Midwest Voice

Abstract Booklet

November 16, 2024
Voxman Music Building
University of Iowa
Iowa City, IA

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KEYNOTE: History And Impact Of Voice Research At The University Of Iowa And The Midwest Generally

Ingo R. Titze

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Keywords: Voice Science; Modelling; Midwest

Abstract

The University of Iowa has been a trailblazer in the field of voice science, significantly advancing the understanding of vocal health, acoustics, and pedagogy. This talk will explore the rich history of voice science at the University, highlighting key milestones, influential figures, and groundbreaking research that have shaped the discipline.

The journey of voice science at the University of Iowa began in the early 20th century with the establishment of the Department of Speech Pathology and Audiology. Early efforts focused on understanding speech disorders and developing therapeutic techniques. The department quickly gained recognition for its innovative approaches and comprehensive research, laying the groundwork for future advancements.

The 1980s and 1990s saw the integration of advanced technology into voice research at the University. The adoption of high-speed imaging, computer modeling, and acoustic analysis tools allowed researchers to explore the intricacies of vocal fold vibration and resonance with unprecedented precision. These technological advancements facilitated a deeper understanding of vocal pathologies and informed the development of more effective treatment protocols.

A significant addition to the University's voice science legacy was the establishment of the field of vocology, including voice pedagogy (with the college of music) and phonosurgery and the Iowa Voice Protocols (with the Dept of Otolaryngology). My own work pioneered research in the biomechanics of voice production and vocal health has been instrumental in shaping modern vocology. Further work also led to the founding of the National Center for Voice and Speech (NCVS) in 1990, working with multiple other institutions. The NCVS has become a cornerstone for voice research, promoting scientific and clinical innovation in voice and speech.

This talk will not only celebrate the historical achievements of the University of Iowa in voice science specifically but also the collaboration with others in the Midwest generally. Additionally, understanding voice science from the larger view must consider the context of humanity, philosophy, and the whole person. This underscores the ongoing commitment to innovation and excellence in the field. Attendees will gain a comprehensive understanding of the evolution of voice science at the University and its enduring impact on both academic research and clinical practice.

Presenter Bio

Dr. Ingo R. Titze is a renowned voice scientist and executive director of the National Center for Voice and Speech. He is a Distinguished Professor Emeritus at the University of Iowa and has significantly advanced the field of vocology through his pioneering research in vocal biomechanics and health.

Advancing Large-Scale Voice Research: Innovative Tools And Techniques For Data Collection And Analysis

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Keywords: Voice Research; Large Data; Team Science

Abstract

Recognizing the collaborative nature of modern scientific research, we emphasize the role of team science in our approach, highlighting the opportunities available at the University of Iowa and throughout the Midwest region. By fostering interdisciplinary collaboration, we integrate expertise from fields such as biomechanics, acoustics, computer science, education, vocal performance, and clinical research to tackle complex research questions. This collaborative approach not only enhances the robustness of our methodologies and accelerates innovation and knowledge dissemination but also fosters a strong and positive work culture, which further increases productivity.

This presentation outlines the next phase of research at the Voice Biomechanics and Acoustics Lab, focusing on expanding into large-scale human subject studies. We address the logistical challenges of scaling up participant numbers by an order of magnitude through cutting-edge computational tools and methodologies. We introduce an open-source, computer-assisted vocal loading protocol that enhances repeatability and efficiency in large-scale data collection. This protocol ensures consistent participant experiences while facilitating seamless data acquisition and promoting external adoption.

As data becomes increasingly multidimensional and multimodal, we recognize the limitations of traditional statistical methods. To address this, we are leveraging machine learning techniques for processing complex datasets. Crucially, we emphasize the importance of interpretability in scientific inquiry by embracing explainable artificial intelligence (XAI) approaches. Here we will present case studies demonstrating the application of our novel data collection protocol and XAI techniques, illustrating their potential to advance large-scale voice research in both clinical and academic settings.

Presenter Bio

Dr. Eric Hunter serves as the chairperson/DEO of the Department of Communication Sciences and Disorders at the University of Iowa, as well as Harriet B. and Harold S. Brady Chair in Liberal Arts and Sciences. His main research interests are occupational voice use and speech signal processing with other interests in biomechanics of speech articulators and biomechanical models of the vocal system.

Dr. Mark Berardi is an assistant research scientist for the Communication Sciences and Disorders Department at the University of Iowa who received his PhD from Michigan State University. His work focuses on the development of computational tools for large-scale speech and voice disorders.

Disclosures

The research reported in this presentation was partially supported by the National Institute on Deafness and Other Communication Disorders, grant number R01DC012315. The content is solely the author's responsibility and does not necessarily represent the official views of the National Institutes of Health.

VOICE MATTERS: THE PATHWAY TO IDENTIFYING AND PREVENTING WORK-RELATED VOICE DISORDERS

LADY CATHERINE CANTOR-CUTIVA, ERIC J. HUNTER

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Keywords: Voice; Voice Disorders; Occupational Health; Public Health

ABSTRACT

In 1996, Vilkman published the first study on occupational risk factors and voice disorders [1]. Considering this moment as a starting point of the field of occupational voice, over the past 28 years, significant progress has been made in identifying and prioritizing risk factors for voice disorders in occupational settings [2]. This talk aims to provide a comprehensive overview of the evolution in the field of occupational voice during this period. Attendees will learn about key milestones, such as the transition from cross-sectional studies, which only test associations, to longitudinal studies that establish causal relationships between working conditions and voice disorders among occupational voice users, particularly teachers. In this regard, a pivotal moment was in 2016 when Cantor-Cutiva and Burdorf published the first longitudinal study on voice disorders among teachers, reporting an incidence of 44%, a prevalence of 70%, and a recurrence of 78% [3]. These findings quantified the impact of voice disorders on teachers' health over time and allowed us to prove the causality of work-related voice disorders in teachers. From 2013 to 2024, studies have used epidemiological and biostatistical methods to identify important associated and risk factors for voice disorders among occupational voice users, like teachers, broadcasters, and singers. These factors include physical factors like background noise conditions and organizational factors such as class size and teaching hours. Health economics and Health-Related Quality of Life techniques have then been applied to quantify the costs and quality-of-life impacts of voice disorders on teachers, schools, and health systems. In 2015, it was reported that 73% of the costs were related to productivity reduction and 7% to work absenteeism [4]. Further analysis using Social Capital motives showed that income was a primary reason for teachers to keep working despite having voice disorders. Based on these insights, several studies have designed workplace interventions to control hazards and reduce the occurrence of voice disorders among teachers with positive results.

