



Identifying, Perceiving, and Understanding Sound: What We Learned From Year 1 In-Person Site Visits

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August 2023

Background

In collaboration with TERC and informal learning organizations across the United States, COSI's Center for Research and Evaluation (CRE) is part of an NSF-funded project, *Research to Understand and Inform the Impacts of Ambient and Designed Sound on Informal STEM Learning*. Known informally as *Sound Travels*, 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. Along with other project research partners, CRE is working to address 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 a part of this research, *Sound Travels* project leaders planned and hosted a two-day, in-person meeting of the extended team. This meeting served as the kickoff for the program and a way for all partners to physically meet and engage. At the same time, the meeting also provided an opportunity for all partners to share experiences focusing on the sounds in the different learning environments of the four project research sites in Columbus, Ohio. The present document describes the processes for and key takeaways from data collected at this gathering. While preliminary, this work reflects some of our progress toward addressing R1 and R2 in the early days of the project.

Goals and process for the meeting

The in-person meeting was designed to build on the grounding of the first three Sound Circles (held in early 2023). Project leadership developed the agenda with three goals in mind:

- 1) connect the various partners and site representatives
- 2) collectively experience sound at each of the research sites in Columbus (Columbus and Franklin County Metro Parks, Columbus Zoo and Aquarium, COSI, and Franklin Park Conservatory and Botanical Gardens)
- 3) gather information about how the sites and the partners talk about sound in these informal learning spaces

The two days started with a welcome and introduction, including a recap of the project's "origin story." The rest of the meeting was spent visiting locations at each the four Columbus research sites (COSI and Franklin Park Conservatory on day one, and the Columbus Zoo and Aquarium and the Highbanks Metro Park on day two). Eighteen project team members participated.

At each site, project leaders assigned participants (differently for each site) into three groups. Each group then rotated through three site locations in a different order. At each of the three site locations, a project advisor shared a location-specific idea or activity before releasing participants to experience the site location individually. During the experience, participants completed a worksheet containing guiding prompts intended to provoke reflection about sound in the location. The three groups then rotated locations and repeated the exercise. After the groups had been to all three locations, all participants reconvened, and a project team member led a discussion about the experience.

The larger-group discussion topics were different for each of the sites and moved from very broad reflections on sound to critical reflections on the specific sounds heard. At the final site, all participants contributed structured, interactive reflections on the overall experience.

Data emerging from the meeting

The CRE research team gathered data from the in-person meeting in two ways: 1) through systematic observation of the meeting and 2) through written prompts included on the worksheets participants completed. For the in-person meeting, both methods focused on addressing the project's first two research questions.

Observations

Observations focused on capturing conversations and dynamics of exchange between participants (characterized as "Vibes"), along with any evidence of continuity between the

content shared in Sound Circles and the core themes of the discussion (characterized as “Echoes”). Observers documented explicit instances of participants’ applying new learning about sound and/or considering ways to manipulate or leverage sound in informal learning experiences.

The language used to describe this task was intentionally themed around sound, and while it was framed as part of the research for this project, the team also made efforts to limit the burden on participants, to describe it with a friendly tone, and to avoid disrupting the meeting. Four team members (Hayde, Timko, Weiss, and TERC team member Elise Levin-Güracar) had the dedicated task of conducting observations systematically and continuously. In addition, everyone present was informed of the documentation structure and invited to contribute their ad hoc reflections.

Following the in-person meeting, each observer submitted written notes organized by **Vibes** and **Echoes** as described above. The CRE research team analyzed these data by using Vibes and Echoes as initial filters for assembling all the notes. The team then coded for inductive themes within these categories.

Worksheets

The worksheets participants completed at research sites consisted of five prompts, which were identical for each location at each research site:

- *What do you notice about the sound around us in this space?*
- *What do you notice about the sound that we are adding to this space?*
- *What do you notice about how you are processing and making meaning of sound?*
- *As an educator, what would you want to overhear in this space (or not hear)?*
- *Observe how others are experiencing this space. What do you notice about how people react to or engage with sound here?*

These prompts supported the meeting goals by having participants consider the sounds around them more deeply. They also generated data about what participants noticed about sound, how they described sound, and how they thought about sound in relation to informal learning. In all, the worksheet data reflected 165 responses, representing 15 unique individuals’ reactions to 12 locations across 4 informal learning research sites.

The CRE research team analyzed worksheet responses using a combination of deductive and inductive coding. The deductive codes (Table 1) reflected a range of possible and expected ways to describe sound (technical, physical, affective, and relational), as well as instances of applied thinking about sound. The CRE research team also identified inductive codes (Table 2)

via patterns in the data. The inductive codes reflected what sources of sound (programmed sounds, human sounds, other biogenic sounds, atmospheric sounds, and the physical environment) were most noticeable to participants, as well as some commentary about participants' attention and other sensory experiences. Looking both across sites and across locations within each site enabled the CRE research team to characterize distinctive qualities of each of the four research sites. The CRE team shared preliminary analyses of the worksheets with project participants for feedback and meaning-making in June 2023. Takeaways related to the worksheet data reflect this shared understanding.

