Designs for Learning With and Through Sound

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Abstract: This interactive symposium compares observational and design research on learning with and through sound. Four quite different research projects will be presented to support a comparative exploration of how sound and practices of listening are of central importance for learning and for the design of learning environments. Short presentations will introduce elective activities in which the audience will be invited to hear, listen to, and listen for learning. The symposium ends with a discussion of bringing sound and listening into the foreground in design research on learning.

Focus of the symposium

What can be heard or listened for is rarely a leading topic in learning sciences research, despite the importance of ambient sound, music or song, and spoken word as both the content and supporting environment for learning and teaching. Even in ordinary conversation,

> What is being done is more than a succession of moments of talk... the monitoring of talk and listening is necessarily multisensory, involving both visual and auditory perception. (Usually the mutual perception of what the other is doing is also kinesthetic olfactory, and thermal, as speakers and listeners move together in real time, smell one another, and sense one another's body heat. In situations of oral discourse production, the "word" is indeed embodied, made flesh.) (Erickson, 2004, pp. 176-177)

Learning with and through sound is clearly a central, interactive process in formal and informal learning environments, as well as in environments that are designed to incorporate audible performance and listening as supports for subject matter teaching and learning (e.g., Ball & Heath, 1993; Shapiro, Hall & Owens, 2017; Hall & SLaM, in press; Silvis, Taylor & Stevens, 2018).

Unless our hearing is diminished or lost, almost every aspect of learning depends upon sounds we hear and make sense of as sources of information for communication. And even for learners with hearing loss, multiple embodied forms of interaction (signing, facial expression, and movement) help to convey what might otherwise be heard or listened for when learning (Friedner & Helmreich, 2012). Our focus in this symposium is not so much on what can be heard (e.g., is it loud or clear enough, in relation to ambient sound or background "noise"), but more attentive practices of listening and sense making, activities that are often done together (Frith, 2003) and in settings with dynamic sound qualities (Ratliff, 2016). As Ingold (2007) argues, we hear in sound, just as we see in light. Making, hearing, and listening to sound are active, sense-making projects that are deeply involved in learning.

Relevance and contribution

Bodies and embodied activity are ascendant topics in learning sciences research, but there has been little attention to sound, hearing and listening as integral aspects of embodiment. There has been rapid development of research on embodied processes like gesture and mobility in the learning and teaching of particular subject matter domains (e.g., in mathematics, see: Hall & Nemirovsky, 2012; in science, see: Varelas, Pappas, Tucker-Raymond, & Kane, 2009), including proposals for how to design environments and activities in which body activity supports or drives learning (e.g., Abrahamson & Lindgren, 2014). Hearing and listening are also embodied actions that support

learning, yet they have been under studied and are rarely placed in the foreground in design research. This symposium foregrounds the role of sound, hearing and listening in learning.

Papers in this symposium bring together observational and design research for the purpose of comparing how sound, hearing and listening support learning. These research projects consider different types of sound—ambient "noise" in the setting, talking and overhearing others' talk, voice recording (e.g., capturing or listening to oral history interviews), music, and song (i.e., foregrounding lyrics one can listen to/for). The symposium will also invite comparisons across types of settings in which we hear in sound (nature areas, home spaces, city neighborhoods, and performance events). Finally, with the purpose of starting a conversation in the field about design principles for learning with and through sound, we ask authors and the audience to think comparatively about hearing and listening as sense-making or inquiry. Presentations and designed experiences (see organization of the symposium) will focus on the following questions:

- What is the embodied work of *listening to* and *listening for* things we value in sound?
- How is attention to sound organized, including shifts from *ignoring* ambient sound, to *hearing*, to *listening to* and *listening for* what is relevant for learning?
- How do *learners arrange or edit sound* for listening, in support of their own learning?
- Are *sound and place* mutually constitutive and important for learning?
- From a learning sciences perspective, what *design principles* help us to understand how can sound be produced, performed, or placed to support learning?

Organization of the symposium

The symposium is organized around reports from four separate research groups, each engaged either in observational or design research on learning with and through sound. Following an introductory talk that frames the session, each group will describe their project and invite the audience to participate in a project-linked activity designed to explore the theme of the symposium.