REFERENCES

[1] E. Vilkman, "Occupational risk factors and voice disorders," Logo Phoniatr Vocol., 21(3–4), pp.137-141, 1996.
[2] A. Castillo-Allendes, L. C. Cantor-Cutiva, and E. J. Hunter, "Mapping the Landscape of Voice Complaints among Teachers," J Voice, pp. S0892-1997(23)00218–7, Aug. 2023, doi: 10.1016/j.jvoice.2023.07.009.
[3] L. C. Cantor Cutiva and A. Burdorf, "Work-Related Determinants of Voice Complaints Among School Workers: An Eleven-Month Follow-Up Study," Am J Speech Lang Pathol, vol. 25, no. 4, pp. 590–597, 2016.
[4] L. C. Cantor Cutiva and A. Burdorf, "Medical Costs and Productivity Costs Related to Voice Symptoms in Colombian Teachers.," J Voice, vol. 29, no. 6, p. 776.e15–22, 2015, doi: 10.1016/j.jvoice.2015.01.005.

PRESENTER BIO

Dr. Lady Catherine Cantor-Cutiva is a Research Scientist in the Communication Sciences and Disorders Department at the University of Iowa. Her research focuses on the interdisciplinary intersection of health sciences and communication disorders to explain the effects of vocal demands in occupational settings. Her work aims to improve vocal health and develop evidence-based interventions.

DISCLOSURES

The research reported in this presentation was partially supported by the National Institute on Deafness and Other Communication Disorders, grant number R01DC012315. The content is solely the author's responsibility and does not necessarily represent the official views of the National Institutes of Health.

Towards Comprehensive Upper-Airway Imaging Using Information Efficient MRI Methods

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Keywords: Sparse-sampling; model-based reconstruction; zero-echo time MRI; vocal tract and larynx imaging

Abstract

The human upper airway consists of several structures such as the lips, tongue, hard palate, soft palate, larynx (including vocal folds), and pharynx, all of which coordinate with great dexterity to perform the essential day-to-day functions of speaking, swallowing, and breathing. Visualizing the complex movements of these structures is crucial to advance our understanding of speech production mechanism, diagnose speech, and upper-airway collapse disorders (e.g. obstructive sleep apnea), swallowing disorders (e.g. dysphagia), optimize otolaryngology surgical planning procedures on critical organs (e.g. tongue, velum), and improve various technologies related to speech synthesis and recognition. Magnetic Resonance Imaging (MRI) is emerging as a powerful modality for upper-airway imaging due to its excellent soft-tissue contrast, non-ionizing radiation, and capability to image along any arbitrary plane orientations, and capability to perform longitudinal, repeated acquisitions. However, MRI has remaining technical challenges due to fundamental tradeoffs between imaging speed, resolution, and signal to noise, and inability to image bony structures with conventional methods. In this talk, we will describe novel information efficient MRI methods that significantly push the state of art in imaging the human upper airway in applications of speech/voice production and sleep disordered breathing (e.g. obstructive sleep apnea). Specifically, we will describe 1) utility of custom receiver coils to enable high signal to noise imaging of upper-airway; 2) a fast 2D single and multi-slice acquisition and manifold learning-based model that allows for robust rapid imaging of upper-airway at unprecedented high spatio-temporal resolutions (e.g. up to 1.34 mm2/pixel and 10 ms/frame); 3) extensions to a time-aligned 2D multi-slice (aka pseudo-3D) dynamic speech imaging which enables extraction of vocal tract functions that quantify 3D kinematics of vocal tract shaping; 4) application to dynamic laryngeal imaging for visualization of gross changes in glottic configuration during speech and breathing; 5) a 3D zero echo time MRI framework that produces bony structures (e.g. teeth) from MRI scans, and validate it against ultra-low dose CT. Several examples showcasing the improvements offered by the information efficient MRI methods over existing methods will be demonstrated.

Presenter Bio

Sajan Lingala is an Assistant Professor of the Roy J Carver Department of Biomedical Engineering, and Department of Radiology at the University of Iowa. His research focuses on rapid dynamic MRI methods and their application to understand the human upper-airway pathophysiology.

Acknowledgments

We thank the NIH (NIH1R01HL173483) for funding support. The MRI data presented in this work were collected on an MRI instrument funded by the NIH (S10OD025025).

"Tell Me How Much", The Rationale For Doing VRP- Recording Or Voice Mapping

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Keywords: Voice quality; VRP; Voice mapping; Interactive feedback

Abstract

Voluntary or involuntary, voices do change in for instance their overall range, their quality or efficiency. The apparently simple question "How much?" means answering subsequent questions like: What features to take into account? How much in general terms, in absolute terms, or in relative terms? How much in relation to what reference? Moreover, in how much detail can we resolve a change in a voice and how immediate?

