# Patterns in Heteromorphemic Consonant Behavior in St. Lawrence Island Yupik*

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**Abstract:** In this paper we provide a preliminary OT analysis of consonant deletion patterns and apparent OCP-driven intermorphemic phonological changes in St. Lawrence Island/Central Siberian Yupik (Inuit-Yupik-Unangam Tunuu; ISO 639-3 ess; here 'Yupik'), an endangered polysynthetic language of the Bering Strait region. We propose a ranking of four constraints that, among others not discussed here, determine Yupik surface forms: MAX, DEP, *COMPLEX, and a prohibition on fricatives in adjacency known as OCP$_f$ (Lin, 1997). We then describe the results of a pilot study in which native speakers were asked to produce complex forms from a root and a derivational morpheme. Further work will investigate these patterns in more detail and attempt to explain recalcitrant data such as instances of epenthesis in place of consonant (specifically, fricative) deletion.

**Keywords:** Obligatory Contour Principle, St. Lawrence Island Yupik, Optimality Theory, language documentation, phonology, endangered languages

## 1 Introduction

To date, little research has been conducted on specific phonological and morphophonological processes in St. Lawrence Island/Central Siberian Yupik (Eskimo-Aleut; ISO 639-3 ess; here 'Yupik'), an endangered polysynthetic language of the Bering Strait region. An area particularly lacking in description is the behavior of both consonants and vowels at morpheme boundaries. In this paper we provide an Optimality Theoretic analysis of consonant deletion patterns and apparent Obligatory Contour Principle-driven intermorphemic phonological changes in Yupik. We propose a preliminary critical ordering of several constraints for the language that conspire to yield the Yupik grammar, including crucial OCP (McCarthy, 1986) violations, and describe a pilot study with elicited data from native speakers. This work contributes to our understanding of phonological typology from an under-studied language.

In the rest of this section we introduce the Yupik language and its major phonological traits. In Section 2 we argue for a preliminary ranking of constraints based on previously published data, before describing a pilot study with native speakers in Section 3. Section 4 is the conclusion.

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## 1.1 The language

### 1.1.1 Overview

Yupik—also called, at various times, *Yupigestun*, *Akuzipik*, *Sivuqaghhmiistun*, *St. Lawrence Island Yupik*, *Beringian Yupik*, *Asiatic Eskimo*, and *Yuit* (Jacobson, 2001)—is a language spoken in the Bering Strait region, predominantly on St. Lawrence Island (estimated at around 540 speakers by Schwartz et al., In press), a small landmass located between the Alaskan and Chukotkan peninsulae (Simons & Fennig, 2018). A language of the Inuit-Yupik-Unangam Tunuu language family, it is one of four languages in its sub-genus, along with Central Alaskan Yup'ik, Naukan, and Alutiiq/Sugpiaq (also known as Pacific Yupik) (de Reuse, 1994; Jacobson, 2001; Hammarström et al., 2018). Sirenik, now extinct, is perhaps another sub-branch of the Inuit-Yupik subfamily (Jacobson 2001). Yupik displays ergative-absolutive alignment in its case system, and is a polysynthetic language with largely free word order. The language employs more than 600 derivational suffixes and roughly 500 particles, and boasts an extensive system of demonstratives. Yupik is also spoken on the Chukotkan peninsula in Russia where it has been noticeably influenced by Chukchi and other languages of eastern Russia. There, Yupik is known as *Chaplinski* and is spoken by approximately 200 people, by the most recent estimate (Vakhtin, 2001). This study focuses on the phonological behavior of the St. Lawrence Island variety of Yupik alone.

### 1.1.2 Phonological inventory

The phonological inventory of Yupik is rather unremarkable when viewed from the perspective of Maddieson's (1986) typological study of world language inventories. The inventory contains 32 phonemic consonants and 7 vowel phonemes (4 qualitatively distinct vowels, three of which have both regular and long versions). This number falls just outside Maddieson's range of typical inventory sizes (20 - 37) (Maddieson, 1986; 107).

As Figure 1 demonstrates, present in the consonant inventory is a series of voiceless stops; no voiced stops have been observed to date, except perhaps allophonically in intervocalic position (Krauss, 1975).

| | Bilabial | Labiodental | Dental | Alveolar | Postalveolar | Retroflex | Palatal | Velar | Uvular | Pharyngeal | Glottal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Plosive | p | | | t | | | | k$^{(w)}$ | q$^{(w)}$ | | |
| Nasal | m̥ m | | | n̥ n | | | | ŋ̊$^{(w)}$ ŋ$^{(w)}$ | | | |
| Trill | | | | | | | | | | | |
| Tap or Flap | | | | | | | | | | | |
| Fricative | | f v | | s z | | ʂ | | x$^{(w)}$ ɣ$^{(w)}$ | χ$^{(w)}$ ʁ$^{(w)}$ | | h |
| Affricate | | | | | | | | | | | |
| Lateral Fricative | | | | ɬ | | | | | | | |
| Approximant | | | | | | ɻ | j | | | | |
| Lateral approximant | | | | l | | | | | | | |