We have organized the symposium as a hybrid that combines short introductory presentations (telling) with designed activities (doing), in which the audience can elect to experience learning with and through sound (90 min total). The presentations and elective experiences will be used as material for the discussion and Q/A session at the end of the symposium.

(*5 min*) Introduction and framing of the symposium (Chair)

(4 * 10 min = *40 min*) Presentations from each group (study design, leading questions, phenomena and findings, introduction to elective activity/experience)

(4 parallel experiences, *20 min*) Each group builds from the vibrant example (presentation) to explore designs for learning with and through hearing and listening (we would need a prepared space)

(*25 min*) Discussant commentary and audience Q/A

Hearing, listening, and sound scaping for learning public history

Rogers Hall and Emma Reimers

In this paper we ask how what we hear and listen for influences the sense we make of places, how we align ourselves with cultural meanings, and how to design soundscapes for learning (i.e., what we call "sound scaping" as a design practice in learning sciences). We start with a theoretical framing of sound as a medium for hearing and listening, that is co-produced by things and people in proximal and digital environments. We then consider how what can be heard and listened for are used in making sense of places when learning about public history. Finally, we consider two activities we have designed and studied iteratively: *listening sessions* and *making/following story lines* within a framework for making, teaching and learning public history (Hall & Space, Learning and Mobility Lab, to appear).

We focus on how music (primarily songs with lyrics) and voice recordings selected from oral history interviews can be used to deepen or shift engagements with places when learning about and making public history (Seixis & Morton, 2013; Wineberg, Martin & Monte-Santo, 2011). Hearing is not the same as listening, yet both support processes of sense-making, contextualization, and comparison that are important for historical thinking and learning (O'Rourke, 2013; Sakr, Jewitt & Price, 2016). We also argue that sound, as a medium in which we hear and listen, can be designed in ways that have consequences for learning (i.e., what we call "sound scaping").

We report results from analyses of two activities we designed and have studied over several cycles of design research, using interaction analysis of dense, multi-perspective audio and video recordings (Jordan &

Henderson, 1995). The first activity was a "listening session" in which students nominated songs or oral history recordings for close listening and discussion (e.g., listening for geographical space, musical space, lyrical meaning, and flights of imagination; see Ratliff (2016) on ways of listening to music). The second activity was making and following "story lines" while walking, where those story lines associated music and spoken word recordings with places in (or paths through) the neighborhood. Making and following story lines engaged learners in an embodied experience of historical "palimpsest" (Graham, 2010), in which they were both "here" (in the place of an historical event) and "then" (experiencing the place through archival media describing those events).

Listening sessions, both with high school students and teachers in our design studies, were productive for understanding relations between song and social activism (e.g., variations of the traditional song, "Gospel Plow", rewritten as "Eyes on the Prize" and used by civil rights activists during the 1960's; Carawan & Carawan, 1995). When students nominated their own songs (e.g., the best-selling but controversial song regarding sexual consent, "Blurred Lines"), listening *for* meaning (lyrics, imagination, music, and space) led students to differentiate between hearing (most had heard this song) and listening more closely to social positions and values expressed in the song (many realized the meaning of this song's lyrics for the first time). Shifting from hearing to listening played a pivotal role in how students made sense of sound media when making and following story lines.

Making and following story lines put the relation between hearing and listening (to and for content) into motion, as learners carried sound media into the city (on smartphones or tablets) to engage with the public history of neighborhoods. In design research with students and pre-service, high school teachers, participants learned substantial historical content (e.g., knowledge of events) and about the spatial production of racial and economic segregation (Hall & SLaM, in press). Our Analyses also showed learners' ability to create historical narratives about city neighborhoods became more elaborate and showed a deeper, relational understanding of historical events in response to instructional activities we designed.

