Journal of Ethnographic & Qualitative Research
2017, Vol. 12, 29–49 ISSN: 1935-3308

Digital Recording Technologies in Phenomenological Investigations

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Using a phenomenological study of educational games, this article describes how computer-based digital tools were used to simultaneously record computer applications (such as games), voice and sounds, participant facial expressions, and gestures to enliven phenomenological interviews and provide rich, thickly described data. In a study, participants were asked to play games and to describe what they heard after they played. In order to help participants recall their experiences, they viewed a recording of their gameplay and described what they recalled about their experiences of sound in the games. The digital tools used in this study enabled play back of recorded data while also simultaneously recording ongoing, new participant interview dialogue. The visual layout of these tools also enables researchers to simultaneously see both the original gameplay recording and the subsequent participant interview dialogue. When paired with interview techniques such as think-aloud and simulated recall, digital recording technologies can be used to provide participants a context for their descriptions during the interview and are invaluable tools for post-interview data analysis. We discuss how this digital technology system may intensify data generation and analysis in other technology-based phenomenology and qualitative studies.

Using a phenomenological research study on sound in educational games as the research context, we describe how digital computer recording technologies, such as ScreenFlow™, were used in order to support and augment interview techniques such as stimulated recall and think-aloud. We argue these technologies illuminate otherwise transitory and subtle phenomena under study, such as sound listening and learner experiences with educational games (in our research example) but also in other investigations, such as with social media use or learning with technology. In our study, ScreenFlow™ recorded computer gameplay, sound, and facial expressions for six study participants as they played three educational games over three separate interview sessions. They then watched the resulting video recording and talked through their experiences with sound in the games that they played. ScreenFlow™ was instrumental in collecting a wide variety of data to support stimulated recall by participants and observational data for analysis, which aid researchers of phenomenological studies by providing a deeper, enriched record of participant experiences and providing opportunities to directly

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connect participant activities and decisions to their descriptions of experience.

Describing the lived experience of a phenomenon, such as a player's experience of sound in a game, requires an in-depth exploration of that experience. In descriptive phenomenological traditions, such descriptions are typically obtained through in-depth interviews (Giorgi & Giorgi, 2003; Moustakas, 1994). As Van Manen (1990) points out, "The point of phenomenological research is to 'borrow' other people's experiences and their reflections on their experiences…" (p. 62), and one strategy is what Van Manen calls a "conversational interview" that records a lived experience as described, or to "*reflect* [emphasis added] with" the interviewee about their experiences (p. 63). Similarly, Dahlberg, Dahlberg, and Nystrom (2008) hold that research interviews maintain "open dialogues" with participants to ensure that participants are "given a chance to express [their] unique experiences of the phenomenon of interest [such that] the focal point of the interview is what and in what way the interviewee experiences the phenomenon and expresses its meaning" (p. 185). Such an interview process can be informed by ethnographic approaches to in-depth interviews (Dahlberg et al., 2008; Spradley, 1979).

The phenomenological interview elicits deep descriptions of the experience being investigated (Giorgi & Giorgi, 2003). Phenomenological interviews are conducted as conversations that are either semi-structured or unstructured in design (Cilesiz, 2009; Dahlberg et al., 2008; Moustakas, 1994; Van Manen, 1990) and bear a similarity to everyday conversation (Dahlberg et al., 2008). Moustakas (1994) suggests the interviewer is "responsible for creating a climate in which the research participant will feel comfortable and will respond honestly and comprehensively" (p. 114), including beginning with informal conversation and a brief meditative activity to focus the interview and create trust. While conversational in tone, the interview must be structured to elicit in-depth reflection of a phenomenon. The interviewer must maintain focus on the phenomenon being investigated and the research question the interview is designed to address (Van Manen, 1990). Van Manen suggests designing semi-structured questions that help participants explore a phenomenon, but "often it is not necessary to ask so many questions. Patience or silence may be a more tactful way of prompting the other to gather recollections and proceed with a story" (p. 68). The interviewer's role thus requires active engagement in the interview process.

Adapting to unexpected opportunities in order to ask new questions about the phenomenon is part of that engagement, but the interviewer must be prepared to work with the participant. As Dahlberg et al. (2008) describe, "Researchers make a concerted effort to direct the informant's intentionality and awareness towards the phenomenon of interest" (p. 187). This means being prepared with exploratory prompts, such as, "Can you give me an example?" "What was it like?" or "How did you…?" (Van Manen, 1990, p. 68). Researchers commonly prompt for more exploration by asking, "Can you tell me more about [the topic]?" The process to structure interviews to support phenomenological inquiry is a constant balancing act between having enough structure to ensure that the phenomenon is richly described, but not so overly structured that conversation is lost. Interviewers use the term bridling to describe making conscious decisions about how theory and background knowledge are used in interview prompts and clarifying or explanatory questions, focusing on a) when to ask questions, b) how to ask what types of questions, c) the depth to which a topic is explored, and d) the direction that such a line of questioning should take (Dahlberg et al., 2008). Other useful sources of data include participant observations or participant created artifacts that explain lived experiences such as writing, drawings, or dramatizations (Cilesiz, 2010; Dahlberg et al., 2008; Van Manen, 1990).

