

# Articulatory Phonetics of Voice Actors

Colette Feehan

Indiana University Bloomington (USA)

cmfeehan@iu.edu

**Background:** Voice actors are an under-utilized population for linguistic study, with little research focusing on voice actors' unique vocal tract manipulations, and instead focusing on laryngeal setting and voice quality (Teshigawara & Murano, 2004; Starr, 2015).

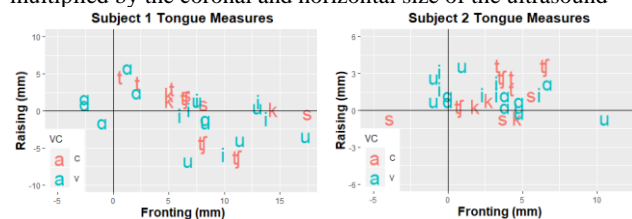
Within linguistics, John Catford (1977) and Bjorn Lindblom (1990) explore the usefulness of investigating what sounds are articulatorily possible as a way of informing our current models of speech production rather than solely investigating gestures produced during natural speech. Bressmann (2012) echoes this sentiment saying that "lingual contortion could serve as a paradigm for research about the plasticity of lingual movement in speech." While there is plenty of literature addressing the plasticity of tongue movement in response to perturbations, fewer studies look at healthy tongues in deliberately contorted positions. This is a gap that this research aims to fill.

**Methods:** This study uses a combination of 3D/4D ultrasound, Electrolaryngography (EGG), and webcam footage of the lips and jaw to describe the different articulatory strategies and deliberate tongue contortions that professional and amateur voice actors use to simulate a smaller vocal tract and achieve a 'childlike' acoustic percept. Each participant read aloud a word list and two short stories in their regular speaking voice and then again in a simulated child voice.

Ultrasound was recorded with a digital 3D/4D transducer and stabilization helmet to prevent probe movement (Scobbie, Wrench, & van der Linden, 2008; Wrench & Scobbie, 2008). Audio was recorded with a microphone mounted in an elastic-suspension shock mount. The audio, Ultrasound, EGG, and webcam footage are all collected simultaneously via a BNC connector block with a foot pedal spliced line.

Webcam footage is used to investigate lip movement, ultrasound is used to analyze gesture fronting/raising and hyoid bone raising, and EGG is used for laryngeal raising. Preliminary results show that actors use different combinations of articulatory strategies in order to create a child-like voice. They can also implement acoustic strategies such as manipulation of fundamental frequency or vowel duration.

**Results and Discussion:** Actors seem to apply different combinations of strategies including; lip rounding/spreading, gesture fronting, hyoid bone raising, and laryngeal raising. For example, figures 1-4 below show the difference in tongue position across the two voice contexts. Tongue measurements were taken from raw ultrasound images by taking x and y coordinates from the midsagittal slice of the point on the tongue that is the highest and farthest forward point of the surface of the tongue. These coordinate values, which correspond to pixel values, were then multiplied by the coronal and horizontal size of the ultrasound



Figures 1 & 2. Difference in tongue placement across the adult and child voice conditions for two female participants. Bullets in the right quadrants reflect a fronted child posture and bullets in the upper quadrants reflect a raised child posture

image, in millimeters. These values were then subtracted in order to produce a single value which reflects the fronting or raising of the tongue in the child condition. Positive values indicate that the child voice was raised or fronted, negative values indicate that the child voice was lowered or backed. This study also makes use of ultrasound and kymogram imaging to look at hyoid bone movement over time across the two voice conditions as well as webcam imaging to analyze lip movement.

Investigation of voice actors' articulations has implications for the fields of linguistics, speech and hearing science, and vocal performance. Future data from voice actors can be used to test or update acoustic-articulatory models of speech and to further our understanding of tongue plasticity. The robustness of an articulatory model could be tested by using actors' regular and 'atypical' articulations that are currently less understood or predictable.

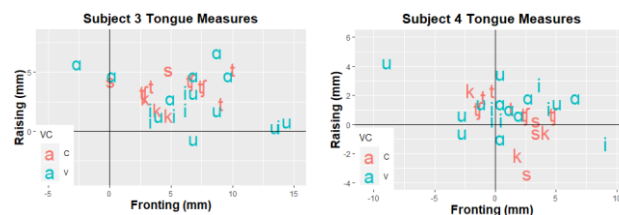
Investigating actors' vocal tract manipulations contributes to our knowledge about which muscles humans can control. For speech therapy this could provide alternate articulatory targets for common speech sounds, which could be useful for individuals with different kinds of pathological speech.

Finally, the field of vocal performance will also benefit from this research. The field currently lacks a pedagogy to teach this kind of voice acting, largely because of the lack of research on the topic. This research can be used to provide performers with a better understanding of this kind of vocal performance.

## References

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**Keywords:** Speech production, Articulatory-acoustic relations, Vocal Performance



Figures 3 & 4. Difference in tongue placement across the adult and child voice conditions for two male participants. Bullets in the right quadrants reflect a fronted child posture and bullets in the upper quadrants reflect a raised child posture

