Acoustic classification of velar fricatives in Assamese

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Research Questions

1. To what extent does allophonic variation affect acoustic discrimination of obstruents in Assamese?  
2. Is the behavior of this contrast system consistent across gender and dialect subgroups?

Background

- Fricative identification can be modeled robustly in acoustics and perception at a global level (in the absence of within-category place and manner variation)\(^1\)
- But allophony is expected to interact with category identification; e.g. in German the realization of /f/ as [s] after /f/ influences the contrast with [ff]\(^2\)
- Posterior obstruents in Assamese: /h/, /k\(^b\)/, /h/, /x/, /h/
- Optional word-initial fortition of /h/ (h → x) and post-vocalic lenition of /k\(^b\)/ (k\(^b\) → x) may reduce acoustic discriminability of /x/
- These processes are reported to apply with varying frequency depending on gender and dialect\(^3\)

Participants

- 8 speakers from Jorhat District: 4 female (JF), 4 male (JM)
- 4 speakers from Nalbari District: all male (NM)
- Gender contrast: JF ↔ JM
- Dialect contrast: NM ↔ JM

Materials

- Near-minimal pairs in triggering contexts for allophonic processes on /h/ and /k\(^b\)/
  - CV, VCV, VCV
  - /x/, /h/, /x/, /h/, /x/, /k\(^b\)/, /x/, /k\(^b\)/
- 3 words exhibiting each target sequence were recorded in sentence frames and repeated in 3 randomized blocks

Acoustic Measures

- RMS amplitude (RMS)
- Low- and high-frequency spectral tilt (LFT, HFT)\(^4\)
- Spectral moments (ML, M2, M3, M4)\(^5\)
- All measurements taken at 30 ms windows at consonant onset, midpoint, and offset (C, C\(_0\), C\(_f\)), transitions (VC/VC), and vocal onset/onset (V/Vis)

Models

- Speaker information was partialled out of raw parameter values, with residuals then used in principal components analysis (PCA) to reduce the parameter size to 3
- Cross-validat ed logistic regression on /x/+/h/ and /x/+/k\(^b\)/ contrasts was run stepwise by window

Key Classification Patterns

Word-initial (CV) and word-final (VC) contexts consistently reduce discriminability of /x/, but the Jorhat Female group shows greater influence of /h/ fortition and /k\(^b\)/ lenition word-initially and Nalbari Male speakers show greater influence of /k\(^b\)/ lenition post-vocally.

Phonotactic Frequency

- Incorporation of lexical information should bias classification toward the velar fricative: Relative proportions of /x/+/h/ and /h/+/h/-initial words in a written corpus of Assamese\(^6\) were 0.64 and 0.36, respectively
- Word-final aspirated stops are generally uncommon in Assamese, as was revealed for /k\(^b\)/ in the present corpus, which had a type frequency of 39 as compared with 359 for /x/:
  - Only four items formed minimal pairs, however, suggesting /x/+/h/ discrimination may be less affected by lenition than predicted in native acoustic models

Conclusions

- Classification of velar fricatives in Assamese significantly depends on allophonic variation in acoustically similar posterior obstruents
- The relative impact of processes such as /h/ fortition and /k\(^b\)/ lenition was not constant across speaker groups, and particularly affected Jorhat Female and Nalbari Male classification models
- Posterior obstruent contrasts may be better modeled as separate systems according to gender and dialect
- The extent to which listeners can cope with these differences in perception has yet to be tested

Future Directions

- Predictions from acoustic models need to be validated on perception data from Assamese listeners
- Manipulation of lexical and phonotactic frequencies in perception stimuli will help determine the degree to which listeners can compensate for acoustic ambiguity in maintaining posterior obstruent contrasts

References


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