Understanding and Designing for Accessibility in Audio Production among People with Vision Impairments

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ABSTRACT

Specialized software tools have become essential to many forms of content creation, yet poor accessibility of these tools has led to unequitable opportunities for disabled content creators. My doctoral research contributes to our knowledge of accessibility in computer-supported content creation by studying the context of audio production by people with vision impairments. Through interviews, observations, and content analysis, I develop a comprehensive understanding of how accessibility unfolds during various stages of audio content production for blind audio producers – from learning the tools and practices to developing and exhibiting professional expertise while also pushing back against ableist productivity standards and stereotypes. Critically reflecting upon these insights, I am developing a system to scaffold accessible learning of audio production software in a way that recognizes and leverages the expertise and practices developed by blind audio production trainers. The final phase of my dissertation will evaluate this system with both blind trainers and learners to understand how interactive technologies can promote accessible learning in computer-supported content creation.

CCS CONCEPTS

• **Human-centered computing** → Accessibility.

KEYWORDS

Accessibility, audio production, blind, vision impairment

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1 INTRODUCTION

Technology is an essential component of different forms of content creation including photography, audio, and video content production. There are highly specialized tools to support these content creation practices, such as Adobe Photoshop [19] for photography, Logic Pro [20] for audio production, and DaVinci Resolve [21] for video color grading. These tools have become so central to their corresponding disciplines that being recognized as competent professionals in these fields is as much about demonstrating technical knowledge about the field and exhibiting creativity as it is about excelling at using these highly advanced software tools. Given the indispensability of gaining expertise in specialized software for professional success in these fields, understanding and improving accessibility of software tools is of paramount importance for ensuring equitable opportunities in content creation.

My PhD research focuses on understanding and designing for a very specific context of accessibility in content creation – computer-supported audio production by people with vision impairments. Audio production is the skilled practice of creating professional quality audio content (e.g., music albums) that starts with a recording a few raw, untouched audio tracks which undergo hours of intricate polishing stages known as editing (i.e., trimming the raw tracks to remove unwanted parts, selecting and combining best takes etc.), mixing (i.e., applying effects and making adjustments so that all the tracks of a song sound good together) and mastering (i.e., making subtle adjustments to ensure consistent audio throughout an album). In modern times, audio production has increasingly become computer-supported – editing, mixing, and mastering tasks are mediated using comprehensive software solutions such as digital audio workstations (DAWs) and effects plugins (e.g., compression, equalization, and reverb). While audio production may seemingly appear to be an inherently accessible form of creative work for blind people due to its apparent lack of reliance on visual abilities, most of the software tools that support audio production incorporate complex graphical user interfaces (GUIs) that are heavily geared towards sighted users and often lack accessibility support. As a result, in addition to using the prerequisite audio production tools such as DAWs and effect plugins, a blind audio producer's workflow will also need to factor in screen reader software, additional third-party scripts and hardware tools to make inaccessible DAW features accessible, often at the expense of efficiency. Therefore, for blind audio producers, cobbling together an accessible audio production workflow involves balancing between accessibility and efficiency and navigating a steeper learning curve exacerbated by the lack of accessible learning resources while also having to demonstrate their adeptness in these tools to compete with sighted peers [13].

My doctoral work contributes to a deeper understanding of computer-supported content creation through more than three years of qualitative research with a community of blind audio producers. Through interviews, observations, and content analysis of online conversations, my work contributes new understanding of how accessibility unfolds at different stages of computer-supported content creation – from learning the tools and practices to developing professional expertise – and the central role communities of disabled creators play in sustaining access in their skilled work.

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Drawing on these insights, my ongoing and future work focuses on designing new technologies to scaffold accessible learning opportunities for blind audio producers. Through studying and designing technologies in the context of audio production, my research informs accessibility in skilled work more broadly, which can have implications for other forms of content creation such as photography, graphics, and digital illustration.

2 RESEARCH QUESTIONS

My work is guided by the following research questions:
RQ1. How do blind audio producers create, maintain and advocate for accessibility?
RQ2. How do blind audio producers exchange instructional support and facilitate learning?
RQ3. How might new tools and interactions support accessible learning experiences for blind audio producers?