In this paper, the VRP recording or voice mapping paradigm will be introduced for its property to objectively describe, in large detail, individual voice change. Following a short introduction of the interactive recording procedure, the protocol and the hardware, it will be explained how to interpret the resulting maps. It will be discussed what kind of quality aspects of the voice can all be mapped and how such a multidimensional comprehensive approach will add to our knowledge on a single voice or the voice in general. Finally, it will be addressed how different these maps can be between individuals, while still being very reproducible within individuals, and how the particular mapping on base of fundamental frequency and the absolute sound level is so essential to guarantee an effective answering of the question 'how much?".

References

Pabon, P., & Ternström, S. (2020). Feature maps of the acoustic spectrum of the voice. Journal of Voice, 34(1), 161-e1.

Presenter Bio

Dr. Peter Pabon (1956) has a lifelong obsession with building analog and digital sound analysis/synthesis systems, primarily to explore the voice. He worked as a teacher/researcher at several universities and electronic music institutes and developed several voice recording systems. The latest "Voice Profiler", was marketed from 2003 to 2010.

Disclosures

The earlier mentioned voice recording system, Voice Profiler, and its specific hardware, is no longer commercially available, so there are no financial benefits. Currently, this system is converted to a non-commercial open-source version using standard hardware. Thus, the drive in promoting this system stayed, but it is no longer a commercial interest.

NEUROBIOLOGY OF VOICE PERCEPTION

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Keywords: Neurobiology of voice perception; functional neuroimaging; dysphonia

ABSTRACT

The neurobiology of voice perception jolted into existence shortly before the turn of the millennium, helped by a seminal functional neuroimaging paper by Pascal Belin, Robert Zatorre and colleagues. Before then, the longstanding fascination with the neurobiology of speech and language by the pioneering work of Paul Broca and Carl Wernicke with aphasic patients left a blind spot in understanding the carrier of speech, our voice, and its neurobiological bases from perception to laryngeal voice-motor control. I will overview highlights along this journey, focusing on the neurobiology of voice perception from the complement of insights generated by research with human and nonhuman animals. New work identifies several epistemic gaps and opportunities for the next wave of research into the neurobiology of voice to bridge the gap to research with dysphonia patients, both to better understand the neural system that allows us to perceive individuals ("who is that?") and for this field to contribute towards improving vocal control and production in patients with dysphonia.

REFERENCES

Belin, P., R. J. Zatorre, P. Lafaille, P. Ahad and B. Pike (2000). "Voice-selective areas in human auditory cortex." Nature 403(6767): 309-312.

Perrodin, C., C. Kayser, T. J. Abel, N. K. Logothetis and C. I. Petkov (2015). "Who is that? Brain networks and mechanisms for identifying individuals." Trends in cognitive sciences 19(12): 783-796.

PRESENTER BIO

Chris Petkov is Professor and Vice Chair of Research in the Department of Neurosurgery at the University of Iowa, USA where he is now based. Chris leads an international research program focused on understanding neuronal system mechanisms for language and memory functions, including voice processing and audio-visual (voice/face) integration. The program of work relies on combining advanced neurophysiological and neuroimaging techniques with causal neural system perturbation. Chris trained at the National Institutes of Health, USA prior to completing his PhD in systems neuroscience at the University of California, Davis. He was an Alexander von Humboldt fellow at the Max Planck Institute for Biological Cybernetics in Germany, after which he established his comparative neuropsychology laboratory at Newcastle University Medical School in the United Kingdom. He has held Wellcome Trust and European Research Council awards, and the research program has had continuing funding by joint UK and National Institutes of Health and National Science Foundation grants.

Development Of An Educational Program At The Interface Of Music And Medicine

Music And Medicine On Monday

Evgeniya Molotkova[1], Piper Wenzel[1], Brian Peterson[1], James Edel[2], Ryan Nguyen[2], Tammie Walker[2], Jeremy Manternach[2], Elise DesChamps[2], Ingo Titze[3], Kate Gfeller[1,2] and Henry Hoffman[1]

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Keywords: Professional voice; Vocal health; Health promotion; Education

Abstract

Vocal performers, much like other musicians, may be at risk of developing health conditions related to the use of their instrument: the voice. There is a need for an accessible resource with reliable information to provide performers with an understanding of how practicing and performing impacts their health. Therefore, we introduce a web-based, educational program termed "Music and Medicine on Monday" (M+M+M) as a collaboration between the College of Medicine and the School of Music at the Univ of Iowa. M+M+M has produced two programs targeting the voice: "Teaching Vocal Health as a Music Educator" and "Vocal Health in the Professional Singer."

This initiative disseminates instruction to musicians, clinicians, and music enthusiasts on how to "play (sing) and to stay healthy." The program was launched in March of 2024, with monthly releases available both on the free medical website, The Iowa Head and Neck Protocols, and its associated M+M+M YouTube channel. Each session begins with a School of Music student performance followed by critique from their mentor. Experts in the healthcare field then provide discussion to address relevant medical issues and healthful practices.

Participating experts, including physicians and respiratory, occupational, and physical therapists provide evidence-based recommendations supported by citations from peer-reviewed research with oversight by the Iowa Protocols Review Committee (IPRC). Success of the program is highlighted by its early growth in viewership. The M+M+M YouTube channel has been visited in an escalating fashion with over 300,000 views during the past three months. Additionally, the Iowa Protocols website continues in its growth, with over 2.1 million visits recorded this past year.

This M+M+M program highlights the interdisciplinary approach to vocal care as is practiced in the Speech, Voice, and Swallowing Disorders Clinic at the University of Iowa through collaboration between Speech Pathologists, Teachers of Singing, and Laryngologists in caring for professional vocalists.

References

"Iowa Head and Neck Protocols Mission Statement and History." Edited by Henry Hoffman, *Iowa Head and Neck Protocols*, medicine.uiowa.edu/iowaprotocols/node/2861. Accessed 24 Sept. 2024.

