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Final Vowel Devoicing in Blackfoot

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FINAL VOWEL DEVOICING IN BLACKFOOT

By

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ABSTRACT

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Final Vowel Devoicing in Blackfoot

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This thesis presents a study of final vowel devoicing in Blackfoot, an indigenous language of Montana and Alberta. Previous research on final vowel devoicing in Blackfoot variously suggests word-final, phrase-final, and utterance-final vowel devoicing processes (e.g. Taylor 1965, Bliss & Gick 2009, Frantz 2017), though, the conditioning environment for this phenomenon had not been a research focus prior to this study. The present study investigates intonation units (IUs) as the conditioning domain for final vowel devoicing in Blackfoot.

Final vowel devoicing in Blackfoot is investigated here by examining the common word-final suffixes *–wa* (3SG.AN) and *–yi* (4SG) in two recordings of connected speech. Each recording features a different native speaker of Blackfoot. Speakers were asked to generate a narrative to go along with illustrations in a picture book.

These recordings are interlinearized using ELAN annotation software. Next, tokens of *–wa* and *–yi* are analyzed acoustically using Praat phonetic software. Then, *–wa* and *–yi* tokens are analyzed in terms of their position within the intonation unit (IU-medial or IU-final). Finally, the data are collated, giving the frequencies of different phonetic variants as well as the distribution of phonetic variants across IU-medial and IU-final environments.

The findings of this study are that fully-audible variants of *–wa* and *–yi* almost always occur IU-medially, while devoiced variants are most frequently found in IU-final position. Based on these findings, this thesis proposes an IU-final vowel devoicing rule to describe the phonetic variation and distribution of *–wa* and *–yi* in connected speech.

The analysis put forth in this thesis has implications for the theoretical classification of vowel devoicing phenomena, for linguistic research methodologies, and for the typology of intonation units cross-linguistically. Furthermore, the findings of this work bear on language documentation, revitalization, and pedagogy.

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ABBREVIATIONS & NOTATION

All phonetic representations given in this thesis utilize the International Phonetic Alphabet (IPA) (International Phonetic Association 2018). A full list of IPA symbols and their definitions may be viewed at http://www.internationalphoneticassociation.org.

AN	Animate
CONJ	Conjunctive
DEM	Demonstrative
DIM	Diminutive
DM	Discourse Marker
FRAG	Fragment
INAN	Inanimate
INCHO	Inchoative
INTSF	Intensifier
INTSF	Intensifier
INVS	Inverse
IU	Intonation Unit Boundary
LOC	Locative
MAN	Manner
NEG	Negation
NOM	Nominalizer
NONAFFIRM	Nonaffirmative
PL	Plural
POS	Possessive
PRO	PRO
PST	Past
SG	Singular
THEME	Theme
UNSPEC	Unspecified
VBLZR	Verbalizer
1	First Person
3	Third Person (Proximate)
4	Fourth Person (Obviative)
3>4	Third Person Subject with Fourth Person Object
V	Vowel
V̥	Voiceless Vowel
-	Morpheme Boundary
#	Word Boundary
ɸ	Phrase Boundary
ʊ	Declarative Utterance Boundary
ʊ	Declarative Utterance Boundary
ø	Deleted Morpheme
//	Phonemic Representation
[]	Phonetic Representation
<>	Orthographic Representation

OVERVIEW

This thesis presents a study of final vowel devoicing in Blackfoot. While previous work recognizes the presence of a final vowel devoicing process in the language, the conditioning environment for this phenomenon had not been investigated in particular prior to the present study. This study investigates final vowel devoicing in Blackfoot by examining the common word-final suffixes *–wa* (3SG.AN) and *–yi* (4SG) in recordings of connected speech. These recordings are analyzed in terms of the phonetic realizations of *–wa* and *–yi* tokens as well as their distribution across intonation unit-medial and final environments.

The findings of this study are that fully-audible variants of *–wa* and *–yi* almost always occur intonation unit-medially, while devoiced variants are most frequently found in intonation unit-final position. Based on these findings, this thesis proposes an intonation unit-final vowel devoicing rule to describe the phonetic variation and distribution of *–wa* and *–yi* in connected speech.

The organization of this thesis is as follows: Section 1 provides some background on the Blackfoot language, including demographic information (§1.1), its history of research (§1.2), and an overview of grammatical features which are relevant to this study (§1.3). Section 2 introduces final vowel devoicing in Blackfoot, first presenting a cross-linguistic overview (§2.1) and previous claims about this phenomenon (§2.2), then by describing and motivating the current study (§2.3). Section 3 describes the methods of this study, including descriptions of the recordings used (§3.1), interlinear analysis (§3.2), phonetic analysis (§3.3), distributional analysis (§3.4), and collation of the data

(§3.5). Section 4 presents the data collected in the study, including the phonetic variation of *–wa* and *–yi* (§4.1) and the distribution of phonetic variants (§4.2), exceptional cases (§4.3); followed by a summary of the findings (§4.4). Section 5 discusses the significance of this work, including implications for linguistic theory (§5.1), research methodologies (§5.3), and typology (§5.4); issues for further research (§5.5); and broader impacts (§5.6). Section 6 summarizes the study and offers some concluding remarks.

SECTION 1: BACKGROUND

1.1 THE BLACKFOOT LANGUAGE

Blackfoot is an Algonquian language of the Algic language family (Mithun 2006, Frantz 2017). It belongs to the geographic subgrouping of Plains Algonquian languages. It is the westernmost and most divergent member of the Algonquian languages (Elfner 2006a).[1] The Algic languages and their subgroupings are shown in (1) below (adapted from Mithun 2006).

(1) Algic Language Family

- Algonquian
  - Eastern Algonquian
    - Micmac, Maliseet-Passamaquody, Etchemin, Eastern Abenaki, Western Abenaki, Loup A, Loup B, Massachusett, Narragansett, Mohegan-Pequot, Quipiri, Mahican, Munsee, Unami, Nanticoke, Powhatan, Pamlico
  - Central Algonquian
    - Shawnee, Kickapoo, Meskwaki, Miami-Illinois, Potawatomi, Ojibwa, Cree, Menominee
  - Plains Algonquian
    - Cheyenne, Arapaho-Atsina, **Blackfoot**
- Ritwan
  - Wiyot, Yurok

The name for the language in Blackfoot is *Niitsi'powahsin*, which can be translated as 'original language' (*niit* 'original, genuine' + *i'pówahsin* 'language, talk, speech'; see Frantz & Russell 2017). It is the first language of an estimated 2,800 people today,

[1] Goddard (2015) who notes that Blackfoot may in fact fall outside of the Algonquian subgrouping of Algic languages.

including 2,750 speakers in Canada (Statistics Canada 2016), and about 50 speakers in the United States (p.c. Kipp 2011 in Kipp, DesRosier & Miyashita). Including second language speakers, the estimated total number of Blackfoot speakers is roughly 4,150 (Statistics Canada 2017, U.S. Census Bureau 2015). Speakers are distributed across the four Blackfoot-speaking bands of the Blackfoot Confederacy (see Figure 1 below): the *Siksiká* (Blackfoot), the *Kainai* (Many Chiefs, or Blood), and the *Aapátohsipikani* (Northern Peigan) in Canada; and the *Aamsskáápipikani* (Blackfeet, or Southern Piegan) in the United States (Frantz 2017, Fish 2018).

FIGURE 1. Map of the Bands of the Blackfoot Confederacy[2]

The Blackfoot language comprises four mutually intelligible dialects which correspond to the four bands listed above (Elfner 2006a, Frantz 2017, Weber 2013).[3] The language is classified as endangered (Frantz 2017, Fish 2018), as the majority of first language

[2] Map courtesy of Kevin McManigal.
[3] Miyashita and Chatsis (2015) note that dialect variation can be found even within bands.

speakers today are elderly (Kipp, DesRosier & Miyashita 2015) and language transmission in the home is uncommon (Frantz 2009). That said, significant revitalization efforts are underway, including various levels of language instruction. For example, public schools in Canadian reserves and the Blackfeet reservation in the US offer Blackfoot language and culture classes. The Piegan Institute Cuts Wood School in the Blackfeet reservation provides Blackfoot language immersion. Blackfoot language courses are also taught at the college level. Courses are currently offered at Blackfeet Community College, University of Lethbridge, Red Crow College, and the University of Montana.

1.2 Research in Blackfoot

Research on the grammar of Blackfoot has been ongoing since at least the late 19th century. Some of the oldest records of this work include *A Grammar and Vocabulary of the Blackfoot Language*, compiled by C. M. Lanning in 1882, based on translations by Joseph Kipp and C. W. Gladston Jr.; the *Grammar and Dictionary of the Blackfoot Language in the Dominion of Canada*, published by Rev. John William Tims in 1889; and *The Blackfoot Language*, published in 1896 by Rev. John Maclean.

In 1938, C. C. Uhlenbeck, a Dutch linguist, published his seminal grammar on the language, *A Concise Blackfoot Grammar Based on Material from the Southern Peigans*, which was compiled from data collected on the Blackfeet Reservation in Montana during the summers of 1910 and 1911.[4] Later, Allen Taylor wrote *A Grammar of Blackfoot* for his dissertation at the University of California, Berkeley in 1969. Donald

[4] Uhlenbeck refers to the "Blackfoot Reservation" in his grammar, though today it is known as the Blackfeet Indian Reservation.

Frantz, a colleague of Taylor's, in turn published *Blackfoot Grammar* in 1991, with second and third editions in released in 2009 and 2017, respectively. *Blackfoot Grammar* (Frantz 2017) has a companion dictionary, the *Blackfoot Dictionary of Stems, Roots, and Affixes*, which was compiled in 1989 by Frantz and Norma Jean Russell, a native speaker of Blackfoot. Second and third editions of the dictionary were released in 1995 and 2017, respectively. An online dictionary of Blackfoot was compiled beginning in 2016 by Inge Genee, based on Frantz and Russell's (2017) print dictionary. This online dictionary, accessible at http://dictionary.blackfoot.atlas-ling.ca, was later developed into a hub of integrated resources called "Blackfoot Language Resources and Digital Dictionary," accessible at http://blackfoot.atlas-ling.ca.

Though Blackfoot has a long history of research and documentation, work in the realm of phonetics and phonology is relatively less common and more recent. This type of research became more common in the late 1990s and early 2000s, investigating topics like phonetics (e.g. Derrick 2006), syllable structure (e.g. Elfner 2006a, Elfner 2006b, Denzer-King 2009), pitch accent (e.g. Kaneko 1999, Van der Mark 2003, Stacy 2004, Weber & Allen 2012), prosody (e.g. Miyashita 2011, Weber 2012), and speaker variation (e.g. Bliss & Glougie 2009, Miyashita & Chatsis 2015).

This thesis focuses on word-final vowel devoicing in Blackfoot, which has been described to varying degrees in the literature and documentation listed above. Of particular relevance to the present study, final vowel devoicing has been studied specifically in Bliss & Glougie (2009), Bliss & Gick (2009), Gick et al. (2012), Bliss (2013), and Bliss & Gick (2017). Previous claims about word-final vowel devoicing in Blackfoot are discussed in §2.2.

1.3 BLACKFOOT GRAMMAR

The following section briefly describes aspects of Blackfoot grammar that are relevant to this study. These include its vowel inventory; person, number, and gender systems; and certain phonological rules. This section also discusses how these grammatical features relate to the targets of this study, *–wa* and *–yi*.

1.3.1 VOWEL SYSTEM

Blackfoot has three primary vowels: high front /i/, low central /ɑ/, and mid back /o/ (Taylor 1969, Elfner 2006a, Frantz 2017). Vowels in Blackfoot are contrastively long or short in duration, which is represented in the orthography by single or double characters, respectively (Frantz 1978).[5] This contrast is exemplified by the minimal pair in (2) below.

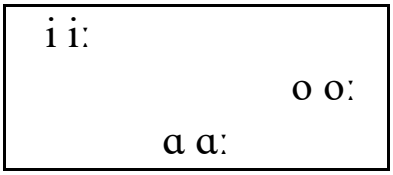
(2) Contrastive Vowel Length

a. áak**o**kaawa 's/he will rope'
b. áak**oo**kaawa 's/he will sponsor a Sundance'

(Frantz 2017:2)

The phonemic vowels of Blackfoot are represented in Figure 2 (adapted from Elfner 2006a) below.

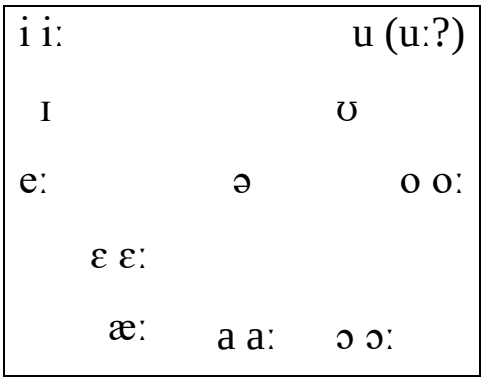
Figure 2. Blackfoot Phonemic Vowels



[5] This thesis orthographically represents words as they are presented in Frantz & Russell 2017, which makes use of Frantz's orthography (see Frantz 1978 for further discussion).

Naturally, each of the phonemic vowels exhibit allophonic variation. The phonetic vowels of Blackfoot are presented in Figure 3 (adapted from Elfner 2006a) below.

Figure 3. Blackfoot Phonetic Vowels[6]



The correspondence between Frant'z (1978) Blackfoot orthography and the International Phonetic Alphabet (IPA) (International Phonetic Association 2018) is shown in Table 1. Dialect variation is indicated by a tilde between pronunciations

Table 1. Orthographic Representation of Blackfoot Vowels

Orthography	IPA	Examples
a	ɑ	s**a** 'no'
	ʌ	**á**nnia 'that's it; okay now'
i	ɪ	**í**sska 'pail'
	i	m**íí**ni 'berry'
o	o	**ó**ki 'hello'
	ʊ	**ó**nni 'their father'
ai	ɛ	**ái**kkiwa 'they blow a whistle'
	eɪ~ɑɪ	**ái**'poyiwa 'they speak'
	æ~eɪ	**ái**pottaawa 'airplane'
ao	ɔ	ponok**áó**mitaa 'horse'
	ɑʊ	ák**ao**'toowa 'they have arrived'
oi	y	nitáakot**oi**ssikópii
	ɔɪ	otahk**ói**nattsi 'yellow'

[6] The notation used in this chart is reproduced in its original form, including the parentheses and question mark around the high back long vowel (uː?). Note that Elfner's chart makes use of the symbol [a] for the low mid vowel, though this is understood by the author to correspond to the IPA symbol [ɑ], which is used throughout this thesis.

Vowels and diphthongs are also affected by pitch accent, a suprasegmental feature marked on some syllables as "relatively higher pitch than that of contiguous syllables" (Frantz 2017:3). Pitch accent is marked orthographically by an acute symbol above the vowel, as shown (3) below:

(3) Contrastive Pitch Accent

a. **á**pssiwa 'it's an arrow'
b. apss**í**wa 'it's a fig'

(Frantz 2017:3)

The suffixes *–wa* and *–yi* can be represented phonemically as /wɑ/ and /ji/ , respectively. Each suffix is a single syllable comprised of a glide and an unaccented short vowel.

1.3.2 Person, Number, and Gender Systems

In Blackfoot, person, number, and gender are marked in both the nominal and verbal domains. According to Frantz (2017), Blackfoot distinguishes proximate and obviative third persons, singular and plural number, and animate and inanimate gender.

For each person, singular and plural forms are available. The 1st person plural differentiates inclusive (addressee included) from exclusive (addressee excluded) (Frantz 2017). Of particular relevance to this study, 3rd persons are also marked for obviation. When multiple 3rd persons are present in a discourse, one is marked as proximate (henceforth 3rd person) and the other is marked as obviative (henceforth 4th

person).[7] This discourse usage of obviation is shown in (4) below, where *matsiyíkkapisaawa* 'frog' is proximate and *pokátsikkapisaayi* 'little frog' is obviative.

(4) Obviation in Discourse

Anna matsiyíkkapisaawa mattsinnohpatskoyiiwa annis pokatsikkapisaayi.

ann**a**	matsiyíkkapisaa**wa**	mattsinnoohpattsko**yiiwa**[8]
ann-**wa**	matsiyíkkapisaa-**wa**	matt-innoohpattsko-**yiiwa**
DEM-**3SG.AN**	frog-**3SG.AN**	again-knock.down-**3>4**

ann**i**s	pokatsikkapisaa**yi**
an-**yi**-s	ohpok-matsiyíkkapisaa-**yi**
DEM-**4SG**-DIM	small-frog-**4SG**

'Frog knocked down the poor little frog again.'

