



4aSC10: Phonation-type contrasts and vowel quality in Marathi

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169th Meeting of the Acoustical Society of America ~ Pittsburgh, PA ~ May 21, 2015

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Background

- Breathy phonation is crosslinguistically rare.
- Questions about its acoustic correlates remain.
- We know that it may yield:
 - SHORTER closure duration in voiced obstruents^{1,2}
 - LONGER breathy intervals^{2,3,4} and subsequent vowels^{4,5}
 - INCREASED H1-H2 and other spectral values^{4,5,6,7,8,9,10}
 - DECREASED Cepstral Peak Prominence (CPP) values^{4,6,7,9}
- Breathy sonorants are particularly rare.
- Phonation-type contrasts in obstruents (plain vs. breathy) often trigger acoustic differences that are weaker, absent, or more variable in sonorants.⁴
 - Ex: H1-A3 diffs. in subsequent vowels sensitive to vowel context & word position for sonorants but not obstruents.⁴

Breathiness and Vowel Quality

- Previous work on breathy sonorants has investigated temporal, spectral, and cepstral measures.⁴
- Consonant phonation-type may also affect the quality of subsequent vowels, however.
- Breathy voice may be associated with:
 - LOWER F1 values in Chantaburi Khmer¹⁰, Chong¹¹, Green Mong¹², Javanese¹³, Moore¹⁴ but NOT in Gujarati.¹⁵
 - More CENTRALIZED F2 values in Javanese¹³, Moore¹⁴

Our question: How does breathy voice affect vowel quality in Marathi? Are there any obstruency-based differences in vowel quality patterns?

Methods

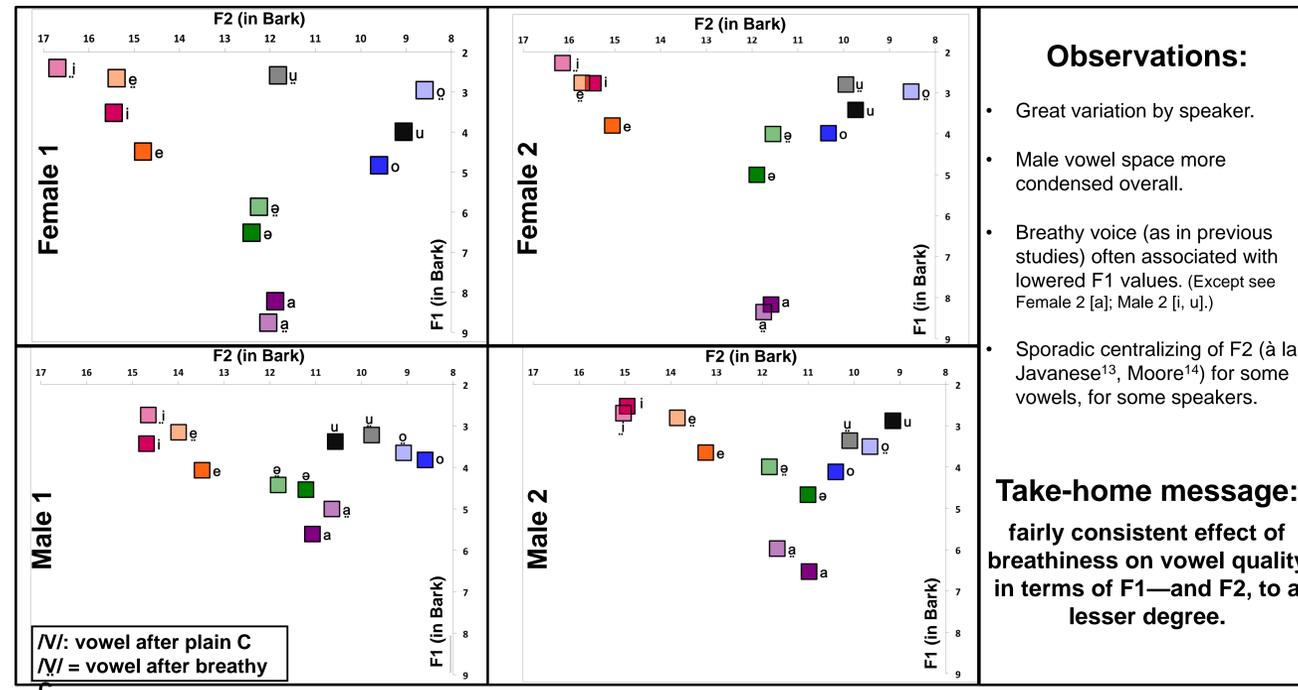
- Marathi (Indic) contains breathy obstruents & sonorants.

