying a word, it is realized as *tiʔiɬ* (with a medial glottal stop [ʔ]) in careful speech. The distal demonstrative loses the word-medial glottal stop [ʔ] in connected (spontaneous) speech when modifying words in the Northern dialect (thus pronounced like the Southern dialect distal demonstrative) (Hess & Hilbert 1995:11).

### 15.2.3 *Hypothetical determiner kʷi*

The hypothetical determiner *kʷi* has been defined as “a, any (hypothetical)” (Bates et al. 1994:125). According to Beck (2020), the determiner *kʷi* (which Beck defined as “remote/hypothetical”) is used as a default when “one is counting in the abstract and not enumerating concrete objects” (2020:2). According to Hess & Hilbert (1995), the hypothetical determiner *kʷi* is said “when referring to something vague and/or remote in time or place, or when there is some doubt as to its existence” (Hess & Hilbert 1995:23). Like the determiners *tiʔəʔ*, *ti*, and *tiił*, the hypothetical determiner *kʷi* has a feminine counterpart, *kʷsi*. An example of the feminine form *kʷsi* can be observed in (10), where the feminine form modifies the feminine noun *d-sk̓ʷuyʔ* ‘my mother’.

| | | | | |
|---|---|---|---|---|
| (10) | hay-du-b=əxʷ | ʔə | kʷ<s>i | d-sk̓ʷuy |
| | know-LTR-PASS=now | OBL | <F>HYP | 1SG.POSS-mother |

‘My mother learned how to sew’ (SSP/History 58)

When the hypothetical determiner *kʷi* heads a predicate of a subordinate clause, the action/event denoted by the predicate is said to occur hypothetically, remotely, or is used to mark a level of “abstractness” denoted by the verb. This can be observed in (11) and (12), where the hypothetical determiner *kʷi* modifies the subordinate predicates to mark the abstractness (or mark the hypothetical situation) of the event (denoted by the verb).

| | | | |
|---|---|---|---|
| (11) | til-əb | kʷi | s-ʔu-lab-dxʷ-s |
| | suddenly-MD | HYP | COMP-PFV-see-LTR-3.POSS |

‘Suddenly he happened to see something’ (AJ/Fly 53)

| | | | | |
|---|---|---|---|---|
| (12) | ƛ̓u-x̌id=čəxʷ | ʔal | kʷi | ƛ̓u-ad-s-hud |
| | HAB-what.do=2SG.SBJ | at | HYP | HAB-2SG.POSS-COMP-burn |

‘ “What do you habitually do when you get burned” ’ (AJ/Fly 51)

In (11), the English gloss *happened* is used to mark the abstractness (or mark the hypothetical situation) of the verbal event. A more literal translation of (12) would be “*hypothetically*, if you did get burned then what do you habitually do in such a situation?”

The hypothetical determiner can also behave like an indefinite determiner, which can be observed in (13), where *kʷi* combines with the noun *s-ʔubədiʔ* ‘hunter’ to mean ‘a hunter’.

| | | | | | | |
|---|---|---|---|---|---|---|
| (13) | łu-ʔay-dxʷ | kʷi | s-ʔubədiʔ | ti | səxʷ-haʔł | gʷəl |
| | FUT-find-LTR | HYP | NMLZ-hunter | PROX | COMP-good | and |
| | səxʷ-ʔu-ʔəłəd | | | | | |
| | COMP-PFV-eat | | | | | |

‘ “[We] may find a hunter that has good in him so that [we] can eat” ’ (AJ/Bluejay 43)

There is also evidence of the hypothetical determiner *kʷi* occurring with proper names. In this case, the interpretation is a little different from the previous examples. The example in (14) (which comes from a recording of the speaker Annie Jack) shows that the hypothetical determiner *kʷi* occurs with the proper name ‘Jack Stuck’, which means that Annie Jack’s father (i.e., Stuck Jack) existed remotely in the past. As we have seen in Chapter 13, the past tense *tu-* can combine with the noun to denote that the entity existed in the past. However, this can also be done with *kʷi* in the absence of a past tense marker.

| | | | | |
|---|---|---|---|---|
| (14) ʔəcə | gʷəl | bədəʔ | kʷi | Jack Stuck |
| 1SG.EMPH | and | child | HYP | Jack.Stuck |

‘I am the daughter of Stuck Jack’ (AJ/Message 00:20.39)

As discussed in Chapter 13, the hypothetical determiner *kʷi* can occur in negation expressions, where the determiner that follows the negation marker *xʷiʔ* is *kʷi*. The hypothetical determiner *kʷi* modifies a subordinate predicate in negation expressions (recall that the negation marker *xʷiʔ* functions as the head of a main clause, as discussed in Chapter 12). This can be observed in (15)-(17), where the word-forms that follow *kʷi* are subordinate predicates.

| | | | |
|---|---|---|---|
| (15) ʔu... | xʷiʔ | kʷi | d-s-t̓uc̓-ut-sid |
| oh… | NEG | HYP | 1SG.POSS-COMP-shoot-TR-2SG.OBJ |

‘Oh, I will not shoot you’ (lit. ‘not any my shooting you’) (AJ/Fly 49)

| | | |
|---|---|---|
| (16) xʷiʔ | kʷi | s-ʔay-dxʷ-s=həlgʷəʔ |
| NEG | HYP | COMP-find-LTR-3.POSS=3PL |

‘They could not find him!’ (AJ/Fly 49)

| | | | |
|---|---|---|---|
| (17) ʔu | xʷiʔ | kʷi | d-s-ʔu-yibuk̓ʷ-txʷ |
| oh | NEG | HYP | 1SG.POSS-COMP-PFV-quarrel-CAUS |

‘Oh, I am not quarreling with him’ (AJ/Fly 59)

As (15)-(17) shows, the hypothetical determiner *kʷi* combines with a subordinate predicate in negation expressions. There is no evidence from the data showing that the other determiners (such as *tiʔəʔ*, *ti*, or *tiił*) can modify a subordinate predicate in negation expressions. The determiner that is used to modify subordinate predicates in negation expressions is exclusively the hypothetical determiner *kʷi*.

### 15.2.4 *Summary*

In this section, I covered each determiner in Lushootseed. These include (1) the proximal/specifier determiner *ti* (and Northern Lushootseed *tiʔəʔ*), (2) distal demonstrative *tiił*, and (3) the hypothetical determiner *kʷi*. Each of these has a feminine version, where the infix -*s*- is inserted to mark the feminine gender of the determiners. The strongest evidence for analyzing the feminine marks as infixes comes from the hypothetical determiner *kʷi*, where the -*s*- is preceded by a non-homorganic stop, suggesting that the initial sequence /ts/ in the proximal/specifier determiners and distal determiner are not underlyingly affricates but are underlyingly a sequence of the initial stop /t/ to the infix -*s*-. Section 15.2.1 showed that, it is possible to interpret *ti* as a specifier in the Northern dialect because it contrasts from the proximal demonstrative *tiʔəʔ*. Moreover, as shown in Section 15.2.3, the hypothetical determiner *kʷi* could be interpreted as an indefinite determiner, which suggests that Lushootseed can encode definiteness/indefiniteness. However, without a semantic test, it is impossible to confirm with certainty that these determiners mark definiteness/indefiniteness.

## 15.3 NOMINAL ROOTS VS. DERIVED STEMS

In this section, I discuss nominal morphology in Lushootseed. There are two types of nominal stems that occur in Lushootseed: nominal roots and derived noun stems. In Section 15.3.1, I cover nominal roots in Lushootseed, and the kinds of sentence structures that can be constructed from these roots. In Section 15.3.2, I cover derived noun stems, where nouns are derived from the nominalizer *s*-, instrumental *səxʷ*-, and the suffix -*təd* (which is a suffix that indicates implement).

Data from the Lushootseed dictionary (Bates et al. 1994), as well as data from primary and other secondary sources, are used to illustrate nominal roots and derived stems in Lushootseed.

### 15.3.1 *Nominal roots*

Nominal roots are unmodified roots that function obligatorily as nouns. Table 15.1 lists a few examples of nominal roots in Lushootseed.

**Table 15.1** Examples of nominal roots in Lushootseed

| **Nominal roots** | **Translation** |
|---|---|
| kʷagʷičəd | elk |
| č̓ač̓aš | child |
| bədəʔ | child (offspring) |
| bad | dad |
| čəgʷəš | wife |
| pus | aunt |
| qsi | uncle |
| xʷuxʷubid | larynx |
| čaləš | hand, forearm |
| qəlu̓ʔb | eye |
| t̓əlkʷ | uvula |
| bayac | mean |

When a noun is the head of a clause, a cleft-like structure is introduced (see Chapter 12 for more details on the cleft marker *diɬ* and the emphatic pronouns). In such instances, the noun that heads the main clause occupies the focus position of a cleft. This can be observed in (18) and (19), where the nouns *kʷagʷičəd* 'elk' and *bayac* 'meat' head the main clause and the following phrases are subordinate clauses (marked with the complementizer *s*-).

| | | | | | |
|---|---|---|---|---|---|
| (18) hikʷ | kʷagʷičəd | tiiɬ | s-ʔəs-ɬil-d-čəɬ | ti | dəgʷi |
| big | elk | DIST | COMP-STAT-give.food-TR-1PL.POSS | DET | 2SG.EMPH |

' "A big elk is what we have given to you" ' (ML/Pheasant 46)

| | | |
|---|---|---|
| (19) bayac | ti | d-s-ɬil-d |
| meat | DET | 1SG.POSS-COMP-give.food-TR |

'Meat is what I gave him' (LD 147)

### 15.3.2 *Derived noun stems*

In Lushootseed, *s-* and *səxʷ-* are nominalizers that derive a noun from a verb root/stem. *səxʷ-* is a nominalizer that derives a noun stem with an *instrumental* meaning. *s-* is a basic nominalizer that combines with a verb root/stem to derive a noun.

Table 15.2 lists a few nouns that are derived when the nominalizer *s-* combines with a verb root/stem. There are a set of nominalized forms that can function as resultatives (i.e., the result of an act/state associated with the verb). This can be observed for the verb root *q̓ʷəlus* 'kipper a salmon' in Table 15.2. When the nominalizer *s-* combines with *q̓ʷəlus* 'kipper a salmon', the object that is derived from the nominalizer *s-* (i.e., *s-q̓ʷəlus* 'kippered salmon') is the result of the act of 'kippering a salmon'. On the other hand, there are a set of nominalized forms whose meaning is closely associated with the action/state associated with the verb (not necessarily the result of an action/state). This can also be observed for the root *kʷatač* 'climb hill, climb something high' in Table 15.2, where the meaning of the object from the nominalized form *s-kʷatač* 'mountain, hill, cliff' is associated with the act of 'climbing a hill'.

**Table 15.2** Examples of the nominalizer *s-* combined with a verb root/stem.

| **Verb root/stem** | ***s-* + root/stem** | **Class** |
|---|---|---|
| p̓əc̓ 'to poop' | s-p̓əc̓ 'poop (noun) | Resultative |
| q̓ʷəlus 'kipper a salmon' | s-q̓ʷəlus 'kippered salmon' | |
| ɬax̌il 'grow dark, become night' | s-ɬax̌il 'night (dark)' | |
| ləx̌il 'grow light, become day' | s-ləx̌il 'day (light)' | |
| kʷatač 'climb hill, climb something high' | s-kʷatač 'mountain, hill, cliff' | Object association |
| qəbuʔ 'nurse, breast feed' | s-qəbuʔ 'breast milk' | |
| čəbaʔ 'carry on back' | s-čəbaʔ 'a pack' | |
| ƛ̓alabac 'put clothes on' | s-ƛ̓alabac 'garment, clothing' | |

According to the Lushootseed dictionary, the prefix *səxʷ-* means "device (for)" (Bates et al. 1994:203). Thus, when the prefix *səxʷ-* combines with a verb stem, the derived noun has an instrumental meaning. Examples of the use of *səxʷ-* on verb roots/stems can be observed in Table 15.3.

**Table 15.3** Examples of the nominalizer *səxʷ-* combined with a verb root/stem.

| **Verb root/stem** | ***səxʷ-* + root/stem** |
|---|---|
| x̌al 'write, mark' | səxʷ-x̌al 'pencil, pen' |
| ʔax̌ʷuʔ 'clam' (v.) | səxʷ-ʔax̌ʷuʔ 'clam gun' |
| kʷatač 'climb hill, climb something high' | səxʷ-kʷatač 'ladder, stairs' |
| yayus 'work' | səxʷ-yayus 'tool' |
| gʷədil 'sit' | səxʷ-gʷədil 'chair' |
| łič̓ 'cut' | səxʷ-łič̓ 'a saw, a scissor' |
| xʷiʔxʷiʔ 'hunt' | səxʷ-xʷiʔxʷiʔ 'fishing tackle' |

There is another nominalizing morpheme that derives an "instrumental" (or "implemental") meaning when combined with a verb stem: The suffix -*təd*, which means "suffix indicating implement" (Bates et al. 1994:220). This suffix is less productive than the nominalizer *səxʷ-* because it has been attested in only two roots. Table 15.4 includes two examples of the suffix -*təd* combining with a verb root/stem.

**Table 15.4** Examples of the suffix -*təd* combined with two verb roots/stems.

| **Verb root/stem** | **Root/stem + -*təd*** |
|---|---|
| łəp 'to blink' | łəp-təd 'eyelash, eyelid' |
| t̓al 'slice open, slice' | t̓al-təd 'a knife used specifically for slicing' |

Both nominalizers *s-* and *səxʷ-* can be used as complementizers in Lushootseed to subordinate a predicate[23]. Examples of *s-* and *səxʷ-* as a complementizer are shown in (20) and (21). The use of the nominalizer *s-* as a complementizer is relatively straightforward: It subordinates a verb stem into a subordinate clause. The use of *səxʷ-* means that an agent "habitually performs some act [or in the state of] associated with the stem" (Bates et al. 1994:203).

[23] Note, however, that I gloss these as COMP when they are used as complementizers to contrast its use from noun derivation.

(20) gʷəl cick̓ʷ=čəd ʔəs-hiił ʔal tiʔəʔ
and very=1SG.SBJ STAT-happy at PROX
d-s-ʔəs-ləq-c-bicid
1SG.POSS-COMP-STAT-hear-ALTV-2SG.OBJ
'And it makes me so happy to hear from you' (SSP/Memories 16)

(21) ʔu tiʔił ad-səxʷ-ʔəs-hay-du-b kʷi s-ʔəs-huy
oh DIST 2SG.POSS-COMP-STAT-know-LTR-PASS HYP COMP-STAT-do
ʔə kʷi dᶻixʷ tu-ʔaciłtalbixʷ
OBL HYP first PST-Native.American
' "Oh, that you sincerely wish to learn about the ways of our ancestors!" '
(SSP/Training 11)

As discussed in Chapter 12, negative elements in Lushootseed (and other Salish languages) function as the main predicate, where they occur clause-initially and are followed by a subordinate clause. The nominalizer *s-* and *səxʷ-* is used on the verb root/stem to subordinate the clause, which is headed by the negation expression *xʷiʔ*. This can be observed in (22) and (23), where the nominalizers *s-* and *səx-* respectively combine with the verb word to derive a subordinate clause in the negation expression.

(22) xʷiʔ gʷə-s-ʔu-ʔəł-txʷ kʷi bədaʔ-s
NEG SBJV-COMP-PFV-eat-CAUS HYP child-3.POSS
'No food was given to their children' (SSP/Training 10)

(23) xʷiʔ gʷə-ƛ̓u-d-səxʷ-ʔəs-šuu-c
NEG SBJV-HAB-1SG.POSS-COMP-STAT-see-ALTV
'I had never even see her before' (SSP/Training 6)

### 15.3.3 *Summary*

There are two types of nominal word-forms in Lushootseed: (1) Nominal roots, which are unmodified bases that are not derived from a nominalizer; and (2) derived noun stems, which are noun stems that are derived from the combination of a nominalizer *s-* or *səxʷ-* with a verb root/stem. As discussed in Section 15.3.1, when a noun is the head of a main clause and is unmodified by a determiner, a cleft-like structure is formed (where the noun occupies the focus position of a cleft). Moreover, as Section 15.3.2 showed, nominalizers *s-* and *səxʷ-* can be used as complementizers, which subordinates a predicate stem into a subordinate clause (note that I gloss the nominalizers *s-* and *səxʷ-* as COMP when they are used as complementizers to contrast its use from noun derivation).