(Shirlee Crow Shoe in "Friends" 05:35)

In addition, entities possessed by 3rd persons are obligatorily obviated. For example, as shown in (5) and (6) below, the unpossessed noun *imitaawa* 'dog' is marked for 3rd person, while the possessed noun *otómitaami* 'their dog' is marked for 4th person since the dog is possessed by a 3rd person.

(5) Non-Obviation of an Unpossessed 3rd Person

imitaa**wa**
imitaa-**wa**
dog-**3SG.AN**
'dog'

[7] Algonquianists often distinguish proximate and obviative third persons by referring to them as 3rd and 4th persons, respectively. This is the convention followed in this paper. See e.g. Pustet 1995, Bliss 2013, Frantz 2017 for further discussion.

[8] The verb stem *innoohpattsii* 'knock down' is listed in Frantz & Russell (2017) as a transitive inanimate verb. The stem *innoohpattsko* given here is interpreted as a transitive animate verb based on the *-yiiwa* 3>4 ending. This interpretation was confirmed in consultation Rod Scout, a Siksiká native speaker.

(6) Obviation of a Possessed 3rd Person

otómitaam**i**
ot-omitaa-m-**yi**
3-dog-POS-**4SG**
'their dog'

(adapted from Frantz 2017:15)

The gender system in Blackfoot, as mentioned above, is based on animacy. This system is partially iconic in that nominals referring to biologically animate beings such as humans and animals, as well as spirits and heavenly bodies, are grammatically animate (Mithun 2006, Frantz 2017). Beyond these three categories, nominals which denote inanimate objects are generally grammatically inanimate, though this is not always the case (Uhlenbeck 1938, Mithun 2006, Frantz 2017).

The targets of this research, *–wa* and *–yi*, reflect the person, number, and gender systems outlined above. As shown in Table 2 (adapted from Frantz 2017:16), animate nominals in Blackfoot are marked for 3rd or 4th person singular by *–wa* or *–yi*, respectively; or for plural number by *–iksi*. Inanimate nominals are marked for singular number by *–yi* and for plural by *–istsi*.[9]

Table 2. Blackfoot Nominal Suffixes

	Animate		Inanimate
Person	3	4	
Singular	*–(w)a*	*–(y)i*	*–(y)i*
Plural	*–iksi*		*–istsi*

Verbs, like nominals, are also marked for person, number, and gender, though the verbal morphology does not always parallel the nominal morphology shown in Table 2

[9] The proximate/obviative distinction is absent for animate plural and inanimate nominals. Likewise, this distinction is absent for plural intransitive verbs, as shown in Table 3.

above. As an example, as shown in Table 3 below, intransitive verbs are marked for 3rd person singular and plural by *–wa* and *–yi*, respectively; while 4th person singular and plural are marked by *–yini* and *–yi*, respectively.

Table 3. Blackfoot Independent Intransitive Verbal Morphology

Person	Singular	Plural
3	*-wa*	*-yi*
4	*-yini*	*-yi*

Both nominal and verbal *–wa* and *–yi* are counted as tokens of target morphemes in this study, provided that they occur in word final position.

1.3.3 PHONOLOGY

Note that the semivowels /w/ and /j/ in *–wa* and *–yi* in Table 2 above are shown in parentheses. This notation is used to represent a phonological process that deletes semivowels after consonants, as shown by the rule in (7) below (Frantz 2017).

(7) Semivowel Loss Rule

GLIDE → ø / C ___

This conditioning environment is created when *–wa* and *–yi* are attached to consonant-final stems, as shown in example (8) below.

(8) Application of Semivowel Loss Rule

póósa 'cat'
/pó:s-**wa**/ → [pó:s-**a**]

Of particular relevance to this study, vowels are devoiced in certain environments. There are two distinct processes by which vowels devoice in Blackfoot: vowel-consonant coalescence and final vowel devoicing. Vowel-consonant coalescence occurs when a vowel precedes the dorsal fricative /x/, represented orthographically as <h> (Frantz

2017). Miyashita (2018) analyzes this as a coalescence of the fricative and the preceding vowel, resulting in a voiceless vowel-consonant coarticulation. This process can be observed in example (9) below, where coalescence of /o/ and /x/ is realized as [xʷ].

(9) Vowel-Consonant Coalescence

annohka 'now'
[anːʔ**xʷ**kᵩ̥]

(Miyashita 2018:226)

The other environment in which vowels devoice is generally described as word-final position. This is the subject of investigation in this study. Previous claims about word-final vowel devoicing in Blackfoot are discussed in §2.2 below.

SECTION 2: FINAL VOWEL DEVOICING IN BLACKFOOT

2.1 TYPOLOGY OF VOWEL DEVOICING

Final vowel devoicing, though typologically uncommon is attested in various languages of the world (Gordon 2015). To name a few, vowel devoicing is documented in world languages like Japanese (Japonic; word-medial and word-final vowel devoicing; e.g. Han 1961, Teshigawara 2004, Vance 2008) and French (Italic; sentence-final vowel devoicing; e.g. Cedergren & Simoneau 1985, Smith 2019), as well as in indigenous languages such as Kirundi (Bantu; word-final vowel devoicing; Prins 2019) and Tohono O'odham (Uto-Aztecan; word-final vowel devoicing; e.g. Hale 1965, Zepeda 2016, Miyashita 1993). Among Algonquian languages, both word-final vowel devoicing (e.g. Cree; Knee 2018) and phrase-final vowel devoicing (e.g. Cheyenne; Frantz 1972, Leman & Rhodes 1978) are attested. The exact nature and distribution of vowel devoicing varies from language to language—including phonemic or allophonic devoicing; creaky or

breathy voice; initial, medial, or final devoicing; and combinations of the above (see Gordon 2015 for further discussion).

2.2 Previous Claims

As mentioned in §1.2, final vowel devoicing in Blackfoot has been described to varying degrees in previous documentation and theoretical work. The general consensus in the literature seems to be that vowels are either devoiced or deleted in a final position. The following is a chronological overview of previous claims made about this phenomenon in Blackfoot.

In Uhlenbeck's (1938) grammar, final vowel devoicing is not described explicitly, though it does include examples of words, ending in various forms of *–wa* and *–yi,* including instances of fully voiced <*–ua*> [wɑ], glide-only <*–u*> [w], and omission of the entire suffix [ø]. This indicates that variability in the voicing of the vowels in these suffixes was attested in Blackfoot at the time of Uhlenbeck's fieldwork over 100 years ago, though it was not formally described at that time.

Taylor (1969) discusses vowel devoicing in both phrase-final and utterance-final positions. He observes that "unstressed short vowels before a phrase-final boundary are…always voiceless," (Taylor 1969:42). As shown in (10) below, the words in (a—c) contain unstressed short vowels /i/, /u/, and /ɑ/ which are devoiced in word-final position.[10]

[10] Transcription and glosses in (10) are given as they appear in Taylor (1969), where voicelessness is marked by a line beneath the vowel. In general, this thesis uses Frantz's orthography (see Frantz 1978) unless otherwise noted.

(10) Phrase-final Vowel Devoicing

a. óapsspi̲ ‘his eye’
b. ksáxku̲ ‘dirt, earth, soil’
c. nitsóoka̲ ‘I slept’

(Taylor 1969:43—47)

Taylor’s (1969) claim about phrase-final vowel devoicing described above can be represented by the phonological rule in (11), which states that unstressed short vowels are devoiced in phrase-final position, indicated here by the ɸ symbol.

(11) Phrase-final Vowel Devoicing Rule

V [-STRESS -LONG] → V̥ / ___ ɸ

Additionally, Taylor (1969) describes a phenomenon he calls the *declarative terminal boundary*, which is “marked by a complete decrescendo, with gradual expiration of the articulatory force” and before which “are found only voiceless final syllables, followed by an obligatory silence." (Taylor 1969:38). This is taken to mean that at the ends of declarative utterances, there is a decrease of pulmonic activity followed by a pause. Taylor (1969) also notes that final vowel devoicing does not occur in what he calls *non-terminal boundaries*, which refer to right-edge word and phrase boundaries which do not coincide with the end of an utterance. These claims taken together suggest that the conditioning environment for final vowel devoicing in Blackfoot is utterance-final position. This process can be observed in the example shown in (12) below, in which only the final vowel of the utterance is devoiced.[11]

[11] Transcription and glosses in (12) are given as they appear in Taylor (1969), where voicelessness is indicated by a line beneath the vowel.

(12) Terminal Boundary Vowel Devoicing

“Sá**á**, nitáaakɛi?kowan?**i**,” misskawáániʔw**a**.
‘“No, I’ll go on playing” he said anyhow.’

(adapted from Taylor 1969:38)

Taylor’s (1969) observation about terminal boundary vowel devoicing can be represented by the phonological rule in (13) below, which states that vowels are devoiced in utterance-final position, indicated here by the ʊ symbol.

(13) Terminal Boundary Vowel Devoicing Rule

V → V̥ / ___ ʊ

An exception to terminal boundary vowel devoicing is the case of *emphatic terminal boundaries* (Taylor 1969:38). Emphatic utterances, like their declarative counterparts, are followed by a pause, but are distinctively not associated with any decrease in pulmonic activity. This is shown in (14) below, where both word-final vowels in the utterance are voiced. Emphasis is indicated here by an exclamation mark.

(14) Emphatic Utterance with No Final Vowel Devoicing

Aa**á**, máátuxtsikyoʔp**a**!
‘Aw, we don’t care about that!’

(adapted from Taylor 1969:38)

Similarly, Frantz (2017) identifies question sentences as another case of fully-voiced vowels occurring utterance-finally. He states that in verbs where neither the subject nor the primary object is third person, the final vowel of the word is voiced, when it would otherwise be devoiced. This is shown in (15) below, where the voiced final vowel is shown in IPA.

(15) Question Sentence with No Final Vowel Devoicing

Kitsikákomimmokihp[**a**]?
kit-ikakomimm-ok-i-hpa
2-love-inv-1-NONAFFIRM
'Do you love me?'

(adapted from Frantz 2017:147)

Though Frantz (2017) does not propose a generalized phonological rule for final vowel devoicing, he does refer to word-final in various notes and footnotes. In one such note, Frantz (2017:21) refers to word-final vowels as "usually voiceless" or "softly whispered." This is taken to mean that the conditioning context for final vowel devoicing is word-final position. This is shown in (16) below, in which the final vowel of *nitáópii* 'I'm sitting/staying' is devoiced.[12]

(16) Word-final Vowel Devoicing

nitáóp**ii** 'I'm sitting/staying'
[nit-ɔ́ːp̥i̥]

(adapted from Frantz 2017:6)

Referencing the nominal suffix *–wa* (3SG.AN) specifically, he reports that "the final vowel of this suffix is rarely audible, and many speakers completely omit the entire suffix" (Frantz 1995, 2017:10). This is shown in (17) below, in which the entire *–wa* suffix has been deleted.

[12] Frantz (2017) also notes that the lack of voicing masks the phonemic contrast between long and short vowels. This means that in theory this final vowel could also be represented as [i̥i̥], though the singleton voiceless [i̥] is utilized in this thesis for the sake of simplicity. It is also the case that long vowels may be shortened in word-final position (see Bliss & Glougie 2009, Bliss & Gick 2017).

(17) Deletion of Entire *–wa* Suffix

natáyo**wa** ‘lynx’
[nɑtájo-**ø**]

(adapted from Frantz 2017:10)

Based on Frantz’s (2017) discussion of final vowel devoicing, one might formulate the phonological rule in (18), which states that vowels are devoiced or deleted in word-final position, indicated here by the # symbol.

(18) Word-final Vowel Devoicing Rule

V → {V̥, ø} / ___ #

Collectively, the descriptions summarized above point to a phonological process of lenition that targets vowels in some kind of final environment.

The above claims represent impressionistic accounts of the distribution of final vowel devoicing phenomena observed in the Blackfoot language. The following study by Bliss and Gick (2009) presents an instrumental analysis of the phonetic realization of voiceless vowels in *–wa* and *–yi*. Bliss and Gick (2009:2) identify the vowels in these suffixes as “soundless” and claims that they are “visually perceptible [but] typically inaudible.” Using a combination of acoustic analysis, speaker perception, lip aperture measurement, and ultrasound, Bliss and Gick (2009) determine that the vowels in *–wa* and *–yi* are articulated but not vocalized, and these visual cues are perceptible to speakers without being audible. This analysis is compatible with anecdotal descriptions by speaker consultants in this study which characterize these vowels as “puffs of air” or “silent sounds” (Bliss & Gick 2009:2). Example (19) below shows the devoicing of the final vowel in *ki’somma* ‘moon.’

(19) Devoicing of *–wa* Suffix

*ki'somm**a*** 'moon'
[kiʔsomː-ḁ]

(adapted from Bliss & Gick 2009:7)

The present investigation (presented in §2.2), like Bliss and Gick's (2009) study, is comprised of an instrumental analysis. The focus of this study, however, is the distribution of final vowel devoicing, rather than on the articulatory and acoustic properties of devoiced final vowels.

2.3 INVESTIGATION

As described in §2.1 above, the presence of final vowel devoicing is relatively well-documented in Blackfoot, yet the conditioning environment for this process is not consistent across all analyses. It is also the case that identifying the conditioning context for final vowel devoicing in Blackfoot has not been the primary point of investigation in previous research. The goal of this study, then, is to conduct a formal investigation of the behavior of word-final vowels in Blackfoot. This is accomplished by examining the common word-final suffixes, *–wa* and *–yi*, in connected speech. This examination consists of identifying their phonetic variations and defining the conditioning environment, or environments, in which these variations surface.

2.3.1 RESEARCH TARGETS: *–wa* AND *–yi*

To investigate word-final vowel devoicing in Blackfoot, this study examines the suffixes *–wa* and *–yi*. Selecting these suffixes in particular as targets for this study is manifold. First, Bliss and Glougie (2009) and Frantz (p.c. 2019) note that *–wa* and *–yi* have both voiced and voiceless allomorphs in connected speech, and that this variation occurs in a domain above the level of the word. This observation has not been investigated in

particular in previous studies, though *–wa* and *–yi* have been the targets of other research (e.g. Frantz 1966, Pustet 1995, Bliss & Gick 2009, Bliss & Glougie 2009, Bliss 2013).

In addition to having been investigated previously, these suffixes make a good target for this research because they frequently end words in discourse, providing a wealth of tokens to examine. Crucially, they are grammatically marked on nominals, which licenses the assumption that they are underlyingly present even when they are not audibly perceptible. This allows for the identification of "silent sounds" on a recording.

2.3.2 Connected Speech

Previous descriptions of vowel devoicing in *–wa* and *–yi* (e.g. Bliss & Gick 2009, Frantz & Russell 2017) tend to be based on elicited data (e.g. word lists, carrier sentences, translations, grammaticality judgments). For example, in Bliss and Gick (2009), their experimental design is such that target morphemes to occur in utterance-final position.[13] Though this is ideal for a study of articulation and acoustics of voiceless vowels, it has the effect of conflating word-final and utterance-final environments. The present study, utilizing the notion of intonation units (IU), examines the behavior of *–wa* and *–yi* in both IU-medial and IU-final environments, which allows for the disambiguation of word-final and IU-final environments.

Additionally, discourse is often structured differently than written or elicited language (Du Bois 1991) and may or may not give rise to the same phenomena as is observed in a

[13] Based on Frantz's (1991) claim that short vowels are devoiced in utterance-finally position, Bliss and Gick's (2009) experimental design is such that target morphemes are in utterance-final position to create the ideal conditions for vowel devoicing.

connected discourse. For example, Bliss (2010) identifies varying behavior of the Blackfoot preverb *it-* in elicitations versus narratives. Similarly, Ono & Suzuki (1992) identify varying word order in written versus conversational Japanese. As such, the present study examines discourse with the intention to determine whether previous descriptions of final vowel devoicing hold in a larger domain of speech.