Having established that making and following story lines were productive for learning public history, we conducted a more specific, comparative study of how the same story line was experienced by followers (potential learners) under two conditions. In the first condition (Echoes.xyz app), oral history recordings and songs automatically played as followers entered "bubbles" visible on an iPad they carried while walking; in the second (Storyliner.org), followers had to select which media to hear or listen to, as they followed the story line. We found the interleaving of song (e.g., Bobby Hebb's hit song, "Sunny", written shortly after the murder of his brother at a club along the story line) and voices from oral history interviews with city elders (e.g., what it was like as a 17-year old to play with an as-yet unknown, Jimi Hendrix) were powerful hearing and listening experiences. Both conditions (geo-fenced and media selection) provided an immersive listening experience, particularly in relation to ambient sound in the neighborhood today (e.g., voice and song layers softened and re-contextualized the grinding noise of traffic). But these immersive experiences had different affordances for learning depending on condition. Followers in the geo-fenced condition remarked (while walking) that historical buildings had a sonic "aura", and this gave them an immediate sense of the neighborhood's past; followers in the selection condition (sound must be selected) filled "gaps" between what they listened to with more substantive comparative and critical talk about neighborhood history.

Findings from our design studies have implications for how we understand and design for hearing and listening in learning sciences research. Story lines were both a way of making and following public history that supported learning. The distinction between hearing sound media (songs or oral history) and listening to and for thematic content is also important for learning, evident in how learners gained a new perspective on familiar practices of hearing in listening sessions, and then also in how they used sound media to make story lines as a form of public history. How sound media were organized in story lines as *an* experience for learners (O'Rourke, 2013) also appeared to be critical for inviting conversation, comparison, and reflection while making and following public history.

Sound in the background and foreground of learning arrangements

Deborah Silvis and Katie Headrick Taylor

Sounds and music saturate everyday life, yet when the school bell rings, the phones are put on mute, instruments stored until band practice, and the radio is silenced (Bickford, 2017). In recent learning sciences research, music and sound play a larger part in the story of how people think and act. Scholars treat music and sound as organizing ensemble learning (e.g. Ma & Hall, 2018), as the content with which learners are engaging (e.g. Shapiro, Hall & Owens, 2017), or as a metaphor for learning (e.g. Phillips & Lund, 2019). This paper joins this sonic turn by addressing sound as foregrounding and background-ing learning.

We explore ways that learning involves music and sound by highlighting an interplay between sound as *medium for* and a *focus of* learning. When music or sound are a medium, they serve as an ambient acoustic

environment that can support learning, helping people organize their activity through, for example, a soundtrack. Hearing people's music in the background can also help others track their activities when not collocated. On the other hand, as a focus of learning, sound is itself something that must be tracked, presenting a new form of attention to history, technology, and shared activity. Listening to sounds together expands possibilities for collaborative activity. As both focus and medium, music and sound constitute a "public sensorium" (Goodwin, 2018, p. 348), drawing people's attention together in shared endeavors.

We report two studies where sound was important for learning. Study 1 was an ethnographic study of eighteen children from thirteen families living in two separate US cities. Data were primarily video recordings of children and families going about their daily routines around the house and their local neighborhoods (Silvis, Taylor & Stevens, 2018). Through interaction analysis (Jordan & Henderson, 1995), we noticed that music played a significant role in how families' activities were structured. We identified key instances in which music was played or discussed by participants and focus on one that is representative of the common use of background music during homework and chores. Study 2 was part of a larger design study that took place in an undergraduate learning theories course and was organized around a series of video recorded visits to sites in the surrounding city neighborhoods. One of these activities was a SensEscape, where groups of students studying learning theories in locations adjacent to their campus engaged all their senses while learning about local history on-the-move (Taylor, Silvis, Kalir, Negron, Kramer et al., 2019).

Drawing from these studies, we present two versions of using sound to support learning. One instance of this occurred when sisters Lara and Latasha did their homework after school. As the older sibling, Latasha placed certain restrictions on her younger sister's use of her room and her books. During one visit to their home, Lara was allowed brief access to retrieve a nonfiction book of Latasha's about fossils and rocks, then returned to her room to read. Lara then attempted to get her iPhone to play some music while reading, but she met with technological resistance (Taylor, Silvis & Stevens, 2018). Fortunately for Lara, though Latasha would not allow Lara *in* her room, she played music aloud *from* her room, sound-tracking their separate activities. This produced a public sensorium as a basis of activity, a way of keeping track of each other in spite of their separation.

