

InFormant 

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Kristen Sullivan, Editor
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It is our goal throughout the second year of the InFormant newsletter to bring you updates on the diverse vocology research and practice being conducted by PAVA members. We strive to deliver this information in a manner that is inclusive of our membership's disciplines and experiences. As always, we welcome your participation in creating InFormant content. Please visit [this page](#) to submit your ideas. Best wishes in the new year!

Your InFormant Editors,

Kristen Sullivan & Paul Patinka

Science and Research

Tongue Tuning. Physioacoustic and Pedagogy of Morphological Changes in the Tongue during Formant Tuning

Angelika Nair, Ph.D.

The year 2020 has affected every one of us in a multitude of ways. I am grateful to God that I have only experienced a “research progress” inconvenience. In consequence, I am only able to provide a background discussion.

My main research interests are the tongue and the mandible (jaw). My latest project centers around the tongue. The idea started with the question “What is the tongue doing during vowel modification/formant tuning?” This evolved into the Tongue Tuning – Physioacoustic’s and Pedagogy of Morphological Changes in the Tongue during Formant Tuning.

The fact that we do not see our instrument while using it makes bridging the gap between science and practical application not easy. This is why I believe that biofeedback, such as ultrasound, is a crucial part in gaining control of internal functions and self-regulation. Ultrasound also gives us insight of the fascinating works of the tongue and its various shapes for all phonemes.

Over the last decades, vowel modification or formant tuning has been the interest of many research papers (including Miller, Shutte 1990; Carlson, Sundberg 1974, 1991; Gregg, Scherer 2005; Sundberg et.al. 2012; Ritzerfeld, Miller 2016). Acoustic analysis and synthesized simulations have been used to examine whether there are common tuning strategies among singers.

In order to avoid hyperfunction or excessive tongue tension, register breaks as well as timbral variety, various strategies – such as the tuning of F1/ F2 to a specific harmonic partial once fo exceeds – have been identified and been found to be applied across all singer classifications. Drawn from these acoustical measurements, a variety of conclusions about physiological changes (laryngeal position, lips, mandible) within the vocal tract have been suggested and both confirmed and revised (including Estill 1988; Titze 2007; Guzman et.al 2014; Sundberg et.al. 1993; Echternach et.al. 2014; Nair et.al. 2016). However, the physioacoustics (the relationship between the anatomy and physiology of the singing voice and the radiated acoustical result) of formant tuning in particular continues to be not well understood, incomplete, and the majority of techniques remain conjecture. This is true in particular of one of the most malleable active articulators within the vocal tract, the tongue.

One of the major limitations is that most material is limited to the two-dimensional midsagittal plane (showing only high/low, front/back movements) and a lower frame rate. There are other studies that have included the tongue in their measurements, but most often only one parameter such as the Highest Point of the Tongue (HPT) was included in image analysis (Echternach et.al. 2016).

Research and analysis of the tongue through ultrasound and the consideration of its anatomy and physiology suggest that these analyses and interpretations are incomplete. This is one of the biggest oversights and excludes what I believe to be a crucial puzzle piece in the physioacoustic of formant tuning and style.

The complex musculature architecture of the tongue – whose hydrostatic nature moves by deforming local regions – changes surface shapes and positions. These irregularities, plus the overall shape of the tongue, are of particular importance for the acoustic aspects of all phonemes as well as timbre (see Fig. 1).

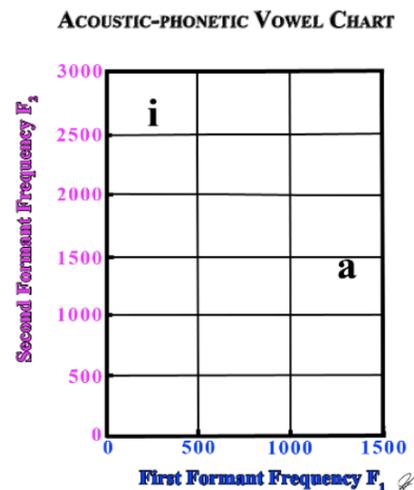
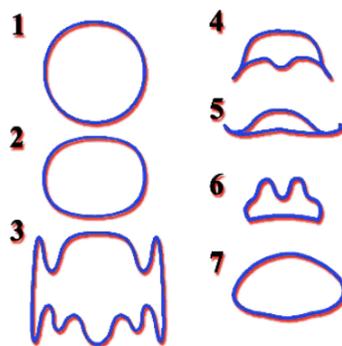
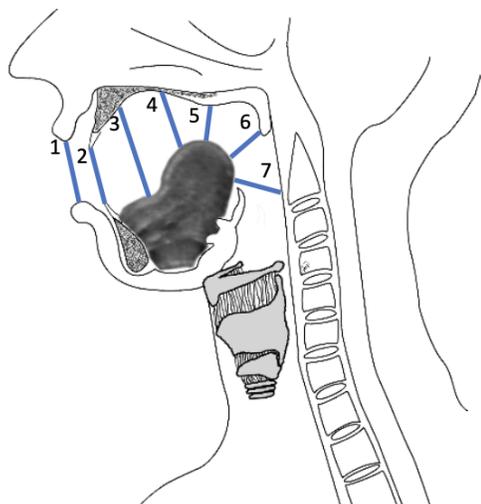


