Communicating Across Bodies in the Voice Lesson

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This position paper outlines my research on singers' understanding and communication of their tacit knowledge, particularly in the voice lesson. Voice teachers use metaphors to describe action and multimodal sensory experiences to their students. However, the use of abstract representations when talking about the body can lead to confusion or misunderstanding. For singers, this can lead to unnecessary strain and injury. This communication breakdown when discussing movement and sensory experience is common even in face-to-face voice lessons; in virtual spaces, where the teacher cannot see the student well or sounds are lost in audio filtering, the difficulty increases. Using auditory and haptic feedback generated from biosignals, information about movement can be conveyed to singers as they explore their technique. By allowing students to feel an augmentation of their own movements or a physical sensation of their teacher's movements and vice versa, we can provide more methods for communication and understanding, even across distances.

CCS Concepts: • **Human-centered computing** → **HCI design and evaluation methods**; • **Applied computing** → *Arts and humanities.*

Additional Key Words and Phrases: singing, embodiment, EMG, sensory communication, vibrotactile feedback

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COMMUNICATING THE EXPERIENCE OF SINGING

In this position paper, I would like to introduce my research on vocalists and their relationships with their bodies, and how the use of haptic feedback can improve these connections and the way we communicate sensory experience. I use the voice lesson and vocal performance as an environment to understand more broadly how people perceive very refined movements which they feel internally. My research seeks to understand how we communicate these sensory experiences in human-to-human interaction and how we can augment or communicate sensory experience through technology. I examine perception of these experiences through different feedback modalities, namely auditory and haptic feedback. Providing new ways to communicate our sensory experiences can lead to improvements in understanding between two individuals (for instance teacher and student). In virtual singing lessons, where the majority of voice study is being done in early 2022, this is especially important, as many of the common ways of interacting with the voice have disappeared with the transition to online interaction.

I find the relationship between vocalist and voice so fascinating because the interaction with the body happens almost purely internally; there is no physical interface to touch. Although we can see some movements as we sing, many action paths employed in singing consist of small internal movements. Singers understand these movements through tacit knowledge, and internal, physical sensations are thought of as being the language of singers [6, 7]. As with other fine-grained actions based on tacit knowledge, it is very hard to find appropriate language to describe what it feels like

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to sing. This is true of other vocalisation – what does it feel like to speak? [2, 10, 12]. Yet, voice teachers are able to communicate about healthy singing practice using metaphors to represent their own experiences in an understandable way [5]. Voice teachers must be able to describe their awareness of their own bodies in a way which is relatable but not so specific so that a student cannot interpret the metaphor within their own experience. This metaphor-based teaching has been used as the basis for vocal pedagogy for hundreds of years. As a singer myself, I have experienced this type of teaching and often use it myself when discussing vocal technique with other singers. This is particularly the case when working with students who are still developing their own sensory understanding of their movement.

Even for non-singers, the voice is part of our identity – it is how how we express ourselves and communicate with others. As well, since the quality of the voice depends on individual physiology, everyone's voice is a unique, identifying aspect. Many singers form strong identities through their voices and their craft (as is common with other artistic practices) [1, 11]. While this connection is a powerful tool in terms of musical expression, it can cause detriments to emotional, mental, and physical well-being when the connection to the voice is disrupted. This is unfortunately a common occurrence in the voice lesson. I have been working with voice teachers who work with beginner students and have explored some of the main issues in communication during the voice lesson[1]. There is a large body of musical research which stresses how metaphorical-based teaching can potentially lead to communication breakdown between teachers and students when not employed correctly [9]. This can be personally distressing to students when the miscommunication is not quickly addressed or met with flexibility and support from the teacher during the learning process. These students, who have personal identities rooted in their singing, may push their bodies too far in an attempt to please their teacher or meet their own expectations of themselves. This can potentially lead to physiological damage and even loss of the ability to sing.

The pandemic has made these communication breakdowns even more difficult to resolve. Teachers rely on hearing their students to detect issues such as pushing and strain on the larynx. As well, many of the metaphors used by teachers are visual and physical, using movement and other more tangible references to communicate healthy singing behaviours. When separated online, it is difficult for teachers and students to see and hear each other correctly; gestures, postures, facial expressions, and other non-verbal communication methods are obscured in the view of video communications, and audio is filtered by software in ways which make it hard to determine how a student sounds in actuality. In order to address issues of communication in face-to-face and virtual lessons, I have been looking at biosignals and a combination of audio and haptic feedback to express movement during singing. Through my research I hope to provide teachers and students with more tools to understand each other better and to communicate with empathy to each other's experiences.

