Identifying, Perceiving, and Understanding Sound: What We Learned From Participants in Sound Circles Discussions

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Background

TERC, COSI's Center for Research and Evaluation (CRE), and informal learning organizations across the United States are engaging in an NSF-funded project named *Sound Travels* (though officially named *Research to Understand and Inform the Impacts of Ambient and Designed Sound on Informal STEM Learning*). The project brings together a collaboration of informal STEM learning (ISL) researchers, designers, and educators to 1) broaden the research foundation for sound design in informal science learning (ISL) experiences, and 2) develop design recommendations for informal learning institutions. Project Research team partners are helping to answer the following research questions over the course of the four-year project:

R1: *How are soundscapes used by ISL practitioners?*

R2: *What are the qualities of soundscapes at different ISL sites*?

R3: *How do informal learners at ISL sites experience sound? To what extent does sound impact attention attraction, dwell time, and shared learning in these learners?*

R4: *How do qualities of the soundscape correlate with indicators of learning: attraction, attention maintenance, and shared learning?*

As part of this research, the research team designed and facilitated three virtual 90-minute Sound Circles group discussions in Spring 2023 that included representatives from the project's Columbus-based research sites (i.e., Center of Science and Industry (COSI), Columbus Zoo and Aquarium, Franklin Park Conservatory and Botanical Gardens, and Columbus & Franklin County Metro Parks), and representatives from programmatic sites (i.e., North Park Villege Nature Center in Chicago and Wild Indigo in Detroit), as well as the project's PI and co-PIs, the project evaluator, and two project advisors.

Before the first Sound Circle meeting, participants were instructed to think about sounds they experience in their work or daily lives. The first Sound Circle began with the research team engaging participants to talk about their "favorite" sounds. Participants were then encouraged to describe and characterize the sounds they experienced (e.g., human, mechanical, animal,

natural, unwanted, wanted). The research team facilitated a discussion about how these sounds might be grouped. Participants were given an assignment to make a sound map of a place at their work site for the second Sound Circles discussion meeting.

The second Sound Circles meeting began with an overview of DIP-TiPS (Duration, Intensity, Pitch, Timbre, Pattern, and Speed). Participants were divided into small groups to use a DIP-TiPS worksheet to characterize and describe sounds they recorded in their workplace. Part of the discussion included talking about how location might affect each category. Participants were invited to share with the full group their sound maps. The research team facilitated a conversion about what makes a good sound recording. Participants were instructed to use DIP-TiPS to describe at least two different sounds in their work place for the third Sound Circle.

The third Sound Circles meeting began with participants brainstorming places where they might find sounds that are considered natural without human sound or noise, natural with human sound or noise, or natural within a constructed environment (e.g. coffee shop, sports arena, other), The discussion continued by exploring possible sounds that would be around us, between us, or within us. The research team facilitated a discussion about aspects of sound that can be measured using technology, as well as sound affecting learning. Participants engaged in a writing exercise to reflect on how sounds are a part of their programming and instruction and how sound can be better used for these efforts.

The purpose of the Sound Circles was to engage project partners in learning about each other, to think about sounds and soundscapes in their work environment, to explore ways of thinking about sound, and to think about connecting sound to how visitors to their organization learn. In addition, the Sound Circles intended to help prepare project partners to visit in person four informal learning environment sites in Columbus, Ohio, to explore soundscapes at these sites, and to consider how sound may increase learning.

CRE research team members took notes on the discussions that occurred during the Sound Circles meetings. The project evaluator solicited thoughts and reflections from participants following each Sound Circles discussion.

Identifying, Perceiving, and Understanding Sound

The following provides a summary from notes of participant discussions that occurred during the three facilitated Sound Circles as to where sound happens, sources of sound, describing sound, reacting to or engaging with sound, and thoughts about using sound for human learning.

Sound Circles participants shared examples of sounds around, between, and within them.

Sound happens around us, between us, and in us. With few exceptions, there is almost always sound around us, the soundscape comprised of environmental/natural (living and non-living), human-made, and people sounds (e.g., Bones et al., 2018). This is what we usually think of as "sound." Yet, in the case of between people, there is a different type of sound – that of the spoken and non-verbal language with its own classifications of voiced language sounds and other classifications of vocal paralanguage (e.g., Abercrombie, 1968). This source of sound has a wide array of nuance in the messages sent and how they are received. And finally, there is sound within us – the ways we interpret sounds and the unique meaning-making each person does in response to various auditory stimuli (Murail, 2005).