2.3.3 Defining Intonation Units

As mentioned above, there has been some discussion of final vowel devoicing in Blackfoot operating in a domain above the level of the word. This study seeks to determine whether position within an utterance, or intonation unit, could be that domain. For the purposes of this study, *intonation unit* (IU) is defined as a recognizably coherent unit of contiguous speech, bounded on either side by a pause. This definition is based on previous work on IUs including Chafe's (1994:57) designation of IUs as "functionally relevant segments," as well as Du Bois et al.'s (1992) list of prototypical features, given in (20) below. A prototypical intonation unit is characterized by the following qualities:

(20) Prototypical Features of an Intonation Unit

a. *Coherent Contour:* a unified intonation contour
b. *Reset:* a resetting of the baseline pitch level at the beginning of the unit
c. *Pause:* a pause between units
d. *Anacrusis:* a sequence of accelerated syllables at the beginning of the unit
e. *Lengthening:* a prosodic lengthening of syllable(s) at the end of the unit

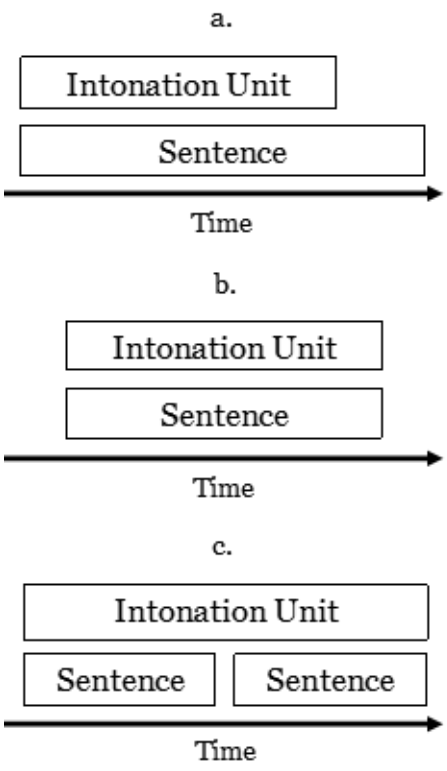
(adapted from Du Bois et al. 1992:100)

Features (a—d) in figure (20) above are all readily observed in Blackfoot, based on the recordings consulted in this thesis (see §3.1 for discussion of recorded material). Feature (e) however, is inappropriate for Blackfoot due to the fact that final vowel devoicing

obscures any lengthening of final syllables that may occur, as stated in §2.2. In addition, IU-final lengthening is not observed in the recordings consulted in this thesis. As such, this criterion is not used to identify or segment IUs in this study (see §5.3).

Note that IU segments may encompass both IUs (prosodic units) and sentences (syntactic units), the boundaries of which may or may not coincide with one another. As illustrated in Figure 4 below, IUs can be comprised of (a) part of a sentence, (b) a whole sentence, (c) or multiple sentences, since pauses in speech do not always coincide with syntactic structure.

Figure 4. IU-Sentence Alignments



For example, the single sentence in (21) below is divided across three contiguous intonation units (a—c), reflecting alignment (c) in Figure 4 above.

(21) IU-Sentence Alignment at 00:04—00:16 in “Friends”

a. Amao’kaa imitáíkoana,

amao’kaa	imitáíkoana
am-wa-o’ka	imitaa-ikoan-wa
DEM-3SG.AN-VBLZR	dog-DIM-3SG.AN
This is puppy,	

b. matsiyíkkapisaawa,

matsiyíkkapisaawa
matsiyíkkapisaa-wa
frog-3SG.AN
frog,

c. sspopííwa ki Tsáániwa.

sspopííwa	ki	Tsáániwa
sspopíí-wa	ki	Tsááni-wa
turtle-3SG.AN	and	Johnny-3SG.AN
turtle, and Johnny.		

The distinction between IUs and sentences (or other syntactic structures) is not made here in this study, as only IUs are examined. The possibility of a syntactic component to final vowel devoicing in Blackfoot has been raised previously (see Bliss & Glougie 2009), though that is beyond the scope of the current research.

SECTION 3: METHODS

The following section describes the methodology of this research, including descriptions of the recordings used (§3.1), interlinear analysis (§3.2), phonetic analysis (§3.3), distributional analysis (§3.4), and collation of the data (§3.5).

3.1 RECORDED MATERIAL

The data used in this study come from recordings and accompanying transcriptions of stories produced by two Blackfoot speakers. One speaker is female and the other is male.

They are from two different bands, one in Canada and the other in the U.S. Shirlee Crow Shoe (SCS) is a *Piikani* (Northern Piegan) woman in her 50s at the time of recording in 2009. She is a native speaker of Blackfoot. Earl Old Person (EOP) is an *Aamsskáápipikani* (Blackfeet) man in his 80s at the time of recording in 2013. He is also a native speaker of Blackfoot. While data from two speakers is not necessarily representative of the language as a whole, the representation of different dialect groups (e.g. region, gender) reduces the potential impact of idiolectic variation.

The recordings were conducted by Mizuki Miyashita as a part of her research on Blackfoot prosody.[14] Both narrations are based on the wordless picture book *One Frog Too Many* (Mayer & Mayer 1975). Speakers were asked to generate a story spontaneously to go along with the scenes depicted on each page (p.c. Miyashita 2017). A sample page and accompanying narration are given in Figure 5 below.

Figure 5. Sample Image from "One Frog Too Many" by Mayer & Mayer 1975
Narration from "Friends" by Shirlee Crow Shoe 00:18—00:23

Tsáániwa áó'ohkoitapiiyiwa isóómonii'pawa.
'Johnny received a gift.'

[14] Funded by NSF-DEL [BCS-1251684], Humanities Montana [09R24], Jacobs Research Funds (awarded 2008), and NEH-DEL [FN-50064-10]. Recordings and transcripts accessible at http://www.umt.edu/blg/research1/transcripts/default.php.

The first recording, “Friends,” features Shirlee Crow Shoe and is 8 minutes and 42 seconds in length. This recording was transcribed and translated by Shirlee Crow Shoe and interlinearized by Mizuki Miyashita in consultation with Donald Frantz.[15] The second recording, “One Frog Too Many,” features Earl Old Person and is 7 minutes and 52 seconds long. This recording was transcribed and translated by Rosella Many Bears, the language consultant for this project, in 2014 (p.c. Miyashita 2018).[16] The interlinearization was later added by the author as a component of this study.

3.2 Interlinear Analysis

The recordings are transcribed and interlinearized using EUDICO Linguistic Annotator software (ELAN) (Max Planck Institute for Psycholinguistics 2019).[17] Each recording is annotated with five tiers for items listed in (22) below with their abbreviations in hierarchical order.

(22) Interlinearization Tiers in ELAN

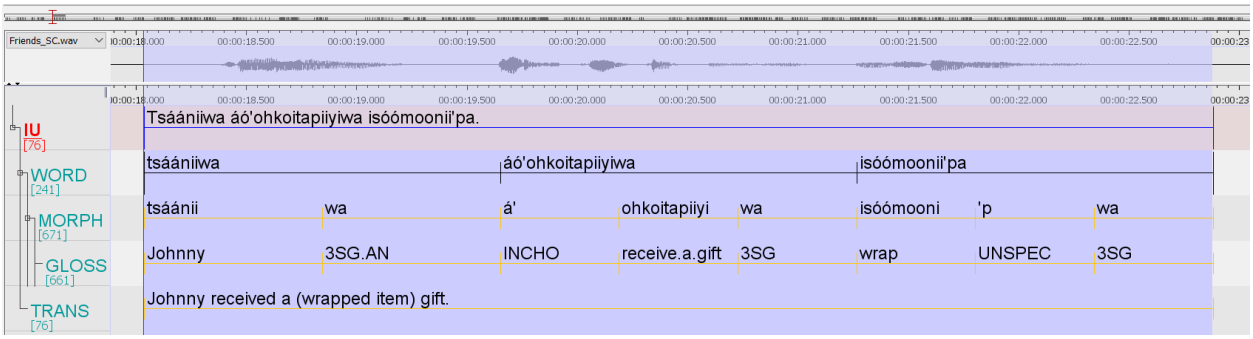
i. Intonation Unit (IU)
ii. Free translation (TRANS)
iii. Word-level analysis (WORD)
iv. Morphological analysis (MORPH)
v. Morpheme gloss (GLOSS)

As stated in §3.2 above, “Friends” had been interlinearized prior to this study, and “One Frog Too Many” was interlinearized by the author, consulting the Blackfoot dictionaries

[15] In cases where the spellings given in the transcription did not match citation forms given in Frantz & Russell (2017), they were changed accordingly. Any resulting errors in orthography or analysis are my own.
[16] Rosella Many Bears is a Kainai woman in her 60s at the time of transcription.
[17] ELAN was developed by the Max Planck Institute for Psycholinguistics. See further Sloetjes and Wittenburg (2008).

Frantz & Russell (2017) and Frantz & Genee (2019). A sample of "Friends" annotated with the five tiers of interlinear analysis in (20) is given in Figure 6 below.

Figure 6. Interlinearization from "Friends" 00:18—00:23 in ELAN



In addition to the five tiers of interlinear analysis, additional tiers (AUD and ENVIRON) are added in ELAN as a part of the phonetic and environment analyses outlined in §3.4 and §3.5 below.

3.3 Phonetic Analysis

First, by listening and reading along with the transcript several times, the phonetic variants of *–wa* and *–yi* were initially recognized. As a result, an additional annotation tier (AUD) was added to identify the phonetic variation of *–wa* and *–yi*. Phonetic realizations of *–wa* and *–yi* are coded according to the metrics shown in (23).

(23) Coding System for AUD Tier in ELAN.

Inaudible: No part of the suffix is perceptible. (1)
Glide only: only the glide is perceptible. (2)
Devoiced: the vowel is devoiced.[18] (3)
Fully Audible: both the glide and vowel are perceptible. (4)

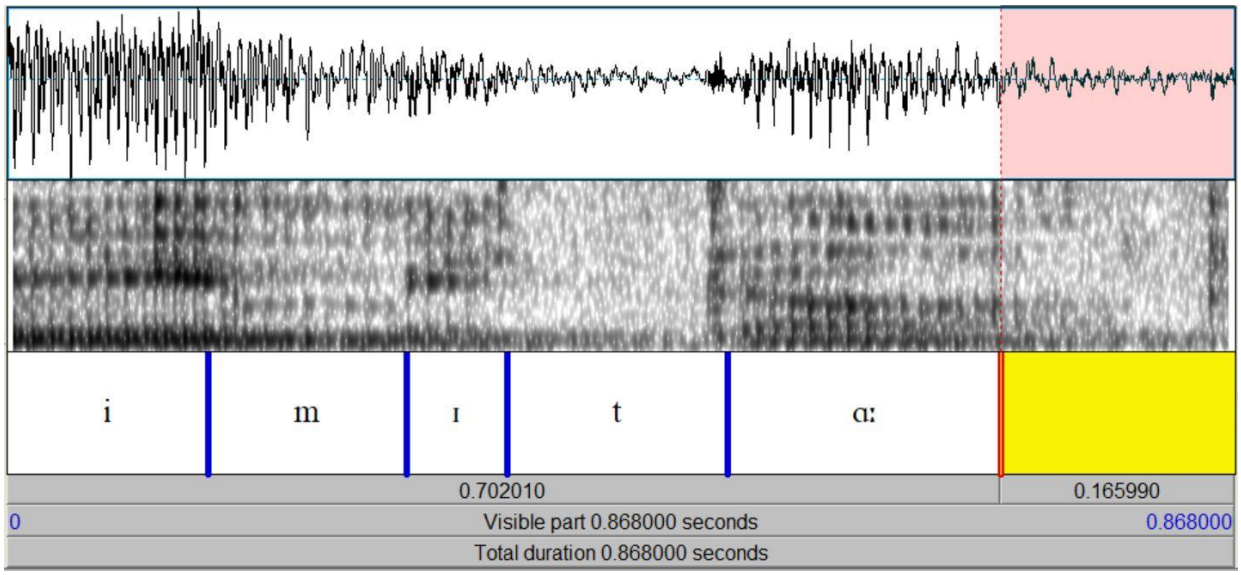
[18] It is also possible that part or all of the glide is devoiced in addition to the vowel, as seen in Tohono O'odham (see Miyashita 2000).

Note that glide-only variants are only possible in cases where the –wa or –yi suffix attaches to a vowel-final stem. When these suffixes attach to a consonant-final stem, the glide is deleted per the semivowel loss rule given in §1.3.3 (Frantz 2017). Cases of both consonant-final and vowel-final stems are included in this study.

Following this process, these tokens were verified by acoustic analysis using Praat phonetic analysis software (Boersma & Weenink 2019). The phonetic realization of *–wa* and *–yi* tokens is determined by spectrogram analysis. The spectrograms in Figures 7—10 below show examples of each of the phonetic variant described in (21) above, along with the interlinearized intonation unit from which they were sampled.

The spectrogram in Figure 7 shows an inaudible (1) *–wa* token, which is characterized by the lack of a voicing bar at F0 as well as the lack of any other discernable formants at F1, F2, or F3. The transcription for this word's parent IU is given in (24) below.

Figure 7. Inaudible (1) *–wa* in "One Frog Too Many" 01:04



(24) Intonation Unit at 01:00—01:05 in "One Frog Too Many"

Oma sspoppíiwa, matsiyíkkapisaawa, ki oma **imitááwa**

oma	sspopíiwa	matsiyíkkapisaawa[19]
om-wa	sspopíi-wa	matsiyíkkapisaa-wa
DEM-3SG.AN	turtle-3SG.AN	frog-3SG.AN
ki	oma	**imitááwa**
ki	om-wa	imitáá-wa
and	DEM-3SG.AN	dog-3SG.AN

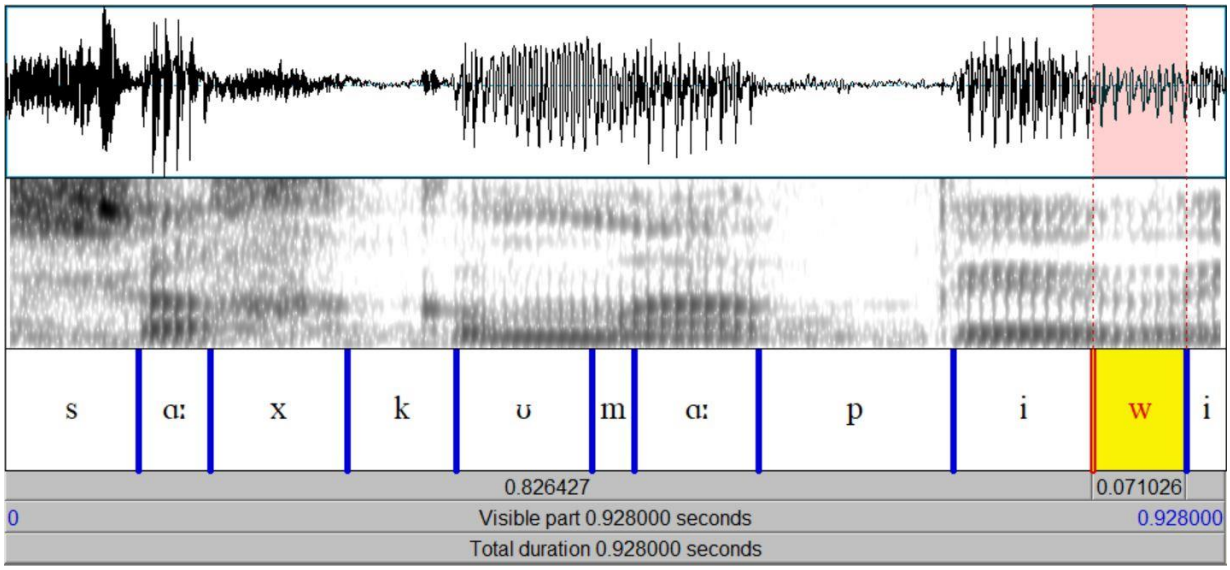
'The turtle, frog, and the dog'

The spectrogram in Figure 8 shows a glide-only *–wa* token. This is identifiable by the stem-final vowel [i] (indicated by the voicing bar at F0 and formants at F1, F2, and F3) transitioning to the glide [w] (indicated by the diverging formants at F2 and F3). The

[19] The citation form for this word indicates that the third syllable is accented, though speakers in both recordings tend to accent the first syllable, as in *mátsiyikkapisaa*.

glide is followed by the initial vowel [i] of the following word. The transcription for this word's parent IU is given in (25) below.