3 RESEARCH APPROACH AND METHODS

Drawing on literature in Human-Computer Interaction, assistive technology, and critical disability studies, my research approach foregrounds the experiences of people with vision impairments in understanding and designing for accessibility in computer-supported content creation. Within HCI and accessible computing, a growing body of work examines accessibility in creative work across a variety of contexts including photography [2, 10], drawing [4], writing [7], 3D printing [8, 15], and making [3, 6]. However, accessibility in computer-supported content creation, particularly in the context of audio production has remained relatively under-explored.

My doctoral work addresses this gap in research by studying how blind audio producers learn and engage in audio production through qualitative analysis of data collected from semi-structured interviews, remote and in-person observations and online forum conversations. Furthermore, drawing on disability studies literature [1, 9, 11], I analyze the intertwined nature of accessibility and professional skill in computer-supported content production and how existing inaccessible systems feed ableist narratives and perpetuate inequality [5].

Insights gained from my qualitative work forms the basis of my technology design to scaffold accessible learning practices in software tools for skilled work. Recognizing the existing work of experienced blind audio producers in creating learning resources and providing training to new learners in the blind audio community, I aim to design technologies that not only support accessible learning for beginners but also place blind audio production trainers in the central role of creating and disseminating these new accessible learning opportunities. In doing so, I employ a multi-stage design approach involving formative observations with blind audio production trainers followed by iterative system development and rigorous evaluation with both blind trainers and learners.

4 WORK TO DATE

4.1 Understanding Audio Production Practices of People with Vision Impairments

My first study addresses RQ1 by developing an understanding of how blind audio producers navigate mainstream tools and practices to perform their work [13]. Through the analysis of semi-structured interviews with 18 blind audio professionals and hobbyists, I found that accessibility in audio production requires piecing together a complex suite of hardware and software tools, some custom-made by members within the blind audio communities, where challenges arising from any single tool may have negative implications for their entire workflow. For example, standard audio production software tools such as Digital Audio Workstations (DAWs), digital instruments, and effect plugins all offer varying degrees of accessibility and efficiency for screen reader users. For cases where the extent of available accessibility falls short or makes fast retrieval and interpretation of information difficult in audio production tools, my participants have to resort to external interventions like unofficial accessibility scripts (e.g., Flo Tools [22] for Pro Tools, OSARA [23] for REAPER) developed by members within blind audio communities and external hardware tools (e.g., control surfaces, see Figure 1). However, this uphill battle of piecing together accessible workflows is often exacerbated by software updates breaking native accessibility support of tools or making the unofficial accessibility scripts obsolete - which may result in a complete breakdown of the workflow a blind audio producer may have cobbled together over years. Thus, for these blind audio producers, reliance on so many tools to increase accessibility and efficiency comes with added risks of their workflow being hampered due to a failure in any of the tools. On the flip side, reliance on fewer tools may decrease the likelihood of such a breakdown, but at the cost of convenience and efficiency.

My analysis further revealed the important role of communities of blind audio producers in creating and maintaining access through developing accessibility scripts, figuring out and sharing workarounds to increase accessibility and efficiency, creating documentations and tutorials for screen reader users, advocating for accessibility with software developers, and overall, helping each other through an exchange of support and guidance. In particular, some experienced members of these communities take the role of advocating for access and providing training for other blind people interested in audio production. For example, consider the case of Alex, who not only is an experienced blind audio producer himself but also runs a school that specializes in providing accessible audio production training for blind people. The tools, workflows and learning resources these communities have developed not only originate from their own challenges but are also designed to maximize efficiency for screen reader users, knowing the importance of this for professional success.

Overall, through my investigation of audio production practices of people with vision impairments, my first study provides one of the first empirical analyses of this important but under-studied career path, hobby, and form of content creation. My analysis details the difficult processes of maintaining access and efficiency by piecing together a complex web of tools, learning audio production