## 15.4 Conclusion

In this chapter, I covered determiners and nominal morphology in Lushootseed. Each of the determiners showed their own unique functions, where determiners can mark gender, which can either agree with the gender of the noun that it modifies or specifies the gender of a non-gendered noun. Contrary to Matthewson's analysis (1996), determiners can mark specification and definite/indefiniteness. Nouns can either come in the form of nominal roots (i.e., underived noun bases) or derived stems (i.e., derived from the set of nominalizers). The set of nominalizers in Lushootseed can be used to subordinate a predicate into a subordinate clause (where I gloss the nominalizers as COMP to distinguish its function of noun derivation).

# PART 4. CONCLUSION

# Chapter 16. CONCLUSION

## 16.1 SUMMARY OF FINDINGS

In this dissertation, I described aspects of the phonetics, phonology, and morphology of Lushootseed by analyzing recordings from the Metcalf collection, as well as transcribing data from primary and secondary sources. There are several unique contributions of the dissertation research, where each chapter covers different aspects of Lushootseed phonetics/phonology and Lushootseed morphology.

In Chapter 4, I provided a brief illustration of Lushootseed sound systems. Allophones for consonants and vowels are also discussed, where I analyze acoustic data from recordings of the Southern Lushootseed speaker Annie Jack and the Northern Lushootseed speaker Martha Lamont. There are some unique findings that are discussed in this chapter. For instance, there are consonant allophones that are dialect-specific in Lushootseed. This is observed in the deletion of the lateral approximant /l/ in word-final position for the inchoative morpheme /-il/ INCH, which is observed for Annie Jack but not Martha Lamont. Another predictable process is the insertion of schwas in obstruent clusters that involve a voiced stop preceded by a voiceless fricative. These patterns were not previously observed (or documented), providing a unique contribution towards our understanding of Lushootseed allophones.

In Chapter 5, I analyzed vowel qualities between the two dialects of Lushootseed. The purpose of this chapter was to test the claims made by Hess & Hilbert (1976) and Zahir (2019), that the vowels /i u/ tend to be realized as [e o] respectively in the Southern dialect but realized as [i u] respectively in the Northern dialect. Although previously impressionistic observations were made on the quality of these two vowels across dialects, there have been no acoustic phonetic data that tested this claim. This chapter provides the first acoustic analysis of vowel qualities across dialects in Lushootseed. The current findings reveal that there is little-to-no difference in the realization of the two vowels between the two dialects, which suggests that there is unlikely to be dialectal differences in the realization of vowels (especially /i u/) in Lushootseed.

In Chapter 6, I conducted the first acoustic analysis of obstruents in Lushootseed. There were several observations that were made from this chapter. The VOT of voiceless stops indicates that they are slightly aspirated (neither unaspirated nor aspirated). Moreover, the findings also suggest that only voiced stops with a more anterior closure (i.e., /b d/) are fully voiced during the articulatory closure; full voicing is not observed for velar or labiovelar stops. Moreover, I test whether ejectives in Lushootseed can be classified as either stiff or slack, using Lindau (1984) and Kingston’s (1985, 2005) typology of ejectives. Ejective stops and affricates are compared with voiceless and voiced stops and affricates. The conclusions that arise are (1) ejectives have long (but variable) VOT (like stiff ejectives), (2) ejective stops have louder burst intensity (like stiff ejectives), (3) ejectives have depressed f0 perturbation (like slack ejectives), and (4) ejectives have creaky voiced onset (like slack ejectives). There is considerable variability to the realization of ejectives, contrary to the Lindau and Kingston model of ejectives. Moreover, this chapter provided the first acoustic analysis on the realization of ejectives in connected (spontaneous) speech, which is the natural output of everyday communication. The problem with previous studies on the realization of ejectives is that data from other languages primarily looked at ejectives produced in wordlists. The current findings may suggest that ejectives show far more variable realization in natural connected speech than citation (wordlist) form. Another unique observation in this chapter is the pattern of intensity for the affricates’ release frication, where they differ based on their laryngeal type (i.e., voiced, voiceless, ejective). The amplitude of the release frication for voiced affricates increases as it moves into the period of voicing for the following vowel, whereas it decreases as it moves into the period of silence for ejectives. However, the amplitude of the release frication for voiceless affricates is relatively stable and neither increases nor decreases as it transitions into the following vowel. There were also some problems when measuring spectral moments for the voiceless alveolar fricative [s] and affricate [ts] ‹c›. The Center of Gravity was (on average) lower than the expected 4~5kHz, as well as being more varied than the other fricative consonants. This is most likely due to the upper-frequency cutoff (near 5-7kHz) of the microphone signal in the recordings. Moreover, there is a second formant band that is traceable in the spectrum for [s], which may have been due to less tongue braising along the sides of the palate in the production of [s] in connected speech for the one speaker who was analyzed, Annie Jack. Despite these difficulties, it was still possible to obtain relative differences in Center of Gravity from these recordings by using Time-averaging (Shadle 2013, 2023). Moreover, the lateral ejective affricate [tɬ’] ‹ƛ̓› had a lower Center of Gravity than voiceless post-alveolar affricates, which may suggest that the gestural target for the lateral ejective affricate is either more retracted than lateral obstruents in other languages (Gordon et al. 2002; Ladefoged & Maddieson 1996; Hargus et al. 2020), or that the length of the buccal cavity was longer during the release. Obstruent clusters in this analysis provide interesting results as well: (1) there is evidence of sibilant-sibilant clusters in coda position, (2) stop-stop clusters involve the deletion of a nuclear schwa /ə/ from the root when stress was placed on the following syllable, and (3) there was also evidence of clustering between ejective stops from patterns of reduplication in Lushootseed. Although consonant clusters were previously documented impressionistically (Bates et al. 1994), this chapter provides the first acoustic analysis of consonant clusters in Lushootseed.

In Chapter 6, I also tested claims on the realization of obstruents in Lushootseed (Cun Xi 2009, Maddieson 2008, Zahir 2019). It was previously claimed that voiced stops in Lushootseed are implosives (Cun Xi 2009, Maddieson 2008). However, the findings from this chapter reveal that the voicing amplitude of voiced stops starts to decrease as it reaches the burst release, indicating that these are pulmonic voiced stops and not implosives (Lindau 1984). Other claims concern the realization of the consonant ‹xʷ›, which was previously claimed to be a labio-glottal fricative [hʷ] (Zahir 2019 and personal communication). However, the findings reveal that, when compared with underlying [h] when preceded by the close back rounded [u], there are no additional peaks in the upper frequency range for ‹xʷ› compared to [hu], indicating that ‹xʷ› was a labiovelar fricative /xʷ/.

In Chapter 7, I analyzed the effects of uvular consonants on vowel quality in Lushootseed. Although previous studies have analyzed this for Interior Salish languages (Bessell 1992, 1998; Flemming et al. 2008), there have been none that for Coast Salish languages. This chapter provides the first acoustic analysis of the effects of uvular consonants on vowel quality in Lushootseed, as well as being the first acoustic analysis of this effect in Coast Salish. The findings reveal that uvular consonants increase F1 and decrease F2 of the adjacent vowel both pre- and post-vocalically. Unlike previous studies that based the magnitude of the effect by calculating the mean difference between the formants in uvular vs. nonuvular environments (Alwan 1986, Bessell 1998, Zawaydeh 1999), this chapter provides the first use of effect sizes to test whether the magnitude of the effect is greater on F1 or F2. The findings suggest that the magnitude of the effect is greater for F1 than F2, contrary to previous findings.

In Chapter 8, I analyzed denasalization in Lushootseed, conducting the first qualitative and quantitative acoustic analysis of voiced stops, some of which are derived from the denasalization process. This chapter addressed the question of whether residual nasality is present in voiced stops which are historically derived from the denasalization process. The current findings provided evidence that voiced stops that are derived from the denasalization process are partially (weakly) nasalized in domain-initial position, while voiced stops that are not derived from denasalization show no residual nasality. The evidence addressed important problems concerning the phonological status of voiced stops in Lushootseed, where voiced stops were previously claimed to pattern with sonorants and underlyingly do not have a [voice] feature (Rice 1993, Urbanczyk 1996). Contrary to the claims made by Rice (1993) and Urbanczyk (1996), the findings from this chapter suggest that voiced stops underlyingly have a [voice] feature, where the partial (weak) nasality in voiced stops that historically derived from denasalization is used to enhance the voicing contrast in prosodically strong environments. Moreover, there were other evidence showing that voiced stops do not pattern with sonorants and instead have a [voice] feature. For example, voiced stops do not laryngealize in reduplicant syllables, whereas sonorant consonants do. Moreover, there was evidence of the voiced stop /d/ devoicing (though rarely) in prosodic domain-initial position. Although there were other problems on denasalization that was not fully addressed in this chapter, the current findings is a first step towards addressing problems concerning the phonetic and phonological representation of nasality and voiced stops in Lushootseed. Moreover, it is the most detailed account of the presence of both phonetic nasality and the phonological representation of voiced stops in the language.

In Chapter 9, I characterized the acoustic and physiological correlates of laryngealized sonorants and glottal stops in Lushootseed. Several acoustic measures were applied to distinguish laryngealized sonorants from plain sonorants in Lushootseed. These measures included jitter, f0, intensity, spectral tilt, and Cepstral Peak Prominence (CPP), widely used measures to differentiate laryngealized sonorants from plain sonorants. Spectral tilt did not appear to reliably differentiate laryngealized laterals from plain laterals. The acoustic measures indicates that laryngealized sonorants were realized with canonical creaky voice. A comparison was made between glottal stops that are lenited in intervocalic position and laryngealized sonorants. The findings revealed that lenited glottal stops and laryngealized sonorants had the same canonical creaky voice, which may (tentatively) provide evidence that laryngealized sonorants were historically derived from the lenition of glottal stops that were adjacent to a sonorant consonant.

Chapter 10 provided a detailed analysis and description of stress and intonation in Lushootseed. Although there was no fixed acoustic correlate of stress in Lushootseed, there were some noteworthy cues that was identified from the recordings. For example, stress could be identified by relative duration and intensity of a syllable. Word-level stress in Lushootseed was also predictable based on the morphological composition of words; however, there were dialect-specific and lexical-specific differences that may not always conform to the common types of stress patterns in the language. This chapter also provided the first system of transcribing intonation in Lushootseed using an autosegmental-metrical approach towards intonation. The first lut-ToBI model was introduced in this chapter to identify the pitch accents and the perceived disjuncture between words (i.e., break indices). The pattern of intonation in Lushootseed is simple, where there is only one type of intonational contour that can be identified across utterances: f0 declination. Speakers use distinct pitch ranges across each intonational contour, as well as making pauses that separates intonational phrases and intermediate phrases, to convey distinct pragmatic meanings across utterances. The intonation contour for *yes-no* and *wh*-questions are the same as declaratives: both sentence types are characterized by f0 declination. Although the pitch range for *yes-no* and *wh*-questions are relatively higher than declaratives, the most important cue that speakers use to differentiate the two sentence types is the question particle *ʔu* to mark *yes-no* questions and the position of the *wh*-word in the sentence.

In Chapter 11, I provided a background on Lushootseed morphology, where I conducted the first quantitative analysis of classifying the morphological typology of the language. The findings suggested that Lushootseed can be classified as synthetic and a cross between fusional and agglutinative. Moreover, I also provided the first analysis of the [$g^w$]~[$k^w$] alternation in Lushootseed, where I analyze the alternation as coda devoicing. Chapter 11 also characterized some patterns of reduplication (i.e., diminutive and distributive), as well as conjunctions and negation expressions.

In Chapter 12, I cover pronominal morphology in Lushootseed. Pronominal subjects are marked as clitics, which can also function cumulatively as a conjunction when introducing a new clause. Pronominal objects are suffixes that occur at the end of a verbal predicate and are always direct objects. Possessive pronouns are affixes in Lushootseed, which can function as agents when combined with subordinate predicates. Independent pronouns are focus-inducing markers that can form a cleft-like sentence.

In Chapter 13, I cover the set of Tense-Aspect-Mood (TAM) prefixes in Lushootseed. Each TAM prefix has been analyzed using data from primary sources. Although TAM prefixes have been previously described (Bates 1999, 2002; Bates & Hess 2001; Hess 1967; Hess & Hilbert 1967, 1995; Bates et al. 1994), an analysis of position class restrictions of these TAM prefixes was not previously done. This chapter provided the first analysis of position class restrictions on TAM prefixes in Lushootseed. The findings from this chapter revealed that the ordering restrictions of the TAM prefixes are predictable from their unique phonological shapes, where prefixes that occupy the same templatic slot share similar phonological features with each other. For example, there is strong evidence for the habitual aspect /tɬ’u-/ ‹ƛ̓u-› HAB to occupy the same templatic slot as the future tense /ɬu-/ FUT, where both prefixes are initialized with a lateral obstruent that involves delayed release. Moreover, the perfective /ʔu-/ PFV occupies the same templatic slot as the stative aspect /ʔəs-/ STAT, where they are both initialized with a glottal stop. This suggests that the position class restriction for TAM prefixes is due to their unique phonological shapes, and that prefixes that occupy the same templatic slot share similar phonological features with each other.

In Chapter 14, I analyzed valency-changing operators in Lushootseed. Valency-changing operators can be broadly classified as (i) transitives (control, lack-of-control, and causative), (ii) applicatives (relational, dative, and allative), and (iii) middles (anti-passive and passive). Moreover, valency-changing operators can combine with other valency-changing operators to derive a complex argument structure. This chapter describes the argument structure of these complex combinations in Lushootseed by analyzing data from primary and secondary sources. The position class restrictions were predictable based on their unique phonological shapes. However, there are some unattested sequences, which suggests that there are some restrictions on the types of valency-changing operators that can combine in Lushootseed.

In Chapter 15, I described determiners and nominal morphology in Lushootseed. Although the function of determiners and nominal morphology has been briefly described (Bates 2004, Hess 1967, Hess & Hilbert 1995, Matthewson 1996), they have not been analyzed extensively using data from primary sources. I find that, contrary to Matthewson's (1996) analysis, determiners in Lushootseed can mark specificity and definiteness/indefiniteness from the determiner *ti* and the hypothetical determiner *kʷi*. The nominalizer *s-* in Lushootseed can function as a resultative (i.e., the result of an act/state associated with the verb) or object association (i.e., not necessarily the result of an action/state, but is associated with the meaning of the act).

## 16.2 Directions for Future Research

There are several areas for future research, which I will discuss concerning the phonetics, phonology, and morphology of Lushootseed.

In Chapter 5, I found that there is little-to-no dialectal differences in Lushootseed vowels. However, it is possible that there are word-level differences in the realization of the vowel qualities in Lushootseed. For example, based on impressionistic analysis, the vowel /i/ in the Northern Lushootseed word /tsitskʷ’/ ‹cick̓ʷ› ‘very’ sounded like a close-mid front vowel [e], as in [tsetskʷ’]. However, the stressed vowel in the first syllable of the word /t’iwił/ ‘religion’ sounded like a close front vowel [i]. This may suggest that there are word-level differences in the realization of vowels in Lushootseed. Whether there are word-level differences across dialects is difficult to address from the current data because the same words are not always produced by the two speakers of the two dialects in recordings of connected (spontaneous) speech (for example, the word for ‘very’ in the Southern dialect is /tsajˀ/ ‹cay̓›). For this reason, it is uncertain whether word-level differences across dialects can be identified. However, it might be possible to identify word-level differences in the realization of vowels within dialects from these recordings.