"Music and Medicine on Monday (M+M+M) at the University of Iowa - Schedule of Events and Disclaimer." Edited by Henry Hoffman, *Iowa Head and Neck Protocols*, medicine.uiowa.edu/iowaprotocols/music-and-medicine-monday-mmm-university-iowa-schedule-events-and-disclaimer. Accessed 24 Sept. 2024.

"Iowa Head and Neck Protocols." Edited by Henry Hoffman, *Iowa Head and Neck Protocols*, medicine.uiowa.edu/iowaprotocols/. Accessed 24 Sept. 2024.

Presenter Bio

Evgeniya (Jenia) Molotkova is a medical student at the Virginia Tech Carilion School of Medicine. She is completing a year of research at the University of Iowa as the Medical Student Research Scholar Fellow under the mentorship of Dr. Henry Hoffman, MD.

Acknowledgments

This endeavor would not have been possible if it were not for the remarkable collaboration provided by members of the University of Iowa School of Music, especially Tammie Walker (School of Music Director), James Edel (Music Production Manager) and Ryan Nguyen (A/V & Electrics Coordinator).

Disclosures

Henry Hoffman would like to disclose his roles as a research consultant for MeiraGtx, advisory board member for RiboX, and author for UpToDate without conflicts related to this presentation. All other authors have no disclosures.

Research Directions in Functional Voice Disorders

Miriam van Mersbergen
School of Communication Sciences and Disorders, University of Memphis, Memphis, Tennessee, USA

Keywords: Functional Dysphonia; Voice Disorders; Motor programming; Neuroscientific advances

Abstract

The interest in Functional Dysphonia (FD), a voice impairment without observable organic or peripheral neurological cause [1] waxes and wanes throughout history and appears to enjoy attention when new technologies or theories are presented to explain this difficult-to-describe phenomenon [2,3]. Over the past 20 years, our understanding of FD has relied heavily on self-report measures and descriptions of clinical phenomena, often relating historical events to the development of voice problems. Understanding how such broad and hard-to-measure phenomena lead to disrupted vocal technique can prevent the careful voice researcher from truly uncovering what is happening in this population. However, neuroscientific advances in a parallel clinical field, Functional Neurological Disorders [4], has uncovered compelling evidence that functional disorders arise from disruptions in motor programming that arise from changes in attention, sensory detection, body awareness, and emotional processing [5]. Researching these sensory, cognitive, and emotional systems, which can be tested and measured, can begin to provide new insights into how one can develop FD. This talk will present the basic theoretical model of functional neurological disorders, relate past voice research that fit this models, present ongoing research on how to begin testing these models, and discuss possible future directions in this area.

References

[1] Roy N. Functional Dysphonia. Curr Opin Otolaryngol Head Neck Surg. 2003;11(3):144-148.

[2] Baker J. PsychoSocial Management of Voice Disorders. Comptom Publishing Ltd.; 2017.

[3] Baker J. Functional voice disorders: Clinical presentations and differential diagnosis. In: Handbook of Clinical Neurology. Vol 139. Elsevier B.V.; 2016:389-405. doi:10.1016/B978-0-12-801772-2.00034-5

[4] Hallett M. The most promising advances in our understanding and treatment of functional (psychogenic) movement disorders. Parkinsonism Relat Disord. 2018;46:S80-S82. doi:10.1016/j.parkreldis.2017.07.002

[5] Drane D, Fani N, Hallett M, Khalsa S, Perez D, Roberts N. A Framework for Understanding the Pathophysiology of Functional Neurological Disorder. CNS Spectr. 2022;x(x):1-7. doi:10.1017/S1092852920001789.A

Presenter Bio

Dr. Miriam van Mersbergen is an Associate Professor at the University of Memphis, specializing in voice disorders. She directs the Voice Emotion and Cognition Laboratory, exploring how emotional and cognitive factors influence vocalization. Her research integrates psychometric, behavioral, and psychophysiological methods.

KEYNOTE: "THE CONSTITUTION OF VOICE KNOWLEDGE"

LYNN HELDING

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Keywords: Voice; Pedagogy; Epistemology; Community

ABSTRACT

Since its inception as a field, singing voice pedagogy has consisted of a mix of science, artistic experience and historic voice knowledge. Throughout its history, avid exhortations for voice teachers to engage with "as much science as he or she can get" (Miller, 1991) have been met with equally vehement claims that "the science which seeks to reduce everything to the mechanical model is not appropriate to the human activity of singing"; (Hemsley, 1998). Rather than engage this debate further, it seems more fruitful to interrogate the epistemological questions of knowledge acquisition and constitution.

How do we know what we know? How do we decide upon the ingredients that comprise the fund of pedagogy knowledge that we, as a singing community, agree on? Which bits of knowledge are included, and which left out? Does the fund evolve over time and if so, what—or who—are the forces that drive change? In the words of author Jonathan Rauch, how do we "constitute knowledge"? In his highly regarded 2021 book of the same name, Rauch explored this essential question, showing how science ultimately became the most sturdy vehicle for both creating and testing the human knowledge base and—crucially—demonstrating that the constitution of knowledge is, at its core, a community based endeavor, or what Rauch called "the ultimate social network." This presentation considers "Science-Informed Voice Pedagogy" through Rauch's framework to arrive at "A hybrid singing voice pedagogy that unites science and art" for the 21st century (Helding, 2020).

REFERENCES

Jonathan Rauch, "The Constitution of Knowledge: A Defense of Truth," Brookings Institution Press, 2021.

Lynn Helding, *The Musician's Mind: Teaching, Learning, and Performance in the Age of Brain Science* (Lanham, MD: Rowman & Littlefield Publishing, 2020); Helding, "The Constitution of Voice Knowledge." *Journal of Singing* 80, no. 2 (2023): 117-121; Helding, Chapter 15 "Science-Informed Vocal Pedagogy," in *The Routledge Companion to Interdisciplinary Studies in Singing* Volume II: Education, Gudmundsdottir, Beynon, Ludke, Cohen, eds. (Routledge Publishing, Abingdon, UK: May 2020).