In a different learning arrangement from a design-based study in a higher education setting, sound moved from background to foreground and became the focus of activity. Groups of students studying learning theories participated in SensEscape by attending to relationships between a site and its sounds in the city. Students sat in the alley outside the city's first coffee bar, established in 1975, and listened to the many sounds around them while they drew images evoked by the soundscape onto a transparency paper. Individual transparencies were then overlaid, producing a single drawing of a group's sound images, including representations of a shrill squeak of the café's door as customers came and went, the noisy cawing of a crow atop a neighboring building, or a pedestrian yelling down the alley from a needle exchange across from the café. Foregrounding sonic experiences of this historic site was part of building a public sensorium where learners constructed a shared understanding of their university community.

From a design perspective, sound as background and sound as foreground are not mutually exclusive within an activity. For example, the practice of using music to keep track of one another was a reason for field hollers; enslaved African people sang calls and responses to keep coordinated during forced labor (African American Song). In protest marches, people employ song to keep coordinated and to teach onlookers about their message (e.g., "We Shall Overcome," Adams, 2013). Whether they help people *stay* on track, keep track of *each other*, or as something *to* track, music and sound are important for learning. Tuning in to sound and listening for learning is also a way of making public the rich and varied sense experiences that have been relegated to the background or rendered invisible. We need radical new forms of attention to develop an ear for listening to each other and the world around us.

Exploring computational making through the sounds of hip hop

Dionne Champion, Eli Tucker-Raymond, Brian Gravel, and Amon Millner

> Don't make me wait too long cause I'm a move on
> The dance floor when they put something smooth on
> So turn up the bass, it's better when it's loud
> Cause I like to move the crowd (Eric B. & Rakim, Move the Crowd, 1987)

This paper explores sound as a resource for STEM learning and identity development through computational Hip Hop making. STEMCees is a three-year design project that focuses on developing an integrated STEM and computing informal learning environment for historically underrepresented middle school youth. The project uses Hip Hop as a medium for culturally sustaining pedagogy (Emdin, 2011; Paris & Alim, 2014). We share findings

from a 60-hour summer camp, the first iteration of our multi-cycle design research project. Our case explores one project group of four girls who used physical programming, circuitry, and the manipulation of sound to create a DJ battle station that participants in an end-of-camp "block party" would use to compete against each other to create the best sound effects over a musical selection.

Our approach integrates sound as an aesthetic, embodied, and politicized phenomenon (Abdurraqib, 2019), with an expansive sense of computational practice as defining rules that combine to produce emergent forms of behavior (Gravel, Tucker-Raymond, Olivares, & Benedetto, forthcoming; Knight & Stiny, 2015). As youth engaged in sound production using computer code to prepare beats and samples for others to mix, they became architects of others' future experience. In manipulating sound and creating rules for manipulating sound they constructed "substrates not only to shape the actions of those who will use them, but through this process to create new forms of action" (Goodwin, 2018, p. 269). Through their interactions with tools and each other, sound became the medium through which they produced, assessed, and revised their own interactions in the space, and crafted an experience for others to interact and have opportunities to learn with and through the substrates they produced.

The context of this study was a summer camp at a dance studio in a mid-size city in the Midwestern US. Champion, the first author, is director of the studio and functioned as the lead facilitator of the camp. Twenty-seven participants who mostly identified as African American (one identified as Puerto Rican), learned about the history of Hip Hop, explored electrical circuitry, and used algorithms to create emergent dances. They engaged in dancing, rapping, graffiti writing, building paper circuits, and deconstructing electronic machines. They also learned about contemporary Hip Hop practices including electronic music production, for example, using digital tools to explore coding. As a final project, participants were tasked with creating an interactive space for a culminating community event—a "block party."