Prompted by a research team facilitator, Sound Circles participants shared examples of sounds they perceive that occur around us that included water boiling, fluorescent lights, footsteps, ringing phone, air conditioner vent blowing air, and a water fountain. Examples that participants shared of sounds that occur between us included workplace conversations, laughter, singing, and cheering from a group for those on stage singing karaoke. Examples of sounds that occur in us included heartbeat, ringing in ears, clinching teeth, thoughts in our heads, and "the whoosh of blood" in our ears.

Sound Circles participants identified sources of sounds in different environments.

Sounds can come from nature or natural environments without human influence, from humans in nature, or constructed or created from humans outside a natural environment. Prompted by a research team facilitator, Sound Circles participants identified sources and examples of sounds from natural environments that included ocean waves hitting cliffs, a desert, a deserted beach, a forest, a mountain top, a deserted or uninhabited island, the middle of a lake, or underwater. Examples of sound sources shared by participants that are produced by humans in natural environments included a local dog park, a boat harbor, campgrounds, a zoo, a tourist beach, a backyard, or a playground. Sources of human created sounds shared by participants outside of a natural environment included a music concert venue, a police or emergency vehicle, building construction sites, a shopping mall, or inside a buzzing coffee shop.

Sound Circles participants described sounds using a variety of affective and technical language.

Where sound happens (whether it be around us, between us, or in us) can influence how we might describe those sounds. Participants described sounds that come from around us as light tapping, faint, "twang" (of a rubber band being pulled and released), and rushing. Descriptions of sounds from around us that could be thought of positively included words such as pleasant, rich, soft, melodic, joyful, soothing, liberating, exhilarating, and transporting. Shared descriptions of sounds from around us that could be thought of negatively included rough, loud, irritating, guttural, harsh, abrasive, jarring, and pollution.

The Sound Circles participants discussed how the way we describe sound may be tied to culture, philosophy, personal place, life experience, spatial position, individual values, and intention. The literature also supports this (Andean, 2014). For example, one Sound Circles participate described some sounds as being “unwanted.” Describing a sound as chaotic, noisy, echoing, squawking, or with one participant as “attention seeking, chatty and gossiping” (produced by squirrels) may be situated positively by some and negatively by others, depending on culture, personal values, and context. Another individual said the sounds of city streets might be described as familiar and comforting by some, while scary and unsafe by others. One person commented that some sounds could be described as sentient. For that person, it encompasses not just what Cartesian scientific thought would categorize as "living," but also sounds that are animate, such as wind, water, voices of stones rubbing together, trees speaking through their limbs. Other sounds could be described as manufactured or inanimate, like the dull, low roar of the ship's engine that was passing by.

One sound expert participant described sound as being biophonic (acoustic functioning that different species have assumed in order to be heard in the overall soundscape of a given ecosystem), geophonic (of the earth), or anthrophonic (from humans). A shared perception was within each of these categories, sounds are either intrinsic (those expected to be part of a specific environment) or extrinsic (sounds from outside that interfere with intrinsic sounds). During the second Sound Circle, a project research team member introduced and described the DIP-TiPS framework as a possible tool for identifying, describing, comparing, and analyzing common, uncommon, and familiar sounds that happen around and between us. A soundscape (i.e., all sounds at a particular location) is made up of many sound events. Sound events are layers within the soundscape.

The research team Sound Circle facilitator explained that sound or a "sound event" typically has a specific source like birds calling from overhead, wind pushing through the trees, or waves crashing on the shore. Combinations of DIP-TiPS make specific sources of sound recognizable. For example, bird calls may be memorable because they have a unique combination of pitch and pattern. The Sound Circles facilitator commented that all the DIP-TiPs categories are culturally situated and a subjective aspect of understanding and describing sound.
One participant commented that using technical language (i.e., DIP-TiPS categories) to describe sounds involved learning how to use the framework categories and then applying these to sounds that were being heard. Another participant said that it required “exercising the brain” to think in different ways and apply different terms to describe sound. Some participants pushed back on the assumed “objectiveness” of DIP-TiPS.

Sound Circle participants explained different ways people react to or engage with sounds.

The location and sources of sounds, as well as how we may individually describe them, can influence how we react or engage with such sound. Sound Circle participants talked about how sounds can produce positive reactions or feelings, such as the sound of owls or other birds,

water, or wind gently rustling in trees. One participant shared how guests may be drawn to the sound of a waterfall, resulting in human created sounds and responses of “oohs” and “ahhs” as guests discover it. One participant felt that some sounds can mentally transport people to places they enjoy, such as a tropical oasis. Some of the same sounds that result in positive feelings and reactions can have an adverse effect on people, such as feeling overwhelmed or even fearful. For example, one participant commented that a space that is full of noise and children’s chatter may fell disconcerting for some people, while others may find child voices to result in feelings of joy and life.