PRESENTER BIO

Lynn Helding is Professor of Practice in Voice and Vocal Pedagogy at USC Thornton School of Music. She is the author of the book *The Musician's Mind,* and editor-in-chief of the *Journal of Singing.* Honors include the 2005 Van Lawrence Voice Fellowship and membership in the American Academy of Teachers of Singing.

Singing In Virtual Reality: A Tool For Performance Preparation

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Keywords: Voice; Pedagogy; Virtual Reality

Abstract

Singers frequently perform in diverse acoustic environments. Often, their rehearsal conditions differ significantly from those of the actual performance venue, creating a challenging discrepancy for performers to manage. Previous research has demonstrated that singers change their vocal production when performing in different environments. The presenter will share how virtual reality (VR) may be useful in the voice studio as a tool for performance preparation. Research recently conducted by the presenters listed demonstrates that virtually replicated venues can elicit statically similar performances as in the real venues. Voice production behaviors were evaluated to explore the effects of real and VR venues on three voice parameters: vibrato rate, vibrato extent, and quality ratio (QR), an estimation of the singer's formant power.

The study revealed significant adaptability in voice production behaviors among ten classically trained professional singers, both male and female, as they performed the aria da camera "Caro mio ben" by Giordani in three different performance venues. Consistency in the performance was found between the condition in the real room and the condition with VR simulating the same room. Notably, vibrato rate, extent, and quality ratio (QR), an estimate of the singer's formant power, remain consistent due to the successful immersion provided by virtual reality technology. These results emphasize the complex interplay between room acoustics and visual perception in influencing the delivery of singing performances and demonstrate that virtual reality could be used as a tool for performance preparation to reduce performance anxiety and increase competence.

Discussion of future ongoing research will be introduced which includes using a VR simulated device and audio headphones providing feedback of a much larger performance venue in an undergraduate voice lesson to recreate the venue in which the students will perform their end-of-the-semester concert.

Presenter Bio

Professor Yvonne Redman's experience rehearsing, performing, and teaching in multiple acoustic spaces has formed her research interests related to the impact that our musical work environments have on our voicing, hearing, and perception. This has resulted in several interdisciplinary studies with the Department of Speech and Hearing Science at Illinois.

Acknowledgments

This project was funded by the Kate Neal Kinley Memorial Fellowship. We thank Dr. Joshua Glasner, clinical fellow in the Lions Clinic, University of Minnesota, for his considerable contributions to this work.

A Comprehensive Performing Arts Health Curriculum In The Choral Ensemble: Moving Beyond 'Drink More Water'

Kourtney R. Austin

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Abstract

Rationale: It is widely known singers experience voice disorders and injuries. Such injuries may be mitigated through education of vocal health concepts and many resources exist to assist choral conductors in guiding singers to competency in this area [1,2]. Due to lack of awareness and knowledge by choral directors of other aspects of performing arts health (PAH), singers may be at risk for non-voice related injuries as a result of their participation in ensemble based singing activities. Because NASM accredited schools are required to fully inform student musicians about occupational health issues, it is important to develop educational interventions for singers that are inclusive of neuromusculoskeletal, hearing, and mental health concerns in addition to vocal health topics.

Purpose: To investigate the awareness, knowledge, and competency of singers about the occupational health hazards related to ensemble based singing activities and assess the efficacy of an inclusionary performing arts health curriculum in the choral rehearsal.

Methods: A 10-week PAH curriculum was developed based on results of a pilot pre-test. Posttest data collection included specific questions on the singers' knowledge and application of performing arts health concepts: musculoskeletal, hearing, mental, and vocal health. Data analysis was done using SPSS software.

Results: Study results (n=24) indicate that while 49.97% of singers were initially knowledgeable of vocal health concepts such as hydration and posture, only 31.26% were likewise knowledgeable of other aspects of PAH. These results diverged from hypothesized student knowledge of vocal health concepts, signifying a continuing need for voice health education in the choral classroom setting. The mean pretest percentage score for overall PAH concept awareness was 35.94%, while the mean posttest score was 89.54%. These data were subjected to the one-sample t test, with the results showing a statistically significant gain ($t = 16.06(23)$, $p = <.001$). The effect size is $d = 3.28$, which is considered a large effect size.

Conclusions: The data show the need for educational intervention regarding what collegiate level singers know about musculoskeletal, hearing, and mental health topics. The findings indicate that while vocal health resources are available to choral conductors, there are many singers involved in ensemble-based musical activities who have not received specific instruction on performing arts health concepts [3]. Results also indicate the need to continue research on how to develop appropriate resources for providing this information, with the goal of reaching every singer in the ensemble.

References

[1] Sataloff, R.T. (2008). Arts medicine: an overview for choir conductors. The Choral Journal. Nov. 1; 49(5), 24.

[2] Smith, B. and Sataloff, R.T. (2013) Choral pedagogy. Plural Publishing.

[3] Grady, M.L., and Brunken, M.C. (2022). Teaching what we were taught: A survey of choral music educators on vocal health, anatomy, and pedagogy. International Journal of Research in Choral Singing. 10, 136-62.

Presenter Bio

Dr. Kourtney R. Austin specializes in voice pedagogy and performing arts health, with a strong focus on vocal health and rehabilitation. She is an active researcher, presenter, and performer, contributing significantly to the field through her publications and conference presentations. Dr. Austin is dedicated to advancing the understanding of vocal mechanics and promoting healthy vocal practices among performers.