Figure 8. Glide Only (2) *–wa* from "One Frog Too Many" 01:33



(25) Intonation Unit at 01:00—01:04 in "One Frog Too Many"

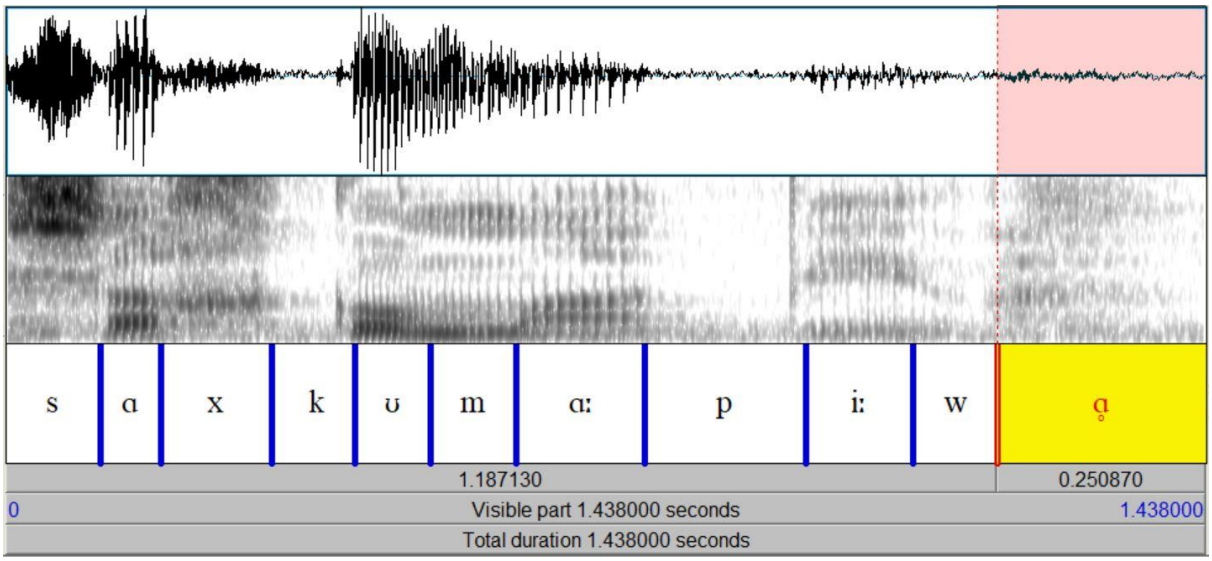
Oki ki ánnimáyi oma **saahkómaapiwa** iitsi- iits- iitsiksímsstaawa maatááhsiimmiwatsiksi amoyi po'ksihi matsiyíkkapisaawa.

oki	ki	ánnimáyi
oki	ki	annimayi
DM	and	DM
oma	**saahkómaapiwa**	iitsi- iits-
om-wa	saahkómaapi-wa	FRAG
DEM-3SG.AN	boy-3SG.AN	FRAG
iitsiksímsstaawa	maatááhsiimmiiwaatsiksi	
ii-iksímsstaa-wa	maat-yááhsimm-yiiwa-atsiksi	
PST-think-3SG.AN	NEG-like.someone-3>4-3SG.NONAFFIRM	
amoyi	po'ksiyi	matsiyíkkapisaayi
amo-yi	po'ksi-yi	matsiyíkkapisaa-yi
DEM-4SG	small-4SG	frog-4SG

'And then the boy he thought he does not like the little frog.'

The spectrogram in Figure 9 shows a devoiced *–wa* token, which is characterized by formants at F1, F2, and F3 in combination with the lacking voice bar at F0. The transcription for this word's parent IU is given in (26) below.

Figure 9. Devoiced (3) *–wa* from "One Frog Too Many" 00:13



(26) Intonation Unit at 00:11—00:14 in "One Frog Too Many

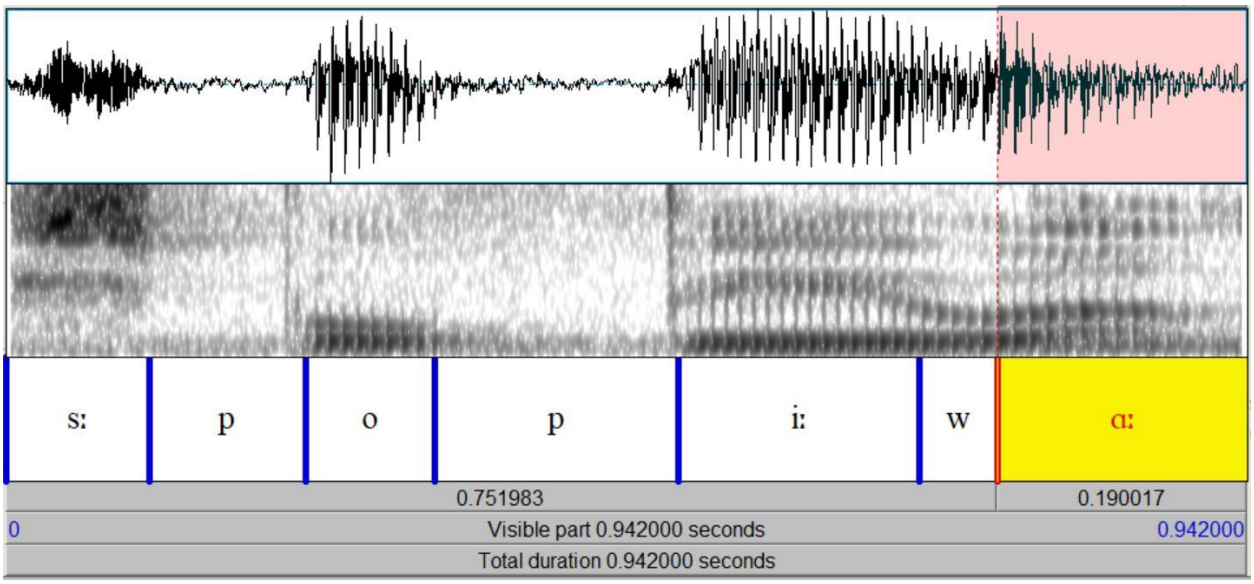
Amowa **saahkómaapiwa**

amowa	**saahkómaapiwa**
amo-wa	saahkómaapi-wa
dem-3sg.an	boy-3sg.an

'This boy'

The spectrogram in Figure 10 shows a fully audible *–wa* token, which is characterized by a dark voicing bar at F0, and clear formants at F1, F2, and F3. Note that the formants at F2 and F3 are converging, indicating the transition from the semivowel [w] to the vowel [ɑ]. The transcription for this word's parent IU is given in (27) below.

Figure 10. Spectrogram of Fully Audible (4) *–wa* from "One Frog Too Many" 01:01



(27) Intonation Unit at 01:00—01:05 in "One Frog Too Many"

Oma **sspoppííwa**, matsiyíkkapisaawa, ki oma imitááwa

oma	**sspopííwa**	matsiyíkkapisaawa
om-wa	sspopíí-wa	matsiyíkkapisaa-wa
DEM-3SG.AN	turtle-3SG.AN	frog-3SG.AN
ki	oma	imitááwa
ki	om-wa	imitáá-wa
and	DEM-3SG.AN	dog-3SG.AN

'The turtle, frog, and the dog'

3.4 DISTRIBUTIONAL ANALYSIS

The environments in which *–wa* and *–yi* occur are also identified. For each instance of *–wa* and *–yi* in the recordings, their position within the intonation unit (medial or final) is indicated in the IU position tier (ENVIRON) in ELAN. The coding system for position within an intonation unit is as follows: IUM, meaning the *–wa* or *–yi* token occurs in a non-final position in the intonation unit (i.e., on a non-final word); and IUF, meaning

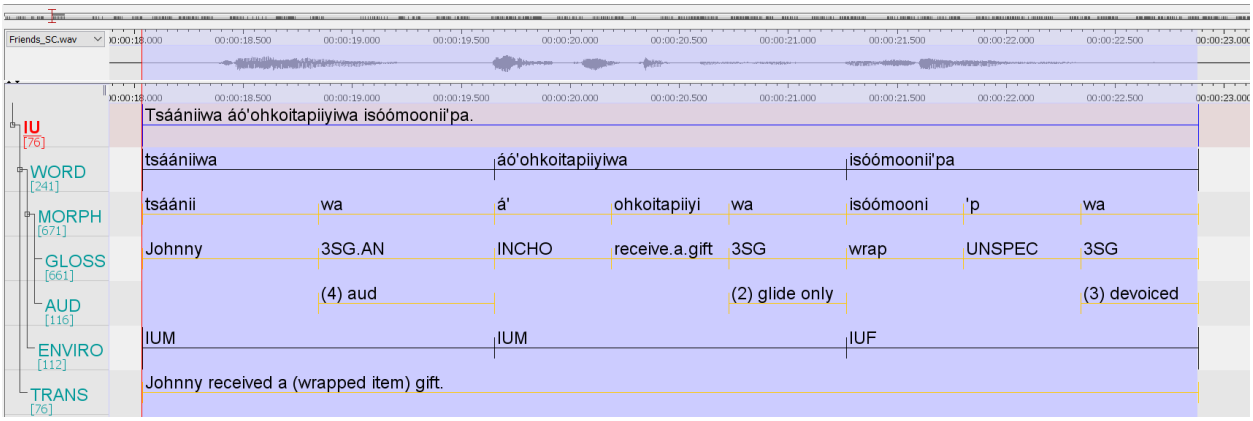
the *–wa* or *–yi* token occurs in IU-final position (i.e., on an IU-final word). This coding system is summarized in (28) below.

(28) Coding system for ENVIRON tier in ELAN

IU-medial: the suffix appears on any word that is not the final word in an intonation unit. (IUM)
IU-final: the suffix appears on the final word in an intonation unit. (IUF)

A sample of an annotated recording as it appears in ELAN, annotated to reflect the metrics above is shown in Figure 11 below.

Figure 11. Annotation from "Friends" 00:18—00:23 with AUD and ENVIRON tiers in ELAN



3.5 Data Collation

First, the data from each recording is compiled and exported from ELAN to Microsoft Excel (full dataset for each recording given in Appendices A and B). To collate the data, the total number of each phonetic variant (AUD 1-4) of *–wa* and *–yi* are compared to the total number of all *–wa* and *–yi* tokens to generate a distributional model of their varying phonetic realizations. Likewise, *–wa* and *–yi* tokens in each environment (IUM and IUF) are compared to the total number of *–wa* and *–yi* tokens. This model is meant to constitute a picture of final vowel behavior in connected speech in Blackfoot.

SECTION 4: DATA AND ANALYSIS

The following sections presents the data and analysis in this study. First, an overview of the data gathered in this study is given. As described in §3.1, two recordings of narratives based on the same picture book are used in this study, titled "Friends" and "One Frog Too Many." As shown in Table 4, the recording "Friends" contains a total of 8 minutes and 42 seconds of recorded material. In this recording, a total of 76 intonation units are identified, containing 84 *–wa* tokens and 27 *–yi* tokens. Of the 111 total tokens, 72 occur in IU-medial position and 39 occur in IU-final position. "One Frog Too Many" contains a total of 7 minutes and 52 seconds of recorded material. In "One Frog Too Many," a total of 71 intonation units are identified, containing 81 *–wa* tokens and 111 *–yi* tokens. Of the 192 total tokens, 149 occur in IU-medial position and 43 occur -finally. The full datasets for each recording are given in Appendices A and B.

Table 4. Data from Recordings

	"Friends"	**"One Frog Too Many"**	**Total**
Speaker	SCS	EOP	2
Duration	8:42	7:52	16:34
IUs	76	71	147
–*wa* tokens	84	81	165
–*yi* tokens[20]	27	111	138
IUM	72	149	221
IUF	39	43	82
Total Tokens	**111**	**192**	**303**

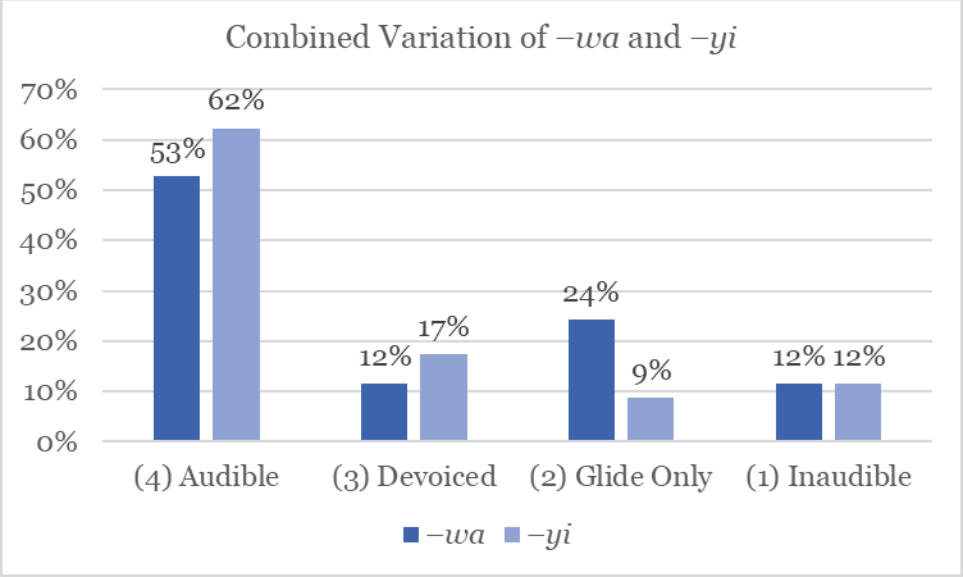
[20] Note that there are far fewer *–yi* tokens in "Friends" than there are in "One Frog Too Many." There are various potential explanations for this, including the frequent use of the distinct third person suffix *–aawa* by SCS (see Frantz 2017 for further discussion of the distinct third person). Since *–wa and –yi* variants behave similarly, as discussed in §4.1, this discrepancy likely does not bear on the findings of this study.

The following sections present the data and accompanying analysis first in terms of the observed phonetic variation of *–wa* and *–yi* (§4.1), and then in terms of the distribution of phonetic variants (§4.2). Exceptional cases are identified and discussed in §4.3. The findings of this study are summarized in §4.4.

4.1 Phonetic Variation of *–WA* and *–YI*

As described in §3.3, *–wa* and *–yi* are coded according to their phonetic realization as one of four variants: fully audible (4), devoiced (3), glide-only (2), and inaudible (1). Synthesizing the data collected from both recordings, as shown in Figure 12 below, 53% of all *–wa* tokens are fully audible, 12% are devoiced, 24% are glide-only, and 12% are inaudible. Similarly, 62% of all *–yi* tokens are fully audible, 17% are devoiced, 9% are glide-only, and 12% are inaudible.

Figure 12. Combined Phonetic Variation



At this point an interesting trend can be already observed: fully audible variants of *–wa* and *–yi* occur rather frequently in the recordings. The high frequency of fully-voiced *–wa* and *–yi* tokens is not expected assuming previous descriptions of word- or phrase-

final vowel devoicing (described in §2.1). Given such descriptions, one would expect to see a majority of *–wa* and *–yi* tokens being devoiced, due to the relative infrequency of intonation unit boundaries compared to word or phrase boundaries in a discourse. Rather, the results of this study point to a final vowel devoicing process whose conditioning environment occurs less frequently in a discourse, such as a an IU-final vowel devoicing rule. The above analysis of the frequencies of phonetic variants in the recordings is supported by distributional data, presented in §4.2 below.

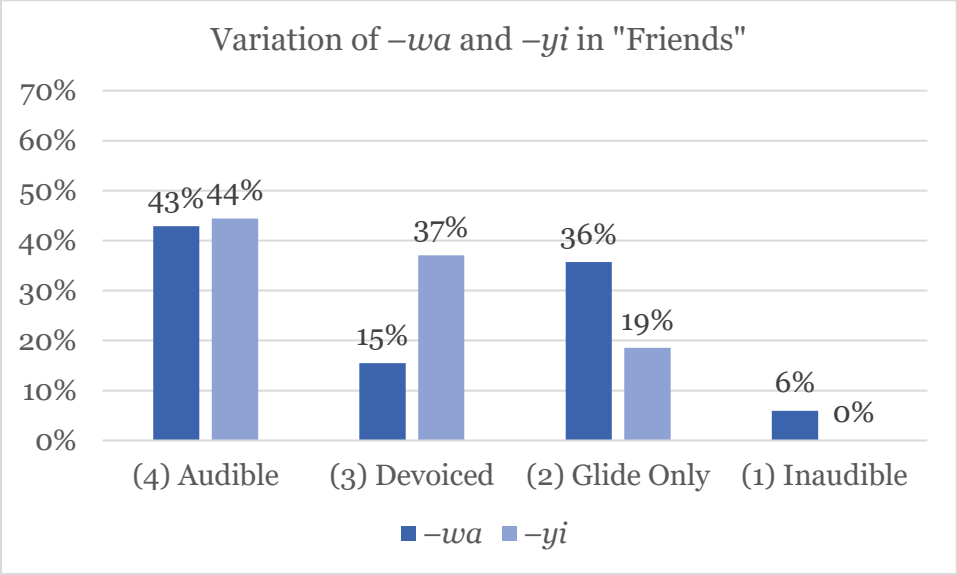
The following data show phonetic variation in each recording individually. In the recording "Friends," specifically as shown in Table 5 below, a total of 84 *–wa* tokens and 27 *–yi* tokens are identified. Of the 84 *–wa* tokens, 36 surface as fully audible, 13 contain a devoiced vowel, 30 surface as a glide-only, and 5 are inaudible. Of the 27 *–yi* tokens, 12 are fully audible, 10 contain a devoiced vowel, 5 surface as a glide only, and 0 are inaudible.