**Figure 1:** Yupik consonants

Both voiced and voiceless nasals are phonemic in Yupik, and all velar and uvular phonemes have corresponding labialized forms as separate phonemes. The retroflex approximant /ɻ/ is considered

by some to be the voiced counterpart of the retroflex fricative /ʂ/ and is phonetically realized somewhere between /ɻ/ and /ʐ/ (Krauss, 1975; de Reuse, 1994). These authors make the same claim of the relationship between /l/ and /ɬ/, often considering them to be a voiced/voiceless pair (de Reuse, 1994: 18). The vowel system is relatively simple and consists of four phonemic vowels, three of which are generally called "full vowels" in the literature and can be contrastively lengthened. These are /i/, /ɑ/, and /u/. The fourth vowel, /ə/, cannot be lengthened and never occurs word-finally (Jacobson, 2001).

### 1.1.3 Syllable structure

Yupik has strict constraints on syllable structure, allowing no complex onsets or codas (see Krauss (1975, p. 53) for a possible exception in /ŋqχʷ/). Simple as well as null onsets and codas both appear to be common (Badten et al., 1987), and the three "full vowels" can be lengthened. The maximal syllable structure in Yupik can therefore be given as (C)V(V)(C), allowing for the structures CV, CVV, CVC, CVVC, VC, VVC, V, and VV (note that no tautosyllabic VV sequences with unlike vowels surface in Yupik). These structures are attested below (from Jacobson, 2001), syllabified utilizing the Maximal Onset Principle (see Kahn, 1976; Clements, 1992).

(1) CV [**sɑ**.vik] - savik 'knife'

(2) CVV [nɑː] - naa 'mother'

(3) CVC [tɑn.qiq] - tanqiq 'moon; month'

(4) CVVC [**tɑ**ː**χ**.tɑ] - taaghta 'doctor'

(5) VC [**iʁ**.nəq] - ighneq 'son'

(6) VVC [ɑːkʷ] - aakw 'blood'

(7) V [ɑ.**təq**] - ateq 'name'

(8) VV [ɑː] - aa 'yes'

A number of phonotactic rules have been documented by previous studies on Yupik, including voicing assimilation of consonants across syllable boundaries and a cross-categorical restriction on word final fricatives (de Reuse, 1994). We can observe the former in the following forms of the verb *negh<e>* 'to eat' (from Jacobson, 2001):

(9) [nə.ʁɑː] - neghaa 'he/she/it/ ate'

(10) [nəχ.tuq] - neghtuq 'he/she/it ate it'

Here the voiced uvular fricative /ʁ/ devoices when in the environment of the voiceless alveolar stop /t/. Jacobson (2001) gives this rule as: "...in a cluster of two (adjacent) consonants either both will be voiced or both will be voiceless" (Jacobson, 2001; p. 5). The rule that restricts word-final fricatives applies to all lexical categories and is predictable in its resolution. Most noun and verb roots end in either /ʁ/ or /ɣ/ underlyingly, and these fricatives occur as the corresponding voiceless stops in the surface form when word-final (de Reuse, 1994; Krauss, 1975). Krauss (1975) notes

one exception to this in *haaw/ahaaw* [hɑːɣʷ]/ [ɑhɑːɣʷ] ‘is anybody (out) there?’. Contrastive pairs are given below (from Jacobson, 2001):

(11) [məq] - meq ‘water’

(12) [mə.ʁət] - meghet ‘waters’

(13) [si.kik] - sikik ‘squirrel’

(14) [si.kiɣ.məŋ] sikigmeng ‘from a/the squirrel’

More will be said about the behavior of fricatives in Section 2.

### 1.1.4 Orthography

The orthographic system employed by those who write Yupik has had many iterations, the most recent of which was devised in 1971 by a group of linguists and native speakers, improving on those that came before (Krauss, 1975). The current system expresses each segment in the inventory with a single mono-, di-, or polygraph and is thus transparent save for one somewhat obscurative, though completely predictable, spelling convention called “undoubling.”[1]

Undoubling is fundamentally an orthographic reduction in sequences of consonants. This convention was developed as a result of the occurrence of certain written words of unreasonable length, due to the concatenative nature of Yupik’s morphology and a few polygraphs generated by the rules of the orthography. The principle relies on the predictability of devoicing across syllable boundaries to simplify the orthographic representation of voiceless (doubled) consonants by writing the voiced (undoubled) counterpart. Since voiced consonants can never occur in the environment of voiceless consonants[2], the grapheme that represents this sound can be written in its voiced form but recognized and read as voiceless. An example of this undoubling is given in (15-16) (from Jacobson, 2001):