Figure 1: Image left showing /a/ vowel. from Angelika Nair, *The Tongue as a Gateway to Voice, Resonance, Style, and Intelligibility*. forthcoming Plural Publishing 2021; Image right: adapted from Fant (1960), p 106

Figure 2: Acoustic Phonetic Vowel Chart /i/ and /a/.

This makes the tongue a crucial part in terms of the SOURCE-FILTER interaction. For one thing, F_1 correlates (negatively) with tongue height while F_2 correlates with tongue fronting (as defined by the cardinal vowel quadrilateral). From another perspective we can say that F_1 is the result of the back-cavity resonance and that F_2 is the result of the front-cavity resonance.

The two cavities are linked by a region of significant cross-sectional area, and the acoustic properties of the two cavities interact. There is a low acoustic impedance between the two cavities. So, the resonances that generate these formants are a result of the interaction between these two cavities.

Because the motion within the tongue is accompanied by deformation, the resulting shapes and irregularities will affect the cross-sectional areas within the vocal tract. This is important either for modification in register shifts (morphing the shape to accommodate the tuning of F_1/F_2 , see Figure 2) and/or in terms of timbre (e.g., in belting, filtering in 3-5fo for the brass-like bite in the sound). Previous research as well as preliminary results suggest specific patterns of tongue shapes for specific vowel selections for both differentiating between singing styles and formant tuning.

However, this complexity still poses challenges to advanced technology, such as MRI. For this reason, both the execution as well as interpretation of 2D imaging techniques have to be seen through and oriented to a 3D structure. Furthermore, in the pedagogical domain both the physiology and acoustics are still challenging to conceptualize, visualize or comprehend for teachers and students alike. This reality often results in well-intended, yet misguided or even counterproductive instructions.

This exploratory/pilot study will investigate the morphological changes of the tongue in formant tuning through the combined use of the following instruments, with a special focus on the relationship of tongue structure, function, and acoustics:

This study aims to provide another puzzle piece to help discern the various patterns of tongue shapes for all phonemes (to what extent certain muscles are involved in various shapes) and, by extension, the correlation to formant tuning and pedagogical language of instruction.

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Hands-On Vocology

Addressing Vocal Fatigue and Muscle Tension

Elissa Weinzimmer, founder of Voice Body Connection

Fourteen years ago while I was a student at the University of Southern California, I experienced an episode of “vocal trauma.” It took me years to gain more clarity about what had transpired in my throat, but I now understand that it was a combination of a vocal hemorrhage, acid reflux, and muscle tension dysphonia. In particular, this latter issue—muscle tension dysphonia—has been spoken about much more widely in clinical circles and beyond in the last few years. I am so glad it has because MTD is an issue that affects many singers and speakers. Muscle tension issues occur on a spectrum, and everyone from vocalists with a propensity towards fatigue to those who have completely lost their voice can benefit from practices to reduce tension.

In order to illustrate why tension inhibits a free voice, I'd like to offer a metaphor...

Think of the human voice as a garden hose. The nozzle that turns on the hose represents breath support. The water flowing through the hose is the voice. The direction you point the hose is akin to resonance. And you know how we like to do that thing where we put our thumb over the end of the hose to make the water spray? Well, there's your articulation. Now, if the hose gets tangled and the water isn't flowing, we've got to untangle it. But if we don't know how to untangle the hose? Well, then the next best solution is to twist the nozzle and turn off the flow of water.

When vocalists experience tension in their shoulders, neck, jaw, tongue, or throat, they often don't know what to do about it. So they either push harder, which is kind of like squeezing the hose in the middle to get as much of a spurt as possible, or they simply shut down their breath support. This means that recovering from vocal muscle tension issues involves a dynamic rebalancing of breath support, tension release, and overexertion. I feel that the best first step to releasing tension in the shoulders, neck, jaw, tongue, and throat is to become familiar with the anatomy - particularly with the muscles and their attachments and directionality - in order to understand specific lines of energy that need recalibration and release. When we get to know these parts of the body that are largely innervated autonomically, we can understand better how to release them.

