

The weighting game: modelling the balance of prominence in Indic word accentuation

Toby Hudson
University of Oxford
toby.hudson@ling-phil.ox.ac.uk

Since the first millennium BCE Indic languages have recurrently developed weight-sensitive stress systems, often reconstructed for Classical Sanskrit (Bühler 1883) and observed today in Hindi, alongside edge-demarcative systems as in Bengali (Schiering et al. 2010). At the same time, the phonetic basis of stress in many modern Indic languages is weak (Lahiri & Kennard 2020: 319) and inconsistently described, as noted by Masica (1993: 121-2). I present a heuristic modelling approach to understanding this instability by exploring how cues to prominence may be reweighted over time.

Acoustic interpolation continua (Coleman et al. 2015) are generated for three trajectories: (i) Vedic pitch-accented forms morphing into Classical Sanskrit-like stress patterns, (ii) Classical to modern Indic reflexes, and (iii) cognates across contemporary Indic languages with different prosodic typologies. Endpoints are recorded tokens; intermediate stages are algorithmically generated, modelling hypothetical configurations rather than attested forms. The continua visualise plausible pathways of phonetic reorganisation (Hudson et al. 2024). Data for Vedic, the earliest attested Indic (Macdonell 1910: 76–107), come from recordings of the *Rigveda* recited in a priestly tradition. For Classical Sanskrit, metrically identical forms were identified in modern languages preserving Sanskritic loans or inherited reflexes. Recordings from freely available sources (e.g. Wikimedia, Forvo, YouTube) were time-aligned and vocoded; interpolants were generated for intensity, fundamental frequency (f_0), and long-term average spectrum (LTAS). Two- and three-dimensional visualisations in MATLAB (The MathWorks, Inc. 2022) track fluctuations in prominence cues. ‘Evolutionary steps’ index putative generations of change; ‘frames’ on the y axis capture points within the word, as in the Vedic—Bengali and Bengali—Hindi examples below. A surface plot of f_0 (Fig. 1) suggests that the historical lexical peak on the final syllable remains but becomes less distinct relative to a rising initial prominence. Fig. 2 shows the intensity surface for Bengali *bíddalay* – Hindi *vidyáalay* ‘school’: despite different structural analyses (initial vs penultimate stress), differences in intensity are minimal, whereas the relative durations of the word’s components are systematically reweighted. These examples illustrate how phonological distinctions of accent may be phonetically shallow, and how different cue weightings can support competing stress templates. The modelling is suggestive of Indic prosodic change as the reweighting of intrinsic prominence cues. More broadly, interpolation continua are presented as a tool for linking synchronic phonetic structure with diachronic prosodic reorganisation.

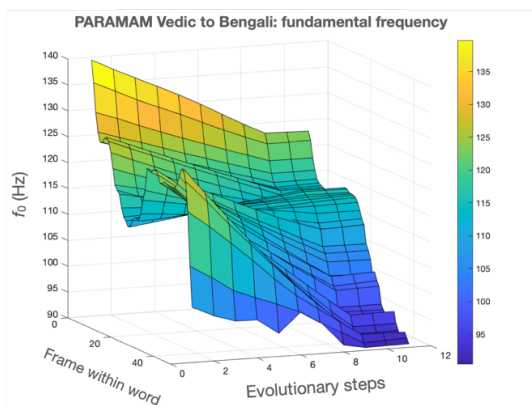


Figure 1: Surface plot of f_0 (Hz) for Vedic *paramám* to Bengali *pórom* ‘highest’.

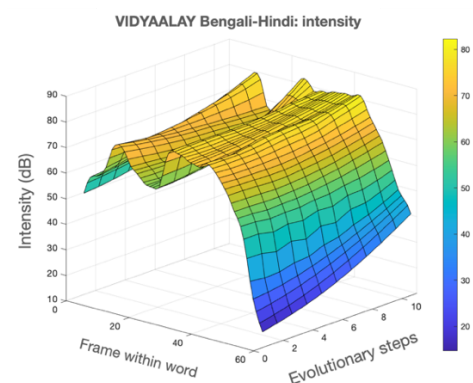


Figure 2: Surface plot of intensity (dB) for Bengali *bíddalay* to Hindi *vidyáalay* ‘school’

References

- Bühler, G. 1883. *Leitfaden für den Elementarunterricht des Sanskrit*. Wien: Konegen.
- Coleman, J., J. Aston & D. Pigole. 2015. Reconstructing the sounds of words from the past. In The Scottish Consortium for ICPHS 2015 (ed.), *Proc. 18th International Congress of Phonetic Sciences* [0296]. Glasgow.
- Hudson, T., J. Wei & J. Coleman. 2024. ‘Using acoustic-phonetic simulations to model historical sound change’. *Diachronica* 41.3: 355–378.
- Lahiri, A. & H. J. Kennard. 2020. The Indian Subcontinent. In C. Gussenhoven and A. Chen (eds), *The Oxford Handbook of Language Prosody*. Oxford: Oxford University Press. Pp. 316-331.
- Macdonell, A. A. 1910. *Vedic Grammar*. Strassburg: Trübner.
- Masica, C. P. 1993. *The Indo-Aryan Languages*. Cambridge: Cambridge University Press.
- The MathWorks, Inc. 2022. MATLAB version: 9.13.0 (R2022b). <https://www.mathworks.com>
- Schiering, R. & H. van der Hulst. 2010. Word accent systems in the languages of Asia. In H. van der Hulst, R. Goedemans & E. V. Zanten (eds), *A Survey of Word Accentual Patterns in the Languages of the World*. Berlin, New York: De Gruyter Mouton.