"Very Mindful, Very Demure": Strategies For Engaging The 21st Century Voice Student Through Sociolinguistic Competency

Jeremiah Sanders, DM and Thaddaeus Bourne, DMA
Voice, School of Music, University of Iowa, Iowa City, Iowa, USA

Keywords: Voice; Pedagogy; Language; Somatic; Mindfulness

Abstract

Part of a singer's journey involves bridging the vocabulary gap between mentor and mentee. Acquiring functional knowledge of this language presents a crucial hurdle in the successful development of a young professional voice user. This hurdle also becomes a barrier to students who are not provided access to this vocabulary early in their development. Because most of our learning comes through language, misunderstanding the terms can not only inhibit growth but lead to the development of faulty technique. While it is important that students learn to communicate through the vernacular of the field, mentors can accelerate the learning process by starting from the student's previously existing vocabulary and building from that point. A Socratic approach can strengthen the student's somatic connection, anatomical understanding of the body, and provide an avenue for incorporating new language and new technique. From that point, stronger associations can be mindfully built between the student and the lexicon of common terminology. By diminishing the language barrier, we as teachers can foster better access to the wider knowledge of our field.

Presenter Bio

Jeremiah Sanders is an artist-teacher with operatic sensibilities that range from bel canto to contemporary repertoire. Sanders research spans creativity, justice, equity, inclusivity, access, and belonging in the arts. An avid recitalist, Sanders enjoys interpreting the works of Romantic, 20th century, and contemporary composers. Currently, Sanders is a Visiting Assistant Professor of Voice at the University of Iowa.

2022 Latin GRAMMY® Award winning album vocalist Thaddaeus Bourne has sung over forty roles performing in the USA, Europe, Africa, and Latin America. His previous faculty appointments include the University of Florida, Troy University, Butler University, Earlham College, and the University of Connecticut.

Intersections Of Vocology And Group Singing

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Keywords: Vocology; Choral Pedagogy, Choir Singing; Acoustics

Abstract

Much of the extant research in voice science relates to individual voicing – either that of speakers or singers. However, for many individuals, the bulk of their singing takes place in group settings. In a 2009 survey, Chorus America estimated that more than 42 million people in the United States participate in some kind of chorus, with the highest participation rate identified as volunteer or community choruses. In choral settings, singers experience different challenges than when singing individually because of their proximity to other singers and because they may make different acoustic choices to serve their aesthetic goals.

The purpose of this presentation is to review some pedagogical tools that have emerged from vocology research. It will include information about choral spacing and self-to-other ratio as well as applications of straw phonation in choral settings and with adolescent choristers. Finally, it will include suggestions for further inquiry related to group singing.

References

Chorus America. The chorus impact study: how children, adults, and communities benefit from choruses. Available at: https://chorusamerica.org/publications/research-reports/chorus-impact-study; 2009. Accessed October 1, 2024.

Presenter Bio

Jeremy Manternach, Ph.D., is Associate Professor and Chair of Music Education at the University of Iowa, where he teaches undergraduate and graduate choral pedagogy, music education, and research courses. His research interests include choral conducting gesture and singer efficiency, choral and vocal acoustics, adolescent vocal development, and teacher voice use.

KEYNOTE: HUMAN AND MONKEY YODELS – A BROADER PERSPECTIVE ON VOICE REGISTERS

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Keywords: voice registers; non-linear dynamics; singing; bioacoustics

ABSTRACT

The notion of voice registers emerged in the singing voice pedagogy literature about half a millennium ago. Registers are traditionally explained on (a) kinesthetic; (b) perceptual (psychoacoustic); and/or (c) physiologic and mechanical voice production levels. Given the gross overall similarity of the laryngeal anatomy in humans, non-human primates and other mammals, it is conceivable that voice registers also arise in the vocalizations of non-human species.

In this presentation, I will discuss the potential for an overarching framework of voice registers in mammals. After briefly reviewing the traditional explanatory approaches in humans, I will present recently collected electroglottographic signals of New World monkey vocalizations. These *in vivo* data reveal abrupt, register-like bifurcations between low-frequency and high-frequency oscillatory states that are analogous to laryngeal mechanisms in humans. However, evidence from excised larynx experiments implies that these phenomena are likely driven by the controlled involvement of the so-called vocal membranes, a thin, upward extension of the vocal folds that was lost during human evolution.

These findings suggest that voice registers are a special case of bifurcations in the context of non-linear dynamics. Such bifurcations can be brought about by a number of factors like tissue eigenmode entrainment, coupled tissue oscillators (e.g., potentially involving the ventricular folds in “non-classical” singing), and source-filter interactions. I thus argue that the “classical”, categorical voice register classification – a historical concept geared towards Bel Canto singing – has limited global explanatory potential. For understanding mammalian vocalizations at large, a broader framework rooted in non-linear dynamics is required.

PRESENTER BIO

Christian T. Herbst is an Austrian voice scientist and voice pedagogue with degrees in voice pedagogy and biophysics. His research concerns singing voice physiology and the physics of voice production in mammals. He has received eleven international research awards and has published, among others, in the prestigious *Science* journal – https://www.christian-herbst.org

Do-It-Yourself Voice Dosimeter Device

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Keywords: Voice; Modelling; Physiology; Pedagogy

Abstract

Voice dosimeters provide essential data on voice production in individuals with voice disorders, supporting both clinical practice and research by deepening our understanding of voice pathophysiology. While several commercial voice dosimeters are no longer available, this tutorial presents a low-cost, do-it-yourself (DIY) alternative, validated through performance testing.

To further increase the utility of these dosimeters, an open-access DIY Voice Acoustic Analysis software was developed using Python. This software automates the analysis of key acoustic voice parameters, including sound pressure level, fundamental frequency, and cepstral peak prominence. Tested with voice recordings from a university professor using the DIY dosimeter during a 70-minute lecture, the software, along with instructional videos, is freely accessible on GitHub. Together, these tools provide a practical and cost-effective solution for clinicians and researchers alike.