(15) Doubled form:
aangqa**ghh**lla**ngng**llaghyu**gg**tuq
[ɑːŋ.qɑ**χ**.ɬɑ**ŋ̊**.ɬɑʁ.ju**x**.tuq]

(16) Undoubled form:
aangqa**gh**lla**ng**llaghyu**g**tuq
[ɑːŋ.qɑ**χ**.ɬɑ**ŋ̊**.ɬɑʁ.ju**x.**tuq] not [ɑːŋ.qɑ**ʁ**.ɬɑ**ŋ**.ɬɑʁ.ju**ɣ**.tuq]

The three consonants which undergo undoubling here are /χ/, written normally as <ghh> but undoubled to <gh>; /ŋ̊/, normally <ngng>, undoubled to <ng>; and /x/, normally <gg>, undoubled to <g>. This allows Yupik words to be written with considerably fewer letters without much confusion for native speakers, though the orthographic undoubling does serve to make the orthography slightly less straightforward for learners.

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[1] See Schwartz & Chen (2017) for a chart of the Yupik alphabet with IPA equivalents (p. 279), as well as discussion of “undoubling” (section 3.1).

[2] Some voiced nasals can occur in the environment of voiceless fricatives and stops, i.e. [ɑːmtɑ] - aamta ‘as we well know’.

A note on our data sources: The Yupik orthographic system was designed such that "a given spoken Yupik word can be written in one and only one way, and a given written word can be read in one and only one way" (Jacobson, 2001). However, the system was designed to be phonemic, not phonetic, so phonetic variations in surface forms, such as changes in vowel quality or some types of assimilation, may not be indicated. This, of course, presents problems for any phonological study of Yupik that does not have direct access to recorded speaker data. Current limitations on computer and smart phone access as well as unreliable internet speeds make it difficult to elicit productions from native speakers without travelling to St. Lawrence Island.

Despite these challenges, an analysis of phonological behavior can still be conducted, relying on the efforts of those linguists and native speakers who developed an orthography designed to represent the spoken language as faithfully as possible. Additionally, because of the relatively recent adoption of the current orthographic system, widespread fossilization of spelling and dramatic linguistic drift are unlikely. For these reasons, we can consider the correspondence of segments to graphemes to be sufficiently reliable to conduct a preliminary study of certain phonological phenomena and lay the groundwork for future fieldwork and analysis of recorded data. In Section 3, we also consider newly gathered data.

## 2 A preliminary constraint ranking for Yupik

Yupik consonants undergo a great deal of morphophonological change at morpheme boundaries, and this behavior is underdescribed. In surface forms, no tautosyllabic consonant clusters are found; very few heterosyllabic adjacent fricatives are allowed to surface; and varied behavior is seen in adjacent fricative-nonfricative pairs. Here we consider what constraints and rankings are required to account for the strategies that Yupik employs to resolve its surface forms in these cases.

First, consider the following examples (from de Reuse, 1994). In each of these cases, one or more morphemes is added to a root, and changes occur to the underlying forms. Deletion is preferred to either cluster creation or epenthesis. In (17), for instance, /ʁ/ is deleted:

(17) /ɑŋ.jɑʁ/ + /χqu/+ /uq/ → [ɑŋ.jɑχ.quːq][3]

In (18), /ɣ/ is deleted:

(18) /qɑ.niɣ/ + /χquːtə/ + /uq/ →[qɑ.niχ.quː.tuq]

In (19), /ʁ/ is deleted and place assimilation occurs:

(19) /ɑʁ.vəʁ/ + /kɻɑk/ → [ɑʁ.vəq.ɻɑk]

Next, consider the following data, which demonstrate the language's method of resolving possible sequences of adjacent fricatives. Deletion and epenthesis (as well as segmental fusion) are preferred to adjacent fricatives in surface forms:

(20) /i.ɣɑʁ/ + /siʁ/ → [i.ɣɑː.siq] (deletion of /ʁ/)

(21) /ɑt.kuɣ/ + /ʂuːk/ → [ɑt.ku.ʂuːk] (deletion of /ɣ/)

[3] Compare /ɻə.pɑ/ + /χqu/ + /uq/ → [ɻə.pɑχ.quːq] (Badten et al., 2008).

(22) /ju.piɣ/ + /stun/ → [ju.pi.ɣəs.tun] (epenthesis of /ə/)

(23) /kiːɣʷ/ + /χɑʁ/ → [kiː.xʷɑq] (segmental fusion)

Given these representative examples, we can observe the following generalizations about Yupik surface forms: There are no tautosyllabic clusters in surface forms; clusters are resolved via deletion rather than epenthesis, and adjacent heteromorphemic fricative sequences are most frequently resolved via deletion or epenthesis. From these observations, we can draw some preliminary conclusions about the ranking of several key constraints at work in the Yupik grammar.

