Phonetic characteristics of Cheyenne voiceless vowels

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Cheyenne (ISO 639-3 chy) has three processes by which vowels can be devoiced (Leman, 2011; Leman & Rhodes, 1978; Vogel & Murray, 2022). Despite the sense that there is "minimal-to-no formant structure during a word-final vowel" (Vogel & Murray, 2022: 224), formants above F1 are often apparent. Because voiceless vowels can still distinguish words (Ute: Givón, 2011: 21; Japanese: Ladefoged & Maddieson, 1990: 117), it is clear that they convey information. Here we present a preliminary study that addresses the following questions for Cheyenne:

1) Are the formants of devoiced vowels different from those of voiced vowels?
2) Is the duration similar for both categories?
3) Does amplitude tell us about vowel category?

Measurements were based on an online version of Cheyenne pedagogical material (Risingsun & Leman, 1990). All voiceless vowels were labeled and analyzed in Praat (Boersma & Weenink, 2024). Duration was based on the labels, and amplitude was averaged across that duration. Formants were estimated by the Burg algorithm (window length, 25 ms), with medians for F2 and F3 computed across the total duration. An equivalent number of tokens of voiced vowels was also measured.

Results indicate that F2 was generally higher than that of the voiced vowels, while F3 was quite similar. (F1 was excluded as it seldom appears in the voiceless vowels.) Thus the vocal tract shape seems to be quite similar for voiced and voiceless vowels.

Durations were quite similar for voiced and voiceless vowels. This indicates that the voiceless vowels were serving the same time function as the voiced vowel.

Amplitude was, as expected, much lower for the voiceless versions, but the pattern across vowel category was not apparent. There may have been an interaction between tone and amplitude that was not separated out in our data.

These results indicate that the voiceless vowels should be categorizable perceptually despite the lack of a fundamental. The formants, which indicate approximately the underlying resonances (Whalen, Chen, Shadle, & Fulop, 2022), were fairly constant. Future work could examine whether there are differences between epenthetic and underlying vowels, especially in terms of amplitude. Final epenthetic /e/ for positive imperatives, which is typically voiceless, seems to be particularly long, which may be part of its use in perception.

The current measurements are based on pedagogical material. Future work should include narration as well.

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