The most important part of the whole process and what shifts the entire paradigm is the reality that if your hose became tangled, so to speak, it's very likely because you were applying too much effort in the first place. This means you won't be able to further "effort" your way out of the problem. When doing any vocal tension release work, it is crucial to remember that how you do an exercise is even more important than what the exercise is. In other words, if you massage your jaw with an air of trying to beat your masseter muscle into submission, then what you are doing is perpetuating the very tension you are trying to release. Therefore, I highly encourage that as we work with our students, we promote kindness toward our vocal instrument. Muscle tension is something to be gently untangled, rather than willfully overcome.

Over the fourteen years since my episode of vocal trauma, I have devoted my career to helping others free their voice and vocal tension. I have deep gratitude for the fields of theatre and singing pedagogy, yoga, somatics, anatomy, neuroscience, and to my mentor and collaborator David Ley founder of Vibrant Voice Technique (a vibrator for your voice) for helping me untangle my vocal tension issues and reclaim my voice. If you would like to learn more about my work, please visit www.voicebodyconnection.com. Additionally, you and your students or clients are also invited to my free vocal health masterclass, How To Have A Healthy Voice, on Wednesday, January 27th. Information is available on my website.

Getting Personal

To learn more about our cross-disciplinary interests, InFormant editors will be interviewing various PAVA members so we can all learn a little more about the diverse fascinations housed in our organization. This past December, Paul Patinka had the honor of interviewing Theodora Nestorova who recently won the “Best Student Presentation Award” at the 2020 Virtually PAVA Symposium. Condensed answers from the conversation can be found below, and a full video and transcript can be found on our [PAVA Facebook pages](#) and [website](#).

1) Can you tell us a little about some projects you are currently working on or recently finished?

I have been continuing the next phase of the vibrato research I presented at the PAVA symposium this summer. I just finished a pilot study in which I am looking at quantifying vibrato shapes and patterns by genre and analyzing vibrato extent's rate of change over time. It's been very interesting to analyze my subject recordings. That's been my favorite part because I get to go through each sample and look at the individuality of each artist and their vibrato. I am also working on a project with Dr. Jamie Dahman on fashioning an article together to elevate and highlight Bulgarian lyric diction.

2) What about vocalization fascinates or inspires you the most?

For me, it's the fact that the human voice mechanism can create so many different sounds that are natural to it. Raw expressions of our spirit, our singing spirit, and body. That I think that's what fascinates me. Vibrato is one of them as well. I think it's something that we change intentionally, culturally, and by genre. It's also something that we use as a tool of expression, like registration, modes, timbre, and all aspects of voicing. The fact that we can make all these sounds and the vocal tract is so malleable and our capability is so vast.

3) What excites you about being a member of PAVA? How does PAVA fit into your overall career trajectory or goals?

I'm very excited and thrilled to be a part of PAVA. First of all, it's been an organization that I've admired through its members and through reading their work. So, for me, what excites me is just being in the community and getting to speak with people and to speak about this stuff, to learn, to attend the webinars, and to attend the conferences and see what advances in voice science and vocology are being made as they are being made. That's the most exciting part.

4) Do you have a mentor in your field whose work you look up to? Who is it and why?

Certainly, Dr. Ian Howell because I've been working so closely with him in his work. I mentioned Dr. Christian Herbst. He's been a huge mentor for me and somebody whom I look up to just for his career trajectory, his path, and his huge body of inquiry. Other PAVA members, like Ken and Joanne Bozeman as well, because both of their works have been instrumental to me as I've grown up in the field. And John Nix for all of his work in voice science and pedagogy, but especially as a great inspiration and reference in my vibrato research journey.

5) If you had unlimited resources and a year of vacation, what is something fun you would like to do with that time?

I would travel to places where I haven't been to. Since I'm originally Bulgarian and I was born in the UK I've been to every country in Europe except for eight. But I want to spread out to be less Eurocentric. I've always wanted to go to Asia, South America, Australia and even, I don't know, Antarctica!

Call For Abstracts

2021 VIRTUALLY PAVA CONFERENCE

The 2021 PAVA Symposium will take place in the Virtual PAVA Village from August 13–15, 2021. It is our pleasure to invite you to submit one or more papers (oral, poster, or workshop) on all aspects of Vocology (eg. Medical, Voice therapy, Voice pedagogy, Voice training, and Basic Sciences). Authors are invited to submit abstracts online via the PAVA website by midnight Eastern Standard Time on **February 8th, 2021**. Selected submissions will be notified the first week of April 2021.

[Submit here](#)