Participant observation was used to collect data, which included field notes, video and audio recordings, and interviews. Using constant comparative methods (Charmaz, 2014) we identified three clear activities of computational practices that involved sound. We used microgenetic analysis to understand how youth constructed the rules and grammars for the scratch program they developed, used an embodied recursive process of testing and manipulating sounds, and created opportunities for others to manipulate sounds in an interactive experience that aligned with Hip Hop aesthetics.

We present the DJ Makey Makey Battle Station as an exemplar to describe and explain three ways in which sound mediated learning and identity development as youth engaged in Hip Hop computation. Students created a carboard platform with two vinyl records and aluminum foil touch pad that faced each other as in a head-to-head competition. The record and touch pads were connected through copper tape to a Makey Makey that was plugged into a computer, situated under the cardboard, running the Scratch programming platform. The program then played corresponding sound effects (e.g., scratching when the DJ moved the record).

Constructing rules. As a group of four girls, ages 6-16, engaged in the design and production of rules and a rule-based system for their design, sound and listening played a necessary and key role in their ability to make computational decisions, test their ideas, and understand how the elements of their program fit together. To create their project, they engaged in a series of listening activities, which included selecting sounds and editing them. Through a process of iterative listening, they decided to input multiple sound-effect tracks instead of one long music track in order to give users *"something they can play around with."* Their process required them to think about the work of a DJ, the elements of live music production, and understand the rules and features comprising the elements of the substrate they created for their users. The process of breaking down and building up highlights their understanding of the elements of a Hip-Hop song, what sounds are part of a song, how to build songs, and how to create a rule-based environment where people have options to build them in different ways.

Refining through iterative and recursive testing of the Hip Hop aesthetic. The group refined their scratch program through an embodied, recursive process of iterative testing. Stepping through bits of their program, they embodied the computational process, using sound outputs to tweak their input decisions. Through multiple iterations, the girls listened to and edited sounds to make them fit with rap vocals. They tested each sound, listening to it along with the vocal track and made minor tweaks to slow down certain sound effects, add echoes or make sounds louder, longer or faster. Programming with sound, which requires listening together instead of simply sharing a screen, changed the way they were able to engage with the content and work together to make decisions. They bobbed their heads as they tested different sound effects played over the vocal track, making decisions about how to edit based on how the sounds fit with the lyrics as well as how it made them move, key aspects of the Hip Hop aesthetic.

The youth were constructing an interactive Hip Hop environment, not just a program for a computer to run. They engaged in a full embodied experience to create a full embodied experience. To do this, they had to consider not only the code, but the physical design, including things like how the foil buttons would need to be

labeled, the use of vinyl records for authenticity, the need for 2 Makey Makey set ups so that DJs could sit across from one another and operate independently. Utilizing physical programming, circuitry, and the manipulation of sound, the girls created the conditions for users to participate in an immersive computational experience that relied on sound to explore circuitry and computational thinking.

Sound, like the other elements of Hip Hop, is about making a space for oneself and crew. Computing with Hip Hop allows youth to draw on their own embodied and lived experiences with sound and use them as resources for computational thinking and identity development. Youth focused not only on their performance, but also on creating an experience for someone else, which is the true focus of the hip hop DJ. Transforming the DJ performance into a computer program was not just about hearing or listening, but hearing that was connected to touch, movement, feeling, identity and computation.

The polyphonics of walking reading and storying land

Ananda Marin and Kyle Halle-Erby

Going on walks, including walks in forested areas (i.e., forest walks), is a common practice in many communities and is culturally variable (Marin, 2013; Ingold & Lee, 2008). Walking, reading, and storying land (WRSL), is one methodology used while on forests walks to learn about, with, and from the natural world (Marin & Bang, 2018; Marin, 2019). WRSL is an ambulatory, place-based, temporal, and everyday methodology where stories, or theories for ways of being in the world, come together with the courses of action (methods) people take to build knowledge. WRSL has evolved over socio-historic time and varies in form and action at the practice level. Importantly, WRSL has been embedded within Indigenous ways of knowing for generations and continues to shape relations between humans and more-than-humans (Cajete, 2000; Kawagely, 2006).