One participant felt that some sounds can seem distracting, such as planes flying overhead in an outdoor informal learning environment. It can result in visitors wanting to wait until the sound of the plane subsides in order to more closely hear sounds produced by nature. One participant said that some sounds can divert attention away from internal thoughts toward external sounds. One participant commented that sounds produced by humans in a natural setting, such as voices or a child crying, can also be distracting to some visitors.

Our various purposes for visiting a location or spending time where there are many sounds can affect the way we process sounds, such as whether we are “trying to focus” on a single sound (and need to filter out others), “reacting to” a sound, or “inviting” sound.

Sound Circle participants considered how sound can affect or be used for human learning.

Where sound happens, the sources of sound, how we describe sound, and how we react to sound can affect how we learn. One Sound Circles participant commented that when thinking of sound it also important to understand neurodiverse persons and how it might be affecting them. Another participant felt that if a sound is overwhelming for a person it can interfere with their learning interaction. However, one participant commented that they believe natural sounds sometimes at a base level in a learning space can calm and prime people for an education experience at a deeper level.

One participant used an example of storytelling with very young children. Being somewhat worried that they wouldn’t sit through the program, she used a drum with the storytelling that captivated the children. Another participant perceived using sounds for human learning to create awareness (process of learning), attention, and agency (i.e., when you start to recognize yourself as one of the sound makers in a larger sound space you can guide attention and understand the relationship between your decisions and actions of other things in the environment). One participant said that listening to sound helps her evaluate how well her teaching is going, such as how the learners are reacting and what sounds they are or are not making.

Discussion

At this stage of the project the Sound Travels Research team learned several things about how the project partners identify, perceive, and understand sound. We learned ways that sound happens around us, between us, and in us. Sounds can be considered as happening or coming from nature or natural environments without human influence, from humans in nature, or constructed or created by humans outside a natural environment. Human engagement with sound can be influenced by the context in which a sound occurs, such as environment and location, coupled with the personal context in which humans experience, engage with, react to, and interpret sound. For example, we learned from the Sound Circles discussion that the way we describe, react to, and engage with sound is often subjective and can be influenced by our own values, culture, personal philosophy, and life experiences. The same sounds that are perceived, described, and understood by some listeners as desirable, "wanted," and resulting in positive emotions and feelings may be perceived by others as harsh, irritating, "unwanted" and resulting in negative feelings and emotions. Therefore, creating a strategy for assessing and "standardizing" our experiences with sounds may be a challenge.

Participants' reflections of their Sound Circle experiences collected by the project's evaluator indicated a healthy blend of learning, thinking, listening, and increased awareness of sound characterized by words such as "interesting" and "enjoyable." Sound Circle participants acknowledged the positive aspects of the diverse perspectives and experiences among the project team that contributed to discussions. They commented on things they had learned through the discussions, such as how sound is perceived differently by different people, and insights into how sound affects us in our daily lives. Some participants commented that as a result of their Sound Circle experience they have become more aware of sounds, noise around them, and how sound makes them feel, and have started listening more fully and intentionally to their environment.

Conclusion

The Sound Circles were designed with two overarching purposes: 1) for all the participants to begin to get to know each other, and 2) to introduce important ideas that underlie the project and the various activities and research in which the participants will engage.

During the Sound Circles, there was strong intention in the project team to invite all of the participants to explore sound together in the discussions. Across the Sound Circles, discussions explored:

- **Ambient sounds**. Participants reported a wide array of sounds across the categories of natural, human-made, and people sounds.

- **Affective descriptions of sound**. These discussions led to shared insights about how individuals have personal interpretations of sound, and how sounds can be positive, negative, or neutral in differing contexts and for different people.
- **Technical descriptions of sound**. There was initial struggle around these more technical descriptions, but working through it together, participants began building a shared vocabulary of sound using DIP-TiPS.
- **How sounds can affect learning**. There were multiple discussions that touched on the influence of or the response to a variety of sounds.

The Sound Circles were successful in bringing the participants together into thinking about sounds in different ways. The Sound Circles were purposely designed to prepare participants for the in-person meeting, where participants would further explore sound and prepare for the work of the project. The ultimate success of this series of videoconferences is best understood in how participants engaged with each other and with sound during this and future face-to-face opportunities.

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