There are several questions that have yet to be addressed concerning Lushootseed obstruents. In Chapter 6, spectral moments for fricatives and affricates are analyzed. According to Shadle (2023), however, spectral moments describe spectral shape and not the probable causes of that shape (2023:1425). Inferences on the articulatory or aerodynamic mechanisms of fricatives cannot be made based solely on spectral moment measurements. It is possible to conduct an acoustic, articulatory (such as palatograph or ultrasound), and/or aerodynamic analysis on living speakers of other Salish languages, which would allow us to compare acoustic, articulatory, and/or aerodynamic data from these languages with the acoustics of fricatives in Lushootseed. Whether the acoustics of fricatives in other languages share the same properties as fricatives in Lushootseed has yet to be investigated. Another question that needs to be addressed concerns the clustering of obstruents in Lushootseed. Although a few obstruent clusters were analyzed in this chapter, there are several kinds of obstruent clusters in Lushootseed that have not been analyzed. Moreover, a full characterization of the phonotactic constraints in Lushootseed has not been conducted. There are several recordings of Lushootseed where obstruent clusters can be analyzed in depth. Moreover, a thorough acoustic analysis of obstruent-to-obstruent coarticulation could be conducted to characterize the acoustic properties of obstruents within clusters, and how they can be differentiated from non-clustered segments.

In Chapter 7, I analyze the effects of uvular consonants on vowel quality in Lushootseed. However, there are some limitations in this study. First, this study worked with only one speaker. It is unknown if these results can be generalized to all speakers of Lushootseed. Whether this effect is unique to the Southern dialect cannot be addressed by examining only one speaker. Data can be collected for the analysis of the effects of uvular consonants on vowel quality from other speakers such as Martha Lamont because there are enough recordings (comparable to the number and length of recordings to Annie Jack) to conduct this kind of analysis. Another limitation of the study is that place of articulation could not be balanced in the Nonuvular condition. Although this study has the benefit of working with natural connected (spontaneous) speech data, there are also flaws to this approach. It is difficult to balance for different places of articulation in the Nonuvular condition because none of the Nonuvular environments could be balanced for each contrastive vowel (e.g., /i a u/, but not /ə/, can be observed in the bilabial__alveolar environment; /a ə/, but not /i u/, can be observed in the postalveolar__alveolar environment; etc….). The environments of the consonants produced in data from connected (spontaneous) speech vary more dramatically than a tightly controlled laboratory setting where place of articulation can easily be controlled through the elicitation of words in citation form. It is unlikely that place of articulation can be controlled in these recordings.

In Chapter 9, I analyze the acoustic properties of laryngealized sonorants in Lushootseed. Although a phonetic analysis of laryngealized sonorants is provided, a thorough phonological analysis of laryngealized sonorants has not been conducted. According to Mellesmoen & Urbanczyk (2021), approximants in CVC+ (or +VC) reduplicated stems are pre-glottalized when preceded by a full vowel and followed by an unstressed vowel (typically schwas). However, there are little-to-no instances of CVC+ (or +VC) reduplicants in the recordings, where the final consonant of the root is an approximant. It is difficult to determine whether there are instances of pre-glottalization of sonorants in reduplicant syllables based on data from the recordings. Textual data from primary and secondary sources (as well as the Lushootseed dictionary) may provide the data that could determine the presence/absence of pre-glottalization in reduplicant syllables.

Another area of future research concerns the identification of different intonational patterns in Lushootseed narrative and discourse. As discussed in Chapter 10, the change in pitch range across narrative styles of speech and repetitions were examined. However, there are other types of discourse phenomena that play a crucial role in determining the pattern of intonation in Lushootseed (for example, there are several other types of discourse repetitions that were not analyzed in Lushootseed but may be observable in other Salish languages such as Hul’q’umi’num’ (Gerdts 2018)).

There are a few questions concerning the morphology of Lushootseed that have yet to be addressed. One of these concerns the analysis of lexical suffixes in Lushootseed. Lexical suffixes have been described in the past (Bates et al. 1994, Hess 1977, Urbancyzk 2001). In Chapter 10, I characterize the pattern of stress for roots and lexical suffixes in Lushootseed. However, an analysis of the position class restrictions on lexical suffixes (if any) was not provided in this dissertation. Data from primary sources can provide evidence of position class restrictions (if any) for the class of lexical suffixes in Lushootseed, and whether lexical suffixes can be categorized with respect to their semantic class. Moreover, the morphosyntactic distribution of lexical suffixes has yet to be addressed. Data from primary sources can be analyzed to determine whether lexical suffixes can be classified as syntactic objects or an element that adds to the meaning of a verb (i.e., incorporation).

Although the position class restrictions for TAM prefixes were characterized in Chapter 13, it is uncertain what the semantics of each combination of TAM prefixes are in Lushootseed (for example, it is uncertain what the combination of past tense *tu*-, additive *bə*-, and progressive *lə*- means when used in discourse). Multiple examples of each combination of TAM prefixes need to be analyzed to determine the semantics of these combinations.

# BIBLIOGRAPHY


Adank, P., Roel Smits, & Roeland Van Hout (2004). A comparison of vowel normalization procedures for language variation research. In *The Journal of the Acoustical Society of America*, *116*(5), 3099-3107.

Ahn, M. J. (2013). Acoustic duration of Korean nasals. In *음성음운형태론연구*, *19*(3), 411-431.

Alexiadou, Artemis, Elena Anagnostopoulou, & Florian Schäfer (2005). The properties of anticausatives crosslinguistically. In *Phases of interpretation*, *91*, 187-211.

Alwan, Abeer A. H. (1986). Acoustic and perceptual correlates of pharyngeal and uvular consonants (Doctoral dissertation). Massachusetts Institute of Technology.

American Anthropological Association (1916). Phonetic Transcription of Indian Languages. In *Smithsonian Miscellaneous Collection, 66*(6).

Aoki, Haruo. (1970). A note on glottalized consonants. *Phonetica*, *21*(2), 65–74.

Arvaniti, Amalia & Mary Baltazani (2005). Intonational analysis and prosodic annotation of Greek spoken corpora. In S.-A. Jun (ed.), *Prosodic Typology: The Phonology of Intonation and Phrasing*, pp. 84-117. Oxford: Oxford University Press.

Babel, Molly, Michael J. Houser, & Maziar Toosarvandani (2012). Mono Lake Northern Paiute. In *Journal of the International Phonetic Association, 42*(2), 233-243.

Ball, Martin J. & Nicole Müller (1992). *Mutation in Welsh*. Routledge, London and New York.

Ballard, Arthur C. (1927). *Some tales of the southern Puget Sound Salish*. American Indians of the Pacific Northwest Digital Collection. Washington: University of Washington Press.

Ballard, Arthur C. (1929). *Mythology of Southern Puget Sound* (Vol. 3). University of Washington Press.

Ballard, Arthur C. (1935). Southern Puget Sound Salish Kinship Terms. *American Anthropologist*, *37*(1), 111-116.

Ballard, Arthur C. (1950). Calendric Terms of the Southern Puget Sound Salish. *Southwestern Journal of Anthropology*, *6*(1), 79-99.

Barthmaier, P. (1998). Lushootseed vowels: A preliminary phonetic study. *nternational Conference on Salish and Neighbouring Languages, 33*, 1-11.

Barthmaier, Paul T. (2000). Lushootseed Argument Structure and the Discourse Function of the Morpheme /-b/. In *The 35th International Conference on Salish and Neighboring Languages, 35*, 1-18. University of British Columbia working papers in linguistics.

Bates, Dawn (1986). An analysis of Lushootseed diminutive reduplication. In *Annual Meeting of the Berkeley Linguistics Society*, *12*, 1-13.

Bates, Dawn (1999). Distance in narrative time and space: aspect markers and determiner choice in Martha Lamont's "Pheasant and Raven". In *34th Proceedings of the International Conference on Salish and Neighboring Languages, 34*, 1-6.

Bates, Dawn (2002). Narrative functions of past tense marking in a Lushootseed text. In *37th Proceedings of the International Conference on Salish and Neighboring Languages, 37*, 16-32.

Bates, Dawn (2004). The expression of NPs in Lushootseed texts. In *International Conference on Salish and Neighboring Languages, 39*, 1-44.

Bates, Dawn & Thom Hess (2001). Tense or aspect? A prefix of future time in Lushootseed. In *36th Proceedings of the International Conference on Salish and Neighboring Languages, 36*, 25-36.

Bates, Dawn, Thom Hess, & Vi Hilbert (1994). *Lushootseed dictionary*. University of Washington Press.

Bayraktar, Emre, & Rachid Ridouane (2016). Le VOT des éjectives: le cas du maya yucatèque (The VOT of ejective stops in Maya Yucatec). In *Actes de la conférence conjointe JEP-TALN-RECITAL 2016, 1,* 1-9.

Beach, D. M. (1938*). The Phonetics of the Hottentot Language.* Cambridge: Heffer.

Beaumont, Ronald C. (1985). *She Shashishalhem, the Sechelt Language: Language, Stories and Sayings of the Sechelt Indian People of British Columbia*. Penticton, British Columbia: Theytus Books.

Beck, David (1996a). Transitivity and causation in Lushootseed morphology. *Working Papers of the Linguistics Circle, 13*, 11-20.

Beck, David (1996b). Some notes on phonological phrasing in Lushootseed. *Toronto Working Papers in Linguistics, 15*.

Beck, David (1999). Words and prosodic phrasing in Lushootseed narrative. *Amsterdam Studies in the Theory and History of Linguistic Science Series 4*, 23-46.

Beck, David (2007). A taxonomy of Lushootseed valency-increasing affixes. In *The 42nd International Conference on Salish and Neighbouring Languages, 42,* 28-88. University of British Columbia working papers in linguistics.

Beck, David, & David Bennett (1998). Arguments for the phonological paragraph: Evidence from Lushootseed narrative. In *Annual Meeting of the LSA.*

Beck, David, & David Bennett (2007). Extending the prosodic hierarchy: evidence from Lushootseed narrative. *Northwest Journal of Linguistics, 1*(1), 1-34.

Beck, David, & Thom Hess (2014). *Tellings from Our Elders: Lushootseed syeyehub: Volume 1: Snohomish Texts*. Vancouver: UBC Press.

Beck, David, & Thom Hess (2015). *Tellings from Our Elders: Lushootseed syəyəhub. Volume 2. Tales from the Skagit Valley.* Vancouver: UBC Press.

Beckman, Mary (1982). Segment duration and the "mora" in Japanese. In *Phonetica, 39*, 113-135.

Beckman, Mary & Janet Pierrehumbert (1986). Intonational Structure in Japanese and English. In *Phonology Yearbook, 3,* 255-309.

Beckman, Mary & Julia B. Hirschberg (1994). The ToBI Annotation Conventions. (ms. Ohio State University).

Belotel-Grenié, Agnes, & Grenié, Michel. (2004). The creaky voice phonation and the organisation of Chinese discourse. In Hess, Wolfgang and Cooke, Martin (eds.), *International symposium on tonal aspects of languages: With emphasis on tone languages*. Retrieved from http://www.isca-speech.org/archive.

Bennett, Wm. G., Maxine Diemer, Jistine Kerford, Tracy Probert, & Tsholofelo Wesi (2016). Setswana (South African). In *Journal of the International Phonetic Association, 46*(2), 235-246.

Bernard, Comrie, Martin Haspelmath, & Bickel Balthazar (2020). The Leipzig glossing rules: Conventions for interlinear morpheme-by-morpheme glosses. Leipzig.

Bessell, N. J. (1992). Towards a Phonetic and Phonological Typology of Post-Velar Articulation (Doctoral dissertation). University of British Columbia.

Bessell, N. J. (1998). Local and non-local consonant–vowel interaction in Interior Salish. *Phonology, 15*(1), 1-40.

Bierwert, Crisca (1996). *Lushootseed Texts: An Introduction to Puget Salish Narrative Aesthetics.* University of Nebraska Press.

Bill, Denise (2012). Native American Educational Leadership in the Pacific Northwest. (Doctoral dissertation, University of Washington).

Bird, Sonya, Donna Gerdts, & Janet Leonard (2016). The realization of obstruents across speakers of Hul'q'umi'num'. *Canadian Acoustics, 44*(3), 134-135.

BJÖRK, L., & NYLEN, B. O. (1961). Cineradiography with synchronized sound spectrum analysis: a study of velopharyngeal function during connected speech in normals and cleft palate cases. In *Plastic and Reconstructive Surgery, 27*(4), 397-412.

Boas, Franz (1911). Chinook. In F. Boas (ed.) *Handbook of American Indian Languages*, 559-677. Bureau of American Ethnology Bulletin no. 40, pt.1. Washington, D.C: Government Printing Office.

Boaz, Franz & Herman Haeberlin (1927). Sound shifts in Salishan dialects. *IJAL, 4*, 117-136.

Boersma, Paul & David Weenink (2021). Praat: doing phonetics by computer [Computer program]. Version 6.1.50, retrieved 20 June 2021 from http://www.praat.org/.

Botma, E. D. (2004). *Phonological aspects of nasality: an element-based dependency approach* (Vol. 90). LOT.

Boulet, Jean-Baptise (1879). *Prayer Book and Catechism in the Snohomish Language*. Tulalip, Washington: Tulalip Mission Press.

Brown, Jason, Henry Davis, Michael Schwan, & Barbara Sennott (2016). Gitksan. In *Journal of the International Phonetic Association, 46*(3), 367-378.

Brunner, J., & Zygis, M. (2011). Why do glottal stops and low vowels like each other? In *Proceedings of the International Conference of Phonetic Sciences*, 376-379.

Bybee, Joan & Shelece Easterday (2019). Consonant strengthening: A crosslinguistic survey and articulatory proposal. In *Linguistic Typology, 23*(2), 263-302.

Campbell, Lyle (1997). *American Indian Languages: The Historical Linguistics of Native America.* Oxford: Oxford University Press.

Campbell, Lyle (2020). *Historical linguistics* (3rd ed.). Edinburgh University Press.

Campbell, Nick (1996). Autolabelling Japanese ToBI. In *Proceeding of Fourth International Conference on Spoken Language Processing, 4*, 2399-2402.

Campbell, Nick (1997). The ToBI (Tones and Break Indices) System and Its Application to Japanese [in Japanese]. In *Journal of the Acoustical Society of Japan, 53*(3), 223-229.

Cartei, Valentina, Alan Garnham, Jane Oakhill, Robin Banerjee, Lucy Roberts, & David Reby (2019). Children can control the expression of masculinity and femininity through the voice. In *Royal Society open science*, *6*(7), 190656.

Catford, John C. (1939). On the classification of stop consonants. *Le Maître Phonétique*, *65*(4).

Catford, John C. (1988). *A practical introduction to phonetics*. Oxford: Clarendon Press.

Chen, M. Y. (1996). Acoustic correlates of nasality in speech. (Doctoral dissertation, Massachusetts Institute of Technology).

Chiba, T., & Kajiyama, M. (1941). *The Vowel: Its Nature and Structure* (Kaiseikan, Tokyo).

Childers, Donald G., & Chih K. Lee. (1991). Vocal quality factors: Analysis, synthesis, and perception. In *Journal of the Acoustical Society of America, 90*(5), 2394-2410.

Cho, Taehong, & Patricia A. Keating (2001). Articulatory and acoustic studies on domain-initial strengthening in Korean. In *Journal of Phonetics*, *29*(2), 155-190.

Cho, Taehong, & Peter Ladefoged (1999). Variation and universals in VOT: evidence from 18 languages. In *Journal of phonetics*, *27*(2), 207-229.

Choi, J. D. (1991). An acoustic study of Kabardian vowels. In *Journal of the International Phonetic Association, 21*(1), 4-12.