First, the constraint *COMPLEX rules out tautosyllabic clusters; given that such clusters do not surface in Yupik, *COMPLEX must be undominated. Next, as deletion occurs to resolve clusters, *COMPLEX and DEP (which penalizes epenthesis) both must outrank MAX (which penalizes deletion) (McCarthy & Prince 1995):

(24) *COMPLEX, DEP >> MAX

Then, we have observed that adjacent heteromorphemic fricative sequences are dispreferred. We may propose a markedness constraint that disallows the adjacency of continuant obstruents that ranks highly in the grammar to disallow certain violations of the Obligatory Contour Principle (OCP)[4]; essentially *[+obs, +cont][obs, +cont]. Lin (1997) proposes the markedness constraint $OCP_f$, that is, the OCP operating on fricatives. This constraint must outrank both MAX and DEP to ensure that deletion and epenthesis are preferred to adjacent fricatives:

(25) $OCP_f$ >> DEP, MAX

These facts taken together yield the following overall ranking:

(26) $OCP_f$ >> DEP >> MAX

While *COMPLEX must remain undominated by $OCP_f$ and DEP, we do not have evidence that it outranks either, as illustrated in Figure 2 below.

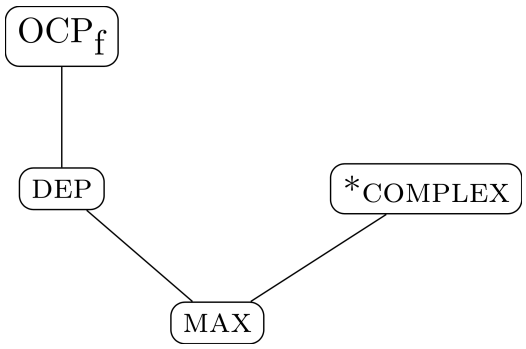


**Figure 2:** Relative rankings of Yupik constraints

[4] "At the melodic level, adjacent identical elements are prohibited" (McCarthy, 1986; p. 208). This constraint considers the difference in sonority values between two adjacent, or semi-adjacent, segments. For a more in-depth discussion of sonority, see Clements (1990) and Parker (2002).

Given that the data on which we have based these rankings is drawn entirely from orthographic representations in the existing literature, and that the most recent sources available are nearly two decades old (Jacobson, 2001), we sought to confirm the observed patterns through additional data elicited directly from native speakers. This procedure is discussed in the next section.

## 3 Further support from elicited data

In this section we describe a preliminary study carried out with native speakers to help validate the rankings developed in Section 2 from existing data. Because of the remoteness of St. Lawrence Island and the relatively poor quality of both internet connections and audio via mobile phone, this exploratory study was conducted via digital written correspondence.

### 3.1 Methods

From the data in the literature it is clear that both deletion and epenthesis are used to resolve fricative-fricative sequences, with deletion appearing to be more common; it is unclear whether forms surface that violate $\text{OCP}_{\text{f}}$. In order to further investigate OCP-driven behavior in the environments in question, we asked speakers to create complex words out of root+derivational suffix combinations. A short list of root-suffix[5] pairs was created and organized by lexical category (to rule out any confounding effects of category on morpheme boundary behavior). In Yupik, the vast majority of noun and verb roots in their underlying forms end in either /ɣ/ or /ʁ/ (de Reuse, 1994; this is a phonotactic effect—these are not morphemes), making it a simple matter to attach to them a series of morphemes each having a unique segment from Yupik's phonemic inventory in initial position. Two roots from each lexical class were chosen, one with each coda.

As discussed in section 1.1.2, there are 32 phonemic consonants in the inventory of Yupik (Jacobson, 2001). Ideally, one suffix would be selected for each legal onset and paired with the four selected roots. This would produce a total of 128 root-suffix pairs to be analyzed for morpheme boundary behavior. However, since fricatives are the primary focus of this study, only one token was selected with an onset from each of the following natural classes: stops, voiced nasals, and null onset (vowel initial). This reduces the total to 84 pairs. Additionally, a number of phonemes either never occur in morpheme initial position, or have not yet been documented to do so, which further reduces the total. These phonemes are indicated in Table 1 by 'N/A'. Ultimately, 27 suffixes were selected: 13 nominal suffixes (meaning they attach to noun roots), and 14 verbal suffixes. These suffixes were combined with the four lexical roots for a total of 54 morpheme pairs. Where possible, monomorphemic roots and suffixes were selected for consistency.

All tokens were selected manually from Jacobson's (2001) grammar and the four-volume Yupik dictionary (Badten et al., 1985), to ensure one of each initial consonant was considered. These pairs are given in Table 1 (see also Appendix A for more details).