Table 1. Deductive codes related to participants' descriptions of sound

Code	Definition
Technical descriptions of sound	presence of language referring to academic or professional ways of describing sound, esp. those referenced in Sound Circles (e.g. anthropogenic sound, references to DIPTIPS, etc.)
Physical descriptions of sound	presence of nontechnical language related to identifying the features of sound (e.g., location, volume, sounds overlapping or drowning each other out, etc.)
Affective descriptions of sound	presence of nontechnical language related to the poetics and/or emotional value of sound (e.g., lovely, shrill), including personal reactions to overall experience of sound (e.g., overwhelm)
Relational descriptions of sound	presence of nontechnical language related to human interactions with or related to sound (e.g., visitors reacting to, producing, or discussing sounds)
Applied thinking about sound	presence of language related to the potential effects of sound in teaching and/or learning (e.g., how sound might be leveraged, how it might interfere, etc., metacognition about own learning/processing)

Table 2. Inductive codes related to sounds reported by participants

Code	Definition
Programmed sounds	specific sounds added with intention by educators/designers
Human sounds	sounds made by people involving the human body
Other biogenic sounds	sounds made by non-human living organisms
Atmospheric sounds	incidental, non-biogenic sounds
Physical environment	sounds made by/as a result of how rooms, exhibit builds, demarcated area, any intentional interpretive spatial features are organized or manufactured for the purposes of creating an experience or place, including props, interactives, etc.
Attention/focus	comments pertaining to engagement (or lack thereof), being drawn to something, etc.
Other senses	comments pertaining to sight, smell, taste, and/or touch

Key takeaways from the meeting

Observations

Conversations during the meeting provided opportunities for participants to think about sound in a range of ways, some of which suggested applications for informal learning practice.

- **Vibes focused most often on how sound can make people feel.** Participants described their own reactions to sound, as well as what they noticed about others' reactions to sound. For example, participants commented frequently on ways that the sounds of water features seemed to cue an emotional response or hold personal associations.
- **Vibes also reflected the ways that sound can be connected to other human senses.** Participants especially often connected what they were hearing to what they were seeing. In response, a partner challenged everyone to try listening without other sensory inputs.

- **As the meeting went on, Vibes included more detailed descriptions of sounds and how participants felt about them.** At each location, verbal instructions emphasized focus and "tuning in" to sound. Participants seemed to engage deeply with these exercises.

Conversations also showed clear connections to previous project efforts.

- **Participants applied some of the technical concepts and terms discussed in the first three Sound Circles.** For example, the DIPTIPS framework (used to describe characteristics of sounds) appeared in both meeting agenda and participants' less formal conversations.
- **At each site, participants spoke about paying attention to how other visitors behaved.** In doing so, they noticed how features of the built environment and the use of programmed sound affected visitors' experiences.
- **Participants talked about becoming aware of how sounds blend and/or layer together.** This also led them to consider the role of ambient sound.
- **Participants were interested in the way specialized imaging can be used to visualize and describe sound.** Several people described the facilitated demonstration of a spectrograph as a key moment for them.

Worksheets

Participants tended to describe sound at the sites in terms of where sounds came from. They paid particularly strong attention to sounds produced by human speech or physical movement.

There were meaningful differences in what sounds stood out to participants at the different sites. These differences seem connected to the experiences offered at each site and participants' expectations about how to move through each site.

- **At the Columbus Zoo and Aquarium, participants thought about how programmed sound could support both animal needs and the visitor experience.** They also noticed how design requirements for habitats and interpretation could affect what they heard.
- **At COSI, participants noticed programmed sound and the built environment.** They saw these features as tools for expressing particular ideas, encouraging exploration, and supporting feelings of immersion.

- **At Franklin Park Conservatory, participants noticed how physical design affected their experiences of sound.** They also made connections to how sights and sounds seemed to work together.
- **At the Highbanks Metro Park, participants paid the most attention to sounds from humans, animals, and plants.** At this site, the sequence of experiences ambient noise both affected what people noticed.

Sometimes, similar sounds represented different meanings across the sites. For example, while participants noticed human sound at every site, they described it as more expected and appropriate at COSI and the Zoo than at Franklin Park Conservatory or the Highbanks Metro Park.

Looking ahead

Although it is still early in the project, the in-person meeting provided us with some data we can use to begin addressing our first two research questions.

How are soundscapes used by ISL practitioners?

Right now, the ISL practitioners working on this project are expanding their knowledge base and developing some shared language about sound. They are also beginning to identify ways they can more intentionally engage sound when they develop informal learning experiences.

What are the qualities of soundscapes at different ISL sites?

Each of the ISL sites where we will conduct project research with visitors has unique affordances related to what people expect to do there. We expect these findings to inform the sound topics we explore at each research site. As a group, the research sites also provide settings where we can systematically explore ideas related to indoor and outdoor sounds, the use of physical space, the use of programmed sound, and visitors' awareness of human sound. The coding framework we developed can also help us organize and analyze visitor data from informal learning experiences during later phases of the project.

Acknowledgments



This project was completed with support from the National Science Foundation (#2215101).

We would like to thank Martha Merson and Elise Levin-Güracar (TERC) for their direct assistance in gathering and sharing data to support the analyses described here. Beyond the direct contents of this document, we would also like to express appreciation for the vision, labor, and collaborative spirit of the entire Sound Travels team, which includes our partners at TERC, Northwestern University, Columbus & Franklin County Metro Parks, Columbus Zoo and Aquarium, COSI, Franklin Park Conservatory and Botanical Gardens, North Park Village Nature Center, and Wild Indigo Nature Explorations, as well as our individual project partners and our project evaluator.

Recommended citation:

Hayde, D., Heimlich, J.E., Meyer, J.R., Weiss, L., & Timko, G. (2023). *Identifying, Perceiving, and Understanding Sound: What We Learned From Year 1 In-Person Site Visits*. COSI's Center for Research and Evaluation.