Comrie, Bernard (1976). *Aspect*. Cambridge University Press, Cambridge.

Craig, R. O. (1858). Vocabulary of the Skagit. In *the library of the Bureau of Ethnology*. MS in Smithsonian Archives (m.s. 2, p.4).

Crystal, Thomas H., & House, Arthur S. (1990). Articulation rate and the duration of syllables and stress groups in connected speech. In *The Journal of the Acoustical Society of America*, *88*(1), 101-112.

Cun, Xi (2009). *A phonetic study on implosives in China*. Hong Kong University of Science and Technology (Hong Kong).

Cutler, Anne (2005). Lexical Stress. In D. Pisoni & R. Remez (eds.), *The Handbook of Speech Perception*, pp. 264-289. Oxford: Blackwell.

Czaykowska-Higgins, Ewa, & M. Dale Kinkade (1998). *Salish Languages and Linguistics: Theoretical and Descriptive Perspectives*. Mouton de Gruyter Berlin: New York.

Dang, Jianwu & Kyoshi Honda (1994). Morphological and acoustical analysis of the nasal and the paranasal cavities. In *Journal of the Acoustical Society of America, 96*(4), 2088-2100.

Dauer, Rebecca M. (1983). Stress-timing and syllable-timing reanalyzed. In *Journal of phonetics*, *11*(1), 51-62.

Davis, Henry (1997). Deep unaccusativity and zero syntax in St'át'imcets. *Anuario del Seminario de Filología Vasca" Julio de Urquijo"*, 55-96.

Davis, Henry (2000). Remarks on Proto-Salish Subject Inflection. In *International Journal of American Linguistics, 66*(4), 499-520.

Davis, Henry (2000). Salish evidence on the causative-inchoative alternation. *AMSTERDAM STUDIES IN THE THEORY AND HISTORY OF LINGUISTIC SCIENCE SERIES 4*, 25-60.

Davis, Henry (2022). Are pronouns ever predicative in Salish? In *Proceedings of the International Conference on Salish and Neighboring Languages, 57*, 1-40.

Davis, Henry, & Lisa Matthewson (2009). Issues in Salish syntax and semantics. In *Language and Linguistics Compass*, *3*(4), 1097-1166.

Dehaene, Stanislas (2009). *Reading in the brain*. New York.

Dehaene, Stanislas, Laurent Cohen, Mariano Sigman, & Fabien Vinckier (2005). The neural code for written words: a proposal. *Trends in cognitive sciences, 9*(7), 335-341.

Dehaene-Lambertz, Ghislaine (1997). Electrophysiological correlates of categorical phoneme perception in adults. *NeuroReport, 8*(4), 919-924.

Dehaene-Lambertz, Ghislaine, Stanislas Dehaene, & Lucie Hertz-Pannier (2002). Functional neuroimaging of speech perception in infants. *science*, *298*(5600), 2013-2015.

Delattre, P. (1969). An acoustic and articulatory study of vowel reduction in four languages. In *IRAL, 7,* 295-325.

Delattre, P. (1971). Pharyngeal features in the consonants of Arabic, German, Spanish, French, and American English. *Phonetica*, *23*(3), 129-155.

DiCanio, Christian (2021). Spectral moments of fricative spectra script in Praat. Retrieved from https://www.acsu.buffalo.edu/~cdicanio/scripts/Time_averaging_for_fricatives_4.0.praat.

DiPaolo, Marianna, Malcah Yaeger-Dror, & Paul Foulkes (2005). Towards best practices in sociophonetics. Workshop held at: NWAV 34, New York University, October.

Dixon, Robert M. W. (1994). *Ergativity*. Cambridge University Press.

Doak, Ivy G. (1997). Coeur d'Alene Grammatical Relations (Doctoral dissertation). University of Texas at Austin, Austin, Texas.

Doke, C. M. (1923). AN OUTLINE OF THE PHONETICS OF THE LANGUAGE OF THE: BUSHMEN OF NORTH-WEST KALAHARI. *Bantu studies, 2*(1), 129-165.

Doke, C. M. (1926). *The phonetics of the Zulu language*. Johannesburg: Witwatersrand University Press.

Douglas, Sir James (1853). Census of Indian Population in Fort Nisqually District as taken in the years 1838-39. In *Private Papers, 2,* 23. MS in Provincial Archives, Victoria B.C.

Drachman, G. (1969). Twana phonology. (Doctoral dissertation, Ohio State University).

Dupoux, Emmanuel, Christophe Pallier, Nuria Sebastián-Gallés, & Jacques Mehler (1997). A destressing 'deafness' in French? In *Journal of Memory and Language*, *36*(3), 406-421.

Dupoux, Emmanuel, Sharon Peperkamp, & Nuria Sebastián-Gallés (2001). A robust method to study stress 'deafness'. In *Journal of the Acoustic Society of America,* 80, 402-415.

Ebing, E.F. (1994). Towards an inventory of perceptually relevant pitch movements for Indonesian. In C. Odé & V. J. van Heuven (eds.), *Experimental studies of Indonesian Prosody*, pp. 181-210. Department of Languages and Cultures of Southeast Asia and Oceania, University of Leiden.

Edmondson, Jerold A., & John H. Esling (2006). The valves of the throat and their functioning in tone, vocal register and stress: laryngoscopic case studies. In *Phonology, 23*(2), 157-191.

Eells, Cushing (1894). *The Results of Fifty-Five Years of Missionary Labors in Washington and Oregon: A Biography of Rev. Cushing Eells, D.D.* Myron Eells (ed.). Boston & Chicago: Congretional Sunday-School and Publishing Society.

Eells, Myron (1887). THE INDIANS OF PUGET SOUND. *The American Antiquarian and Oriental Journal (1880-1914), 9(1)*, 1.

Efrat, Barbara (1978). The interpretation of glottalized resonants in Straits Salish. In *Linguistic and literary studies in honor of Archibald A. Hill* (Vol. II). The Hague: Mouton, 251-257.

Esling, John H., & Jimmy G. Harris (2005). States of the glotts: An articulatory phonetic model based on laryngoscopic observations. In Hardcastle, W. J. & Beck, Janet (eds.), *A figure of speech: A Festschrift for John Laver*, 347-383. Routledge: NY.

Esling, John H., Katherine E. Fraser, & Jimmy G. Harris (2005). Glottal stop, glottalized resonants, and pharyngeals: A reinterpretation with evidence from a laryngoscopic study of Nuuchahnulth (Nootka). In *Journal of Phonetics, 33*(4), 383-410.

Ewan, William & Robert Krones (1974). Measuring larynx movement using the thyroumbrometer. In *Journal of Phonetics, 2*(4), 327-335.

Fallon, P. D. (2001). *The synchronic and diachronic phonology of ejectives*. Routledge.

Fischer-Jørgensen, Eli (1954). Acoustic analysis of stop consonants. In *Miscellanea Phonetica, 2,* 42-59.

Flemming, Edward, Peter Ladefoged, & Sarah Thomason (2008). Phonetic structures of Montana Salish. *Journal of Phonetics*, *36*(3), 465-491.

Fletcher, Janet (2013). The Prosody of Speech: Timing and Rhythm. In W. J. Hardcastle, J. Laver, & Fiona E. Gibbon (eds.), *The Handbook of Phonetic Sciences (2nd-ed.),* pp. 523-602. Wiley-Blackwell Press, Oxford.

Forrest, Karen, Gary Weismer, Paul Milenkovic, & Ronald N. Dougall (1988). Statistical analysis of word-initial voiceless obstruents: Preliminary data. In *Journal of the Acoustical Society of America, 84*(1), 115-123.

Fortescue, Michael (1984). *West Greenlandic*. (Croom Helm descriptive grammars). London: Croom Helm.

Fraile, Rubén, & Juan Ignacio Godino-Llorente (2014). Cepstral peak prominence: A comprehensive analysis. *Biomedical Signal Processing and Control, 14*, 42-54.

Fritzell, B. (1963). An electromyographic study of the movements of the soft palate in speech. In *Folia Phoniatrica et Logopaedica, 15*(4), 307-311.

Fry, Dennis B. (1958). Experiments in the perception of stress. In *Language and Speech, 1*(2), 126-152.

Fujimura, Osamu (1961). Bilabial stop and nasal consonants: a motion picture study and its acoustical implications. In *Journal of Speech and Hearing Research, 4*(3), 233-247.

Fujimura, O., & Lindqvist-Gauffin, J. (1964). The sinewave response of the vocal tract. In *Speech Transmission Laboratory Quarterly Progress and Status Report, 2*(3), 17-37.

Fujimura, Osamu, & Masayuki Sawashima (1971). Consonant sequences and laryngeal control. In *Annual Bulletin of the Research Institute of Logopedics and Phoniatrics*, *5*, 1-7.

Galloway, Brent D. (1997). Nooksack pronouns, transitivity, and control. In *32nd International Conference on Salish and Neighbouring Languages, 32*, 197-243. University of British Columbia working papers in linguistics.

Galloway, Brent D. (2009). *Dictionary of upriver Halkomelem* (Vol. 141). University of California Press.

Garellek, Marc (2013). *Production and perception of glottal stops.* (Doctoral dissertation, UCLA).

Geng, Christian & Christine Mooshammer (2009). How to stretch and shrink vowel systems: Results from a vowel normalization procedure. In *Journal of the Acoustical Society of America, 125*(5), 3278-3288.

Gerdts, Donna B. (1993). Mapping transitive voice in Halkomelem. In *Annual Meeting of the Berkeley Linguistics Society, 19(2),* 22-34.

Gerdts, Donna B. (2018). Classifying rhetorical repetitions in Hul'q'umi'num' narratives. University of Ottawa. (Presented at the Workshop on Structure and Constituency in Languages of the Americas 23, University of Ottawa.)

Gerdts, Donna B., & Thomas E. Hukari (1998, August). Inside and outside the middle. In *The 33rd International Conference on Salish and Neighboring Languages* (Vol. 33, pp. 166-220). University of British Columbia working papers in linguistics.

Gerdts, Donna B., & Thomas E. Hukari (2000). Multiple antipassives in Halkomelem Salish. In *Annual Meeting of the Berkeley Linguistics Society*, *26*(2), 51-62.

Gerdts, Donna B., & Thomas E. Hukari (2006). The Halkomelem middle: A complex network of constructions. *Anthropological linguistics,* 44-81.

Gerdts, Donna B., & Kaoru Kiyosawa (2003). Psych predicates and applicatives in Salish. In *Annual Meeting of the Canadian Linguistic Association, Halifax, Nova Scotia*.

Gerdts, Donna B., & Kaoru Kiyosawa (2005). Halkomelem psych applicatives. *Studies in Language. International Journal sponsored by the Foundation "Foundations of Language"*, *29*(2), 329-362.Ghazeli, Salem (1978). Back consonants and backing coarticulation in Arabic (Doctoral dissertation). University of Texas, Austin.

Gibbs, George (1863). *Instructions for Research relative to the Ethnology and Philology of America*. Washington: Smithsonian Institution.

Gibbs, George (1877). *Tribes of Western Washington and Northwestern Oregon*. North American Ethnology (vol. 1). Washington: Government Printing Office.

Gobl, Christer & Ailbhe Ní Chasaide (2010). Voice source variation and its communicative functions. In Hardcastle, W., Laver, J., Gibbon, F. (eds), *The Handbook of Phonetic Sciences (2nd ed.)*. Oxford: Blackwell, 378-423.

Godjevac, Svetlana (2005). Transcribing Serbo-Croatian Intonation. In S.-A. Jun (ed.), *Prosodic Typology: The Phonology of Intonation and Phrasing*, pp. 146-171. Oxford: Oxford University Press.

Gordon, Matthew (2005). Intonational Phonology of Chickasaw. In S.-A. Jun (ed.), *Prosodic Typology: The Phonology of Intonation and Phrasing*, pp. 301-330. Oxford: Oxford University Press.

Gordon, Matthew, & Peter Ladefoged (2001). Phonation types: A cross-linguistic overview. *Journal of Phonetics, 29*(4), 383–406.

Gordon, Matthew, Paul Barthmaier, & Kathy Sands (2002). A cross-linguistic acoustic study of voiceless fricatives. In *Journal of the International Phonetic Association, 32*(2), 141-174.

Gowda, K. S. Gurubasave (1972). *Ao-Naga Phonetic Reader*. Central Institute of Indian Languages, Nanjangud, Mysore State.

Greenberg, Joseph H. (1959). A quantitative approach to the morphological typology of language. In *International journal of American linguistics*, *26*(3), 178-194.

Grillo, Elizabeth U., Jenna N. Brosious, Staci L. Sorrell, & Supraja Anand (2016). Influence of smartphones and software on acoustic voice measures. In *International Journal of Telerehabilitation, 8*(2), 9.

Gussenhoven, Carlos (2005). Transcription of Dutch Intonation. In S.-A. Jun (ed.), *Prosodic Typology: The Phonology of Intonation and Phrasing*, pp. 118-145. Oxford: Oxford University Press.

Haas, M. R. (1969). Internal reconstruction of the Nootka-Nitinat pronominal suffixes. In *International Journal of American Linguistics, 35*(2), 108-124.

Haeberlin, Hermann, & Franz Boas (1924). Mythology of Puget Sound. In *The Journal of American Folklore, 37*(145/146), 371-438.

Hagiwara, Robert (1989). Pronominal arguments and the syntax of Lushootseed transitives. In *International Conference on Salish and Neighboring Languages, 24*, 61-75.

Hagiwara, Robert (1997). Dialect variation and formant frequency: The American English vowels revisited. In *The Journal of the Acoustical Society of America, 102*(1), 655-658.

Hajek, John & Mary Stevens (2005). On the acoustic characterization of ejective stops in Waima'a. In *Interspeech 2005*, 2889-2892.

Hale, Horatio (1846). *United States Exploring Expedition During the Years 1838, 1839, 1840, 1841, 1842: Ethnography and philology*. Philadelphia: Lea and Blanchard.

Hamann, Silke & Nancy C. Kula (2015). Bemba. In *Journal of the International Phonetic Association, 45*(1), 61-69.

Hargus, Sharon (2011). *Witsuwit'en grammar: Phonetics, phonology, morphology*. UBC Press.

Hargus, Sharon, Gina-Anne Levow, Richard Wright (2020). Acoustic Characteristics of Deg Xinag Fricatives. In *University of Washington Working Papers in Linguistics*, 1-53.

Harris, Jimmy G. (1999). States of the glottis for voiceless plosives. In *Proceedings of the International Congress of Phonetic Sciences*, 2041-2044. San Francisco.

Harris, Jimmy G. (2001). States of the glottis of Thai voiceless stops and affricates. In K. Tingsabadh & A. S. Abramson (Eds.), *Essays in Tai linguistics*. Bangkok: Chulalongkorn University Press, 3-11.

Haspelmath, Martin (1993). *A grammar of Lezgian*. Berlin: Mouton de Gruyter.

Haspelmath, Martin & Andrea D. Sims (2010). *Understanding Morphology* (2nd ed). New York: Routledge.

Hayward, Amber (2021). Twulshootseed Advisory Notice. Retrieved from *Puyallup Tribal Language Program*.

Hayward, K., & Hayward, R. J. (1992). Amharic. In *Journal of the International Phonetic Association, 22*(1-2), 48-52.

Hebert, Yvonne M. (1982). Transitivity in (Nicola Lake) Okanagan (Doctoral dissertation). University of British Columbia, Vancouver, British Columbia.

Heiberger, R., & Holland, B. (2015). Statistical Analysis and Data Display: An Intermediate Course with Examples in R. Springer-Verlag, New York.

Herzog, G., Newman, S. S., Sapir, E., Swadesh, M. H., Swadesh, M., & Voegelin, C. F. (1934). Some orthographic recommendations. *American Anthropologist, 36*(4), 629-631.

Hess, Thom (1967a). Snohomish Grammatical Structure. (Doctoral Dissertation, University of Washington).