To validate the DIY voice dosimeter, ten healthy participants wore the device while producing sustained /a/ vowels and reading text with different levels of vocal effort. These recordings were made simultaneously with a reference microphone. The results demonstrated a mean error of -0.68 dB for sound pressure level and small deviations in fundamental frequency, with uncertainties comparable to those of previously available commercial devices.

References

Bottalico, P., & Nudelman, C. J. (2023). Do-It-Yourself Voice Dosimeter Device: A Tutorial and Performance Results. *Journal of Speech, Language, and Hearing Research*, 1–15.

https://github.com/YehyaS/Dosimetry-App

Presenter Bio

Dr. Pasquale Bottalico is an esteemed expert in speech acoustics and classroom acoustics, with over a decade of research and academic experience. His work focuses on the interaction between room acoustics, vocal effort, and speech intelligibility, significantly advancing understanding of optimal acoustic environments in educational settings.

Acknowledgments

This project was funded by the University of Illinois Provost's Faculty Retreat Grant.

Effects Of Semi-Occluded Vocal Tract Exercise Tubes On Aerodynamic Threshold Measures In Self-Oscillating VF Models Coupled To Realistic Vocal Tracts

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Keywords: Phonation; Self-Oscillating Vocal Fold Model; Aerodynamics; Semi-Occluded Vocal Tract

Abstract

Objective: Studies of voice production often utilize models to examine aerodynamic phenomena that would be difficult, impossible, or too invasive to access *in vivo* in human subjects. Self-oscillating vocal fold models [1,7,8,9] allow for precise control over geometric parameters and material properties and allow for examination of vocal kinematics, acoustics, and aerodynamics. To date, however, there is little extant research investigating the effects of SOVTE tubes on aerodynamic threshold measures in self-oscillating vocal fold models coupled to realistic MRI-based 3D printed vocal tracts [2,3].

Methods/Design: MRI-derived 3D printed models of an adult male producing the vowels /a/ and /u/ [6] were coupled to multi-layered silicone vocal fold models [5,7,8] that yield phonatory aspects analogous to human vocal fold vibration. As in the May & Scherer [5] study, the current study examined the aerodynamic measures phonation threshold pressure (PTP) and phonation threshold flow (PTF). Experimental conditions include: a no vocal tract condition, a uniform cylindrical vocal tract condition, MRI-based /a/ and /u/ vowels, and a variety of tube conditions (with different inner diameters and lengths with the free end submerged in either air or water) simulating semi-occluded vocal tract exercises with lip occlusion around the tubes coupled to the MRI-based vowels.

Results: The effects of SOVTE tube inner diameter, length, and water immersion on pressure and flow threshold measures in an anatomically realistic vocal fold – vocal tract coupled model are examined. We [4,5] found that PTPs and PTFs tended to decrease as vocal tract cross sectional area both near the larynx and far from the larynx decreased (likely due to increased inertance). It is hypothesized that: 1) slight differences in PTPs and PTFs may be observed in /a/ vowel versus /u/ vowel conditions due to small differences in acoustic inertance, 2) tube conditions with moderately large airflow resistance may result in decreased PTPs and PTFs, and 3) submersion of tubes in water should yield oscillating "back" pressures within the vocal tract that may be clinically advantageous. Tube conditions that may be considered optimal with respect to reducing PTPs and PTFs will be discussed.

References

1 Chen, LJ, et al. (2008). Effects of acoustic loading on the self-oscillations …. In *Proc. Ninth Intl. Conf. on Flow Induced Vibration* (Vol. 30).

2 Horáček, J. et al. (2014). Air-pressure, vocal folds vibration and acoustic characteristics of phonation …. *Engin. Mechanics*, 21(3), 193-200.

3 Horáček, J., et al. (2019a). Experimental and computational modeling of the effects of voice therapy using tubes. *JSLHR,* 62(7), 2227-2244.

4 May, N. (2022). *The Effect of Nonlinear Source-Filter Interaction of Aerodynamic Measures in a Synthetic Model of the Vocal Folds and Vocal Tract.* [Doctoral Dissertation: Bowling Green State University].

5 May, N. A., & Scherer, R. C. (2023). The effects of vocal tract constrictions on aerodynamic measures …. *JASA*, 154(5), 3310-3320.

6 Meyer, D. et al. (2022). High-Resolution Three-Dimensional Hybrid MRI+ Low Dose CT Vocal Tract Modeling…. *Journal of Voice*.

7 Murray, P. R., & Thomson, S. L. (2011). Synthetic, multi-layer, self-oscillating vocal fold model fabrication. *JoVE*, (58), e3498.

8 Murray, P. R., & Thomson, S. L. (2012). Vibratory responses of synthetic, self-oscillating vocal fold models. *JASA*, 132(5), 3428-3438.

9 Thomson, S. L. (2024). Synthetic, self-oscillating vocal fold models for voice production research. *JASA,* 156(2), 1283-1308.

Presenter Bio

Nicholas May, M.M., M.S., Ph.D., CCC-SLP joined the Department of Communication Sciences and Disorders as an Assistant Professor in the fall of 2022. His research interests include laryngeal modeling, nonlinear source-filter interactions; voice rehabilitation; and aerodynamic, glottographic, and acoustic measurements of speech and voice.

Acknowledgments

Thanks to current members of The Voice Lab at The University of Maine CSD department for their help with measurement and data collection: Torri MacIntosh, Bethanie Brown, and Jack Forrest.