[5] In the Yupik literature, 'base' is used to refer to the root, and 'postbase' to refer to any derivational suffix that attaches to the root.

| Suffix onset | Nouns | | Verbs | |
|---|---|---|---|---|
| | Bases | Suffixes | Bases | Suffixes |
| Ø | | /iːɻɑːʁ/ | | /usɑq/ |
| Stop | | /pik/ | | /tɑʁ/ |
| Nasal [+voi] | | /ŋə/ | | /nʁitə/ |
| Nasal [-voi] | | N/A | | N/A |
| /v/ | | /vɑk/ | | /vik/ |
| /l/ | | /liːʁ/ | | /luʁ/ |
| /z/, /j/ | | /jɑɣɑ/ | | /juɣ/ |
| /ɻ/ | | /ɻɑːq/ | | /ɻɑkxuːɣ/ |
| /ɣ/ | | N/A | | N/A |
| /ɣʷ/ | /ɑtkuɣ/ | /ɣʷɑːq/ | /iɣɑʁ/ | N/A |
| /ʁ/ | and + | /ʁɑq/ | and + | /ʁɻɑːɣ/ |
| /ʁʷ/ | /ɑŋjɑʁ/ | N/A | /ɑłəɣ/ | /ʁʷɑːʁ/ |
| /f/ | | N/A | | /fqɑʁ/,/fqɑː/ |
| /ɬ/ | | /łɑːk/ | | /łxu/ |
| /s/ | | /si/ | | /siq/ |
| /ʂ/ | | /ʂɑːk/ | | N/A |
| /x/ | | N/A | | /xpə/ |
| /xʷ/ | | N/A | | N/A |
| /χ/ | | /χłɑk/ | | /χłɑɣ/ |
| /χʷ/ | | N/A | | N/A |
| /h/ | | N/A | | N/A |

**Table 1:** Morpheme pairs by lexical category

Bases and suffixes were first transliterated from the standard Yupik orthography used in the grammar and dictionary into IPA, both manually and using Liinnaqumalghiit, a web-based transliteration tool developed by Schwartz and Chen (2017). This tool was developed specifically for transcribing and syllabifying Yupik words and for reducing the opacity of the undoubling process for non-native speakers.

The 13 nominal suffixes and 14 verbal suffixes were then added concatenatively to their respective roots to form a set of expected productions. These forms included obviously illegal clusters such as the three-fricative sequence in [ɑtkuɣχłɑk], but these were left unchanged as the purpose of this initial set was to be a baseline from which to observe fricative behavior in these very environments. The expected productions were for analysis only and were not disclosed to the speakers; rather the paired morphemes, in their standard orthographic form, were sent electronically to the speakers. The speakers were asked to create a word using the two morphemes provided in immediate sequence, along with any other morphological or inflectional material needed to form an actual lexical item, and to write their answers in standard Yupik orthography.

Once received, the elicited forms were compared, token by token, to the expected productions and coded for behavior. Possible behaviors included: no change, root coda deletion, suffix onset deletion, and total deletion. The results of these comparisons are discussed in the following section.

### 3.2 Results

A summary of morpheme boundary behaviors is given below in Table 2. In a few cases, the informants either did not provide a surface form for the morpheme pair provided, or the pair was not semantically compatible and the speakers could not provide a lexical item that included the desired root and suffix in succession. These gaps in the data are indicated by 'N/A' in Table 2. For a full account of expected forms and speaker responses, see Appendix A.