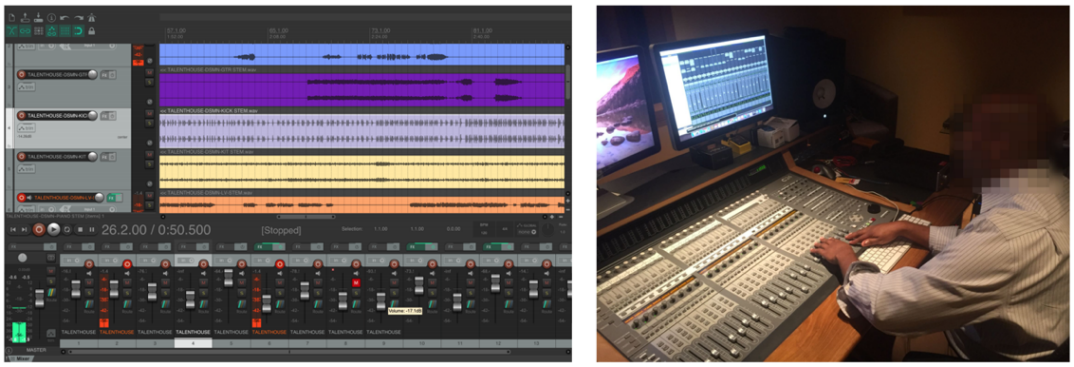

Figure 1: Left: A screenshot of the complex user interface of a Digital Audio Workstation showing 5 audio tracks above and the mixer console below; Right: A participant uses his control surface to perform audio production on his computer

skills in tandem with accessible workarounds, and receiving and providing support through online networks.

4.2 Analyzing Instructional Support Exchange and Learning Practices of Blind Audio Producers

My first study identified online communities of blind audio producers as a key resource for exchanging support on accessible audio production practices. Prior work in HCI and CSCW has extensively studied how members of platforms such as Quora, Stack Exchange etc. help each other in learning and troubleshooting computer-supported work [14, 16, 17]. However, less is known about how people with vision impairments exchange technological support in these communities, which is an important knowledge gap to address especially given the additional burden of accessibility issues faced by blind users due to the often-exclusive use of complex visual interfaces in modern software programs [13]. Furthermore, Prior work has found the importance of a shared visual space in establishing common ground between helpers and help-seekers [18]. Particularly when talking about complex GUIs, shared knowledge and references about the state of the GUI is important for both the helper and help-seeker in maintaining situational awareness and establishing common ground. In the case of the online forums of blind audio producers, the members articulate the questions and answers about complex graphical user interfaces in the absence of a shared visual space – raising opportunities to learn about how blind members in tech-based Q&A forums develop a shared understanding about visual interfaces and how their interactions can help us rethink the visual requirements of conversational grounding.

Through a content analysis of conversations on a forum exclusively consisting of blind audio producers, my second study addresses RQ2 by investigating how blind audio producers engage in online Q&A communities to exchange support regarding accessible audio production software and practices. My analysis reveals that in the absence of a shared visual space, when a help-seeker submits a query regarding audio production tasks and tools, usually one or more experienced helpers reply with their suggestions and solutions, and in doing so, they employ a variety of navigational signposting strategies to help the help-seeker navigate the highly visual interfaces of Digital Audio Workstations (DAWs) using their screen reader. As an example of signposting, blind helpers may use an element's exact name as uttered by the screen reader, the element's type, the name and type of a parent, child, or adjacent element, how data inside a GUI element is organized (e.g., the names and purposes of different rows and columns in a table), and so on. In addition, through a detailed analysis of conversation threads, I bring forth a variety of strategies and factors that aid or disrupt conversational grounding and situational awareness in back-and-forth conversations between blind helpers and blind help-seekers. As an example, in the absence of visual feedback (and screen reader feedback in some cases) about the help-seeker's GUI state, experienced helpers sometimes use their previous experience and contextual knowledge to develop situational awareness of the help-seeker's current GUI state in the absence of visual awareness and despite the issues not being readily apparent from the screen reader announcements.

Overall, my second study contributes an empirical understanding of how blind audio producers seek and exchange support in online Q&A communities. Furthermore, my analysis uncovers the ways in which members develop conversational grounding and situational awareness in the absence of a shared visual space while working with graphical user interfaces, which complements existing understanding of the role of shared visual space in developing conversational grounding and situational awareness for sighted people.

5 ONGOING AND FUTURE DISSERTATION WORK

Grounded in my findings from the previous two studies on accessible audio production practices and learning resources, my final study focuses on addressing RQ3 by developing and evaluating tools to scaffold accessible learning of audio production software. More specifically, while my previous participants highlighted the important role blind audio production trainers play in creating learning resources on accessible ways of audio production, they also pointed out how these resources are difficult to find for newcomers in the blind audio community due to the low visibility and fragmented availability of such resources on the internet. Considering the need

to make accessible learning resources for audio production tools readily available to beginners while also recognizing that creating and disseminating these resources are a source of pride and income for blind audio production trainers, I'm focusing on developing a system to support both blind trainers and learners in creating and consuming interactive accessible tutorials that can be accessed directly from audio production software.