TOWARD A BROADER ANALYSIS OF THE SINGING VOICE: SPECTRAL MOMENT ANALYSIS OF A SYNTHESIZED SINGING VOICE

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Keywords: Spectral Moments; Acoustic Analysis; Voice Pedagogy; Singing

ABSTRACT

The field of voice pedagogy has implemented formant tuning analysis to describe the singing voice for over forty years. Unfortunately, given the diversity of styles, voices, and sounds that this sub-field seeks to analyze, traditional formant tuning analysis is not always a perfect candidate for objective singing voice analysis. Past literature has used spectral moments to characterize recording technology, pre- and post-treatment measures of patients with dysphonia, the EGG decontacting pattern, and speech sounds. They have been useful objective tools in these contexts; however, the literature has yet to fully codify the relationship between various components of the radiated voice output spectrum and spectral moment measurements. This study uses a synthesized singing voice to systematically analyze associations between the first four spectral moments of the LTAS and f_o, vibrato rate, vibrato extent, vowel (f_{R1}, f_{R2}, and f_{R3}), spectral tilt, duration, and sampling rate.

The results of this study found that spectral mean was significantly associated with vibrato extent, spectral tilt, vowel, and duration. Spectral standard deviation was significantly associated with vibrato extent, spectral tilt, and duration. Spectral skewness was significantly associated with f_o, vibrato extent, and duration. Spectral kurtosis was significantly associated with vibrato extent and duration.

Outcomes:

(1) Audience members will learn about the use of spectral moment measurements to characterize the singing voice.
(2) Audience members will learn about ways in which variables characteristic of the radiated voice output spectrum may influence spectral moment measurements.

Based on these findings, it seems that spectral moments of the LTAS may be a useful tool for contextualizing the "broader picture" of spectral features that characterize different styles of singing. Future studies might consider using this set of measures to describe vocal function and singing styles.

PRESENTER BIO

Joshua D. Glasner, M.M., Ph.D. is a speech-language pathologist, singer, researcher, and teacher whose passion is bridging the art and science of the signing voice. His multidisciplinary research spans broad-ranging topics including (but not limited to) voice pedagogy, digital signal processing, auditory-perception of the human voice, and treatment efficacy.

BREATHING STRATEGIES FOR SINGING: DIAGNOSING AND ADDRESSING HYPERFUNCTION

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3 Shenandoah University, Winchester, VA, USA

Keywords: e.g. Voice; Respiration; Pedagogy; Hyperfunction

ABSTRACT

"Chi sa respirare, sa cantare" a phrase central to Italian bel canto voice treatises, states, "One who breathes well, sings well." (McCoy, 2014). There is certainly truth to this time-honored statement in some fundamental way, but many interpret it to mean more is better. How many of us have heard master class clinicians encourage the student to use more "support," regardless of the problem being presented? Respiratory hyperfunction (over breathing) may be as problematic in singing as under breathing, as both may lead to laryngeal tension. In this talk, Dr. David Meyer will address the three most common sources of respiratory hyperfunction in singing:

1) Hyperpnea in singing – breathing too deeply
2) Hyperventilation in singing – breathing too frequently and
3) Hyper-pressurization in singing – using excessive subglottal pressure

Diagnostic and pedagogic strategies will be discussed.

REFERENCES

D. Bartlett, et al, "Laryngeal Regulation of Respiratory Airflow," *Respiration Physiology* 18 (2): 194–204, (1973).

A. Ben-Zeév, "Loving Too Much." n.d. Psychology Today (2009).

T. Bianco, et al. "Measures of Facial Muscle Activation, Intra-Oral Pressure and Mouthpiece Force in Trumpet Playing," (2012).

CDC, "Adult Obesity Facts," Centers for Disease Control and Prevention. (2021). https://www.cdc.gov/obesity/data/adult.html.

E. Caruso and L. Tetrazzini, *Caruso and Tetrazzini on the Art of Singing,* New York: Metropolitan Opera Company, (1909).

A. M. Pellegrini Celoni, *Grammatica o siano regole de ben cantare,* Presso Pietro Piale, e Giulio Cesare Martorelli, (1810).

J. L. Feldman et al. "Neural control of breathing," in *Fundamental Neuroscience*, 2nd edition, Academic Press, (2003), 983–4.

E. Hering, "Die selbststeurung der Atmung durch den Nervus vagus." Sitzber Akad Wiss Wien 57 (1868): 672.

V. Higuera, "Can You Die from Laughing? How and When It's Possible." 2019. *Healthline,* (2019).

R. Leanderson, J. Sundberg, "Breathing for Singing," *Journal of Voice,* 2 (1) (1988): 2–12.

Abraham H. Maslow, *The Psychology of Science*, (1966) p. 15. ISBN 9780976040231.

Scott McCoy, "On Breathing and Support," *Journal of Singing* 70, no. 3 (2014): 321–324.

LG Rowntree, "Water Intoxication," *Arch Intern Med* (Chic). 32(2) (1923):157–174.

J. Rychlewski, "On Hooke's Law," *Journal of Applied Mathematics and Mechanics* 48 (3) (1984): 303-314.

E. S. Schelegle, et al. "An Overview of the Anatomy and Physiology of Slowly Adapting Pulmonary Stretch Receptors." *Respiration Physiology* 125 (1) (2001): 17–31.

M. Szereda-Przestaszewska. "Larynx in the Respiratory Framework," (1981).

S. Tryfon, et al. "Hering-Breuer Reflex in Normal Adults and in Patients …." Respiration 68 (2) (2001): 140–44.

M. Zhong, et al. "Mechanosensing Piezo Channels in … (2017). *Pulmonary* Circulation. 8.

PRESENTER BIO

A leading voice scientist, David Meyer is an active performer, teacher, clinician, and vocologist. He is a member of the Scientific Advisory Board of the Voice Foundation and co-chairs the NATS Voice Science Advisory Committee. Meyer received the 2010 Van L. Lawrence Fellowship, a national award recognizing his contributions to teaching singing and the use of voice science. His students have won numerous awards and have sung in major venues worldwide. See www.davidmeyervoice.com or www.tinyurl.com/Meyer-GoogleScholar.