Table 5. Totals of Phonetic Variants of *–wa* and *–yi* in "Friends"

	–wa	***–yi***
(4) Audible	36	12
(3) Devoiced	13	10
(2) Glide Only	30	5
(1) Inaudible	5	0
Total	**84**	**27**

Figure 13 below shows these totals again in terms of percentages. Of the *–wa* tokens identified (indicated by the darker blue bars), 43% are fully audible, 15% contain a devoiced vowel, 36% surface as a glide only, and 6% are inaudible. Of the *–yi* tokens identified (indicated by the light blue bars), 43% are fully audible, 37% contain a devoiced vowel, 19% contain a glide only, and 0% are inaudible.

Figure 13. Phonetic Variants as Percentages of Total Tokens in "Friends"



Though a higher percentage of devoiced and glide-only variants are found in "Friends," than in the combined results in Figure 12 above, audible variants still occur most frequently. Notably, the frequencies of glide-only and inaudible variants differ between *–wa* and *–yi* tokens. This is discussed further in §4.3.1 below.

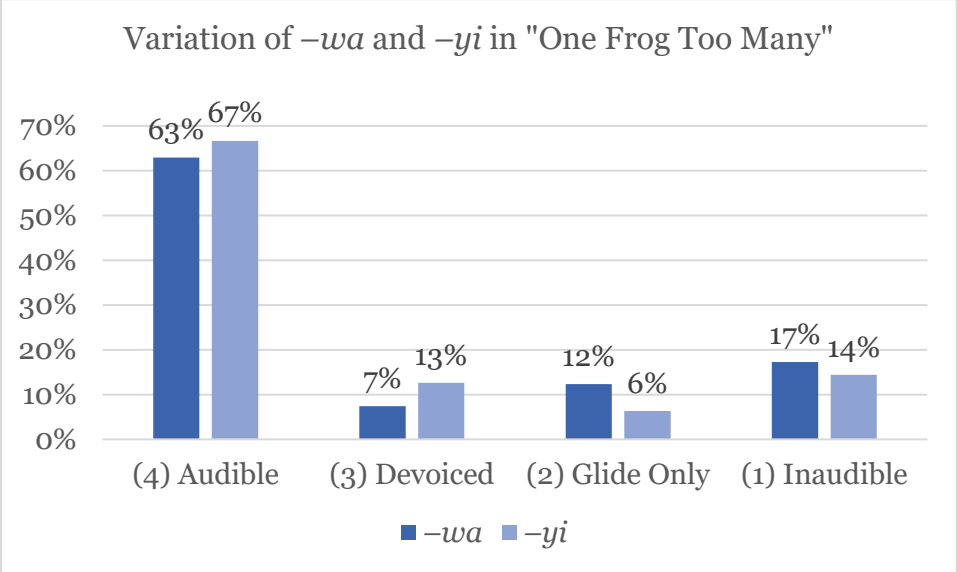
As shown in Table 6 below, "One Frog Too Many" contains a total of 81 *–wa* tokens and 111*–yi* tokens. Of the 81 *–wa* tokens, 51 are fully audible, 6 contain a devoiced vowel, 10 surface as glide-only, and 14 are inaudible. Of the 111 *–yi* tokens, 74 are fully audible, 14 contain a devoiced vowel, 7 surface as a glide only, and 16 are inaudible.

Table 6. Totals of Phonetic Variants of *–wa* and *–yi* in "One Frog Too Many"

	–wa	***–yi***
(4) Audible	51	74
(3) Devoiced	6	14
(2) Glide Only	10	7
(1) Inaudible	14	16
Total	**81**	**111**

These data are repeated in terms of percentages in Figure 14 below. Of the *–wa* tokens identified, 63% are fully audible, 7% contain a devoiced vowel, 12% surface as glide-only, and 17% are inaudible. Of the *–yi* tokens identified, 67% are fully audible, 13% contain a devoiced vowel, 6% contain a glide only, and 14% are inaudible.

Figure 14. Phonetic Variants as Percentages of Total Tokens in "One Frog Too Many"



The frequencies of phonetic variants in “One Frog Too Many” more or less mirror the frequencies of variants in the combined data presented in Figure 12. Again, audible variants of *–wa* and *–yi* occur most frequently, while devoiced, glide only, and inaudible variants occur relatively infrequently.

Examining the phonetic variation of*–wa* and *–yi*, it becomes clear that the two suffixes pattern together, with the exception of devoiced and glide-only variants in “Friends,” which is discussed further in §4.3.1 below. In the combined data presented in Figure 12, the frequencies of each phonetic variant do not differ by more than 15 percentage points between *–wa* and *–yi*. Overall, the most common phonetic realization of both suffixes is the fully-audible variant. Both suffixes surface as either devoiced or inaudible relatively

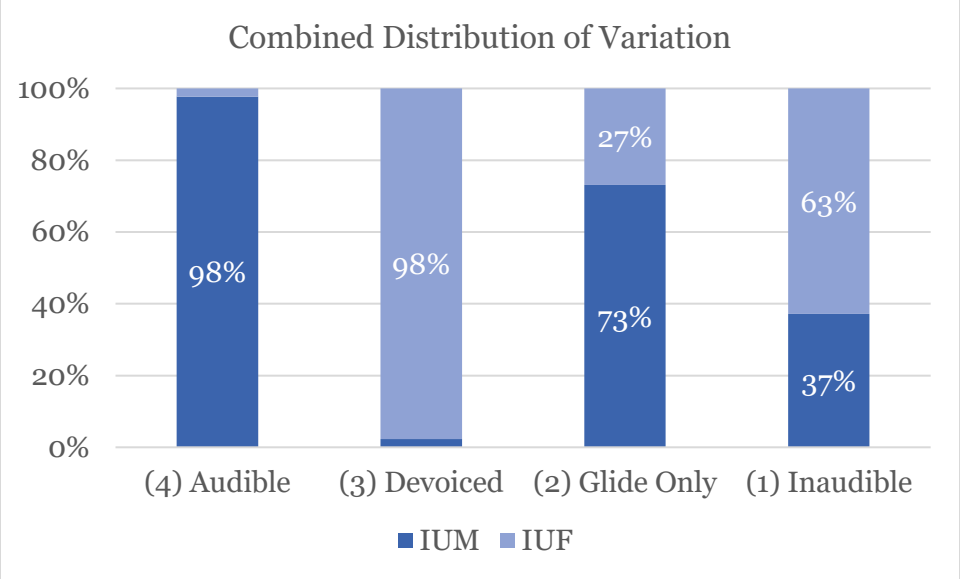
infrequently, though devoiced variants are relatively more common in “Friends” while inaudible variants are more common in “One Frog Too Many.”

4.2 Distribution of Phonetic Variants

For the purposes of calculating the distribution of phonetic variation across IU-medial and IU-final environments, *–wa* and *–yi* are grouped together into a single category. This is motivated by the fact that they behave similarly in terms of their phonetic realizations, as shown in the analyses in §4.1 above.

Figure 15 below shows the distribution of phonetic variants across IU-medial and IU-final environments in both recordings. 98% of audible variants occur IU-medially, while 98% of inaudible variants occur IU-finally. The distribution of glide-only and inaudible variants is less neatly stratified, though the majority of glide-only variants occur IU-medially (73%), while the majority of inaudible variants occur in IU-final position.

Figure 15. Combined Distribution of Variation



Overall, fully audible and devoiced variants are in near-complementary distribution with one another. Glide-only and inaudible variants, however, occur in both IU-medial and IU-final positions. This variable distribution is discussed further in §4.3.2 below.

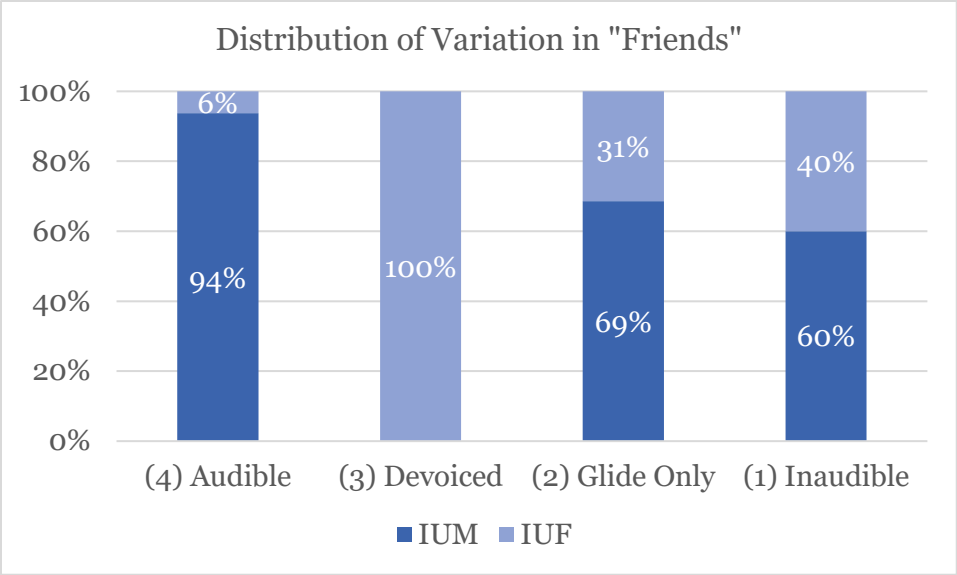
The following data show the distribution of phonetic variants in each recording individually. Distribution of phonetic variants in "Friends," summarized in Table 7 below, is as follows: of the 72 suffix tokens in IU-medial position, 45 are fully audible, 0 are devoiced, 24 surface as glide only, and 3 are inaudible. Of the 39 tokens in IU-final position, 3 are fully audible, 23 contain a devoiced vowel, 11 surface as glide only, and 2 are inaudible.

Table 7. Distribution of Phonetic Variants in "Friends"

	IUM	**IUF**	**Total**
(4) Audible	45	3	48
(3) Devoiced	0	23	23
(2) Glide Only	24	11	35
(1) Inaudible	3	2	5
Total	**72**	**39**	**111**

These data are given again in Figure 16 in terms of percentages. Of the 111 total *–wa* and *–yi* tokens identified in "Friends," 94% of fully audible variants occur in IU-medial position, while only 6% occur in IU-final position. 100% of the variants containing a devoiced vowel occur in IU-final position. The glide-only and inaudible variants are more evenly distributed. 69% of glide-only variants occur in IU-medial position, while 31% occur in IU-final position. 60% of inaudible variants occur IU-medially, while 40% occur IU-finally.

Figure 16. Distribution of Phonetic Variants in “Friends”



The distribution of phonetic variants in “Friends” closely mirrors what is shown in the combined distributional data in Figure 15. Fully audible variants almost always occur in IU-medial position, while devoiced variants occur only in IU-final position. Also as in the combined data, glide-only and inaudible variants occur in both positions. In this recording, however, inaudible variants occur more frequently in IU-medial position, whereas in the combined data they occur mostly in IU-final position.

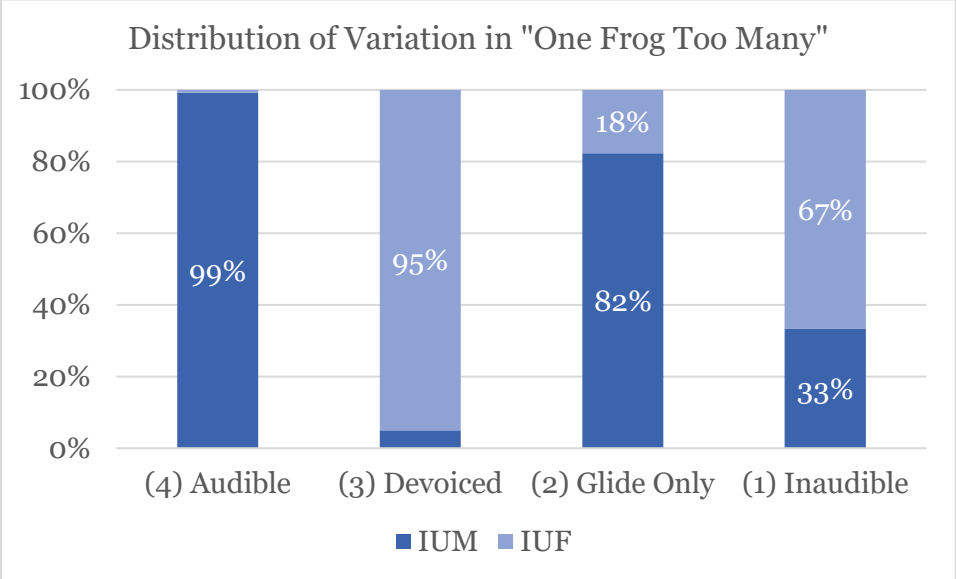
Distribution of phonetic variants in “One Frog Too Many,” summarized in Table 8 below, is as follows: of the 149 suffix tokens in IU-medial position, 124 are fully audible, 1 is devoiced, 14 surface as glide-only, and 10 are inaudible. Of the 43 tokens in IU-final position, 1 is fully audible, 19 contain a devoiced vowel, 3 surface as glide only, and 20 are inaudible.

Table 8. Distribution of Phonetic Variants in "One Frog Too Many"

	IUM	IUF	Total
(4) Audible	124	1	125
(3) Devoiced	1	19	20
(2) Glide Only	14	3	17
(1) Inaudible	10	20	30
Total	**149**	**43**	**192**

These data are repeated in Figure 17 in terms of percentages. Of the 192 total *–wa* and *–yi* tokens identified in "One Frog Too Many," 99% of fully audible variants occur in IU-medial position, while only 1% occur in IU-final position. 95% of the variants containing a devoiced vowel occur in IU-final position. The majority of glide-only variants (82%) occur in IU-medial position, while 18% occur in IU-final position. The majority of inaudible variants (67%) occur in IU-final position, though 33% occur in IU-medially.

Figure 17. Distribution of Phonetic Variants in "One Frog Too Many"



Again, the distribution of phonetic variants in "One Frog Too Many" is very similar to the combined distributional data presented in Figure 15. Fully audible variants almost always occur in IU-medial position, while devoiced variants are almost always found in IU-final position. Also, as in the combined data, glide-only and inaudible variants occur

in both positions, though the glide-only variants are mostly found in IU-medial position, while inaudible variants most frequently occur in IU-final position.

Examining *–wa* and *–yi* in IU-medial and IU-final positions reveals that a clear majority of IU-medial tokens surface as fully-audible, while utterance-final tokens are generally devoiced. Glide-only variants are more frequently found in IU-medial position, though by a narrower margin. Likewise, the majority of inaudible tokens appear IU-finally, though their distribution is not clear enough to propose a phonological suffix deletion rule based on this data. The cases of glide-only and inaudible variants are discussed further in §4.3.2.

As mentioned in §4.1 above, these results are not captured by word-final or phrase-final vowel devoicing rules. Rather, the distribution of variation seen in the data is reflective of an intonation unit-final vowel devoicing rule, proposed in (29), which states that vowels are devoiced in IU-final position, indicated here by IU.