	Sonorant		Obstruent	
	Initial	Medial	Initial	Medial
Modal	[natu] grandson	[sonc] gold	[dada] elder brother	[pɔdc] couplets
Breathy	[nʰavi] barber	[pʰanʰc] mango drink	[dʰaga] thread	[gʰɔdc] donkeys

Table 1: Phonation type contrasts in Marathi sonorants and obstruents

- Experiment 1: Phonation-types & Vowel Quality in Marathi
 - 4 native speakers of Marathi (2 female)
 - 6 monophthongs of Marathi (/i e a ə o u/)
 - Real words, after modal and breathy consonants
 - Plot full vowel space for each speaker
- Experiment 2: Obstruency, Phonation, and Vowel Quality
 - 10 native speakers (5 female)
 - Word-initial [a] & [e] after dentals (/t tʰ d dʰ n nʰ l lʰ/)
 - Do obstruents and sonorants pattern similarly?
- Recorded in KU's anechoic chamber, analyzed w/ Praat.¹⁶

Experiment 1: Phonation-Types & Vowel Quality in Marathi



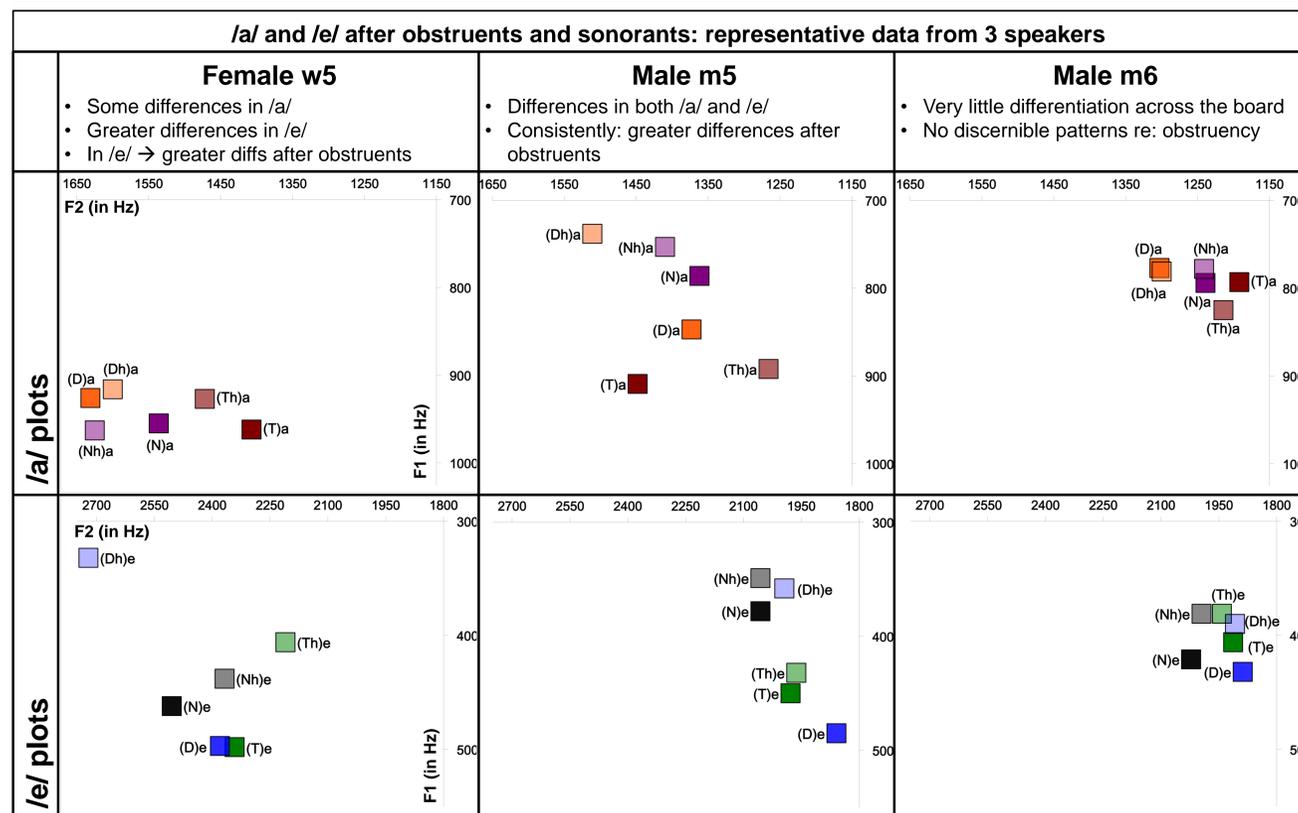
Observations:

- Great variation by speaker.
- Male vowel space more condensed overall.
- Breathy voice (as in previous studies) often associated with lowered F1 values. (Except see Female 2 [a]; Male 2 [i, u].)
- Sporadic centralizing of F2 (à la Javanese¹³, Moore¹⁴) for some vowels, for some speakers.