| Underlying | | | Surface | Underlying | | | Surface |
|---|---|---|---|---|---|---|---|
| /ɣ/ | + | Ø | [ɣ] | /ʁ/ | + | Ø | [ʁ] |
| /ɣ/ | + | /p/, /t/ | [p], [xt] | /ʁ/ | + | /p/, /t/ | [p], [χt] |
| /ɣ/ | + | Nasal [+voi] | Nasal | /ʁ/ | + | Nasal [+voi] | Nasal |
| /ɣ/ | + | Nasal [-voi] | N/A | /ʁ/ | + | Nasal [-voi] | N/A |
| /ɣ/ | + | /v/ | [v], [ɣv] (verbs) | /ʁ/ | + | /v/ | [v], [ʁv] (verbs) |
| /ɣ/ | + | /l/ | [ɣl] (verbs) | /ʁ/ | + | /l/ | [l], [ʁl] (verbs) |
| /ɣ/ | + | /z/, /j/ | [ɣj] | /ʁ/ | + | /z/, /j/ | [ʁj] |
| /ɣ/ | + | /ɻ/ | [ɻ] | /ʁ/ | + | /ɻ/ | [ɻ] |
| /ɣ/ | + | /ɣ/ | N/A | /ʁ/ | + | /ɣ/ | N/A |
| /ɣ/ | + | /ɣʷ/ | [ɣʷ] | /ʁ/ | + | /ɣʷ/ | [ʁʷ] |
| /ɣ/ | + | /ʁ/ | [ɣ] | /ʁ/ | + | /ʁ/ | [ʁ] |
| /ɣ/ | + | /ʁʷ/ | [xʷ] | /ʁ/ | + | /ʁʷ/ | [ʁʷ] |
| /ɣ/ | + | /f/ | [f] | /ʁ/ | + | /f/ | [f] |
| /ɣ/ | + | /ɬ/ | [ɬ] | /ʁ/ | + | /ɬ/ | [ɬ] |
| /ɣ/ | + | /s/ | [xus] | /ʁ/ | + | /s/ | [s] |
| /ɣ/ | + | /ʂ/ | [ʂ] | /ʁ/ | + | /ʂ/ | [ʂ] |
| /ɣ/ | + | /x/ | [x] | /ʁ/ | + | /x/ | [χ] |
| /ɣ/ | + | /xʷ/ | N/A | /ʁ/ | + | /xʷ/ | N/A |
| /ɣ/ | + | /χ/ | [x] | /ʁ/ | + | /χ/ | [χ] |
| /ɣ/ | + | /χʷ/ | N/A | /ʁ/ | + | /χʷ/ | N/A |
| /ɣ/ | + | /h/ | N/A | /ʁ/ | + | /h/ | N/A |

**Table 2:** Summary of morpheme boundary behaviors

As the data demonstrate, fricative deletion is the most common behavior exhibited at the tested morpheme boundaries. Of the 45 total surface forms elicited successfully, there were 32 cases of fricative deletion at the morpheme boundary. Epenthesis occurred only once. Of these, 26 cases were instances in which both segments were fricatives. This lends support to the assertion that Yupik disprefers fricatives in adjacent position. However, fricative deletion also occurred in six cases in which only the initial segment in the contact cluster was a fricative. Deletion was observed before [p], and before all voiced nasals. Of the 32 cases of deletion, 25 were instances of root-final coda deletion—the first segment in the sequence—and only six were instances of suffix-initial onset deletion—the second segment in the sequence. In one case, the deleted segment was not obvious as the sequence consisted of two identical segments, namely /ʁ/ + /ʁ/. These findings show a clear preference for deletion of the first segment in a pair of adjacent fricatives. Note that no optimal candidate includes the sequence CC. or .CC, but in some cases an optimal candidate may

include the sequence F.F (that is, fricatives in adjacency across a syllable boundary). Thus while *COMPLEX is never violated in surface forms, $OCP_f$ can be.

Null onsets behaved as expected, leaving the root-final fricative unchanged in all cases. Interestingly, voicing does not appear to be a contributing factor in triggering fricative deletion. Fricative deletion occurred before voiced fricatives in 12 cases and before voiceless fricatives in 14 cases. However, because of apparent restrictions on voiceless fricatives in onset position, there were fewer pairs that included a voiceless fricative morpheme initially. This means that there could indeed be some effect of voicing to be observed, but a larger sample of available relevant suffixes would be required.

As was mentioned briefly in section 1.1.2, most of the current literature on Yupik phonology considers /ɻ̥/ and /ʂ/ to be a voiced/voiceless continuant pair. The same is true of /l/ and /ɬ/. The data collected in this study may in fact lend support to this theory. Indeed, both /ɻ̥/ and /l/, generally considered to be approximants, seem in Yupik to pattern just like /ʂ/ and /ɬ/ in cases of fricative contact across morpheme boundaries. Both /ɻ̥/ and /l/, as well as /ʂ/ and /ɬ/, trigger deletion of the previous fricative with both uvulars and velars. There is certainly more to be explored in this area, but these results may provide some insight into how the Yupik grammar regards these segments in terms of their featural composition.

## 4 Conclusion

This preliminary study establishes an initial ranking for several key constraints at work in St. Lawrence Island Yupik phonology by considering the behavior of heteromorphemic consonants in adjacency. Specifically, the markedness constraint $OCP_f$ must outrank DEP, which must in turn outrank MAX; *COMPLEX must also outrank MAX.

Future work will prioritize the elicitation of additional written and audio-recorded data in person to determine further rankings that take into account a wider range of factors. For instance, in environments where two adjacent fricatives do surface, another markedness constraint would need to outrank $OCP_f$, or some other explanation (perhaps in terms of variation) would need to be found. In cases where fricatives are deleted before non-fricatives, too, another markedness constraint would be needed to outrank $OCP_f$. Other phenomena that still require explanation include the violable preference for the deletion of the first of two adjacent consonants; instances where epenthesis wins out over deletion; and coalescence-type patterns like that seen in (23). Though there remain many aspects of the phenomena under consideration here that require further investigation, this study provides further insight into the phonological processes of St. Lawrence Island Yupik and lays the groundwork for subsequent investigations into the phonological component of the Yupik grammar.