Hess, Thom (1967b). The Morph /-(ə)b/ in Snohomish. In *International Conference on Salish and Neighbouring Languages, 2,* 1-11.

Hess, Thom (1968). Directive Phrases: A consideration of one facet of Puget Salish syntax. In *International Conference on Salish and Neighboring Languages, 3,* 1-6.

Hess, Thom (1969). Secondary Suffixation in Puget Salish. In *International Conference on Salish and Neighboring Languages, 4*, 1-20.

Hess, Thom (1970). Prefix constituents with /$x^w$/. In *International Conference on Salish and Neighboring Languages, 5.*

Hess, Thom (1972). Some lexical sets in Puget Salish orientation vocabulary. In *International Conference on Salish and Neighboring Languages, 7,* 1-6.

Hess, Thom (1973a). On pedagogical grammars for Salish languages. In *International Conference on Salish and Neighboring Languages, 8,* 1-30.

Hess, Thom (1973b). Agent in a Coast Salish language. *International Journal of American Linguistics, 39*(2), 89-94.

Hess, Thom (1976). *Dictionary of Puget Salish*. University of Washington Press.

Hess, Thom (1977). Lushootseed dialects. *Anthropological Linguistics*, *19*(9), 403-419.

Hess, Thom (1979). A Comparison of Marine and Riverine Orientation Vocabulary in Two Coast Salish languages. In *International Conference on Salish and Neighboring Languages*, *14,* 136-157.

Hess, Thom (1982). Traces of "Abnormal" Speech in Lushootseed. In *Proceedings of the 17^th^ International Conference on Salish and Neighboring Languages,* 89-97.

Hess, Thom (1984). Morphophonemic spelling for pedagogical and other practical purposes. In *International Conference on Salish and Neighboring Languages*, *19,* 132-146.

Hess, Thom (1986). A note on Nitinaht numerals. In *International Conference on Salish and Neighboring Languages, 21,* 38-41.

Hess, Thom (1990). Another component of meaning for {-nəx$^{w}$}. In *International Conference on Salish and Neighboring Languages, 25,* 173-176.

Hess, Thom & Dawn Bates (1998). Semantic Role Assignment in Lushootseed Causatives. In *International Conference on Salish and Neighboring Languages*, *33,* 221-234.

Hess, Thom & Vi Hilbert (1976). *Lushootseed: The language of the Skagit, Nisqually, and other tribes of Puget Sound*. University of Washington Press.

Hess, Thom & Vi Hilbert (1995a). *Lushootseed Grammar Book 1: The language of the Skagit, Nisqually, and other tribes of Puget Sound. An Introduction.* Lushootseed Press.

Hess, Thom & Vi Hilbert (1995b). *Lushootseed Grammar Book 2: Advanced Lushootseed.* Lushootseed Press.

Hess, Thom & J.P. van Eijk (1985). Noun and verb in Salishan. In *International Conference on Salish and Neighboring Languages, 20,* 97-103.

Hilbert, Vi (1974). On transcribing the Metcalf tapes. In *Proceedings of the International Conference on Salish and Neighboring Languages, 9,* 49-53.

Hilbert, Vi (1976). Fieldwork Report. In *Proceedings of the International Conference on Salish and Neighboring Languages*, *11,* 63-68.

Hilbert, Vi (1995). *Aunt Susie Sampson Peter: The Wisdom of a Skagit Elder.* Lushootseed Press.

Hilbert, Vi (1997). *Haboo: Native American Stories from Puget Sound*. University of Washington Press.

Hilbert, Vi (2005). *"Gram" Ruth Sehome Shelton.* Lushootseed Press.

Hilbert, Vi & Thom Hess (1975). A note on ʔə constructions in Lushootseed. In *International Conference on Salish and Neighboring Languages, 10*, 1-6.

Hilbert, Vi, & Thom Hess (1982). The Lushootseed language project. *Language renewal among American Indian tribes*, 71-89.

Hirose, Hajime (1997). Investigating the physiology of laryngeal structures. In W. J. Hardcastle, & J. Laver (Eds.), *The Handbook of Phonetic Sciences (1st edition)*. Oxford: Blackwell, 116-136.

Hockett, Charles F. (1955). A manual of phonology. In *International Journal of American Linguistics, 21*(4).

Hollien, Harry, Paul Moore, Ronald W. Wendahl, & John F. Michel (1966). On the nature of vocal fry. In *Journal of Speech and Hearing Research, 9*(2), 245-247.

Hong, Ki Hwan, & Hyun Ki Kim (1999). Diplophonia in unilateral vocal fold paralysis and intracordal cyst. In *Otolaryngology—Head and Neck Surgery*, *121*(6), 815-819.

Hood, John Linsley (1998). *Audio Electronics* (2nd ed.). Newnes, Oxford.

Hughes, George W., & Morris Halle (1956). Spectral properties of fricative consonants. In *The Journal of the Acoustical Society of America*, *28*(2), 303-310.

Hukari, Thomas E. (1976). Person in a Coast Salish language. *International Journal of American Linguistics*, *42*(4), 305-318.

International Phonetic Association. (1999). *Handbook of the International Phonetic Association: A guide to the use of the International Phonetic Alphabet*. Cambridge University Press.

Imaizumi, Satoshi, & Jan Lindqvist-Gauffin (1991). Acoustic and perceptual characteristics of pathological voices: rough, creak, fry and diplophonia. In *Ann. Bull. RILP*, *25*, 109-119.

Ingram, John, & Bruce Rigsby (1987). Glottalic stops in Gitksan: An acoustic analysis. In Gamkrelidze, Thomas V. and Remmel, Mart (eds.), *Proceedings of the 11th International Congress of Phonetic Sciences, 2*, 134–137. Talinn, Estonia.

Jacobs, Peter (2007). Intonation of yes/no questions in Skwxwú7mesh. In *Proceedings of the 43rd International Conference on Salish and Neighboring Languages*, *43*, 236-255.

Jang, J., Kim, S., & Cho, T. (2018). Focus and boundary effects on coarticulatory vowel nasalization in Korean with implications for cross-linguistic similarities and differences. In *The Journal of the Acoustical Society of America*, *144*(1), EL33-EL39.

Jassem, Wiktor (1962). Noise spectra of Swedish, English, and Polish fricatives. In *Proceedings of the Speech Communication Seminar, Stockholm, Royal Institute of Technology Speech Transmission Laboratory* (pp. 1-4).

Javkin, Hector R., & Ian Maddieson (1983). An inverse filtering study of Burmese creaky tone. *UCLA Working Papers in Phonetics*, *57*, 115–125.

Jongman, Allard, Ratree Wayland, & Serena Wong (2000). Acoustic characteristics of English fricatives. In *The Journal of the Acoustical Society of America, 108*(3), 1252-1263.

Jun, Sun-Ah (1996). *The Phonetics and Phonology of Korean Prosody*. New York: Garland.

Jun, Sun-Ah (1998). The Accentual Phrase in the Korean Prosodic Hierarchy. In *Phonology, 15*(2), 189-226.

Jun, Sun-Ah (2000). K-ToBI (Korean ToBI) labelling conventions: Version 3. In *The Korean Journal of Speech Sciences, 7*(1), 143-169.

Jun, Sun-Ah (2003). Prosodic phrasing and attachment preferences. In *Journal of Psycholinguistic Research, 32,* 219-249.

Jun, Sun-Ah (2005a). Korean Intonational Phonology. In S.-A. Jun (ed.), *Prosodic Typology: The Phonology of Intonation and Phrasing*, pp. 201-229. Oxford: Oxford University Press.

Jun, Sun-Ah (2005b). Prosodic Typology. In S.-A. Jun (ed.), *Prosodic Typology: The Phonology of Intonation and Phrasing*, pp. 430-458. Oxford: Oxford University Press.

Jun, Sun-Ah (2022). The ToBI Transcription System: Conventions, Strengths, and Challenges. In J. Barnes & S. Shattuk-Hufnagel (eds.), *Prosodic Theory and Practice*, pp. 151-181. MIT Press.

Jun, Sun-Ah & Cecile Fougeron (1995). The accentual phrase and the prosodic structure of French. In *Proceedings of XIIIth International Congress of Phonetic Sciences, 2,* 722-725.

Keating, Patricia, Taehong Cho, Cecile Fougeron, & Hsu, C. S. (2004). Domain-initial articulatory strengthening in four languages. *Phonetic interpretation: Papers in laboratory phonology VI*, 143-161.

Keating, Patricia A., Marc Garellek, & Jody Kreiman (2015). Acoustic properties of different kinds of creaky voice. In The Scottish Consortium for ICPhS 2015 (Ed.), *Proceedings of the 18th International Congress of Phonetic Sciences*, *1*, 2-7.

Kemmer, Suzanne (1993). *The middle voice* (Vol. 23). John Benjamins Publishing.

Kent, Raymond D., & Kenneth L. Moll (1969). Vocal-tract characteristics of the stop cognates. In *Journal of the Acoustical Society of America, 46*(6B), 1549-1555.

Kim, Geun-Hyo, In-Ho Bae, Hee-June Park, & Yeon-Woo Lee (2021). Comparison of cepstral analysis based on voiced-segment extraction and voice tasks for discriminating dysphonic and normophonic Korean speakers. *Journal of Voice*, *35*(2), 328-e11.

Kim, Y. S. (2011). An acoustic, aerodynamic and perceptual investigation of word-initial denasalization in Korean. (Doctoral dissertation, UCL (University College London)).

Kingston, John. (1985). *The phonetics and phonology of the timing of oral and glottal events.* Ph.D. dissertation, Department of Linguistics, University of California, Berkeley.

Kingston, John. (2005). The phonetics of Athabaskan tonogenesis. *Amsterdam Studies in the Theory and History of Linguistic Science Series 4, 269*, 137.

Kinkade, M. Dale (1963). Phonology and Morphology of Upper Chehalis: I. In *International Journal of American Linguistics, 29*(3), 181-195.

Kinkade, M. Dale (1967). Uvular-pharyngeal resonants in Interior Salish. In *International Journal of American Linguistics*, *33*(3), 228-234.

Kinkade, M. Dale (1985). More on nasal loss on the Northwest Coast. In *International Journal of American Linguistics*, *51*(4), 478-480.

Kirk, Paul L., Jenny Ladefoged, & Peter Ladefoged (1993). Quantifying acoustic properties of modal, breathy and creaky vowels in Jalapa Mazatec. In Montler, Timothy and Mattina, Anthony (eds.), *American Indian linguistics and ethnography in honor of Laurence C. Thompson*, 435–450.

Kirkham, Sandra P. (1993). *Reduplication in Lushootseed: a prosodic analysis*. University of Victoria.

Kitayama, Itsuki, Kiyohito Hosokawa, Toshihiko Iwahashi, Mio Iwahashi, Shinobu Iwaki, Chieri Kato, et al. (2020). Intertext variability of smoothed cepstral peak prominence, methods to control it, and its diagnostic properties. In *Journal of Voice*, *34*(3), 305-319.

Kiyosawa, Kaoru (2006). Applicatives in Salish languages (Doctoral dissertation). Retrieved from Department of Linguistics-Simon Fraser University.

Klatt, Dennis H., and Laura C. Klatt (1990). Analysis, synthesis, and perception of voice quality variations among female and male talkers. In *Journal of the Acoustical Society of America*, *87*(2), 820-857.

Koenig, Laura L., Christine H. Shadle, Jonathan L. Preston, & Christine R. Mooshammer (2013). Toward improved spectral measures of /s/: Results from adolescents. In *Journal of Speech, Language, and Hearing Research, 56*, 1175-1189.

Koike, Yasuo. (1973). Application of Some Acoustic Measures for the Evaluation of Laryngeal Dysfunction. In Runia, David T., Mendelson, Alan and Winston, David (eds.), *Studia phonologica*, *7*, 17–23.

Koopmans-Van Beinum, Florina J. (1980). Vowel contrast reduction: An acoustic and perceptual study of Dutch vowels in various speech conditions. (Doctoral Dissertation, Academishe Pers B.V., Amsterdam).

Kroeber, Paul D. (1999). *The Salish language family: Reconstructing syntax*. University of Nebraska Press.

Krull, D. (1989). Second formant locus patterns and consonant-vowel coarticulation in spontaneous speech. In *Phonetic Experimental Research at the Institute of Linguistics, 10*, 87-108. University of Stockholm.

Krull, D., & Lindblom, B. (1992). Comparing vowel formant data cross-linguistically. In *Experiments in Speech Processes, PERIL US, 15*, 7-15.

Kuang, Jianjing (2011). *Production and perception of the phonation contrast in Yi.* (Doctoral dissertation, UCLA).

Kuang, Jianjing (2012). Registers in tonal contrasts. In *UCLA Working Papers in Phonetics*, *110*, 46-64.

Kuehn, David P., & Kenneth L. Moll (1976). A cineradiographic study of VC and CV articulatory velocities. In *Journal of Phonetics, 4,* 303-320.

Kuipers, A. H. (2002). *Salish etymological dictionary (No. 16)*. Linguistics Laboratory University of Montana.

Ladd, D. Robert (1988). Declination reset and the hierarchical organization of utterances. In *Journal of the Acoustical Society of America*, 84(2), 530-544.

Ladd, D. Robert (2008). *Intonational Phonology (2nd-ed.)*. Cambridge University Press.

Ladefoged, Peter (1971). *Preliminaries to Linguistic Phonetics.* Chicago: University of Chicago Press.

Ladefoged, Peter (2001). *A Course in Phonetics (4th-ed.)*. Hartcourt College Publishers.

Ladefoged, Peter (2005). Speculations on the Control of Speech. In W. J. Hardcastle & J. Mackenzie Beck (eds.), *A Figure of Speech: A Festschrift for John Laver*, pp. 3-21. Routledge, NY.

Ladefoged, Peter & Ian Maddieson (1996). *The Sounds of the World's Languages*. Blackwell Publishing.

Ladefoged, Peter, Ian Maddieson, & M. Jackson (1988). Investigating phonation types in different languages. In Fujimura, Osamu (ed.), *Vocal physiology: Voice production, mechanisms and functions*, 297-317. New York: Raven Press.

Laksman, Myrna (1994). Location of stress in Indonesian words and sentences. In C. Odé & V. J. van Heuven (eds.), *Experimental studies of Indonesian Prosody*, pp. 108-139. Department of Languages and Cultures of Southeast Asia and Oceania, University of Leiden.

Langacker, Ronald W. (1987). *Foundations of Cognitive Grammar: Theoretical prerequisites* (Vol. 1). Stanford university press.

Langacker, Ronald W. (1992). *Foundations of Cognitive Grammar: Descriptive Application* (Vol. 2). Stanford university press.

Laver, John (1980). *The Phonetic Description of Voice Quality*. Cambridge University Press.

Lee, D., & Frost, J. H. (1844). *Ten years in Oregon*. New York: Published for the authors.

Lehiste, Ilse (1970). *Suprasegmentals*. Cambridge, MA: MIT Press.

Lehiste, Ilse (1977). Isochrony reconsidered. In *Journal of Phonetics, 5*, 253-263.

Levin, Beth, & Malka Rappaport Hovav (1995). *Unaccusativity: At the syntax-semantics interface.* Linguistic Inquiry Monograph. Cambridge, MA: MIT Press.

Lindau, Mona (1984). Phonetic differences in glottalic consonants. In *Journal of Phonetics, 12*(2), 147-155.

Lieberman, Philip (1960). Some acoustic correlates of word stress in American English. *The Journal of the Acoustical Society of America*, *32*(4), 451-454.

Lindblom, Björn (1963). Spectrographic study of vowel reduction. In *The Journal of the Acoustical Society of America, 35*(11), 1773-1781.

Lindblom, Björn (2009). f0 lowering, creaky voice, and glottal stop: Jan Gauffin's account of how the larynx works in speech. In *Proc. Fonetik*, 10-12.

