A Preliminary Investigation of the Phonetic Characteristics of Moklen Tones

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Moklen, an endangered Austronesian language spoken on the Andaman coast of Southern Thailand, is a significant case for studying tonogenesis [1, 2, 3]. While previous research by Pittayaporn et al. [3] confirmed the presence of two lexical tones in Moklen, the nature of this tonal contrast remains unclear. Swastham [4] and Larish [5, 6] proposed that Moklen tones emerged through contact with Southern Thai, but it is uncertain whether Moklen tones developed from segmental sources following Haudricourt’s model of tonogenesis, given that Moklen still maintains contrastive voicing in onsets [7].

Examining the acoustic characteristics of Moklen tones can provide insights into the hypothesis regarding their origins. In this preliminary study, we conducted an instrumental analysis on the phonetic properties of Moklen tones in different syllable types and onset voicing. Our results reveal that Moklen tones primarily differ in fundamental frequency (f0), accompanied by difference in phonation type at the beginning of the vowel.

Methodology: Four native Moklen speakers residing in Takua Pa District, Phang Nga Province, Thailand, participated in the study. They were asked to produce Moklen mono- and disyllables in isolation, with each word repeated three times. The 93 target words were carefully selected to have stressed final syllables with /a, aː/ vowels. These target words were systematically varied in terms of tones, onset voicing, vowel length, and coda classes.

Analysis: Acoustic measurements were obtained from the stressed syllables using PraatSauce [8]. Five acoustic measurements associated with tonation in various languages were selected, including f0, F1, F2, the difference between corrected first harmonics and the corrected spectral amplitude of F3 (H1*-A3*), and Cepstral Peak Prominence (CPP). Each measurement was z-scored by speakers and time-warped to a fixed length, facilitating meaningful comparisons. We employed separate linear mixed effect regressions with four dependent variables: (i) the mean values of f0, F1, F2, H1*-A3*, and CPP during the first quarter of vowel trajectories, (ii) the intercepts (indicating means of each trajectory), (iii) the linear coefficients (indicating slopes), and (iv) the quadratic coefficients (indicating curvatures). Polynomial curve fitting was applied to each acoustic trajectory to obtain coefficients (ii)-(iv). Independent variables included tone, onset voicing, vowel length, and coda class. Subject was included as a random intercept in the analyses.

Results: The results demonstrated significant differences in the first quarter values of f0 (Tone 1 > Tone 2), mean (Tone 1 > Tone 2), slope (with steeper Tone 2 slope > Tone 1), and curvature across Moklen tones. Notable differences were also observed in the beginning of H1*-A3* (Tone 1 < Tone 2) and CPP (Tone 1 > Tone 2), indicating a breathier voice quality for Tone 2. Additionally, we found significant effects of onset voicing on several acoustic measures, including the first quarter, mean, slope, and curvature of f0, the first quarter, mean, and slope of F1, the first quarter and mean of F2, the first quarter and mean of H1*-A3*, and the first quarter, mean, and slope of CPP. Moreover, vowel length exerted significant effects on the first quarter of f0, the first quarter, mean, and slope of F1, the first quarter and mean of F2, and the first quarter and curvature of CPP. Lastly, the coda class exhibited marginal effects on the first quarter of f0, the first quarter and slope of F1, the curvature of F2, the curvature of H1*-A3*, as well as the first quarter, mean, slope, and curvature of CPP.

Discussion and Conclusion: Our experimental findings suggest that f0 is the primary phonetic cue for tonal contrast in Moklen, accompanied by the difference in phonation type at the beginning of the vowel. Specifically, Tone 1 is characterized by higher pitch and a vowel with modal voice, while Tone 2 has a lower pitch and a breathier vowel. These characteristics bear similarities to register distinctions observed in Austronesian languages of Southeast Asia [9], suggesting a possible transphonologization of laryngeal properties into prosodic ones in Moklen. However, the exact segmental sources of Moklen tones still remain an open question.
Figure 1: F0 trajectories of Moklen tones over the vowel. Trajectories of f0 for CV(V)N syllables are over the entire rimes.

Figure 2: Boxplot of mean values of f0, F1, F2, H1*-A3*, and CPP during the first quarter of vowel trajectories. Significant differences across tones are found for f0, H1*-A3*, and CPP.

References