5.1 Phase 1: Understanding Tutorial Creation

My primary consideration for implementing a system to record interactive tutorials is that blind audio production trainers should be able to record interactive tutorials by leveraging the strategies and practices they have honed over the years without any significant changes or disruptions to their current workflows. Therefore, to develop an understanding of their current process of recording tutorials for blind learners, I have conducted observation sessions with six blind audio production trainers where they walked me through their practices and strategies for making accessible tutorials for blind users by recording sample tutorials during the session. The observations revealed several key insights, including how the trainers set up their software and hardware tools for recording tutorials, how they describe the navigation of highly visual DAW interfaces for blind users, how they strategically ensure that the different audio channels (e.g., the trainer's voice, screen reader announcements, the music files in the audio production software etc.) do not overlap with each other while recording tutorials, and so on.

5.2 Phase 2: System Design

Informed by the insights from the observation sessions, I am currently implementing a prototype application that allows blind audio producers to record and play interactive tutorials that work as a seamless layer on top of Garageband [24] and Logic Pro [20], two commonly used DAWs. I am using v11 [12], a JavaScript-based abstraction of Apple's accessibility APIs to develop the system. During the tutorial recording phase, the prototype automatically divides a recorded tutorial into multiple steps based on start and stop timestamps of the trainer's voice and timestamps of changes to the accessibility API. The finished tutorial then guides a screen reader user (e.g., a learner) through each step of the task as they practice it on their DAW, allowing them to pause and continue at their own pace. This tutorial experience is interactive in that at each step, the prototype waits for the learner to finish the step before it provides the instructions for the next step. These tutorials can be shared by the trainers and loaded into the learners' computers, making them easy to create and disseminate.

5.3 Phase 3: Proposed System Evaluation

In this phase of the study, I will first conduct an exploratory evaluation by having blind audio production trainers record interactive tutorials using my system. I will collect open-ended feedback from the trainers during and after the session to identify opportunities for improving the tutorial recording process for trainers.

Next, I will conduct a controlled between-subjects study with learners of audio production with vision impairments to understand how my interactive tutorial system performs in helping them learn basic audio production tasks with respect to traditional non-interactive audio tutorials. I will collect data and conduct quantitative analysis on several measures including success and failure counts, time to complete tasks, number of requests for assistance due to forgotten actions or keyboard shortcuts etc. I will also conduct a post-session interview to collect qualitative feedback on their overall experience with the system and potential improvements.

Overall, through the implementation of my system, I aim to support blind audio production trainers in leveraging their existing practices and knowledge to provide an interactive and accessible learning experience for new learners with vision impairments. Further, by evaluating the interactive tutorials with blind trainers and learners, I aim to investigate how this new form of learning resource might aid or disrupt the training process of blind audio producers compared to existing forms of learning resources.

6 CURRENT AND EXPECTED CONTRIBUTIONS

I aim to make three key contributions through my doctoral research. First, through my qualitative investigation of accessibility in audio production for people with vision impairments, I contribute a deeper understanding of accessibility in learning and performing computer-supported skilled work. Second, by studying how blind trainers and learners communicate and resolve problems regarding the complex graphical interfaces of audio production software, my work adds to our existing understanding of conversational grounding and situational awareness in computer-supported work in the absence of a shared visual space. Finally, through the design and evaluation of interactive tutorials for audio production software, my work will provide new insights for scaffolding accessible learning and training opportunities in computer-supported skilled work.

7 DISSERTATION STATUS AND LONG-TERM GOALS

I am a fourth year PhD student in the Technology and Social Behavior program at Northwestern University. I expect to fulfill my PhD candidacy requirements by the end of Winter 2022. I plan to wrap up the remaining phases of my final study by Summer 2022 (system design by Spring 2022 and system evaluation by Summer 2022) and defend my dissertation within Spring 2023. Upon graduation, I'd like to seek UX Research positions in industry where I can work towards improving accessibility in software tools and web-based services.

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