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Addressing Transdisciplinary Challenges Through Technology: Immersive Soundscape Planning Tools

1. Introduction

We discuss the challenges with transdisciplinary research, and preliminary results of our own transdisciplinary work in progress. Through this, we hope to share methods for productively engaging with those from different fields, as well as professionals outside of academia.

Our project centers around the design and development of immersive tools (e.g., Virtual Reality (VR)) to help non-sound professionals plan for better sounding public spaces. Currently, Professionals of the Built Environment (PBEs) (e.g., urban planners and designers (Steele, 2018)) do not have adequate access to sound-planning tools; they primarily focus on maximum allowable sound levels, as opposed to creating a pleasant auditory experience for city users (Bild, Coler, Pfeffer, & Bertolini, 2016). Unfortunately, this lack of sound-planning by PBEs discounts the significant benefits to be had when sounds are properly planned for. Examples include promoting public space utilization (Steele, Bild, Tarlao, & Guastavino, 2019), fostering social interactions (Steele et al., 2019), and promoting stress recovery by providing a calm environment (Krzywicka & Byrka, 2017).

Yet, to address such a problem, one must draw from many different sources: software development for the tool (computer science); the auditory experience (psychoacoustics); city planning (e.g., urban design and planning); the needs of the city users (sociology), etc. Such a problem requires not only an interdisciplinary solution that considers the above fields, but rather a *transdisciplinary* solution, as this research must be grounded in the pragmatic needs of professionals from outside of academia, in order to facilitate future adoption and change that may benefit society.

2. Challenges associated with interdisciplinary and transdisciplinary research

Specialized skills and information can take years – even decades – to acquire. Yet, due to the hard-to-acquire nature of these, it will often fall victim to the ‘dreaded’ information silo; an insular tower wherein information cannot flow freely between one another. However, this is an inevitability of specialized information – even the most dedicated learners are limited in what they can absorb and apply in their lifetime. Although this specialized information *can* be shared,

it will not necessarily be understood by others in a significant way unless they have a certain degree of foundational knowledge in each silo – or discipline of study. As each individual discipline advances, so too do opportunities to combine and synthesize this new knowledge with that from other disciplines, resulting in an ever-expanding potential for research – if one can keep up with multiple silos.

This shared knowledge between disciplines facilitates interdisciplinary approaches, resulting in new synthesized knowledge, which may produce innovative technologies. For example, computer science combined with linguistics has resulted in valued technologies such as speech recognition and automated language translation. However, as valuable as such technologies may be, it requires further steps to become transdisciplinary. Namely, the inclusion of non-academic stakeholders.

> "Transdisciplinarity, like interdisciplinarity, is descriptive of collaborative research and problem solving that, unlike interdisciplinarity, crosses both disciplinary boundaries and sectors of society by including stakeholders in the public and private domains." (Repko, 2008, p. 15)

By considering the relevant stakeholders outside of the academia bubble, we can understand how to affect changes on society as a whole.

3. Our software, City Ditty

The intent of our software is to A) act as a tangible focal point for bridging the knowledge gap between silos/disciplines and facilitate conversation, and B) to help raise PBE's sound-awareness to help them better plan for sound. To do this, we adopt the conceptual framework of soundscapes, which considers "an acoustic environment as it is perceived or experienced and/or understood by people, in context" (ISO, 2014). This body of literature includes studies on how to use sound as a resource, rather than just treat it as a nuisance to be mitigated. By doing so, we can better understand the needs of city users and increase everyone's experiences in public spaces.

Finally, by allowing PBEs to import their own 3D models into an immersive 3D environment with spatialized sound, we hope to empower them with the ability to plan better sounding cities for city users with their own projects. Given that PBEs come from both the private and public sectors, we expect a varied response in how they wish to best serve their city users.

4. A user centered-design process to manage stakeholders and development

Our transdisciplinary process borrows from a software development process called user-centered design, which puts the needs of the user first (Norman, 1988). This involves identifying the primary stakeholder(s), as well as their specific needs, followed by designing towards those. It is also imperative to regularly check-in with the users during the development process to ensure that development is still progressing in the right direction, giving ample opportunity for corrective action as necessary. This process is designed to be particularly useful when the user

requirements are not clear at the start, for any given reason. The usefulness of this process also applies when there is a lack of shared knowledge between two groups (e.g., multiple silos/disciplines), as both parties may struggle to understand one another. If this is the case, the research will likely take an early exploratory form, which would benefit best from qualitative data collection.

5. Iterative design process

Because PBEs do not have enough experience to directly answer what their software needs are yet, the researcher must do their best to facilitate a conversation that draws these out. Through the iterative process of designing, getting feedback, and implementing the feedback multiple times, these user requirements will become much clearer, as will the final quality of the software. While initial feedback will likely be very practical relating to how they use the software, the conversation can be expected to shift away from the software itself, to a richer discourse on they can create a better sounding city to help fill the needs of city users in the broader society.

Earlier workshops with PBEs have improved this knowledge gap between PBEs and academics, which, through each iteration, has improved our understanding of one another's needs and goals (Steele, Kerrigan, & Guastavino, 2020). These fed into a future's workshop in 2019 which gauged PBE's interest levels and gathered requirements, feeding directly into the current software design (Yanaky, Tarlao, & Guastavino, 2020).

6. Current work: usability study of City Ditty

City Ditty is designed in Unity, and is deployed with an HTC Vive Pro VR set. A usability test is first utilized with non-PBEs to ensure that the software functions well, so that the next study with PBEs are not detracted by unwieldy software.

This test walks participants through the software, which includes a guided sound-awareness session in a virtual urban space. This demonstrates several soundscape techniques, such as sound masking (e.g., using a fountain or music to hide the nearby noise of traffic) and sound barriers to block unwanted sounds. Afterwards, participants are tasked with performing these actions on their own, to improve a soundscape through these and other methods such as strategically placing objects that can attract wanted sounds (e.g., a birdfeeder to attract birds). Researchers note any functional troubles that participants experienced, and discuss participant's experience in a short exit interview. The design methods utilized are presented.

7. Future Direction

The next step of our iterative process includes inviting both public and private sector PBEs to trial the software in the same way as in our usability test. However, after trying the software, a longer semi-structured interview will further explore themes from previous workshops. Such detailed interviews are expected to result in more practical functionalities that will help take a large step forward in integrating soundscape planning into their current practices with the aid of innovative technology.

8. Concluding remarks

While the focus of this paper is on leveraging technology for addressing a transdisciplinary challenge, we would like to emphasize that this process need not be limited to computers and technology. For instance, the user centered design process stems from 'The Design of Everyday Things' (Norman, 2013), which includes everything from computers, to door handle designs, to soundscapes in urban spaces (Bild, Tarlao, Guastavino, & Coler, 2016; Steele et al., 2019) – all which design something according to the needs of users. Similarly, other communication/data collection methods outside of workshops exist and can be applied, according to the situation (e.g., see Muller and Kuhn (1993) for a review). Regardless, all of these methods have much to gain from the iterative process with multiple points of contact with the stakeholders.

Throughout this experience, one message remains clear: one should not avoid interdisciplinary or transdisciplinary studies just because one is not intimately familiar with all related disciplines; if this were the case, many exciting new topics and solutions would never be found. However, one must still be critical of acknowledging both what you know and don't know, including being cautious of how to approach and talk to disciplinary strangers for collaboration, as their disciplinary norms and values may be drastically different than your own. Finally, one must carefully examine the scope and feasibility with your current resource; risks are high, but so are potential payoffs for novel research.

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