Lindsey, Geoff, Katrina Hayward, & Andrew Haruna (1992). Hausa glottalic consonants: a laryngographic study. *Bulletin of the School of Oriental and African Studies, University of London*, 511–527.

Lindqvist-Gauffin, Jan (1969). Laryngeal mechanisms in speech. In *STL-QPSR*, (2-3), 26-31.

Lindqvist-Gauffin, Jan (1972). A descriptive model of laryngeal articulation in speech. In *STL-QPSR*, *13*(2-3), 1-9.

Lindqvist-Gauffin, Jan, & J. Sundberg (1976). Acoustic properties of the nasal tract. In *Phonetica, 33*(3), 161-168.

Lisker, Leigh, & Arthur S. Abramson (1964). A cross-language study of voicing in initial stops: Acoustical measurements. *Word*, *20*(3), 384-422.

Lobanov, Boris M. (1971). Classification of Russian vowels spoken by different speakers. In *The Journal of the Acoustical Society of America*, *49*(2B), 606-608.

Lonsdale, Deryle (2021, August). *Some Data on Nasal Loss in Lushootseed* [Power Point Slides]. Presentation at the meeting of the *56th International Conference of Salish and Neighboring Languages*, University of British Columbia.

Lowell, Soren Y., & Jennifer A. Hylkema (2016). The effect of speaking context on spectral-and cepstral-based acoustic features of normal voice. In *Clinical Linguistics & Phonetics*, *30*(1), 1-11.

Ludolf, Hiob (1661). *Grammatica Æthiopica*. London: Roycroft.

Mackenzie, Sir Alexander (1970). *The journals and letters of Sir Alexander Mackenzie.* W. Kaye Lamb (ed.), London; New York: Cambridge University Press.

Maddieson, Ian (1984). *Patterns of Sounds*. Cambridge University Press.

Maddieson, Ian (1997). Phonetic Universals. In J. Laver & W.J Hardcastle (eds.) *The Handbook of Phonetic Sciences*, pp. 619-639. Oxford: Blackwells.

Maddieson, Ian (2001). Good timing: Place-dependent voice onset time in ejective stops. In *Seventh European Conference on Speech Communication and Technology*.

Maddieson, Ian (2008). Glottalized Consonants. In Haspelmath, Martin, Dryer, Matthew S., Gil, David, & Comrie, Bernard (eds.) *The World Atlas of Language Structures Online*. Munich: Max Planck Digital Library, Chapter 7. Available online at https://wals.info/chapter/7. Accessed on 11/8/2022.

Mai, Anna, Andrés Aguilar, & Gabriela Caballero (2019). Ja'a Kumiai. In *Journal of the International Phonetic Association, 49*(2), 231-244.

Mann, Virginia A. (1986). Phonological awareness: The role of reading experience. *Cognition*, *24*(1-2), 65-92.

Marantz, Alec (1993). Implications of asymmetries in double object constructions. In Theoretical aspects of Bantu grammar (pp. 113-150). CSLI.

Massey, Noel S. (1994). Transients at stop-consonant releases. In *The Journal of the Acoustical Society of America*, *95*(5), 2976-2976.

Matthewson, Lisa (1996). Determiner Systems and Quantificational Strategies: Evidence from Salish (Doctoral Dissertation, University of British Columbia).

McCarthy, J. J. (1991). Semitic gutturals and distinctive feature theory. In *Perspectives on Arabic linguistics*, *3*, 63-91.

McCloy, Daniel R. (2014). *Semi-Auto Formant Extractor*. Retrieved from https://github.com/drammock/praat-semiauto/blob/master/SemiAutoFormantExtractor.praat.

McCloy, Daniel R. (2016). *phonR: tools for phoneticians and phonologists.* R package version 1.0-7.

McCollum, Adam G., Si Chen (2021). Kazakh. In *Journal of the International Phonetic Association, 51*(2), 276-298.

McGlone, Robert E. (1967). Air flow during vocal fry phonation. In *Journal of Speech and Hearing Research, 10*(2), 299-304.

Meinhof, C. (1915). *An introduction to the study of African languages*. JM Dent & Sons, Limited; New York.

Mellesmoen, Gloria (2018). Sonorant Voicing ([SV]) in Comox-Sliammon. In *Proceedings of the 53rd International Conference on Salish and Neighboring Languages*, *53*, 125-141.

Mellesmoen, Gloria, & Suzanne Urbanczyk (2021). Some Remarks on the Distribution and Representation of Glottalized Resonants in Salish. In *Proceedings of the International Conference on Salish & Neighboring Languages*, *56,* 244-267.

Miller, Jay (1999). Suquamish Traditions. *Northwest Anthropological Research Notes*, *33*(1), 105-174.

Miller, Jay (2005). *Regaining Dr Herman Haeberlin Early Anthropological and Museology in Puget Sound, 1916-17.* Lushootseed Press

Miller, Jay (2014). *Elders Dialog: Ed Davis & Vi Hilbert Discuss Native Puget Sound Language, Culture, and Herritage.* Lushootseed Press.

Mitchell, Marjorie R. (1968). *A dictionary of Songish, a dialect of Straits Salish.* (MA thesis, University of Victoria).

Monsen, Randall B., & A. Maynard Engebretson (1977). Study of variations in the male and female glottal wave. In *The Journal of the Acoustical Society of America, 62*(4), 981-993.

Moore, Paul (1971). *Organic voice disorders.* Prentice Hall, Englewood Cliffs.

Moore, Paul & Hans von Leden (1958). Dynamic variations of the vibratory pattern in the normal larynx. In *Folia Phoniatrica et Logopaedica, 10*(4), 205-238.

Montler, Timothy R. (1986). An outline of the morphology and phonology of Saanich, North Straits Salish. *Occasional Papers in Linguistics* (4). Missoula: University of Montana Press.

Montler, Timothy R. (1996). Some Klallam paradigms. In *The 31st International Conference on Salish and Neighbouring Languages, 31,* 257-263.

Montler, Timothy (2012). *Klallam dictionary*. University of Washington Press.

Montler, Timothy (2018). *SENĆOŦEN: a dictionary of the Saanich language*. University of Washington Press.

Morais, José, Luz Cary, Jésus Alegria, & Paul Bertelson (1979). Does awareness of speech as a sequence of phones arise spontaneously?. *Cognition, 7*(4), 323-331.

Munson, Benjamin (2001). A method for studying variability in fricatives using dynamic measures of spectral mean. In *Journal of the Acoustical Society of America, 110*(2), 1203-1206.

Murray, Elizabeth S Heller, Andie Chao, & Lauren Colletti (2022). A practical guide to calculating cepstral peak prominence in Praat. In *Journal of Voice,* (in press), 1-6.

Murry, Thomas (1969). Subglottal pressure measures during vocal fry phonation. (Doctoral Dissertation, University of Florida).

Murry, Thomas & W. S. Brown (1971). Subglottal air pressure during two types of vocal activity: vocal fry and modal phonation. In *Folia Phoniatrica, 23*(6), 440-449.

Muysken, Pieter. 1981. Quechua causatives and logical form. In Adriana Belletti (ed.) *Theory of Markedness in Generative Grammar: Proceedings of the 1979 GLOW Conference*. Pisa: Scuola Normale Superiore.

Muysken, Pieter. 1986. Approaches to Affix Order. *Linguistics* 24. 629-43.

Narasimhan, Bhuvana, Vittorio Di Tomaso, & Cornelia M. Verspoor (1996). Unaccusative or unergative? Verbs of manner of motion. In *Quaderni del Laboratorio di Llinguistica, 10*.

Nespor, Marina & Irene Vogel (1986). *Prosodic Phonology*. Dordrecht: Foris.

Odé, Cecilia (1994). On the perception of prominence in Indonesian. In C. Odé & V. J. van Heuven (eds.), *Experimental studies of Indonesian Prosody*, pp. 27-107. Department of Languages and Cultures of Southeast Asia and Oceania, University of Leiden.

Ohala, John J. (1981). The listener as a source of sound change. In Masek, Carrie S., Hendrick, Roberta A. & Miller, Mary F. (eds.), *Chicago Linguistic Society 17: Papers from the Parasession on Language and Behavior*, 178-203. Chicago: Chicago Linguistic Society.

Ohala, John and Manjari Ohala (1993). The phonetics of nasal phonology: theorems and data. In W. Blumstein and R. Krakow (Eds.) *Phonetics and phonology 5: Nasal, nasalization and velum,* 225-249. NY, Academic Press.

den Os, E. (1988). Rhythm and tempo of Dutch and Italian: A contrastive study. (Doctoral Dissertation, Rijksuniversiteit, Utrecht).

Payne, Thomas E. (2017). Morphological typology. In A. Aikhenvald & R. M. W. Dixon (eds.), *The Cambridge handbook of linguistic typology*, 78-94. Cambridge University Press.

Percival, Maida (2015). Dene stop contrasts: Data from Délı̨nę Slavey. In The Scottish Consortium of ICPhS 2015 (ed.), *Proceedings of the 18th International Congress of Phonetic Sciences*, 976-981.

Percival, Maida (2016a). Affricate contrasts in Délı̨nę Slavey. In *171st Meeting of the Acoustical Society of America, May 27, 2016.*

Percival, Maida (2016b). Affricate contrasts in Eastern Oromo. In *Acoustics Week in Canada 16*/

Percival, Maida (2019). Contextual variation in the acoustics of Hul’q’umi’num’ejective stops. In Calhoun, Sasha, Escudero, Paola, Tabain, Marija, & Warren, Paul (eds.), *Proceedings of the 19th International Congress of Phonetic Sciences, 19,* 3270-3274.

Perkell, Joseph S. (1969). Physiology of speech production: Results and implication of quantitative cineradiographic study. *Monograph, 53*.

Peterson, Gordon & Harold L. Barney (1952). Control methods used in a study of the vowels. In *Journal of the Acoustical Society of America, 24*(2), 175-184.

Pierrehumbert, Janet B. (1980). The phonology and phonetics of English intonation. (Doctoral dissertation, Massachusetts Institute of Technology).

Pierrehumbert, Janet B. & Mary Beckman (1988). *Japanese Tone Structure*. Cambridge, MA: MIT Press.

Pierrehumbert, J., & Julia B. Hirschberg (1990). The meaning of intonational contours in the interpretation of discourse. In P.R. Cohen, J. Morgan, & M.E. Pollack (eds.), *Intentions in Communication,* pp. 271-311. Cambridge, MA: MIT Press.

Powell, John Wesley (1891). Indian linguistic families of America north of Mexico. In *Annual Report of the Bureau of American Ethnology for the years 1885-86, 7,* 1-142. Washington.

Pylkkänen, Liina (2000). What applicative heads apply to. *University of Pennsylvania Working Papers in Linguistics*, *7*(1), 18.

R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Reichard, Gladys A. (1938). Coeur d'Alene. In *Handbook of American Indian Languages* (Vol. 3, pp. 517-707). New York: J. J. Augustin.

Rice, Keren D. (1993). A reexamination of the feature [sonorant]: the status of ‘sonorant obstruents'. In *Language, 69*(2), 308-344.

Riordan, Carol J. (1980). Larynx height during English stop consonants. In *Journal of Phonetics, 8*(3), 353-360.

Roach, Peter (1979). Laryngeal-oral coarticulation in glottalized English plosives. In *Journal of the International Phonetic Association, 9,* 2-6.

Roach, Peter (1982). On the distinction between “stress-timed” and “syllable-timed” languages. In D. Crystal (ed.), *Linguistic Controversie: Essays in Linguistic Theory and Practice in Honour of F. R. Palmer,* pp. 73-79. London: Edward Arnold.

Roberts, Helen H., and Herman Haeberlin (1918). Some Songs of the Puget Sound Salish. In *The Journal of American Folklore, 31*(122), 496-520.

Rose, Sharon (1996). Variable laryngeals and vowel lowering. In *Phonology, 13*(1), 73-117.

Sapir, Edward (1915). Noun Reduplication in Comox, a Salish Language of Vancouver Island. Canada Department of Mines, Geological Survey, Memoir 63, Anthropological Series, no. 6. Ottawa: Government Printing Office.

Sapir, Edward (1923). The phonetics of Haida. *International Journal of American Linguistics*, *2*(3/4), 143-158.

Shadle, Christine H. (1985). The Acoustics of Fricative Consonants. (Doctoral Dissertation, Massachusetts Institute of Technology).

Shadle, Christine H. (2012). Acoustics and aerodynamics of fricatives. In A. Cohn, C. Fougeron, and M Huffman (eds.) *Handbook of Laboratory Phonology*, pp. 511-526. Oxford University Press, Oxford, UK.

Shadle, Christine. H. (2023). Alternatives to moments for characterizing fricatives: Reconsidering Forrest et al.(1988). In *The Journal of the Acoustical Society of America*, *153*(2), 1412-1426.

Shadle, Christine H., & Celia Scully (1995). An articulatory-acoustic-aerodynamic analysisof [s] in VCV sequences. *Journal of phonetics*, *23*(1-2), 53-66.

Shibatani, Masayoshi, & Prashant Pardeshi (2002). The causative continuum. In *Typological studies in language, 48*, 85-126.

Silverman, Daniel D. (1995). Phasing and recoverability. (Doctoral Dissertation, UCLA).

Silverman, Kim EA, Mary E. Beckman, John F. Pitrelli, Mari Ostendorf, Colin W. Wightman, Patti Price, Janet B. Pierrehumbert, and Julia Hirschberg (1992) ToBI: A standard for labeling English prosody. In *ICSLP, 2*, 867-870.

Simon, Olivier, Jean-François Mangin, Laurent Cohen, Denis Le Bihan, & Stanislas Dehaene. (2002). Topographical layout of hand, eye, calculation, and language-related areas in the human parietal lobe. *Neuron*, *33*(3), 475-487.

Smith, Carlota S. (1992). *The Parameter of Aspect*. Reidal, Dordrecht.

Snyder, Warren A. (1957). *A phonemic and morphological analysis of Southern Puget Sound Salish*. University of Washington.

Snyder, Warren A. (1968a). *Southern Puget Sound Salish: Phonology and Morphology* (Vol. 8). Sacramento, Calif.: Sacramento Anthropological Society, Sacramento State College.

Snyder, Warren A. (1968b). *Southern Puget Sound Salish: Texts, Place Names, and Dictionary* (No. 9). Sacramento Anthropological Society, Sacramento State College.

Sohn, Ho-Min (2001). *The Korean Language*. Cambridge University Press.

Stevens, Isaac (1854). Washington. From *Annual report of the Commissioner of Indian Affairs, for the year 1854* (pp. 184-254). Washington, D.C.: G.P.O., [1854].

Stevens, Kenneth N., Samuel J. Keyser, & Haruko Kawasaki (1986). Toward a phonetic and phonological theory of redundant features. In J.S. Perkell & D.H. Klatt (eds.), *Invariance and variability in speech processes*, pp. 426-463. New Jersey: Lawrence Erlbaum Associates.

Stevens, Kenneth N. (2000). *Acoustic phonetics* (Vol. 30). MIT press.

Stevens, Mary, & Hajek, John (2008). Positional Effects on the Characterization of Ejectives in Waima'a. In *ISCA*, 1124-1127.

Summers, W. V., Pisoni, D. B., Bernacki, R. H., Pedlow, R. I., & Stokes, M. A. (1988). Effects of noise on speech production: Acoustic and perceptual analyses. In *The Journal of the Acoustical Society of America, 84*(3), 917-928.

Sussman, H. M., Hoemeke, K. A., & Ahmed, F. S. (1993). A cross-linguistic investigation of locus equations as a phonetic descriptor for place of articulation. In *The Journal of the Acoustical Society of America, 94*(3), 1256-1268.

Swadesh, Morris (1952). Salish phonologic geography. In *Language, 28*(2), 232-248.

Swadesh, Morris (1955). Chemakum Lexicon Compared with Quileute. In *International Journal of American Linguistics, 22*, 60-72.