WRSL is comprised of at least three dimensions: coordinating attention and observing, generating explanations, and finding evidence (Marin & Bang, 2018; Marin, 2019). These dimensions are situated within particular contexts and locations. In our work, we examine the micro-practices (e.g., question asking, issuing directives, pointing gestures, and shifts in movement) that urban dwelling, Indigenous families use while engaging in WRSL to be in relationships with the more-than-human and natural world. In this paper, we attend to the soundscape of forest walks and specifically how sounds created by more-than-humans and heard by humans influence action across the three dimensions of WRSL.

We present a case study of a forest walk taken by a Native American mom (Chiricahua Apache/Spirit Lake Dakota) and her 5-year-old son. This family was invited to go on five walks over the period of two months. Their walks were part of a larger study series that included five other participating families. While on the walks, all families used wearable cameras in order to capture their experiences from their point of view. The soundscape on forests walks (i.e., the noises created by humans and more-than-humans including land/waters) is audible in the video recordings and importantly, transcends multiple scales. For example, if we are examining the soundscape from the perspective of human participants then it is important to note that sounds are heard and sometimes intentionally listened for from varying points of distance and beings — animals, insects, water, and the noises beyond the forest canopy like cars. However, in analyses we have often backgrounded the soundscape of forest walk ecologies in order to focus on talk-in-interaction. We speculate that this may be due in part to the fact that participants on forests walks use words like “see,” “look,” and “notice,” more often than they use words like “hear,” “listen,” and “feel.” This pattern, which is similar in many ways to researcher’s tendency to privilege seeing and talking in studies of teaching and learning, has the potential to shape professional vision or one’s process for naming, categorizing, and making phenomena in the world available for meaning making (Goodwin, 2018; Stevens & Hall, 1998). The line of analysis that we pursue in this paper demands that we as researchers discipline our perceptions to more intently attend to the activities of hearing and listening as important resources for WRSL.

With the purpose of better understanding the role of hearing and listening as an integral part of embodied courses of actions, we intentionally selected a walk where the sounds of more-than-humans were clearly present in the video recording. In other words, the sound of human voices was just as audible as the sound of birds chirping, crickets, mosquitoes, and the like. In this walk Mom and son, like other families who participated in the forest walk studies, used verbal resources (directives and questions), pointing gestures, and whole-body movements to create a shared line of sight and attentional space for meaning making. At the same time, there were key moments when sound was taken up as a resource for intellectual activity. For example, we found that hearing and listening for more-than-human sounds played an important role in this family’s imaginative perspective taking about the lives of the more-than-humans they were observing and attempting to interact with. More specifically, hearing and listening became a resource for questions and lines of inquiry the mother and son had in relation to birds, water animals, and bigger creatures like Big Foot and Loch Ness. Noticing this pattern, we traced a key

moment where sound became integral to the course of action the family took and the son's desire to 1) find Big Foot and Loch Ness and 2) determine if Loch Ness was real and living in the pond that they visited during their forest walk.

Our analysis focuses on three patterns. First, hearing sounds like the chirping of birds led to questions about the activities of more-than-humans as well as the sounds that more-than-humans make and hear. Second, perceptually attuning to the sounds of more-than-humans was central to this family's practice of imaginative perspective taking. Once lines of questioning about hearing and listening to the sounds of more-than-humans were opened up, additional attention was given to the potential for hearing more-than-humans sounds. This also led to the recognition of moments when more-than-humans might hear the actions of humans. In these cases, mom and son were both imagining from the perspective of more-than-humans and imagining possible courses of action that might be taken if more-than-humans recognized the sounds they were making. Third, these lines of inquiry took the form of micro-stories or reports of observations that are linked to past, present, and future events (Marin, 2019). In conclusion, we offer that this study speaks to how WRSL can be expanded upon to account for the emplaced, embodied, mobile, and polyphonic aspect of learning about, with, and from the natural world. Moreover, the patterns we have identified led us to assert that focusing on hearing and listening to soundscapes supports what Kimmerer (2013) calls re-story-ation, or re-imagining relationships between humans, more-than-humans, and land/waters in ways that create conditions for cultural resurgence

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