Take-home message:

fairly consistent effect of breathiness on vowel quality in terms of F1—and F2, to a lesser degree.

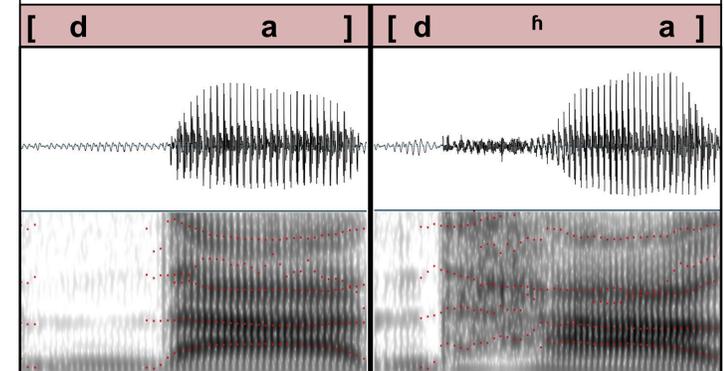
Experiment 2: Obstruency, Phonation, and Vowel Quality



Acknowledgments: Thank you to Dr. Allard Jongman, Dr. Joan Sereno, Dr. Jie Zhang, Goun Lee, Maria Martínez-García, Namrata Barve, Narayani Barve, and numerous Marathi language consultants for their assistance and feedback.

Discussion

- Among 14 speakers—4 in Exp. 1, 10 in Exp. 2—there is no dearth of variability.
- Breathy phonation affects vowel quality in terms of both F1 and F2, but:
 - How much, in which vowels, and the extent to which obstruency interacts with quality effects differs widely.
- More data (more speakers, tokens, vowels, word-position and segmental contexts, etc.) is desirable and will (hopefully) allow more generalized patterns to emerge.
- An issue: "The leakage of air through the partially open glottis [in breathy voice] widens the bandwidth of individual formants, thereby obscuring formant structure" (Gordon 2001: 4)¹⁷.
- Too true: computerized methods of collecting data are sometimes challenged by this, as illustrated with data from Praat below.



- Praat—and VoiceSauce—struggle to find formants in heavily breathy vowels. Future work needs to address this difficulty.
- Future investigation of the interaction between phonation type, vowel contrasts, and obstruency in other languages will also be enlightening.

References

REFERENCES: (1) Benguerel, A. & T. Bhatia. (1980). Hindi stop consonants: An acoustic & fibroscopic study. *Phonetica*, 37:134-148. (2) Mikuteit, S. & H. Reetz. (2007). "Caught in the ACT: the timing of aspiration & voicing in Bengali." *Lang. & Speech*, 50.2: 247-277. (3) Davis, K. (1994). Stop Voicing in Hindi. *J.Phon.*, 22.2: 177-193. (4) Berkson, K. (2013) *Phonation Types in Marathi: An Acoustic Investigation*. Ph.D. diss, Univ. of KS. (5) Dutta, I. (2007). Four-way stop contrasts in Hindi: An acoustic study of voicing, f0 & spectral tilt. Ph.D. diss., UIUC. (6) Blankenship, B. (2002). The timing of nonmodal phonation in vowels. *J.Phon.*, 30: 163-191. (7) Esposito, C.M. (2006). *The Effects of Linguistic Experience on the Perception of Phonation*. Ph.D. diss., UCLA. (8) Huffman, M. K. (1987). Measures of phonation in Hmong. *JASA*, 81: 495-504. (9) Khan, S. D. (2012) The phonetics of contrastive phonation in Gujarati. *J.Phon.*, 40: 780-795. (10) Wayland, R. & A. Jongman (2003). Acoustic correlates of breathy and clear vowels: the case of Khmer. *J.Phon.*, 31: 181-201. (11) Thongkum, T. L. (1988). Phonation types in Mon-Khmer languages. *Voice production: Mechanisms and functions*, 319-333. (12) Andruski, J. E., & Ratliff, M. (2000). Phonation types in production of phonological tone: The case of Green Mong. *JIPA* 30(1-2): 37-61. (13) Thurgood, E. (2004). Phonation types in Javanese. *Oceanic ling.* 43.2: 277-295. (14) Calamal, S., & Bertinetto, P. M. (2005). Indagine preliminari sul vocalismo orale della lingua mooré (Gur, Niger Congo). *Quaderni del Laboratorio di Ling.*, 5. (15) Fischer-Jørgensen, E. (1967). Phonetic analysis of breathy (murmured) vowels in Gujarati. *Indian ling.* 28: 71-139. (16) Boersma, P. & Weenink, D. (2010). Praat Version 5.1.32 - www.praat.org. (17) Gordon, M. (2004) Linguistic aspects of voice quality w/special reference to Athabaskan. In *Proceedings of the 2001 Athabaskan Languages Conference*(pp. 163-178).