## References


Badten, A. et al. (1987). *A Dictionary of the St. Lawrence Island/Siberian Language.* Fairbanks: Alaska Native Language Center.

Clements, G. (1990). The role of the sonority cycle in core syllabification. In M. Beckman and J. Kingston, eds., *Papers in Laboratory Phonology 1*, Cambridge University Press, Cambridge.

Clements, G. (1992). The Sonority Cycle and Syllable Organization. In W. Dressler, H. Luschutzky, O. Pfeiffer, and J. Rennison (eds.) Phonologica 1988. Cambridge: Cambridge University Press.

de Reuse, Willem J. (1994). *Siberian Yupik Eskimo: The Language and Its Contacts with Chukchi. Studies in Indigenous Languages of the Americas*. University of Utah Press. Salt Lake City, Utah.

Hammarström, H., Bank, S., Forkel, R. & Haspelmath, M. (2018). *Glottolog 3.2*. Jena: Max Planck Institute for the Science of Human History. (Available online at http://glottolog.org).

Jacobson, S.A. (2001). *A Practical Grammar of the St. Lawrence Island/Siberian Yupik Eskimo Language.* Fairbanks: Alaska Native Language Center.

Kager, R. (1999). *Optimality Theory*. New York: Cambridge University Press.

Kahn, D. (1976). *Syllable-based generalizations in English phonology*. Bloomington, IN: Indiana University Linguistics Club.

Kennedy, R. (2008). Evidence for morphoprosodic alignment in reduplication. *Linguistic Inquiry* 39:589-614.

Krauss, M.E. (1975). St. Lawrence Island Eskimo Phonology and Orthography. *Linguistics* 152:39-72.

Lamontagne, G. A. (1993). Syllabification and consonant cooccurrence conditions. Doctoral dissertation, University of Massachusetts.

Leben, W. (1973). Suprasegmental Phonology. Doctoral dissertation, MIT, Cambridge, Massachusetts.

Lin, Y. (1997). Syllabic and moraic structures in Piro. *Phonology* 14:403-36.

Maddieson, I. (1986). The size and structure of phonological inventories: Analysis of UPSID. In J. Ohala and J. Jaeger (Eds.), *Experimental Phonology*. Orlando: Academic Press.

McCarthy, J. (1986). OCP Effects: Gemination and Antigemination. *Linguistic Inquiry*, 17(2), 207-263.

McCarthy, J. (1993). A case of surface constraint violation. Canadian Journal of Linguistics, 23.

Parker, S.G. (2002). Quantifying the Sonority Hierarchy. Ph.D. dissertation, University of Massachusetts, Amherst.

Schwartz, L. & Chen, E. (2017). Liinnaqumalghiit: A web-based tool for addressing orthographic transparency in St. Lawrence Island/Central Siberian Yupik. *Language Documentation & Conservation* 11: 275-288.

Schwartz, L., Schreiner, S.L.R., & Chen, E. (In press). Community-focused language documentation in support of language education and revitalization for St. Lawrence Island Yupik. *Études Inuit Studies* 42(1).

Simons, G.F. & Fennig, C.D. (eds.). (2018). *Ethnologue: Languages of the World, Twenty-first edition*. Dallas, Texas: SIL International. Online version: http://www.ethnologue.com.

Vakhtin, Nikolai B. 2001. *Yazyki narodov Severa v XX veke: Ocherki yazykovogo sdviga (Languages of the Peoples of the North in the 20th Century: Essays on Language Shift)*. St. Petersburg, European University at St. Petersburg.

Yip, M. (1988). The Obligatory Contour Principle and Phonological Rules: A Loss of Identity. *Linguistic Inquiry*, 19(1), 65-100.

## Appendix A Expected forms and speaker responses

Tables A1 and A2 contain the expected productions formulated through simple concatenation of the selected morphemes as well as the actual productions provided by the speakers. Table A1 presents the forms of the two selected noun roots, /ɑtkuɣ/ and /ɑŋjɑʁ/, while table A2 presents the verbs /iɣɑʁ/ and /ɑɬəɣ/. Items are labelled as 'N/A' if there were no available or documented suffixes to be tested or if the informants did not provide a response.

