Learning Music Blind: Understanding Accessibility Challenges and Future Opportunities

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For people who are blind or visually impaired (BVI), screen reader software and tactile braille displays are essential tools used to learn and engage with information. However, being a BVI music learner poses a set of new challenges as it involves using one's hands and ears to learn and play music while not having access to conventionally available assistive technologies. This paper identifies accessibility challenges faced by BVI music learners and speculates on future development of multisensory assistive technologies that address these needs.

CCS CONCEPTS • Human-Centered Computing • Accessibility • Accessibility Technologies

Additional Keywords and Phrases: Blind or Low Vision, Visually Impaired, Accessibility, Assistive Technology, Music Learning, Braille Music, Non-Verbal Communication, Music Pedagogy

1 INTRODUCTION

For people who are blind or visually impaired (BVI), screen reader software [14, 28] and tactile Braille displays [22] are essential tools for learning and exploring information. Learning music as a BVI person, however, introduces a set of new challenges as one's hands and ears are simultaneously engaged in learning and playing music [10]. Baker and Green [4] studied the collective experiences of adult blind musicians and found that current pedagogical practices fall woefully short of meeting the needs of BVI music learners. They proposed a flexible approach to music teaching and learning that centered around the capability of the student. Recent assistive technologies address some of these challenges with tools to convert conventional notations into Braille Music [7, 11], making notation more accessible to low vision music learners [15, 19], and converting popular music notation formats such as guitar tabs into screen reader friendly outputs [26]. These systems, however, do not address the broader challenges of learning and collaboration faced by BVI music learners, as they only focus on access to music notation, which still largely requires touch or sound as the primary mode of interaction [2].

This workshop paper presents an initial overview of the literature on BVI music learning, highlighting key accessibility problems and discusses potential multisensory systems and approaches that can address these needs.

2 ACCESSIBILITY CHALLENGES AND POTENTIAL SOLUTIONS

We identify three key accessibility challenges in learning and playing music, focusing on music notation, non-verbal communication when playing music and pedagogical practices for teaching BVL music learners.

2.1 Music Reading and Notation

Low vision music learners have access to music scores using screen readers that allow for magnification, panning and high contrast to help with music reading [15, 19] while more recent developments allow for handsfree navigation with the use of a foot pedal [9] as well as a heads up display [16]. Goldstein [10] notes that music scores can alternatively be transcribed into Braille Music which allows BVI music learners to read tone, octave and timing with the use of Braille cells. However, BVI musicians are resistant to learning Braille Music as they find the symbols confusing and the action of reading and playing music at the same time cumbersome and unnecessary [1]. BVI musicians must memorize entire musical scores for performance regardless.

The central accessibility challenge of music reading lies in the modality of interaction as conventional assistive technologies use sound and touch to convey information while BVI music learners require the use of their hands and ears to play and learn music. Based on the idea of sensory substitution [3], one promising development in addressing this challenge comes in the form of a wearable haptic glove [30] with motors on each finger that vibrate as a haptic cue to press a button in sync with background music which allows BVI users to play the game Guitar Hero [12]. Alternatively it may be possible to use electrotactile stimulation of the tongue [3] to convey real time information about a musical score. There have also been promising developments in creating a multimodal wayfinding system that uses bone conduction headphones along with a wearable haptic device which allows users to be aware of ambient sound while also having hands free access real-time information [6].

2.2 Non-Verbal Communication

Sighted musicians have the ability to develop a collaborative understanding of visual cues and gestures to communicate, collaborate and play music while staying in Flow [8]. The gestural aspect of learning that includes nodding, pointing and facial expressions is implicit to teaching, practicing and performing music [4]. BVI music learners are customarily not privy to this information and struggle to ask for clarification and explicit instruction [4]. The reason sighted musicians and teachers use body language and gesture to communicate ideas comes from their intention to continue playing music and staying in Flow while also collaborating and communicating with one another [18]. The accessibility challenge lies in altering the modality of engagement from visual to other modes that are not disruptive and subtle while also being easily understood.

Quek and Oliveira [21] propose the use of a haptic glove to read embodied communication such as pointing while teaching mathematics to BVI students. The glove is embedded with vibration motors and placed on top of a raised line graph that replicates the information on the adjacent blackboard which allows BVI students to follow a lecture while also being aware of what the teacher is pointing at. McDaniel et al. [17] mapped vibrotactile feedback from facial expressions onto the back of a chair to allow BVI individuals to sense basic emotions in a discreet way while Yasmin and Panchanathan [29] designed Haptic Mirror that allows BVI individuals to understand how their own facial expressions feel like through the use of a haptic device such as Touch X [27]. Other commercially available assistive technologies such as the Orcam [13] can be attached to any pair of reading glasses and allow BVI individuals to recognize faces and read text through an onboard camera that provides real time in ear voice over feedback.

2.3 Pedagogical Practices

As mentioned before, music teachers and current pedagogical practices are not equipped to meet the needs of BVI music learners [4]. In addition, Quaglia [20] notes that there is an increasing variability in learning amongst students based on learning preference, physical and cognitive ability, linguistics and even psycho-emotional background. In response, a Universal Design in Learning (UDL) [23] framework creates space for varied practices and techniques without singularly promoting one method over another. Taking the perspective of UDL and applying it to multisensory interactions for learning and understanding musical concepts, we identify projects that meet the variable and changing needs of BVI music learners.

Projects such as Haptic Wave [25], which creates haptic feedback that allows BVI music producers to interact and understand sound amplitudes and position, are encouraging. While, FluxMarker [24] provides BVI individuals an alternative means through which dynamic information can be communicated and depicted on a tactile surface. Additionally, Baptiste-Jessel et al. [5] discusses an alternative representation of musical scores into hexagonal lattice structures that are easily identifiable through touch.

3 DISCUSSION

From our initial review of the literature, it is fair to conclude that the development of assistive technologies for music learning and performance are at an early stage. Most research has focused on music reading, utilizing touch and audio feedback as the primary modality of interaction. However, most BVI music learners prefer to avoid music reading all together [10] as they must memorize music for performance even after having read the musical score. Additionally, BVI music learners are not privy to nonverbal cues and body language, which is implicit to learning, playing and performing music with other musicians [4]. Lastly, there is a need to understand music and performance through alternative multisensory modalities that help BVI music learners understand musical concepts and develop their practice through a learning style that works for them.

Based on the current state of research, we propose the following workshop discussion:

- *What multisensory modalities of interaction address key accessibility challenges of music learning and performing?*
- *How can multisensory technologies address challenges considering cognitive load, variability in learning and simultaneous use of the senses?*

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