(29) Intonation Unit-Final Vowel Devoicing Rule

$V \rightarrow \underset{\circ}{V} / \_\_\_ IU$

4.3 Exceptional Cases

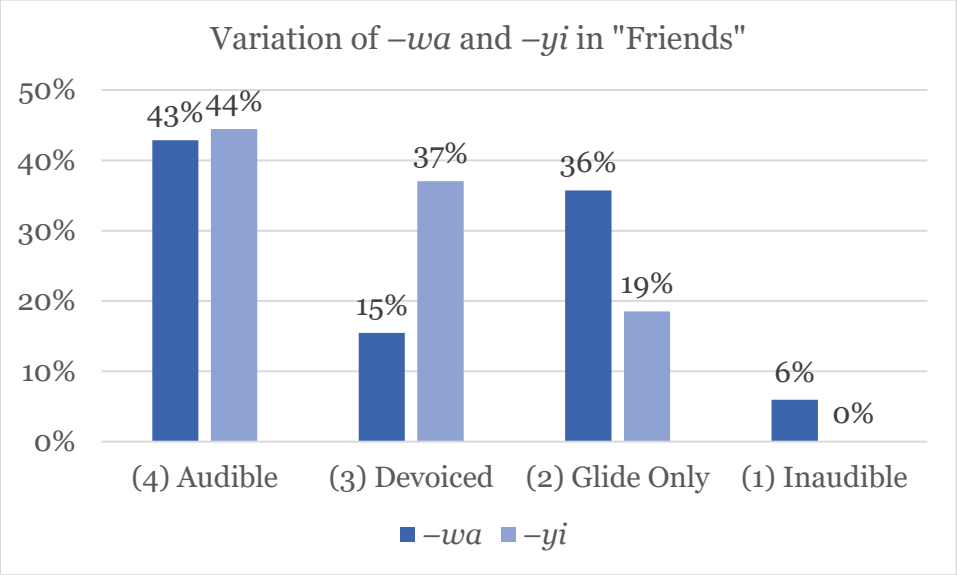
The following section discusses two exceptional cases in the data which concern devoiced, glide-only, and inaudible variants in the recordings. These cases are presented as issues for further research in §5.5.

4.3.1 Divergent Behavior of *–wa* and *–yi* in "Friends"

In general, *–wa* and *–yi* appear to behave similarly to one another in terms of phonetic variation. The following exception aside, the relative frequencies of phonetic variants of

–wa and *–yi* are no more than 6 percentage points apart in either recording (see Figures 13 and 14 above). An exception to this pattern can be found in the cases of devoiced and glide-only variants in "Friends." Notably, *–wa* and *–yi* seem to exhibit divergent behavior in these cases. As shown in Figure 18, *–yi* tokens are more frequently devoiced (37% of total *–yi* tokens), while *–wa* tokens are more frequently realized as glide-only (36% of total *–wa* tokens).

Figure 18. Phonetic Variants as Percentages of Total Tokens in "Friends"



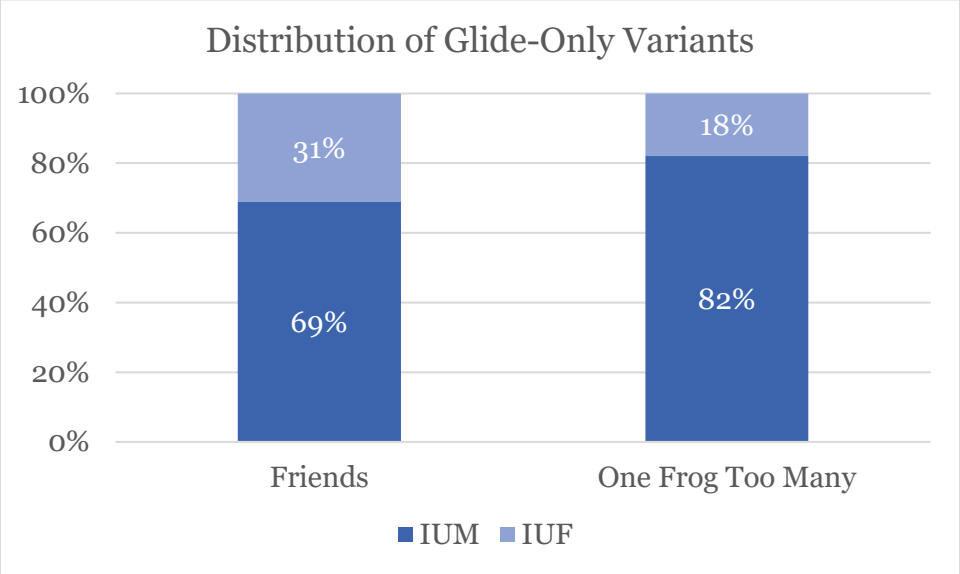
There are various potential explanations for this departure. The following non-exhaustive list includes some factors which may have an effect on the data: (i.) the IU-position of each suffix in this particular recording (i.e. whether each token is IU-medial or IU-final); (ii.) interaction with another phonological process, such as hiatus resolution in the case that the word following the token begins with a vowel; (iii.) an increased likelihood of high vowels to devoice in the case of *–yi*, as suggested by Silva (1998) for São Miguel Portuguese (Italic), and by Miyashita (2011) for Tohono O'odham (Uto-Aztecan); or (iv.) a discourse strategy, such as turn-marking. A finer-grained

analysis which takes this type of information into account could help explain why one variant might be selected over another in a case such as this.

4.3.2 Variable Distribution of Inaudible and Glide Only Variants

In general, inaudible and glide-only variants appear not to be restricted to either IU-medial or IU-final position. As shown in Figure 19 below, 69% of inaudible variants occur IU-medially in "Friends," while 82% occur IU-medially in "One Frog Too Many." In both cases, the majority of glide-only variants are found in IU-medial position.

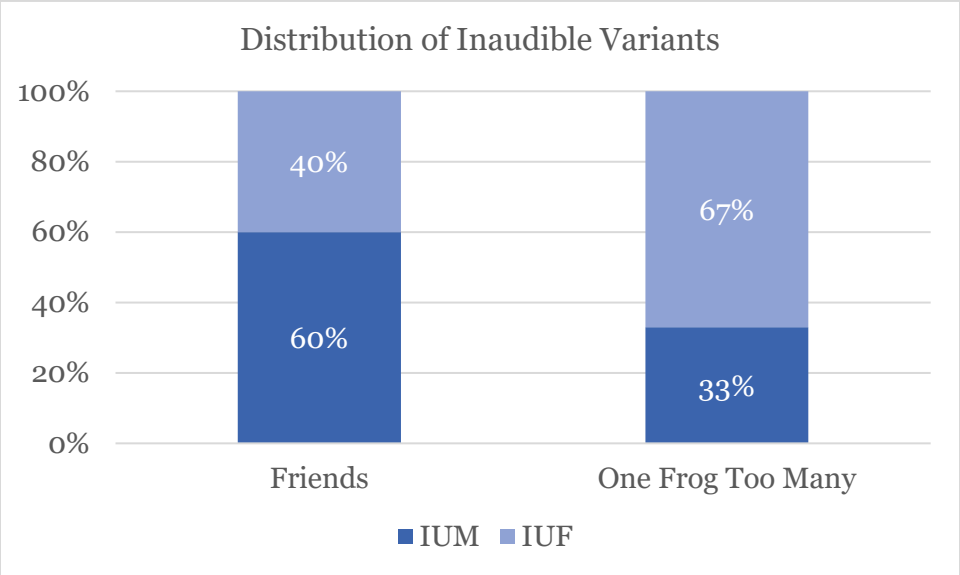
Figure 19. Distribution of Glide-Only Variants



In both cases, the majority of glide-only variants occur IU-medially, though this distribution is not as categorical as the distribution of fully audible and devoiced variants, where nearly all tokens of each variant occur IU-medially and IU-finally, respectively. The variable distribution of glide-only variants could be a result of one or more of several other non-phonological processes, such as information structure or discourse strategy. Other possible explanations include generational or idiolectical variation.

As shown in Figure 20 below, 60% of inaudible variants of *–wa* and *–yi* occur in IU-medial position in "Friends," while only 33% of inaudible variants occur in IU-medial position in "One Frog Too Many." Conversely, only 40% of inaudible variants occur in IU-medial position in "Friends," while 67% of inaudible variants occur in IU-final position in "One Frog Too Many."

Figure 20. Distribution of Inaudible Variants



The variable distribution of inaudible variants could simply be a result of the difficulty involved in identifying inaudible variants on a recording. As discussed in §2.2.1, inaudible tokens of *–wa* and *–yi* are identifiable by virtue of their obligatory grammatical status. It is possible, however, that there are cases where the suffix is not underlyingly present, as assumed in this study. It is also possible that inaudible variants surface are the result of deletion by some other non-phonological process, such as information structure or discourse strategy. This could also be a result of generational or idiolectic variation.

Another caveat to the identification of inaudible variants in this study stems from the fact that phonetic targets in Blackfoot can be visual in nature without being acoustically perceptible at all, as shown in Bliss and Gick's (2009) study. This means that analyses based on audio recordings without accompanying video or other measurements may be incomplete on some level. Investigations of glide-only and inaudible variants of *–wa* and *–yi* using video or other instrumentation could shed some light on this exceptional case.

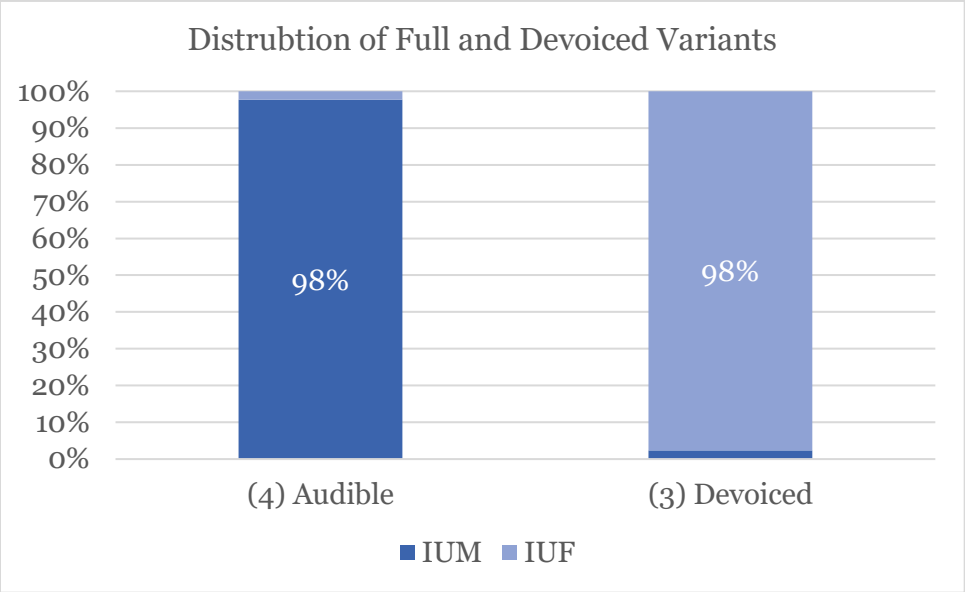
4.4 Summary of Results

In 16 minutes and 28 seconds of total recorded speech, a total of 303 *–wa* and *–yi* tokens were identified, distributed across 147 intonation units. Across both the phonetic variation and IU environment data, fully-audible tokens generally occur in IU-medial position, while devoiced tokens generally occur IU-finally.

The distribution of glide-only and inaudible variants of *–wa* and *–yi* is relatively unstable compared to that of fully audible and devoiced variants, as these variants are found in both IU-medial and IU-final environments. That said, glide-only variants do occur more frequently in IU-medial position, while inaudible variants are more frequent IU-final position. This suggests that glide-only variants follow a similar pattern as audible variants, and that inaudible variants pattern similarly to devoiced variants. This tendency, while interesting, is not strong enough to substantiate their inclusion in a general phonological rule at this time. As discussed in §4.3, the unclear distribution of these variants may be motivated by a number of factors and merits further research in its own right.

Setting aside glide-only and inaudible variants, a clear trend emerges among the fully audible and devoiced variants. Reanalyzing the data focusing on these two categories generates the following generalization, shown in Figure 21: audible *–wa* and *–yi* tokens occur almost exclusively in IU-medial position, while inaudible tokens are almost always found in IU-final position.

Figure 21. Combined Distribution of Audible and Devoiced Variants



Based on this analysis, this thesis proposes an intonation unit-final vowel devoicing rule to describe these findings. This rule, repeated from (29) in §4.2 above, is given in (30) below in phonological notation.

(30) Intonation Unit-Final Vowel Devoicing Rule

$$V \rightarrow \underset{\circ}{V} / \_\_ \text{IU}$$

This rule describes the devoicing of word-final *–wa* and *–yi* in IU-final position, while also accounting for the full articulation of IU-medial *–wa* and *–yi*.

SECTION 5: DISCUSSION

The following section offers some discussion of the significance of this work, including implications for linguistic theory (5.1), research methodologies (5.2), and typology (5.3); issues for further research (5.4); and broader impacts (5.5).

5.1 THEORETICAL DOMAIN OF FINAL VOWEL DEVOICING

As discussed in §2.1, the exact manifestation of this process varies cross-linguistically, as does the theoretical classification thereof. For example, in the case of Kinyarwanda (Bantu), Meyers & Crowhurst (2006) argue that word-final vowel devoicing is a phonetic, i.e. non-phonological process, claiming that "[i]t would not do justice to the facts to say that there is a category of voiceless vowels that occur only at the end of an utterance" and rather, that the devoicing of final vowels is a result of coarticulation with the silence which follows an utterance (Meyers & Crowhurst 2006). This analysis is in line with the typological perspective presented Gordon (2015:96), who notes that in the majority of languages for which voiceless vowels are attested, "[they] are a surface non-contrastive property, and thus less clearly belong to the phonology."

That said, Gordon (2105) further claims that phonological processes may be phonetically motivated. This type of inter-domain interaction is promoted by theoretical frameworks such as phonetically-driven phonology, grounded phonology, and laboratory phonology which appeal to functional, articulatory, and perceptual reasoning to explain phonological processes (e.g. Hayes 1999, Archangeli & Pulleyblank 1994, Pierrehumbert & Clopper 2010). It is also true that phonetic environments and phonological environments sometimes overlap. For example, IU-final position can be argued to be a phonetic environment in that it refers to the location where a final

segment is followed by a pause, leading to coarticulation with silence. On the other hand, IU-final position can be considered a phonological environment in terms of it being a systematic conditioning environment for allophonic variation. This further blurs the distinction between the two domains.

Making a determination about whether particular phenomenon belongs one theoretical domain or another may not always be possible (Gordon 2015). Based on the above discussion, IU-final vowel devoicing in Blackfoot could be argued to belong to the domain of phonetics or phonology, or both.

5.2 Research on Connected Speech

This study contributes an analysis of data from connected speech to the body of Blackfoot literature. This type of data is particularly valuable in the case understudied and endangered languages, as samples of connected speech are less readily available for documentation, analysis, and materials development in such cases. The representation of various domains of language in documentation is desirable both in terms of comprehensiveness (Mithun 2006) and descriptive adequacy, as language behavior may vary across different domains. As mentioned in §2.3.2, certain morphology (e.g. Blackfoot preverb *it-*, Bliss 2010; Japanese word order, Ono & Suzuki 1992) has been shown to have a different distribution and function in elicitations versus narrative contexts. Likewise, the findings of this study speak to the potential for variation in distribution and function of certain morphology, e.g. *–wa* and *–yi,* in connected speech compared to elicited data. Studies such as these demonstrate the importance of working with as many language domains as possible when engaging in the documentation and analysis of linguistic phenomena.

5.3 Typology of Intonation Units

As argued in §5.2.3 above, linguistic analysis of connected speech is a crucial component of comprehensive documentation and description. Discourse-level analyses, however, pose a different set of challenges for data processing than those posed by elicited data. One such challenge is the meaningful segmentation of discourse into cohesive units. Du Bois et al. (1992) identify intonation units as the basic unit of analysis in the transcription of connected speech. Recall the prototypical features of intonation units described by Du Bois et al. 1992, repeated in (31) below from (20) in §2.3.3.

(31) Prototypical Features of an Intonation Unit

a. *Coherent Contour:* a unified intonation contour
b. *Reset:* a resetting of the baseline pitch level at the beginning of the unit
c. *Pause:* a pause between units
d. *Anacrusis:* a sequence of accelerated syllables at the beginning of the unit
e. *Lengthening:* a prosodic lengthening of syllable(s) at the end of the unit

(adapted from Du Bois et al. 1992:100)

As discussed previously, feature (e) in (25) above is problematic in the case of Blackfoot, as any potential lengthening of final syllables is obscured by the devoicing or deletion of final vowels (see example 15 in §2.2). Thus, lengthened final syllables are not a feature of intonation units in Blackfoot. Since, as shown in this study, IU-final vowels are very frequently devoiced, a set of Blackfoot-specific criteria for intonation units including IU-final devoicing may be proposed. As shown in (27) below, feature (e) has been changed from lengthening to reduction to reflect the findings of this study.