**Table A1:** Nouns

| Suffix onset | Base-final segment: /ɣ/ | | Base-final segment: /ʁ/ | |
|---|---|---|---|---|
| | Expected | Actual | Expected | Actual |
| Ø | ɑtkuɣiːɻɑːʁ | ɑkuɣiːɻɑːʁɑquq | ɑŋjɑʁiːɻɑːʁ | ɑŋjɑʁiɻɑːq |
| stop | ɑtkuxpik | ɑtkupik | ɑŋjɑχpik | ɑŋjɑpik |
| nasal [+voi] | ɑtkuɣŋə | ɑtkuŋuq | ɑŋjɑʁŋə | ɑŋjɑŋuq |
| nasal [-voi] | N/A | N/A | N/A | N/A |
| /v/ | ɑtkuɣvɑk | ɑtkuvɑɣəstun | ɑŋjɑʁvɑk | ɑŋjɑvɑk |
| /l/ | ɑtkuɣliːʁ | N/A | ɑŋjɑʁliːʁ | ɑŋjɑliːq |
| /z/,/j/ | ɑtkuɣjɑɣɑ | ɑtkuɣjɑɣət | ɑŋjɑʁjɑɣɑ | ɑŋjɑʁjɑɣət |
| /ɻ/ | ɑtkuɣɻɑːq | N/A | ɑŋjɑʁɻɑːq | N/A |
| /ɣ/ | N/A | N/A | N/A | N/A |
| /ɣʷ/ | ɑtkuɣɣʷɑːq | ɑtkuɣʷɑːq | ɑŋjɑʁɣʷɑːq | ɑŋjɑʁʷɑːq |
| /ʁ/ | ɑtkuɣʁɑq | ɑtkuɣɑq | ɑŋjɑʁʁɑq | ɑŋjɑʁɑq |
| /ʁʷ/ | N/A | N/A | N/A | N/A |
| /f/ | N/A | N/A | N/A | N/A |
| /ɬ/ | ɑtkuxɬɑːk | ɑtkuɬɑːk | ɑŋjɑχɬɑːk | ɑŋjɑɬɑːk |
| /s/ | ɑtkuxsi | N/A | ɑŋjɑχsi | N/A |
| /ʂ/ | ɑtkuxʂɑːk | ɑtkuʂɑːk | ɑŋjɑχʂɑːk | ɑŋjɑʂɑːk |
| /x/ | N/A | N/A | N/A | N/A |
| /xʷ/ | N/A | N/A | N/A | N/A |
| /χ/ | ɑtkuɣχɬɑk | ɑtkuxɬɑk | ɑŋjɑʁχɬɑk | ɑŋjɑχɬɑk |
| /χʷ/ | N/A | N/A | N/A | N/A |
| /h/ | N/A | N/A | N/A | N/A |

**Table A2:** Verbs

| Suffix onset | Base-final segment: /ʁ/ | | Base-final segment: /ɣ/ | |
|---|---|---|---|---|
| | Expected | Actual | Expected | Actual |
| Ø | iɣaʁusaq | iɣaqusaq | aɬəɣusaq | aɬəkusaq |
| stop | iɣaχtaʁ | iɣaχtaχɬaxtuq | aɬəxtaʁ | aɬəxtaːɣuq |
| nasal [+voi] | iɣaʁnʁitə | iɣanʁitut | aɬəɣnʁitə | aɬənʁitut |
| nasal [-voi] | N/A | N/A | N/A | N/A |
| /v/ | iɣaʁvik | iɣaʁvik | aɬəɣvik | aɬəɣvik |
| /l/ | iɣaʁluʁ | iɣaʁluχtuq | aɬəɣluʁ | aɬəɣlukutukut |
| /z/,/j/ | iɣaʁjuɣ | N/A | aɬəɣjuɣ | N/A |
| /ɻ/ | iɣaʁɻakxuːɣ | iɣaɻakəxtuq | aɬəɣɻakxuːɣ | aɬəɻakəxtuq |
| /ɣ/ | N/A | N/A | N/A | N/A |
| /ɣʷ/ | N/A | N/A | N/A | N/A |
| /ʁ/ | iɣaʁʁɻaːɣ | N/A | aɬəɣʁɻaːɣ | aɬəɣɻaːxtukut |
| /ʁʷ/ | iɣaʁʁʷaːʁ | iɣaʁʷaːχtuq | aɬəɣʁʷaːʁ | aːɬxʷaːχtuq |
| /f/ | iɣaχfqaː | iɣafqaːvək | aɬəxfqaː | aɬəfqaːvək |
| /ɬ/ | iɣaχɬxu | iɣaɬxuːq | aɬəxɬxu | aɬəɬxuːq |
| /s/ | iɣaχsiq | iɣaːsiq | aɬəxsiq | aːɬxusiq |
| /ʂ/ | N/A | N/A | N/A | N/A |
| /x/ | iɣaʁxpə | iɣaχpənaːni | aɬəɣxpə | aɬəxpənaːni |
| /xʷ/ | N/A | N/A | N/A | N/A |
| /χ/ | iɣaʁχɬaɣ | iɣaχɬaxtukut | aɬəɣχɬaɣ | N/A |
| /χʷ/ | N/A | N/A | N/A | N/A |
| /h/ | N/A | N/A | N/A | N/A |