

PRIMATE PROTO-VOWELS AND THE EARLY EMERGENCE OF SPEECH

LOUIS-JEAN BOË¹ and THOMAS R. SAWALLIS^{*2}

^{*}Corresponding Author: tom.sawallis@google.com

¹GIPSA-lab, CNRS, Grenoble INP & U. Grenoble Alpes, Grenoble, France

²New College, U. of Alabama, Tuscaloosa AL, USA

1. Laryngeal Descent Theory Refuted

The publications elaborating the Laryngeal Descent Theory (LDT) began 50 years ago (Lieberman, Klatt, & Wilson, 1969). LDT eventually claimed that only anatomically modern *Homo sapiens* (AMHS) could have full language, because only they had the vocal tract (VT) anatomy required to produce contrasting vowels. Other primates, Neanderthals included, were limited to the schwa-like vocalizations generated by a uniform-tube configuration of the VT.

Criticism of LDT began about 20 years ago, and culminated recently in two technologically updated replications of early LDT studies. Fitch et al. (2016) used x-ray videos of macaque facial gestures to estimate the VT's area function and then synthesized the vowels implied by those configurations. Boë et al. (2017) analyzed naturally produced calls by Guinea baboons. In normalized F1-F2 space, the synthetic macaque vowels exceeded LDT's predicted schwa, covering about a quarter of the vowel triangle, and included tokens in /u/ and /a/ zones, while the baboon tokens occupy over twice the macaque space, and include tokens in /i æ a ɔ u/ zones. Both species lack key elements of AMHS vocal anatomy, so their contrasting vowel qualities refute LDT's claim that only AMHS can produce non-schwa vowel qualities.

2. Contrasting Proto-Vowels Discovered in Previous Primate Studies

Extending the search for primate vowel contrasts requires tools. We review how vowel spaces are normalized for cross-species comparison using VT length

(VTL), and how to estimate VTL from formant values when anatomic measurements are unavailable. We also document functions for schwa formant frequencies by VTL and for certain known primate VTLs. We then examine a selection of articles (1993 – 2016) for potential non-schwa vowels in other living primates. Our analysis (in press, *Science Advances*, Dec. 2019) reveals vowel qualities outside the schwa region in gorillas, baboons, macaques, Diana monkeys, and even lemurs. We conclude that the ability to produce potentially contrastive non-schwa vowel qualities dates back at least to our last common ancestor with Cercopithecoidea (Old World monkeys) some 27 Ma ago.

3. The Dawn of Speech vs. the Dawn of Language

The LDT was early and influential in the burgeoning field of language evolution, and has been cited since by researchers (up through, e.g., Hauser et al., 2014) as reinforcing the case for language emergence as recently as 100 – 70 ka ago. Their scenario is a recent, sudden, and simultaneous emergence of speech and language triggered by the speciation event distinguishing AMHS from previous hominid forms, about 300 ka ago.

Our findings render that scenario untenable. The Dawn of Speech in the form of contrasting vowel sounds is not recent, but early, about 100x earlier than AMHS speciation. Speech emergence was therefore not sudden, but extended, probably via stages now inviting both theory and investigation. Its final developments necessarily coincided with language emergence, but the duration difference, 2 orders of magnitude, makes simultaneity meaningless. Language, whenever it emerged, had to integrate into some previously developed speech system.

References

- Boë, L.-J., Berthommier, F., Legou, T., Captier, G., Kemp, C., Sawallis, T. R., ... Fagot, J. (2017). Evidence of a vocalic proto-system in the baboon (*Papio papio*) suggests pre-hominin speech precursors. *PLOS ONE*, 12(1), e0169321. <https://doi.org/10.1371/journal.pone.0169321>
- Fitch, W. T., de Boer, B., Mathur, N., & Ghazanfar, A. A. (2016). Monkey vocal tracts are speech-ready. *Science Advances*, 2(12), e1600723.
- Hauser, M. D., Yang, C., Berwick, R. C., Tattersall, I., Ryan, M. J., Watumull, J., Chomsky, N., Lewontin, R. C. (2014). The mystery of language evolution. *Frontiers in Psychology*, 5, 401.
- Lieberman, P., Klatt, D. H., & Wilson, W. H. (1969). Vocal tract limitations on the vowel repertoires of rhesus monkey and other nonhuman primates. *Science*, 164(3884), 1185–1187.