AUDITORY & HAPTIC FEEDBACK IN WEARABLES

I use surface electromyography (sEMG) to measure the activation of laryngeal muscles [13] and sonify them so that a singer can "hear" the small movements of their body while singing [14]. I have found in my own practice that this allowed me to uncover aspects of my practice that I was overlooking. For instance, I was able to connect more with my breath through the auditory feedback [14]. Currently, I am conducting a study with a group of vocalist participants who are incorporating sEMG sonification into their practice. We are using the sonification as an external way of interacting with motions that are ingrained in larger action paths. As well, we use the sonification to provide a new way to speak about movement and perception of movement. The

[1]This research is currently in active review. I will be able to share this in more specific detail at the time of the workshop.

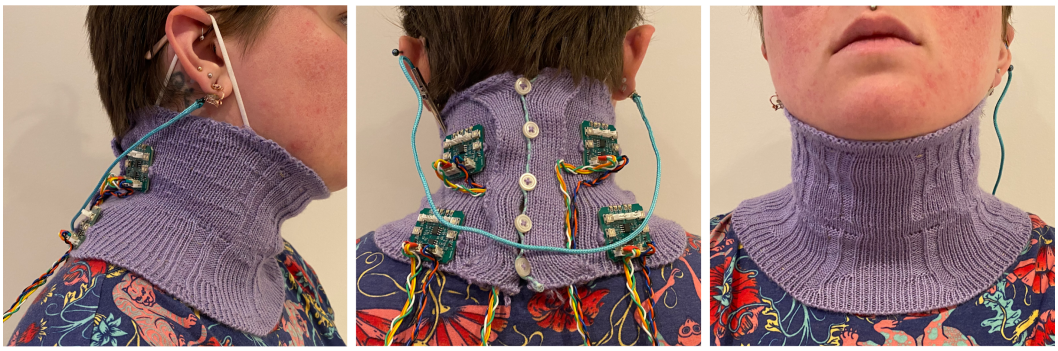

Fig. 1. Wearing the Singing Knit, which gathers data on muscular activation using fabric electrodes placed on large laryngeal muscles.

auditory feedback provides a conduit for communication; rather than trying to describe often wordless feelings of movement, we are able to discuss the sonification as a metaphor for these hard-to-articulate sensory experiences

I have also begun to explore haptic feedback, namely vibrotactiles, as a way to convey sensations of movement. For instance, the movement of the small muscles of the larynx can be augmented through vibration on the muscles in the chest and abdomen where they can be felt on larger scale. I have worked in developing a wearable knit collar for vocalists to capture sEMG of the laryngeal muscles [15]. The Singing Knit (**Figure 1**) gathers sEMG signals which can be represented through auditory and vibrotactile feedback. I am also currently working with other researchers to combine this collar into a larger setup with another tactile vocal wearable, The Body Electric [4]. This corset uses pneumatic fibres to expand and contract the garment as the wearer breathes [8], creating an extension of the sensation of breathing, or that the garment breathes back in response to the wearer's movement [16]. With the help of this feedback, we can observe and describe the sensation of the breath in both the abdomen and the neck and jaw. Additionally, by capturing the movements of one singer and presenting them to the other singer through haptic actuation, we are able to physically feel the movement of another person as we engage in our own practice [3]. This has the potential to create mutual understanding of the motion between two individuals.

In an online setting, this haptic feedback would be especially useful for teachers and students to be able to get a sense of each other's tactile experience. For instance, presenting a vibrotactile representation of the student and teacher's movement could allow individuals to feel differences between bodies in movement and help discussion. The most useful aspect is that, like the auditory feedback, it provides a discussion point to articulate otherwise hard-to-describe tacit knowledge. As well, adding external feedback where there is not normally any can provide new insights to movement. This data can be shared over distances, allowing teachers and students to record their movements and then reflect on each other's experience during the lesson or in individual practice time. Understanding the other person with this feedback can provide support to the traditional metaphors used in the voice lesson and a better sense of the other person's practice. A teacher might be able to feel the tension in their student's body and help them to find more control over it, preventing issues early on in the experience. This is useful in a face-to-face lesson and also in a virtual setting where audio-video connection might introduce more misunderstandings. In the near future, I will conduct a study with other voice researchers in working with voice teachers. Using haptic feedback through both vibrotactile stimulation and pneumatic compression, we will explore areas of tension in breathing and help teachers to better recognise stress in the body. This tension,

often brought from the outside environment into the voice lesson, can make it difficult for students to breathe in a properly supported way. Through a haptic-based communication, we will study how sharing these sensations of tension and resistance can help teachers to talk with their students and work to teach awareness and release of stress within the body. Providing a way to communicate the sensory experience can help to resolve misunderstandings or create some feelings of familiarity in another person's body and experience.

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