(32) Prototypical Features of Blackfoot Intonation Units

a. *Coherent Contour:* a unified intonation contour
b. *Reset:* a resetting of the baseline pitch level at the beginning of the unit
c. *Pause:* a pause between units
d. *Anacrusis:* a sequence of accelerated syllables at the beginning of the unit
e. *Reduction:* devoicing or deletion of the final syllable of the unit

As noted in Castillo (2003), the phonetic correlates of intonation units, a conceivably universal unit of speech, do vary cross-linguistically. In fact, based on Castillo's (2003) study of intonation units in Navajo (Athabaskan), the following list of prototypical IU features is proposed:

(33) Prototypical Features of Navajo Intonation Units[21]

a. *Coherent Contour:* a declination of fundamental frequency over an IU
b. *Reset:* reset in pitch from one IU to the next
c. *Pause:* a pause between units
d. *Lengthening:* lengthening of IU-final vowels
e. *Absence of Creaky Voice:* IU-medial vowels preceding a glottal stop become creaky, while IU-final vowels preceding a glottal stop do not

(adapted from Castillo 2003)

Note that features (a—d) in (33) also appear in Du Bois et al.'s universal list in (31). As in the case of the Blackfoot IU list in (32), feature (e) is language specific, due to the segmental effects of glottal stops in Navajo. Interestingly, Navajo, like Blackfoot, has phonemic vowel length, which seems to have an effect IU-final lengthening. Castillo (2003) notes that for Navajo, though there is an increase in duration for vowels in

[21] The features given in Castillo (2003) have been adapted to reflect the list format utilized in this thesis for the sake of comparison. Note that anacrusis is not examined in Castillo's (2003) study, and its exclusion from the list in (27) is reflective only of that fact. That is to say, anacrusis may or may not be a feature of Navajo IUs.

IU-final position, this increase is not statistically significant, and thus this feature is not a primary indicator of an IU boundary.

Typologically speaking, this suggests that languages with phonemic vowel length may exhibit distinct IU-final lengthening phenomena than languages without phonemic vowel length. Additionally, it is possible that some IU features, like coherent contour, reset, and pause, may be more universal than others, like lengthening. Practically speaking, the development of language-specific transcription practices may be appropriate for the ease and accuracy of processing connected speech for analysis.

It is also the case that a typology of intonation units may be a useful tool for the classification of languages more broadly. Theoretically, this metric for classification has the potential generate new insights into how discourse is produced, organized, and processed by interlocutors.

5.4 Issues for Further Research

Examining *–wa* and *–yi* contributes to the documentation of vowel devoicing in Blackfoot while also laying the groundwork for further studies on final vowels in this and other languages. A logical next step in this research is to examine all word-final vowels and suffixes, beyond just *–wa* and *–yi,* in order see if the findings presented here are upheld.

Any further studies would ideally include data from more speakers, and in more than one format. As discussed in §3.1, this study is based on data from two speakers in a narrative format. As mentioned in §5.3 above, comprehensive and descriptively adequate documentation is based on a wide variety of language domains. It would be

interesting to see if the findings presented here are upheld in other domains of speech, e.g. storytelling, singing, or dialogue.

The topic of this study also merits some investigation from a variationist perspective. While the data in this study is representative of two bands (Piikani and Blackfeet) and two genders (male and female), both speakers in the recordings might be categorized as speakers of generational dialects of Blackfoot.[22] Again, in the interest of comprehensiveness and descriptive adequacy, further studies would consult data from other potential dialect groups.

An additional consideration for further studies and documentation projects is the inclusion of different data methodologies. As shown in Bliss and Gick's (2009) study, voiceless vowels in Blackfoot may have both visual and acoustic articulatory targets, which are not observable in recordings alone. Thus, in future studies, video recording, as well other instrumental measurements (e.g. ultrasound, lip aperture measurement), may be necessary to get a complete picture of IU-final vowel devoicing. In particular, as discussed in §4.3, video and instrumental studies of glide-only and inaudible variants are needed to address their variable distribution across IU-medial and IU-final environments.

5.5 Broader Impacts

When researching endangered Indigenous languages, implications for revitalization and pedagogy are particularly important. Linguistic documentation and description can be

[22]See e.g. Bliss & Glougie 2009, Miyashita & Chatsis 2015, Genee & Junker 2018 for further discussion of variation in Blackfoot.

informative tools for the development of language pedagogy, which is a key component of language revitalization. In some cases, legacy documentation serves as the only extant record of a language, and the sole source of information from which to generate teaching materials (see e.g. Baldwin et al. 2018, Warner et al. 2007, Lukaniec 2018 for further discussion). That being the case, it is particularly vital that linguistic documentation and analysis be comprehensive, descriptively adequate, and representative of language as it is actually used. As discussed in §5.2 above, the analysis of connected speech, such as that presented in this thesis, is a key component of such documentation.

In the case that language materials do not discuss language variation overtly, confusion may arise for language learners when there is a discrepancy between the language represented in pedagogical materials and the language used by speakers. For example, Miyashita and Chatsis (2015) note that in classroom settings, students recognize differences between certain forms produced by their native speaker instructor and their corresponding dictionary entries, in some cases due to final vowel devoicing in *–wa* and *–yi*. This recognition is paired with the idea that there should be only one form taught in class, and that some sort of standard variation ought to be acknowledged. According to Miyashita and Chatsis (2015), this is indicative of the students' ideology of "standard" being in conflict with the natural variability of language and the instructor's ideology of equal respect for all variation. This speaks to the necessity of comprehensive and descriptively adequate documentation which both represents and validates language variation.

In other cases, language variability is overtly discussed in classrooms, yet teachers are unable to rely on documentation to identify the specifics of the phenomena they know to

be present. For example, Naatosi Fish, a heritage speaker and instructor of Blackfoot at the University of Montana, teaches his students about the variation *–wa* and *–yi,* but directs them to fully articulate these suffixes so they recognize them as underlyingly present in the grammar. Then, as students become more comfortable in the language, he directs them to start devoicing *–wa* and *–yi* where they feel it is appropriate, which he reports usually leads them to devoicing the suffixes everywhere (Fish, p.c. 2019). As shown in this study, however, this may not mirror the IU-final vowel devoicing observed in native speakers. Given that heritage language learners want to sound "native-like" (Fish 2018), this case highlights the importance of comprehensive and descriptively adequate documentation and its potential to inform language pedagogy.

The two cases above point to the importance of how language is represented in descriptive and pedagogical materials, as well as the potential for linguistic analysis to aid in the development of pedagogical materials and language curriculum. This also reinforces the point made in §5.2 that analysis of connected speech is necessary to fully encapsulate language as it is actually used, which language learners seek to emulate and eventually achieve themselves. That said, language documentation need not only be comprehensive and descriptively adequate, but it also must be instructive.

SECTION 6: SUMMARY AND CONCLUSION

This thesis presents a study of the Blackfoot suffixes *–wa* and *–yi* in terms of their varying phonetic realizations in IU-medial and IU-final environments. This investigation addresses ambiguity in previous descriptions of these suffixes in particular and of final vowel devoicing in general. While previous work recognizes the presence of

a final vowel devoicing process in the language, the conditioning environment for this phenomenon had not been investigated in particular prior to the present study.

This study investigates final vowel devoicing in Blackfoot by examining the suffixes *–wa* and *–yi* in connected speech. This investigation is based on recorded narrations by two native speakers of Blackfoot. These recordings are analyzed in terms of the phonetic realizations of *–wa* and *–yi* tokens as well as their distribution across IU-medial and IU-final environments.

The findings of this study are that fully-audible variants of *–wa* and *–yi* almost always occur IU-medially, while devoiced variants are most frequently found in IU-final position. Assuming that this pattern extends to all final vowels, this thesis proposes an IU-final vowel devoicing rule to account for the data presented in §4. This rule is repeated in (34) below.

(34) Intonation Unit-Final Vowel Devoicing Rule

$V \rightarrow \underset{\circ}{V} / \_\_\_ IU$

As discussed previously, the findings of this study do not necessarily parallel previous claims about final vowel devoicing in the literature. Specifically, the data in this study are not captured by generalized word- or phrase-final vowel devoicing rules. In other words, devoicing of word-final vowels in Blackfoot does indeed occur, but the conditioning environment for this phenomenon is IU-final rather than word- or phrase-final, as previously thought.

An additional finding of this study is that final vowel devoicing does not take the form of a binary contrast (i.e. voiced vs. voiceless), but rather, generates a variety of surface

realizations. Specifically, word-final *–wa* and *–yi* were shown to surface as one of four variants: fully audible, devoiced, glide-only, and inaudible.

The findings of this study address a gap in the literature on Blackfoot phonology, and also has implications for typology, theory, and research methodologies. Additionally, this work has the potential to inform pedagogical and revitalization work in Blackfoot.

APPENDIX A: "FRIENDS" FULL DATASET

The following chart is a result of a data export from the ELAN annotation file for the recording "Friends" featuring Shirlee Crow Shoe. This chart includes only the forms analyzed in this study (i.e. those ending in either *–wa* or *–yi*). As per the metrics described in §3, this chart reflects the interlinearization of the recording. Each token of *–wa* or *–yi* is associated with a timestamp as well as its parent word. The gloss of the parent word is also included. The AUD and ENVIRON columns indicate the phonetic and distributional analysis of each token.

TIME	MORPH	WORD	GLOSS	AUD	ENVIRON
00:07.5	wa	imitaáíkoana	puppy	(3) devoiced	IUF
00:10.5	wa	matsiyíkkapisaawa	frog	(3) devoiced	IUF
00:12.8	wa	sspopííwa	turtle	(4) aud	IUM
00:14.3	wa	tsáániwa	Johnny	(4) aud	IUF
00:18.8	wa	tsáániiwa	Johnny	(4) aud	IUM
00:20.7	wa	áó'ohkoitapiiyiwa	receive.a.gift	(2) glide only	IUM
00:22.4	wa	isóómoonii'pa	wrap	(3) devoiced	IUF
00:33.4	wa	tsáániwa	Johnny	(4) aud	IUM
00:35.0	wa	isskai'táámssiwa	be.happy	(2) glide only	IUM
00:41.9	wa	iikayinnima	open	(4) aud	IUM
00:42.5	yi	anni	DEM	(4) aud	IUM
00:43.9	yi	isóómoonii'pi	wrap	(3) devoiced	IUF
00:48.7	wa	imitaáíkoana	puppy	(4) aud	IUM
00:50.0	wa	matsiyíkkapisaawa	frog	(4) aud	IUM
00:51.3	wa	sspopííwa	turtle	(4) aud	IUF
01:00.4	wa	aanistá'piiwa	be	(2) glide only	IUM
01:02.3	yi	otahkóitapiiyissini	receive	(3) devoiced	IUF
01:05.8	wa	tsáániwa	Johnny	(4) aud	IUM
01:08.0	yi	tamsookitsii	suddenly	(4) aud	IUM
01:09.6	wa	iihto'takiwa	take	(4) aud	IUM
01:10.7	yi	anni	DEM	(4) aud	IUM
01:12.0	yi	ataksáakssini	box	(3) devoiced	IUF
01:17.4	wa	matsiyíkkapisaawa	frog	(3) devoiced	IUF
01:25.4	wa	sskaitaami'takiwa	feel.good	(2) glide only	IUM
01:26.2	wa	tsáániwa	Johnny	(4) aud	IUM
01:29.1	yi	akkaamotsiyi	have.as.friend	(3) devoiced	IUF

01:37.3	wa	…kkapisaawa	frog	(3) devoiced	IUF
01:42.0	wa	imitááwa	dog	(4) aud	IUM
01:43.5	wa	skai’itaami'takiwa	feel.happy	(4) aud	IUM
01:45.2	wa	sspopííwa	turtle	(2) glide only	IUF
01:47.4	wa	itai'sawaahsitakiwa	feel.sad	(2) glide only	IUM
01:48.4	wa	'matsiyíkkapisaawa	frog	(2) glide only	IUF
01:57.1	yi	amoyi	DEM	(4) aud	IUM
01:59.4	wa	maanakkaawa	new.friend	(3) devoiced	IUF
02:14.3	wa	'matsiyíkkapisaawa	frog	(2) glide only	IUM
02:27.8	wa	tsáániwa	Johnny	(4) aud	IUM
02:33.2	wa	imitááwa	frog	(4) aud	IUM
02:35.3	wa	sspopííwa	turtle	(2) glide only	IUF
02:42.1	wa	tsáániwa	Johnny	(4) aud	IUM
02:53.7	wa	kitaahkisitaissataistotowa	make.angry	(2) glide only	IUF
03:07.9	wa	tsáániwa	Johnny	(4) aud	IUM
03:09.0	wa	iitomowa	go	(1) inaud	IUM
03:09.9	wa	imitááwa	dog	(2) glide only	IUM
03:11.2	wa	ipookiisapoo	follow	(1) inaud	IUF
03:12.9	wa	sspopííwa	turtle	(4) aud	IUM
03:14.5	wa	'matsiyíkkapisaawa	frog	(2) glide only	IUM
03:16.0	wa	itohkitopii	sit.on	(1) inaud	IUF
03:17.6	wa	pokatsíkkapisaawa	small.frog	(2) glide only	IUM
03:18.8	wa	itapatopiwa	sit.on.back	(2) glide only	IUM
03:30.0	yi	''matsiyíkkapisaawa	frog	(2) glide only	IUM
03:36.0	yi	pokatsíkkapisaawa	small.frog	(3) devoiced	IUF
03:42.2	wa	kai'sohkawaa'sainiwa	cry.out	(2) glide only	IUF
03:43.5	wa	tsáániwa	Johnny	(4) aud	IUM
03:48.7	wa	imitááwa	dog	(4) aud	IUM
03:55.9	wa	maatsoka'piiwa	be.not.good	(3) devoiced	IUF
04:09.8	wa	otááhkioohsa'tsoowa	his.boat	(3) devoiced	IUF
04:12.6	wa	tsáániwa	Johnny	(4) aud	IUM
04:18.9	yi	'matsiyíkkapisaayi	frog	(2) glide only	IUM
04:36.5	wa	...aohtaahkioohsiwa	travel.by.boat	(3) devoiced	IUF
04:41.6	wa	...to'tohpaawaniiwa	jump	(2) glide only	IUM
04:42.9	wa	'matsiyíkkapisaawa	frog	(2) glide only	IUF
04:56.6	yi	pokatsíkkapisaayi	small.frog	(3) devoiced	IUF
05:14.8	yi	anni	DEM	(4) aud	IUM
05:15.7	yi	aohkííyi	water	(4) aud	IUM
05:17.0	wa	sspopííwa	turtle	(4) aud	IUM
05:19.7	yi	'matsiyíkkapisaayi	frog	(2) glide only	IUM
05:21.9	yi	mattanistsiihpi	do.again	(3) devoiced	IUF
05:30.8	wa	sspopííwa	turtle	(4) aud	IUM
05:35.5	wa	annawa	DEM	(2) glide only	IUM

05:36.5	wa	'matsiyíkkapisaawa	frog	(1) inaud	IUM
05:40.3	yi	pokatsíkkapisaayi	small.frog	(4) aud	IUF
05:57.3	wa	sayippoma'pssiwa	bad.person	(3) devoiced	IUF
06:05.7	wa	ohkanaa'pssammawa	look.for	(2) glide only	IUM
06:07.3	wa	pokatsíkkapisaawa	small.frog	(2) glide only	IUM
06:12.2	yi	miisawattsiistaahtssapipiyi	look.under	(4) aud	IUM
06:15.6	wa	sspopííwa	turtle	(4) aud	IUM
06:17.6	wa	nohkattapssapiwa	look.for	(2) glide only	IUF
06:18.7	wa	imitááwa	dog	(4) aud	IUM
06:25.0	wa	'matsiyíkkapisaawa	frog	(4) aud	IUM
06:56.1	yi	'matsiyíkkapisaayi	frog	(3) devoiced	IUF
07:03.7	wa	tsáániwa	Johnny	(4) aud	IUM
07:05.7	wa	sskao'tsawaahsi'takiwa	be.sad	(2) glide only	IUF
07:08.1	wa	sotamikakitaihtsiwa	be	(2) glide only	IUM
07:09.0	yi	otokssíni	bed	(4) aud	IUM
07:10.3	wa	awaasai'niwa	cry	(3) devoiced	IUF
07:12.2	wa	imitááwa	dog	(4) aud	IUM
07:15.4	wa	sspopííwa	turtle	(4) aud	IUM
07:17.6	wa	tsikakitapittahkapiwa	crawl.into	(2) glide only	IUM
07:20.3	yi	ookóówani	house	(3) devoiced	IUF
07:23.8	wa	'matsiyíkkapisaawa	frog	(2) glide only	IUM
07:26.7	wa	ohkanohkookimmawa	mad.at	(3) devoiced	IUF
07:29.3	wa	maatomaisamowa	long.in.time	(4) aud	IUM
07:30.8	wa	tamsokoohtsimiwa	hear	(2) glide only	IUM
07:31.6	wa	imitááwa	dog	(2) glide only	IUM
07:37.2	wa	aikkatsimaawa	croak	(2) glide only	IUF
07:45.6	yi	aiyoohtoyiy	hear	(4) aud	IUM
07:47.3	yi	aikkapisaayi	croak	(3) devoiced	IUF
07:53.0	yi	pokatsíkkapisaayi	small.frog	(2) glide only	IUM
07:55.5	wa	aikkapisaawa	croak	(3) devoiced	IUF
08:02.2	wa	sotamitohkitohpiiwa	sit.on	(4) aud	IUM
08:03.4	yi	anni	DEM	(4) aud	IUM
08:05.1	yi	'matsiyíkkapisaayi	frog	(4) aud	IUM
08:08.4	yi	otaisskayookimmokatsai	not.like	(2) glide only	IUF
08:24.0	wa	tsikiwa	boy	(4) aud	IUM
08:25.3	wa	tsáániwa	Johnny	(4) aud	IUM
08:26.9	wa	annawa	DEM	(4) aud	IUM
08:27.6	wa	imitaáíkoana	puppy	(1) inaud	IUM
08:29.1	wa	sspopííwa	turtle	(4) aud	IUM
08:30.6	wa	annawa	DEM	(4) aud	IUM
08:31.5	wa	'matsiyíkkapisaawa	frog	(2) glide only	IUM
08:33.9	wa	pokatsíkkapisaawa	small.frog	(2) glide only	IUF

APPENDIX B: "ONE FROG TOO MANY" FULL DATASET

The following chart is a result of a data export from the ELAN annotation file for the recording "One Frog Too Many" featuring Earl Old Person. This chart includes only the forms analyzed in this study (i.e. those ending in either *–wa* or *–yi*). As per the metrics described in §3, this chart reflects the interlinearization of the recording. Each token of *–wa* or *–yi* is associated with a timestamp as well as its parent word. The gloss of the parent word is also included. The AUD and ENVIRON columns indicate the phonetic and distributional analysis of each token.