Taylor, Herbert C. (1974). Anthropological Investigation of the Medicine Creek Tribes Relative to Tribal Identity and Aboriginal Possession of Lands. In Horr, David Agee (ed.), *Coast Salish and Western Washington Indians II*, 401-473.

Teshigawara, Mihoko (2004). Auditory and Acoustic Correlates of Vocal Stereotypes of Good Guys and Bad Guys. In *International Commission on Acoustics 2004*, 3329-3332.
Thom, Brian (2011). Maps Relating to Central Coast Salish Languages and Culture. *Brian Thom's Coast Salish Homepage*. http://web.uvic.ca/~bthom1/maps.html/ (accessed February 11, 2020).

Thompson, Laurence C. (1979). Salishan and the Northwest. In Lyle Campbell (ed,) and Marianne Mithun (ed.) *The languages of Native America: Historical and comparative assessment*, 692-765.

Thompson, Laurence C. (1985). Control in Salish grammar. In *Relational typology*, 391-428.

Thompson, Laurence C., & M. Terry Thompson (1972). Language universals, nasals, and the Northwest Coast. In *Studies in Linguistics in Honor of George L. Trager, Mouton, The Hague*, 441-56.

Thompson, Laurence C., & M. Terry Thompson (1985). A Grassmann's law for Salish. *Oceanic Linguistics Special Publications*, (20), 134-147.

Thompson, Laurence C., & M. Terry Thompson (1992). *The Thompson Language.* In series *Occasional Papers in Linguistics* 8. University of Montana Umopl.

Thompson, Laurence C. & M. Dale Kinkade (1990). Languages. In Wayne Suttles (ed.) and William C. Sturtevant's (ed.) *Handbook of North American Indians: Northwest Coast, 7*, 30-51. Washington: Smithsonian Institution.

Trubetzkoy, N.S. (1926). Studien auf dem Gebiete der vergleichenden Lautlehre der nordkaukasischen Sprachen. In *Caucasica, 3,* 7-36.

Tuttle, Siri G. & Sharon Hargus (2004). Explaining variability in affix order: The Athabaskan areal and third person prefixes. In Gary Holton & Siri G. Tuttle (eds.), *Working Papers in Athabaskan Languages 4*, 70-98. Fairbanks: Alaska Native Language Center.

Tweddell, C. E. (1947). *An Outline of the Phonemics and Morphology of the Snoqualmie-Duwamish (Coast Salish) Dialects of Central Puget Sound, Washington.* (Doctoral dissertation, University of Washington).

Tweddell, C. E. (1950). *The Snoqualmie-Duwamish Dialects of Puget Sound Coast Salish*. Seattle: University of Washington Press.

Urbancyzk, Suzanne (1996). Patterns of reduplication in Lushootseed. (Doctoral Dissertation, University of Massachusetts Amherst).

Urbancyzk, Suzanne (1996). *Patterns of reduplication in Lushootseed*. (Doctoral Dissertation, University of Massachusetts Amherst).

van Atteveldt, Nienke, Elia Formisano, Rainer Goebel, & Leo Blomert (2004). Integration of letters and speech sounds in the human brain. *Neuron*, *43*(2), 271-282.

Van der Woerd, Benjamin, Min Wu, Vijay Parsa, Philip C. Doyle, & Kevin Fung (2020). Evaluation of acoustic analyses of voice in nonoptimized conditions. In *Journal of Speech, Language, and Hearing Research, 63*(12), 3991-3999.

Van Eijk, Jan P. (1997). *The Lillooet Language: Phonology, Morphology, Syntax*. Vancouver: UBC Press.

Van Eijk, Jan P., & Hank Nater (2020). Some Notes on Proto-Salish Phonology. In Reisinger, Daniel K. E., Green, Hannah, Huijsmans, Marianne and Mellesmoen, Gloria (eds.), *Proceedings of the 55th International Conference on Salish and Neighbouring Languages, 55,* 326–345.

Venditti, Jennifer J. (1995). Japanese ToBI Labelling Guidelines. (ms., Ohio State University).

Venditti, Jennifer J. (2005). The J-ToBI Model of Japanese Intonation. In S.-A. Jun (ed.), *Prosodic Typology: The Phonology of Intonation and Phrasing,* pp. 172-200. Oxford: Oxford University Press.

Vicenik, Chad (2010). An acoustic study of Georgian stop consonants. *Journal of the International Phonetic Association*, *40*(1), 59-92.

Vidyalal, V., K. Rajasree, and V. Sivanand (2003). A Simple Design of High-Quality Bandstop Filter. In *Electronics Projects*, *17*, 11-12. ISBN: 81-88152-10-2.

Warner, Natasha (1996). Acoustic characteristics of ejectives in Ingush. In *Proceeding of Fourth International Conference on Spoken Language Processing. ICSLP'96, 3,* 1525-1528.

Wassink, Alicia Beckford (2015). Sociolinguistic Patterns in Seattle English. In *Language Variation and Change, 27*, 31-58.

Waterman, Thomas T. (1920). Puget Sound Geography. [Manuscript No. 1864 in National Anthropological Archives, Smithsonian Institution, Washington, D.C.]

Waterman, Thomas T. (1921). The geographical names used by the Indians of the Pacific Coast. *The Geographical Review*, 12, 175-194.

Waterman, Thomas T. (1924). The Shake Religion of Puget Sound. *Smithsonian Institution, Annual Report for 1922,* 499-507.

Waterman, Thomas T. & Geraldine Coffin (1920). *Types of Canoes on Puget Sound.* New York: Indian Notes and Monographs, Museum of the American Indian.

Waterman, Thomas T. & Ruth Greiner (1921). *Indian Houses of Puget Sound*. New York: Museum of the American Indian Heye Foundation.

Watts, Christopher R., Shaheen N. Awan, & Youri Maryn (2017). A comparison of cepstral peak prominence measures from two acoustic analysis programs. In *Journal of Voice, 31*(3), 387.e1-387.e10.

Watt, Dominic, Tyler Kendall, & Anne Fabricius (2010). More on vowels: Plotting and normalization. In M. DiPaolo & M. Yaeger Dror (eds.), *Sociophonetics: A student's guide.* London: Routledge.

Westbury, John R. (1979). Aspects of the temporal control of voicing in consonant clusters in English. In *Texas Linguistic Forum Austin, 4*, 1-304.

Westbury, John R. (1983). Enlargement of the supraglottal cavity and its relation to stop consonant voicing. In *Journal of the Acoustical Society of America, 73*, 1322-1336.

Wetzels, W. Leo, & Andrew Nevins (2018). Prenasalized and postoralized consonants: The diverse functions of enhancement. In *Language*, *94*(4), 834-866.

Wright, Richard, Sharon Hargus, & Katherine Davis (2002). On the categorization of ejectives: data from Witsuwit'en. *Journal of the International Phonetic Association, 32*(1), 43–77.

Yoder, Janet (2004). Hilbert, Vi (1918-2008). In *HistoryLink.org Essay 7130*. Retrieved from https://www.historylink.org/File/7130.

Yoder, Janet (2022). *Where the Language Lives: Vi Hilbert and the Gift of Lushootseed.* Seattle: Girl Friday Books.

Yoo, K. (2015). Domain-initial denasalization in Busan Korean: A cross-generational case study. In *Proceedings of the 18th International Congress of Phonetic Sciences (ICPhS 2015),* 0845.1-5.

Yoshida, K. (2008). Phonetic implementation of Korean denasalization and its variation related to prosody. In *IULC Working Papers, 8*(1).

Zahir, Zalmai (2019). Elements of Lushootseed Grammar in Discourse Perspective (Doctoral dissertation). Retrieved from University of Oregon's Scholar banks.

Zawaydeh, Bushra A. (1999). The phonetics and phonology of gutturals in Arabic (Doctoral Dissertation). Indiana University, Indiana.

Zemlin, W. R. (1998). *Speech and Hearing Science, Anatomy and Physiology (4rd ed.)*. Allyn & Bacon A Viacom Company.

# APPENDIX A. SUMMARY STATISTICS FOR OBSTRUENT MEASUREMENTS

**Table A.0.1** Means and standard deviations of VOT for all stop places of articulation in Lushootseed.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /b/ | 25 | -104.32 | 23.5 | 4.7 |
| /p/ | 19 | 29.10 | 9.91 | 2.27 |
| /p’/ | 10 | 55.07 | 34.41 | 10.88 |
| /d/ | 17 | -93.9 | 55.54 | 13.47 |
| /t/ | 116 | 30.1 | 11.38 | 1.06 |
| /t’/ | 43 | 70.06 | 23.56 | 3.59 |
| /g/ | 7 | 28.41 | 15.89 | 6.01 |
| /k/ | 17 | 54.38 | 13.55 | 3.29 |
| /k’/ | 4 | 87.71 | 21.78 | 10.89 |
| /g$^w$/ | 63 | 28.03 | 13.56 | 1.71 |
| /k$^w$/ | 30 | 52.87 | 22.99 | 4.2 |
| /k$^w$’/ | 30 | 93.73 | 31.09 | 5.68 |
| /q/ | 25 | 56.28 | 26.94 | 5.39 |
| /q’/ | 11 | 103.16 | 38.95 | 11.74 |
| /q$^w$/ | 11 | 69.69 | 21.14 | 6.37 |
| /q$^w$’/ | 15 | 117.39 | 46.02 | 11.88 |

**Table A.0.2** Means and standard deviations of f0 perturbation for all stop places of articulation in Lushootseed.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /b/ | 25 | -5.78 | 11.21 | 2.39 |
| /p/ | 19 | -2.63 | 19.67 | 4.51 |
| /p’/ | 10 | -11.02 | 36.89 | 11.67 |
| /d/ | 17 | -8.55 | 17.62 | 4.27 |
| /t/ | 116 | 2.12 | 12.24 | 1.14 |
| /t’/ | 43 | -15.27 | 26.67 | 4.07 |
| /g/ | 7 | 3.17 | 4.15 | 1.57 |
| /k/ | 17 | 6.74 | 7.14 | 1.73 |
| /k’/ | 4 | -18.97 | 22.91 | 11.45 |
| /g$^w$/ | 63 | -2.25 | 7.81 | 0.98 |
| /k$^w$/ | 30 | 9.34 | 9.18 | 1.68 |
| /k$^w$’/ | 30 | -12.15 | 19.29 | 3.52 |
| /q/ | 25 | -0.09 | 17.13 | 3.57 |
| /q’/ | 11 | -2.97 | 10.99 | 3.31 |
| /q$^w$/ | 11 | 3.47 | 6.48 | 1.95 |
| /q$^w$’/ | 15 | -13.41 | 19.33 | 4.99 |

**Table A.0.3** Means and standard deviations of jitter perturbation for all stop places of articulation in Lushootseed.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /b/ | 22 | 2.39 | 4.59 | 0.98 |
| /p/ | 18 | 2.01 | 1.71 | 0.40 |
| /p’/ | 10 | 6.20 | 4.30 | 1.36 |
| /d/ | 16 | 1.48 | 2.04 | 0.51 |
| /t/ | 112 | 3.17 | 2.74 | 0.26 |
| /t’/ | 43 | 8.99 | 6.21 | 0.95 |
| /ɡ/ | 7 | 0.17 | 2.38 | 0.89 |
| /k/ | 15 | 2.21 | 1.87 | 0.48 |
| /k’/ | 4 | 5.28 | 3.65 | 1.82 |
| /ɡʷ/ | 59 | 3.71 | 3.46 | 0.45 |
| /kʷ/ | 29 | 2.71 | 1.56 | 0.29 |
| /kʷ’/ | 30 | 5.58 | 4.17 | 0.76 |
| /q/ | 21 | 2.38 | 3.12 | 0.68 |
| /q’/ | 11 | 6.86 | 4.91 | 1.48 |
| /qʷ/ | 11 | 1.75 | 1.53 | 0.46 |
| /qʷ’/ | 15 | 6.83 | 6.04 | 1.56 |

**Table A.0.4** Means and standard deviation of VOT for each affricate in Lushootseed.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /dz/ ‹dᶻ› (positive) | 5 | 42.98 | 7.86 | 3.52 |
| /dz/ ‹dᶻ› (negative) | 7 | -87.55 | 28.3 | 10.7 |
| /ts/ ‹c› | 54 | 66.75 | 15.84 | 2.17 |
| /ts’/ ‹c̓› | 7 | 102.66 | 20.3 | 7.67 |
| /dʒ/ ‹ǰ› | 4 | -72.74 | 23.41 | 11.71 |
| /tʃ/ ‹č› | 35 | 80.92 | 18.08 | 3.06 |
| /tʃ’/ ‹č̓› | 18 | 98.39 | 21.12 | 4.98 |
| /tɬ’/ ‹ƛ̓› | 19 | 87.6 | 18.3 | 4.31 |

**Table A.0.5** Means and standard deviation of release frication duration for each affricate in Lushootseed.

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /dz/ ‹dᶻ› | 8 | 46.95 | 22.02 | 7.79 |
| /ts/ ‹c› | 54 | 66.75 | 15.84 | 2.17 |
| /ts’/ ‹c̓› | 7 | 60.10 | 9.03 | 3.41 |
| /dʒ/ ‹ǰ› | 4 | 52.44 | 18.36 | 9.18 |
| /tʃ/ ‹č› | 35 | 80.92 | 18.08 | 3.06 |
| /tʃ’/ ‹č̓› | 18 | 68.15 | 16.52 | 3.89 |
| /tɬ’/ ‹ƛ̓› | 19 | 54.82 | 15.03 | 3.54 |

**Table A.0.6** Means and standard deviations of spectral moment measurements for each affricate in Lushootseed.

| Consonant | *N* | *CoG* (in Hz) | *SD* | *Kurtosis* | *SD* | *Skew* | *SD* | *Variance* | *SD* |
|---|---|---|---|---|---|---|---|---|---|
| [dz] ‹dᶻ› | 9 | 4097.11 | 1818.58 | 4.62 | 7.25 | 2.03 | 1.19 | 4959.79 | 1009.90 |
| [ts] ‹c› | 53 | 3016.67 | 955.42 | 65.19 | 81.87 | 4.08 | 2.39 | 2088.89 | 1662.59 |
| [ts’] ‹c̓› | 7 | 3193.93 | 1209.76 | 10.48 | 6.01 | 2.10 | 1.31 | 2730.38 | 1014.83 |
| [dʒ] ‹ǰ› | 3 | 1843.23 | 202.93 | 37.27 | 28.39 | 3.17 | 2.03 | 1377.79 | 277.22 |
| [tʃ] ‹č› | 35 | 2438.71 | 421.69 | 204.09 | 173.32 | 7.64 | 3.61 | 976.66 | 849.49 |
| [tʃ’] ‹č̓› | 18 | 2733.33 | 460.39 | 169.94 | 154.83 | 5.87 | 3.09 | 980.45 | 920.45 |
| [tɬ’] ‹ƛ̓› | 18 | 1518.90 | 458.81 | 50.24 | 27.69 | 5.03 | 2.31 | 1612.93 | 768.38 |

**Table A.0.7** Means and standard deviations of f0 perturbation for each affricate in Lushootseed

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /dz/ ‹dᶻ› | 8 | -6.24 | 8.53 | 3.02 |
| /ts/ ‹c› | 54 | 3.58 | 8.46 | 1.16 |
| /ts’/ ‹c̓› | 7 | -7.45 | 10.09 | 3.82 |
| /dʒ/ ‹ǰ› | 4 | -2.60 | 15.63 | 7.82 |
| /tʃ/ ‹č› | 35 | 11.71 | 11.03 | 1.86 |
| /tʃ’/ ‹č̓› | 18 | -16.27 | 23.48 | 5.53 |
| /tɬ’/ ‹ƛ̓› | 19 | -12.11 | 13.78 | 3.25 |

