Phonetic documentation of coronal continuants in Akuzipik

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Background: Akuzipik (St. Lawrence Island Yupik, ISO 639-3: ess) is an under-documented, endangered Indigenous language spoken natively by 800-900 people mainly on St. Lawrence Island, Alaska, USA [1, 2]. Previous impressionistic descriptions of the language propose a phonemic inventory consisting of 31-32 consonants and 4-7 vowels [3, 4]. Most subsequent studies on the language have focused on its morphosyntactic properties [5, 6], but recent acoustic analyses of the Akuzipik vowel system confirmed 7 distinct phonetic vowel qualities [7, 8]. Akuzipik consonants, however, remain to be phonetically investigated.

Research goals: The current work is a descriptive study of the acoustic and articulatory properties of coronal continuants in Akuzipik. It consists of a production experiment designed to investigate the sounds represented by the graphemes ⟨l ll r rr s z y⟩ in intervocalic environments. We use graphemes because no consensus has been achieved as to the identity of the phonemes corresponding to each grapheme. The study targets coronal continuants because their articulatory properties in the language are particularly unclear. For instance, earlier studies describe each sound in the pairs ⟨l⟩/⟨ll⟩ and ⟨r⟩/⟨rr⟩ as voiced/voiceless counterparts, but more recently it has been suggested that they may also differ in other aspects [9].

Participants: Two adult native speakers of Akuzipik participated in this production experiment: one male in his 30s (“M”) and one female in her 40s (“F”). As is the case with most, if not all, current Akuzipik speakers [2], M and F were bilingual in English, which they acquired around age 6 when they started school.

Materials: The stimuli consisted of a list of 71 inflected Akuzipik nouns of 2-5 syllables (most were trisyllabic). The word list was developed with the help of a native Akuzipik speaker. All the words had the following structure: (C)V_1.ˈ**C**V_2… where **C** is one of the seven target consonants ⟨l ll r rr s z y⟩ in the onset of a stressed syllable and V is one of the seven vowels ⟨a aa e i ii u uu⟩. In coronal environments, short and long vowel pairs differ in length but have similar quality [7, 8]; thus, for this study, the two vowels in each short-long pair were considered to be the same vowel, and words containing short vowels were selected whenever possible. The stimuli included all possible V_1.ˈ**C**V_2 combinations for each target consonant, and only the environments deemed impossible by the Akuzipik speaker were not represented in the word list. In total, 6-8 repetitions of each word were recorded per speaker.

Methods: Audio recordings and ultrasound images of the tongue body movements at the midsagittal plane were collected simultaneously, and the entire recording session took approximately 60 minutes per speaker. Spectrographic analysis (in Praat [10]) was used to measure duration and acoustic correlates for each consonant. For the articulatory analysis (in AAA [11]), we examined the constriction location, the shape of the tongue body, and the relative location of the anterior parts of the tongue (tongue blade and tip) for each of the target consonants.

Results: The graphemes ⟨s z y⟩ showed acoustic and articulatory cues typically expected for [s z j]. For the pairs ⟨l⟩/⟨ll⟩ and ⟨r⟩/⟨rr⟩, there was variation in duration across speakers and items, but it did not indicate a gemination contrast for either grapheme pair. Acoustic cues for fricative manner were observed in the spectrographic analyses for ⟨rr ll⟩, but not for ⟨r l⟩ (Figs. 1-2). Articulatorily, more lingual constriction (higher and more retracted tongue body) was found for ⟨rr⟩ than for ⟨r⟩ for both speakers (Fig. 3). Overlapping places of articulation were found for ⟨l ll⟩ for both speakers, but between-speaker variation was observed (Fig. 4).

Discussion: The acoustic analysis confirmed seven distinct coronal continuants in the investigated environments. As expected, the graphemes ⟨s z y⟩ correspond to the segments [s z j]. However, in contrast with early descriptions, the pairs ⟨l⟩/⟨ll⟩ and ⟨r⟩/⟨rr⟩ differed not only in voicing, but also in manner of articulation: while ⟨l r⟩ are voiced approximants, ⟨ll rr⟩ are voiceless fricatives. Additionally, articulatory analyses found overlapping tongue configurations for the two sounds in the pair ⟨l⟩/⟨ll⟩, indicating the same place of articulation. However, while there was within-speaker consistency, between-speaker variation was observed: each participant had a different tongue configuration for the pair ⟨l⟩/⟨ll⟩, which could be due to a number of sociolinguistic factors. Moreover, for both participants, different tongue configurations were observed for each sound in the pair ⟨r⟩/⟨rr⟩: the tongue body was visibly higher and more retracted for ⟨rr⟩ than for ⟨r⟩, resulting in greater constriction. Notably, although ⟨r⟩/⟨rr⟩ were previously described consistently as retroflex, neither M nor F produced these sounds as retroflex in this experiment. We propose the following representations for ⟨l ll r rr⟩: [l ɬ ɹ ʃ̲].