TIME	MORPH	WORD	GLOSS	AUD	ENVIRON
00:08.6	wa	amowa	DEM	(4) aud	IUM
00:10.3	wa	ataksáakssini	box	(3) devoiced	IUF
00:11.9	wa	amowa	DEM	(1) inaud	IUM
00:12.8	wa	saahkómaapiwa	boy	(3) devoiced	IUF
00:17.7	yi	iihpoka'apassiimiwayi	be.with	(1) inaud	IUF
00:18.4	yi	ami	DEM	(4) aud	IUM
00:19.0	yi	imitááyi	dog	(4) aud	IUM
00:19.9	yi	anni	DEM	(4) aud	IUM
00:21.2	yi	matsiyíkkapisaayi	frog	(1) inaud	IUF
00:23.2	yi	ami	DEM	(4) aud	IUM
00:23.8	yi	sspopíiyi	turtle	(1) inaud	IUF
00:35.1	wa	oma	DEM	(4) aud	IUM
00:35.8	wa	saahkómaapiwa	boy	(4) aud	IUM
00:37.1	yi	ataksáakssini	box	(1) inaud	IUF
00:39.3	yi	aanistapataksáakssini	box	(4) aud	IUM
00:43.2	yi	iihkotahpi	give	(3) devoiced	IUF
00:49.4	wa	kitsikayinima	open	(4) aud	IUM
00:50.6	yi	ami	DEM	(4) aud	IUM
00:51.9	yi	ataksáakssini	box	(4) aud	IUM
00:58.9	wa	itssapihtsiiwa	be.inside	(1) inaud	IUF
01:00.6	wa	oma	DEM	(4) aud	IUM
01:01.6	wa	sspopíiwa	turtle	(4) aud	IUM
01:02.8	wa	matsiyíkkapisaawa	frog	(4) aud	IUM
01:03.7	wa	oma	DEM	(4) aud	IUM
01:04.4	wa	imitááwa	dog	(1) inaud	IUF
01:05.3	wa	oma	DEM	(4) aud	IUM

01:05.7	wa	saahkómaapiwa	boy	(1) inaud	IUM
01:07.3	wa	ihkanaisaapssapiwa	look.in	(2) glide only	IUF
01:10.9	yi	iisaohkiaaki	stick.out.head	(4) aud	IUM
01:11.5	yi	ami	DEM	(4) aud	IUM
01:12.1	yi	po'ksiyi	small.one	(4) aud	IUM
01:13.4	yi	matsiyíkkapisaayi	frog	(3) devoiced	IUF
01:19.0	wa	saahkómaapiwa	boy	(1) inaud	IUM
01:19.7	wa	oma	DEM	(4) aud	IUM
01:20.2	wa	imitááwa	dog	(4) aud	IUM
01:20.9	wa	sspopííwa	turtle	(1) inaud	IUF
01:21.7	wa	oma	DEM	(4) aud	IUM
01:22.4	wa	omahksimma	big.one	(4) aud	IUM
01:23.1	wa	matsiyíkkapisaawa	frog	(1) inaud	IUM
01:25.5	yi	anni	DEM	(4) aud	IUM
01:27.8	wa	stamitanistapaopiiwa	sit.alone	(2) glide only	IUF
01:33.4	wa	oma	DEM	(4) aud	IUM
01:33.9	wa	saahkómaapiwa	boy	(2) glide only	IUM
01:41.2	yi	po'ksiyi	small.one	(4) aud	IUM
01:42.1	yi	matsiyikkapisaawa	frog	(2) glide only	IUF
01:49.6	yi	saakiohkanaitomannistsiyi	be.together	(4) aud	IUM
01:56.9	yi	otanistsihpi	dog	(4) aud	IUM
01:57.3	wa	oma	DEM	(4) aud	IUM
01:58.2	wa	omahksimma	big.one	(4) aud	IUM
01:59.6	wa	matsiyíkkapisaawa	frog	(3) devoiced	IUF
02:02.2	yi	ami	DEM	(4) aud	IUM
02:02.9	yi	po'ksiyi	small.one	(4) aud	IUM
02:04.0	yi	matsiyíkkapisaayi	frog	(1) inaud	IUF
02:09.2	yi	anni	DEM	(4) aud	IUM
02:14.1	yi	ami	DEM	(4) aud	IUM
02:14.6	yi	omahksimmi	big.one	(4) aud	IUM
02:15.9	yi	matsiyíkkapisaayi	frog	(2) glide only	IUM
02:18.2	yi	ami	DEM	(4) aud	IUM
02:18.7	yi	po'ksyi	small.one	(4) aud	IUM
02:19.8	yi	matsiyíkka…	frog	(1) inaud	IUM
02:22.5	wa	oma	DEM	(4) aud	IUM
02:25.1	yi	ami	DEM	(4) aud	IUM
02:25.6	yi	po'ksiyi	small.one	(4) aud	IUM
02:26.5	yi	matsiyíkkapisaayi	frog	(2) glide only	IUM
02:27.7	wa	saahkómaa..	boy	(1) inaud	IUF
02:30.3	yi	ami	DEM	(4) aud	IUM
02:30.6	yi	omahksimmi	big.one	(4) aud	IUM
02:31.5	yi	matsiyíkkapisaayi	frog	(1) inaud	IUF
02:32.6	wa	oma	DEM	(4) aud	IUM

02:33.0	wa	imitááwa	dog	(2) glide only	IUM
02:33.7	wa	sspopííwa	turtle	(2) glide only	IUM
02:42.4	yi	yiistapooyi	go.away	(4) aud	IUM
02:46.9	wa	oma	DEM	(4) aud	IUM
02:47.4	wa	saahkómaapiwa	boy	(2) glide only	IUM
02:49.6	yi	ami	DEM	(4) aud	IUM
02:51.3	yi	ootomitaami	dog	(1) inaud	IUF
02:52.8	wa	oma	DEM	(4) aud	IUM
02:53.5	wa	matsiyíkkapisaawa	frog	(1) inaud	IUM
02:54.3	wa	oma	DEM	(4) aud	IUM
02:54.9	yi	po'kayi	small.one	(4) aud	IUM
02:55.9	yi	matsiyíkkapisaayi	frog	(4) aud	IUM
02:57.2	yi	aitohkitopiiyi	sit.on	(2) glide only	IUM
02:57.6	yi	ami	DEM	(4) aud	IUM
02:58.4	yi	sspopííyi	turtle	(3) devoiced	IUF
02:59.9	yi	aomaatooyi	go	(3) devoiced	IUF
03:14.2	yi	ami	DEM	(4) aud	IUM
03:14.8	yi	omahksimmi	big.one	(4) aud	IUM
03:15.4	yi	matsiyíkkapisaayi	frog	(1) inaud	IUM
03:17.6	yi	ami	DEM	(4) aud	IUM
03:18.4	yi	po'ksiyi	small.one	(4) aud	IUM
03:19.6	yi	matsiyíkkapisaayi	frog	(4) aud	IUF
03:23.9	yi	ami	DEM	(4) aud	IUM
03:24.6	yi	omahksimmi	big.one	(4) aud	IUM
03:25.4	yi	matsiyíkkapisaayi	frog	(2) glide only	IUM
03:26.1	wa	oma	DEM	(4) aud	IUM
03:26.5	wa	saahkómaapiwa	boy	(2) glide only	IUM
03:29.7	yi	o'tohpo'ksimmi	small.one	(4) aud	IUM
03:30.4	yi	imitááyi	dog	(4) aud	IUM
03:31.7	yi	sspopííyi	turtle	(1) inaud	IUF
03:38.3	wa	oma	DEM	(4) aud	IUM
03:39.4	wa	omahksimma	big.one	(4) aud	IUM
03:40.3	wa	matsiyíkkapisaawa	frog	(2) glide only	IUM
03:43.1	yi	o'tohpo'ksimmi	small.one	(3) devoiced	IUF
03:44.8	wa	oma	DEM	(4) aud	IUM
03:46.7	yi	ami	DEM	(4) aud	IUM
03:47.9	yi	po'ksimmi	s	(4) aud	IUM
03:48.9	yi	matsiyíkkapisaayi	frog	(1) inaud	IUM
03:49.5	yi	ami	DEM	(4) aud	IUM
03:51.8	wa	aitsapakopiwa	?	(1) inaud	IUF
03:56.3	yi	ami	DEM	(4) aud	IUM
03:56.9	yi	omahksimmi	big.one	(4) aud	IUM
03:58.6	yi	matsiyíkkapisaayi	frog	(1) inaud	IUF

04:12.5	yi	ami	DEM	(4) aud	IUM
04:13.4	yi	omahksimmi	big.one	(4) aud	IUM
04:14.6	yi	matsiyíkka…	frog	(3) devoiced	IUF
04:28.3	yi	ami	DEM	(4) aud	IUM
04:29.0	yi	omahksimmi	big.one	(4) aud	IUM
04:29.6	wa	matsiyíkkapisaawa	frog	(4) aud	IUM
04:31.4	yi	ami	DEM	(4) aud	IUM
04:32.0	yi	po'ksiyi	small.one	(4) aud	IUM
04:33.2	yi	matsiyíkkapisaayi	frog	(3) devoiced	IUF
04:37.8	yi	aatohkimmi	get.mad	(4) aud	IUM
04:38.2	yi	ami	DEM	(4) aud	IUM
04:38.9	yi	omahksimi	big.one	(4) aud	IUM
04:39.6	yi	matsi-	frog	(1) inaud	IUF
04:44.4	yi	ahkitapinnohpaatsskoyi	bIUMp	(2) glide only	IUM
04:56.7	wa	maahkohkonnohsa	find	(4) aud	IUM
04:57.2	yi	ami	DEM	(4) aud	IUM
04:57.6	yi	po'ksiyi	small.one	(4) aud	IUM
04:58.7	yi	matsiyíkka…	frog	(1) inaud	IUF
05:00.6	yi	aokimmi	mad.at	(4) aud	IUM
05:01.0	yi	ami	DEM	(4) aud	IUM
05:01.9	yi	omahksimmi	big.one	(1) inaud	IUF
05:03.8	yi	matsiyíkkapisaayi	frog	(3) devoiced	IUF
05:10.5	yi	amo	DEM	(4) aud	IUM
05:11.1	yi	imitááyi	dog	(4) aud	IUM
05:13.8	yi	stamisamaaniiayaatooyi	howl	(4) aud	IUM
05:15.5	yi	iisawahsii'takiyi	feel.sad	(3) devoiced	IUF
05:16.6	wa	oma	DEM	(4) aud	IUM
05:17.2	yi	saahkómaapiyi	boy	(4) aud	IUM
05:19.0	yi	staamanistsinaamanyi	appear.as	(4) aud	IUM
05:22.6	yi	ahkomatawasainii	cry	(3) devoiced	IUF
05:33.2	yi	ami	DEM	(4) aud	IUM
05:35.1	yi	matsiyíkkapisaayi	frog	(1) inaud	IUM
05:35.7	wa	oma	DEM	(4) aud	IUM
05:36.3	wa	imitááwa	dog	(4) aud	IUM
05:38.3	wa	oma	DEM	(4) aud	IUM
05:39.7	yi	ami	DEM	(4) aud	IUM
05:40.7	yi	miistsisi	tree	(3) devoiced	IUF
05:42.1	wa	oma	DEM	(4) aud	IUM
05:43.8	wa	aisipinnakiwa	lift	(4) aud	IUM
05:44.7	wa	saahkómaapiwa	boy	(1) inaud	IUF
05:47.3	wa	stamitannistapaoopiiwa	sit.around	(4) aud	IUM
05:48.5	wa	ihkaannookimma	get.mad	(2) glide only	IUM
05:50.6	wa	maatsikakahsi'takiwa	not.happy	(3) devoiced	IUF

05:57.9	yi	aatomatapoyi	start.again	(3) devoiced	IUF
05:58.9	wa	oma	DEM	(4) aud	IUM
05:59.5	wa	saahkómaapiwa	boy	(1) inaud	IUM
06:00.1	wa	oma	DEM	(4) aud	IUM
06:00.7	wa	sspopííwa	turtle	(4) aud	IUM
06:01.9	wa	imitááwa	dog	(1) inaud	IUF
06:03.1	yi	sotamitsskitsi	leave.behind	(4) aud	IUM
06:03.7	yi	ami	DEM	(4) aud	IUM
06:04.9	yi	omahksimmi	big.one	(4) aud	IUM
06:06.0	yi	matsiyíkkapisaayi	frog	(3) devoiced	IUM
06:11.6	yi	ami	DEM	(4) aud	IUM
06:12.9	wa	oma	DEM	(4) aud	IUM
06:13.9	wa	saahkómaapiwa	boy	(1) inaud	IUM
06:19.0	yi	ami	DEM	(4) aud	IUM
06:19.5	yi	otómiitaami	dog	(4) aud	IUM
06:27.0	wa	oma	DEM	(4) aud	IUM
06:27.5	wa	sspopííwa	turtle	(4) aud	IUM
06:35.8	wa	oma	DEM	(4) aud	IUM
06:37.4	wa	omahksimma	big.one	(4) aud	IUM
06:38.3	wa	matsiyíkkapisaawa	frog	(4) aud	IUM
06:42.5	wa	maatsooki'itakiwa	not.feel.good	(4) aud	IUM
06:46.3	wa	maatsawaahsi'itakiiwa	not.feel.sad	(3) devoiced	IUF
06:52.8	wa	oma	DEM	(4) aud	IUM
06:53.7	wa	saahkómaapiwa	boy	(3) devoiced	IUF
07:02.9	yi	ami	DEM	(4) aud	IUM
07:03.8	yi	po'ksiyi	small.one	(4) aud	IUM
07:05.0	yi	matsiyíkkapisaayi	frog	(2) glide only	IUM
07:17.7	yi	ami	DEM	(4) aud	IUM
07:18.6	yi	omahksimmi	big.one	(4) aud	IUM
07:19.8	yi	matsiyíkkapisaayi	frog	(3) devoiced	IUF
07:29.6	wa	oma	DEM	(4) aud	IUM
07:30.1	wa	saahkómaapiwa	boy	(2) glide only	IUM
07:30.7	wa	oma	DEM	(4) aud	IUM
07:31.3	wa	imitááwa	dog	(4) aud	IUM
07:31.9	wa	oma	DEM	(4) aud	IUM
07:32.3	wa	sspopííwa	turtle	(1) inaud	IUF
07:39.7	wa	aakaisookapiwa	be.good	(4) aud	IUM

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