**Table A.0.8** Means and standard deviations of jitter perturbation for each affricate in Lushootseed

| Consonant | *N* | *M* (in ms) | *SD* | *SE* |
|---|---|---|---|---|
| /dz/ ‹dᶻ› | 7 | 1.85 | 1.91 | 0.72 |
| /ts/ ‹c› | 52 | 2.52 | 2.06 | 0.29 |
| /ts’/ ‹c̓› | 5 | 5.87 | 1.69 | 0.76 |
| /dʒ/ ‹ǰ› | 4 | 1.07 | 0.42 | 0.21 |
| /tʃ/ ‹č› | 34 | 2.59 | 2.46 | 0.42 |
| /tʃ’/ ‹č̓› | 18 | 5.42 | 5.20 | 1.57 |
| /tɬ’/ ‹ƛ̓› | 19 | 2.22 | 2.05 | 0.59 |

**Table A.0.9** Means and standard deviations of spectral moment measurements for each fricative (except for [h]) in Lushootseed.

| Cons. | N | CoG (in Hz) | SD | Kurtosis | SD | Skew | SD | Variance | SD |
|---|---|---|---|---|---|---|---|---|---|
| [s] | 45 | 2769.45 | 948.82 | 16.64 | 11.05 | 3.33 | 0.99 | 3082.86 | 1014.79 |
| [ʃ] ‹š› | 10 | 2093.46 | 271.45 | 352.8 | 256.29 | 13.77 | 6.05 | 805.67 | 471.43 |
| [ɬ] | 37 | 1984.28 | 611.68 | 31.75 | 18.72 | 4.80 | 1.30 | 2589.39 | 845.66 |
| [xʷ] | 78 | 1294.05 | 496.55 | 98.10 | 73.27 | 8.75 | 3.16 | 1860.9 | 851.49 |
| [χ] ‹x̌› | 13 | 1236.2 | 193.12 | 177.42 | 89.18 | 10.99 | 2.46 | 1133.76 | 356.29 |
| [χʷ] ‹x̌ʷ› | 6 | 938.83 | 251.93 | 150.998 | 180.32 | 10.47 | 5.52 | 1688.87 | 664.36 |

# APPENDIX B. LIST OF WORDS ANALYZED FOR UVULAR EFFECTS ON VOWEL QUALITY

**Table B.0.10** Words and morphemes analyzed in Chapter 7

| Words/Morphemes | Orthography | Translation | Environment |
|---|---|---|---|
| ʔa | ʔa | there | Nonuvular |
| ʔal | ʔal | at | Nonuvular |
| ʔ>a<tabəd | ʔatabəd | die | Nonuvular |
| ʔ>a<t͡siɬtalbixʷ | ʔaciɬtalbixʷ | person | Nonuvular |
| ʔat͡s>i<ɬtalbixʷ | | person | Nonuvular |
| ʔə | ʔə | OBL | Nonuvular |
| ʔəq̓ʷ>u<t͡sidid | ʔəq̓ʷucidid | let out | Uvular (R) |
| ʔəs- | ʔəs- | STAT | Nonuvular |
| ʔət͡ɬ’ | ʔəƛ̓ | come | Nonuvular |
| ʔ>i<bat͡s | ʔibac | grandchild | Nonuvular |
| ʔib>a<t͡s | | grandchild | Nonuvular |
| ʔiɬ | ʔiɬ | PART | Nonuvular |
| ʔiq̓ʷ | ʔiq̓ʷ | sweep | Uvular (L) |
| ʔu- | ʔu- | PFV | Nonuvular |
| ʔu-(Q) | ʔu-(Q) | PFV | Uvular (L) |
| ʔ>u<ləχ | ʔuləx̌ | gather | Nonuvular |
| ʔul>ə<χ | | gather | Uvular (L) |
| ʔ>u<ʃəb | ʔušəb | pity | Nonuvular |
| ʔuʃ>ə<b | | pity | Nonuvular |
| ʔus>i<l | ʔusil | dive | Nonuvular |
| ʔuχʷ | ʔux̌ʷ | go | Uvular (L) |
| >-a<bat͡s | -abac | body | Nonuvular |
| -ab>a<t͡s | | body | Nonuvular |
| b>i<bədaʔ | bibədaʔ | small child | Nonuvular |
| bibəd>a<ʔ | | small child | Nonuvular |
| bə- | bə- | ADD | Nonuvular |
| bə-(Q) | bə-(Q) | ADD | Uvular (L) |
| bəd>a<ʔ | bədaʔ | child | Nonuvular |
| bək̓ʷ | bək̓ʷ | all | Nonuvular |
| -bid | -bid | REL | Nonuvular |
| d>ə<t͡ʃ’uʔ | dəč̓uʔ | one | Nonuvular |
| dət͡ʃ’>u<ʔ | | one | Nonuvular |
| d>ii<t͡ʃ’uʔ | diič̓uʔ | one person | Nonuvular |
| dəxʷ- | dəxʷ- | reason for (COMP) | Nonuvular |
| -dub | -dub | LTR+PASS | Nonuvular |
| -dup | -dup | DISTR | Nonuvular |
| d͡z>i<ʔd͡ziʔ | dᶻiʔdᶻiʔ | pregnant one | Nonuvular |
| d͡ziʔd͡z>i<ʔ | | pregnant one | Nonuvular |

| | | | |
|---|---|---|---|
| d͡ʒat͡ʃʼ | ǰač̓ | unknown gloss | Nonuvular |
| -əb | -əb | MD | Nonuvular |
| -əd | -əd | TR | Nonuvular |
| (Q)-əd | (Q)-əd | TR | Uvular (R) |
| -əx$^{w}$ | -əx$^{w}$ | now | Nonuvular |
| (Q)-əx$^{w}$ | (Q)-əx$^{w}$ | now | Uvular (R) |
| gaq | gaq | step aside | Uvular (L) |
| gaq̓ | gaq̓ | look for | Uvular (L) |
| hud | hud | burn | Nonuvular |
| -il | -il | INCH | Nonuvular |
| (Q)-il | (Q)-il | INCH | Uvular (R) |
| lab | lab | see | Nonuvular |
| laq | laq | behind | Uvular (L) |
| laʔ | laʔ | point out | Nonuvular |
| l>a<ʔlab | laʔlab | see (DISTR) | Nonuvular |
| laʔl>a<b | laʔlab | see (DISTR) | Nonuvular |
| lə- | lə- | PROG | Nonuvular |
| lə-(Q) | lə-(Q) | PROG | Uvular (L) |
| ləχ | ləx̌ | light | Uvular (L) |
| liq̓$^{w}$ | liq̓$^{w}$ | falling down | Uvular (L) |
| ɬad- | ɬad | FT+2sg.poss | Nonuvular |
| ɬas- | ɬas | FT+STAT | Nonuvular |
| ɬ>a<ɬaɬli(l) | ɬaɬaɬlil | many reside | Nonuvular |
| ɬ>a<χil | ɬax̌il | night | Uvular (L) |
| ɬaχ>i<l | | night | Uvular (R) |
| ɬ>ə<t͡ʃil | ɬəčil | arrive | Nonuvular |
| ɬəχ | ɬəx̌ | spread out | Uvular (L) |
| ɬ>ə<χub | ɬəx̌ub | hunt | Uvular (L) |
| ɬəχ>u<b | | hunt | Uvular (R) |
| ɬiɬ | ɬiɬ | remote | Nonuvular |
| ɬu- | ɬu- | FT | Nonuvular |
| ɬup | ɬup | early morning | Nonuvular |
| ɬχilt͡ʃ | ɬx̌ilč | stand up | Uvular (R) |
| t͡ɬ’at͡ʃ | ƛ̓ač | abdomen | Nonuvular |
| t͡ɬ’aχ$^{w}$ | ƛ̓ax̌$^{w}$ | grow | Uvular (L) |
| t͡ɬ’iq̓ | ƛ̓iq̓ | stick | Uvular (L) |
| t͡ɬ’u- | ƛ̓u- | HAB | Nonuvular |
| t͡ɬ’u-(Q) | ƛ̓u-(Q) | HAB | Uvular (L) |
| p>u<q$^{w}$ab | puq$^{w}$ab | pile | Uvular (L) |
| pus | pus | throw | Nonuvular |
| p̓əq̓$^{w}$ | p̓əq̓$^{w}$ | drift | Uvular (L) |
| qa | qa | a lot | Uvular (R) |
| q>a<had | qahad | a lot (TR) | Uvular (R) |
| qah>a<d | | a lot (TR) | Nonuvular |

| | | | |
|---|---|---|---|
| qədxʷ | qədxʷ | mouth | Uvular (R) |
| qəp̓ | qəp̓ | alight, land | Uvular (R) |
| qid | qid | top | Uvular (R) |
| qʷuʔ | qʷuʔ | water | Uvular (R) |
| q̓al | q̓al | convince | Uvular (R) |
| q̓ʷ>u<ʔq̓ʷuʔ | q̓ʷuʔq̓ʷuʔ | many gather | Uvular (R) |
| q̓ʷuʔq̓ʷ>u<ʔ | | many gather | Uvular (R) |
| q̓ʷuʔ | q̓ʷuʔ | gather | Uvular (R) |
| saq̓ʷ | saq̓ʷ | fly | Uvular (L) |
| saxʷ | saxʷ | jump | Nonuvular |
| sbałχ>a<d | sbałx̌ad | muddy bog | Uvular (R) |
| səxʷ- | səxʷ- | device for (COMP) | Nonuvular |
| sl>ə<χi(l) | sləx̌il | day | Uvular (L) |
| sləχ>i<(l) | | day | Uvular (R) |
| sł>a<dajʔ | sładay? | lady | Nonuvular |
| spit͡sχʷ | spicx̌ʷ | a mythological bird | Nonuvular |
| sqaʔ | sqaʔ | older brother | Uvular (R) |
| sq>a<təds | sqatəds | older sisters | Uvular (R) |
| sq>ə<diχ | sqədix̌ | muskrat | Uvular (R) |
| sqəd>i<χ | | muskrat | Uvular (L) |
| sq>i<gʷat͡s | sqigʷac | deer | Uvular (R) |
| stab | stab | thing | Nonuvular |
| st̓>ə<q̓apəd | st̓əq̓apəd | slap on butt | Uvular (L) |
| st̓əq̓>a<pəd | | slap on butt | Uvular (R) |
| st͡ʃ>a<tqłəb | sčatqłəb | grizzly bear | Nonuvular |
| st͡ʃ>ə<txʷəd | sčətxʷəd | bear | Nonuvular |
| su-(Q) | su-(Q) | COMP+PFV | Uvular (L) |
| s>u<q̓ʷaʔ | suq̓ʷaʔ | younger sibling | Uvular (L) |
| sʔuʃəb>a<btxʷ | sʔušəbabtxʷ | pitiful | Nonuvular |
| sχ>a<ltəd | sx̌altəd | cradle board/basket | Uvular (R) |
| sχaχ>a<ʔ | sx̌ax̌aʔ | in-law | Uvular (R) |
| sχikʷ | sx̌ik̓ʷ | ugly | Uvular (R) |
| ʃ>a<lbixʷ | šalbixʷ | outside | Nonuvular |
| ʃə | šə | the particular one | Nonuvular |
| ʃəq | šəq | above | Uvular (L) |
| ʃəq>a<latxʷ | šəqalatxʷ | roof | Uvular (R) |
| ʃəqal>a<txʷ | | roof | Nonuvular |
| ʃəq>i<ligʷat͡s | šəqiligʷac | unknown gloss | Uvular (R) |
| ʃus | šus | unknown gloss | Nonuvular |
| ʃχ>a<təd | šx̌atəd | unknown gloss | Uvular (R) |
| tas- | tas- | PST+STAT | Nonuvular |
| taχ | tax̌ | fall forward | Uvular (L) |
| -təb | -təb | TR+PASS | Nonuvular |
| -təd | -təd | TR | Nonuvular |

| | | | |
|---|---|---|---|
| təxʷ | təxʷ | buy | Nonuvular |
| təχʷ | təx̌ʷ | stretch | Uvular (L) |
| ti | ti | this | Nonuvular |
| tiɬ | tiił | that | Nonuvular |
| tu- | tu- | PST | Nonuvular |
| tu-(Q) | tu-(Q) | PST | Uvular (L) |
| -tub | -tub | CAUS+PASS | Nonuvular |
| tulʔ>a<l | tul̓al | from | Nonuvular |
| tuχʷ | tux̌ʷ | just | Uvular (L) |
| t̓əq | t̓əq | thick | Uvular (L) |
| t̓iq̓ʷ | t̓iq̓ʷ | smoke | Uvular (L) |
| t̓uk̓ʷ | t̓uk̓ʷ | go home | Nonuvular |
| t̓ut͡s’ | t̓uc̓ | shoot | Nonuvular |
| tsi | tsi | this.F | Nonuvular |
| -t͡sid | -cid | you (obj) | Nonuvular |
| tsiɬ | tsiił | that.F | Nonuvular |
| t͡sut | cut | say | Nonuvular |
| t͡s’>a<gʷusəb | c̓agʷusəb | wash face | Nonuvular |
| t͡s’agʷ>u<səb | | wash face | Nonuvular |
| t͡s’akʷ | c̓akʷ | wash | Nonuvular |
| t͡s’əb>i<q̓id | c̓əbiq̓id | scratch | Uvular (L) |
| t͡s’əbiq̓>i<d | | scratch | Uvular (R) |
| t͡ʃad | čad | where | Nonuvular |
| t͡ʃadᶻ | čadᶻ | hide | Nonuvular |
| t͡ʃ>a<lad | čalad | chase | Nonuvular |
| t͡ʃal>a<d | | chase | Nonuvular |
| t͡ʃəd | čəd | I | Nonuvular |
| t͡ʃ>ə<gʷəʃ | čəgʷəš | wife | Nonuvular |
| t͡ʃəɬ | čəł | we | Nonuvular |
| t͡ʃəxʷ | čəxʷ | you (sbj) | Nonuvular |
| t͡ʃq>a<təd | čqatəd | unknown gloss | Uvular (R) |
| t͡ʃ’aʃ | č̓aš | dirty | Nonuvular |
| t͡ʃ’axʷ | č̓axʷ | hit with a stick | Nonuvular |
| t͡ʃ’>a<t͡ʃ’aʃ | č̓ač̓aš | child | Nonuvular |
| t͡ʃ’iq̓ʷ | č̓iq̓ʷ | rotten | Uvular (L) |
| t͡ʃ’ut͡ʃ’ɬ>a<ʔ | č̓uč̓łaʔ | small leaves | Nonuvular |
| -ub | -ub | MD | Nonuvular |
| wil>i<q̓ʷ | wiliq̓ʷ | ask | Uvular (L) |
| səxʷ>u<qagʷətəb | səxʷuqagʷətəb | unknown gloss | Uvular (L) |
| səxʷuq>a<gʷətəb | | unknown gloss | Uvular (R) |
| χ>a<həb | x̌ahəb | cry | Uvular (R) |
| χ>a<t͡ʃuʔ | x̌ačuʔ | lake | Uvular (R) |
| χaχ>a<ʔ | x̌ax̌aʔ | sacred | Uvular (R) |
| χ>ə<pajat͡s | x̌əpayac | cedar tree | Uvular (R) |

| | | | |
|---|---|---|---|
| χat͡ɬ’ | x̌aƛ̓ | want | Uvular (R) |
| χəɬ | x̌əɬ | sick | Uvular (R) |
| χət͡ʃ | x̌əč | feel | Uvular (R) |
| χid | x̌id | how | Uvular (R) |
| χit͡ɬ’ | x̌iƛ̓ | chop down tree | Uvular (R) |
| χiχ>ə<d | x̌ix̌əd | what's being done | Uvular (R) |
| χʷubt | x̌ʷubt | paddle | Uvular (R) |
| χʷul̓ | x̌ʷul̓ | just | Uvular (R) |
| χʷut | x̌ʷut | pull apart | Uvular (R) |