Future directions: Further research will include more participants (different ages, places of residence, dominant language, etc.) as well as stimuli in English to investigate sociolinguistic factors that may influence language change and/or variation. Additionally, future studies will extend to more varied phonological contexts as well as to other sounds in the language.

This work is part of a larger community-centered language documentation and revitalization project; as such, it contributes to a deeper understanding of the phonetic properties of Akuzipik consonants, providing a valuable resource for the community members and researchers working toward the documentation and revitalization of this endangered language.

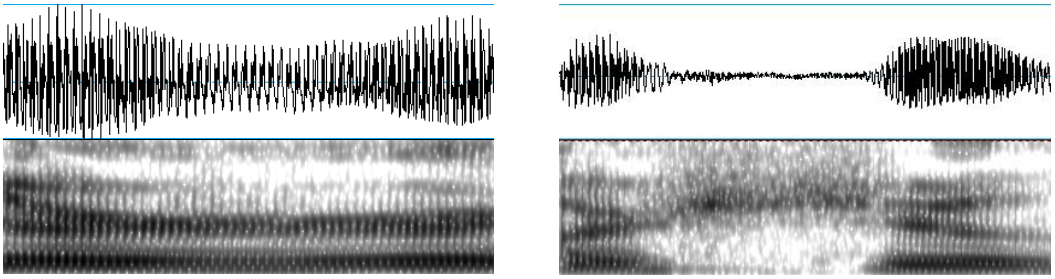

Fig. 1. Waveform and spectrogram representations of F's production of ⟨ere⟩ in *terelleq* (left) and ⟨erre⟩ in *nayeqerregagh* (right).

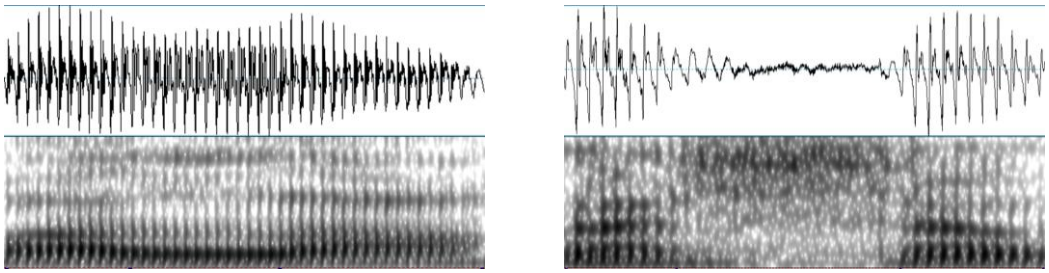

Fig. 2. Waveform and spectrogram representations of M's production of ⟨ala⟩ in *palaghhaq* (left) and ⟨alla⟩ in *kallagneq* (right).

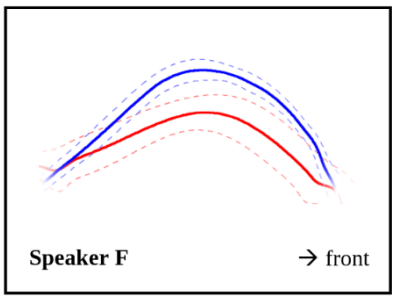

Fig. 3. ⟨r⟩ (red) and ⟨rr⟩ (blue). Mean (solid lines) and SD (dashed lines) tongue configurations.

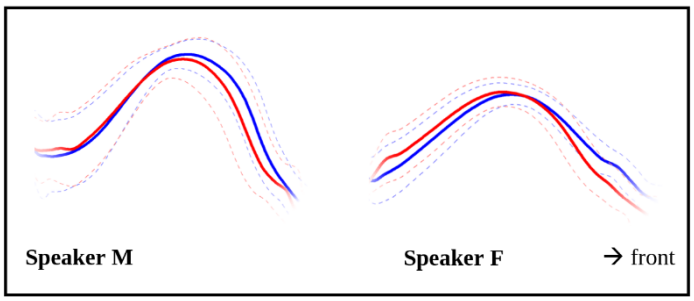

Fig. 4. ⟨l⟩ (red) and ⟨ll⟩ (blue). Mean (solid lines) and SD (dashed lines) tongue configurations.

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