Phenomenology researchers rely upon participant descriptions of experience, typically audio recorded for verbatim transcription, to build an analyzable corpus of data. Recently, educational technology researchers employed phenomenology to examine the lived experience of people who use complex technology (Miller, Veletsianos, & Doering, 2008) and who use technologies in ways that are complex or critically transformative (Cilesiz, 2009). Both of these studies relied upon audio-recorded, participant reflections of past technological experiences, not real-time descriptions of experience.

Neither interview techniques incorporated real-time audio playback for stimulated recall and think-aloud descriptions of experience. Similarly, Mallon and Webb (2006) conducted a descriptive phenomenology study of 25 participants' gameplay and analysis and relied on transcriptions from audio-recorded reflections for their data. Video or screen recordings were not used for the study.

Lee and McFerran (2015), however, conducted an interpretive phenomenological study that incorporated video data. Pairs of music therapy practitioners and clients were video recorded. Therapists then reviewed the session video recording, identified a "meaningful moment," and described its meaningfulness. While their video recording technique was not described, Lee and McFerran's study is the only one we found that involves phenomenology interviews and digital technology systems, such as screen and video recording tools, to record real-time activity and serve as a reference for participants to describe their experiences.

Thus, the present article advances the role for digital screen and video technologies as computer-aided research methods in phenomenology studies by describing a study of participant experiences of sound in educational games that relied heavily upon the use of audio, video and screen recording to capture participant experiences. We introduce the present research case in order to build this methodology in which technologies are instrumental in enabling researchers to capture participant descriptions, physical reactions (e.g., surprise) and computer activity (gameplay in our research). These technologies enabled immediate clarification of participant descriptions, provided a reference for participants as they talked, and enabled review of participants' actual real-time experiences after the interview sessions were concluded. Phenomenology investigations of participant experiences of gameplay (or other technological activities) may benefit from this innovative technological methodology for the interview process.

Method

The following sections describe the instance of research that serves as a case for the use of layered, multimedia data in phenomenological research studies. The first author collected the data by video recording gameplay, interviewing the participants, and analyzing the data. Included images of technologies and participants accord with participant opt-in consent within university Institutional Review Board guidelines.

Research Context

Games are collections of complex systems of rules, play experiences, and cultural representations that are bound together in ways that are organized and designed (Salen Tekinbas & Zimmerman, 2003). These play experiences typically require a wide range of formal and dramatic elements for digital games to work, from rules and mechanics to visual design, narrative, and audio to create immersive interactive experiences (Fullerton, 2014). Thus, games immerse players in complex experiences, using multiple modalities to present information and foster interaction. This investigation examined experiences of sound, which is not often addressed during gameplay.

Describing what we hear can be difficult because we cannot close our ears to what we hear in the way that we can shut our eyes to what we see (Ihde, 2007; Jorgensen, 2009). As a result, eliciting a phenomenological description of both gameplay and sound during gameplay requires the interview be a real-time exploration of participant experience. Thus, digital recording tools transformed the methodology to ask and answer the question: What is it like to experience sound while playing educational games? Phenomenological approaches explored people's lived experience of sound during and after their gameplay.

Participant Selection

We used criterion sampling (Cilesiz, 2010) to select six adult participants with hearing ability, college attendance, gameplay experience, ability to articulate experiences, and scheduling availability. Each participant played one game in each of three separate sessions, scheduled approximately one week apart (Cilesiz, 2010). In each session, the participant played a game and was interviewed about their experiences of gameplay. The interview employed techniques to stimulate participant recall about the sound heard while playing games, which were described out loud. The study generated 603

pages of transcriptions, reflecting 16.05 hours of interview dialogue out of a total of 22.68 hours of recorded gameplay, body and facial expressions, and interview dialogue. The data reached saturated descriptions of sound in gameplay.

Data Analysis

A descriptive phenomenological approach (Colaizzi, 1978; Moustakas, 1994; Robinson, 1994) and interpretive phenomenological perspective (Dahlberg et al., 2008) provided a framework to analyze the data. This process identified meaning units to reflect the horizons of participant experiences with sound for each educational game, organized these meaning units into tentative clusters of meaning and identified the constituents of meaning that structured and described these experiences. We then derived essential meanings of the phenomenon of sound in educational games through the participants' experiences and interpreted them through our lens as researchers (Dahlberg et al., 2008). We then connected these essential meanings to current theoretical foundations in game sound research.

Game Selection

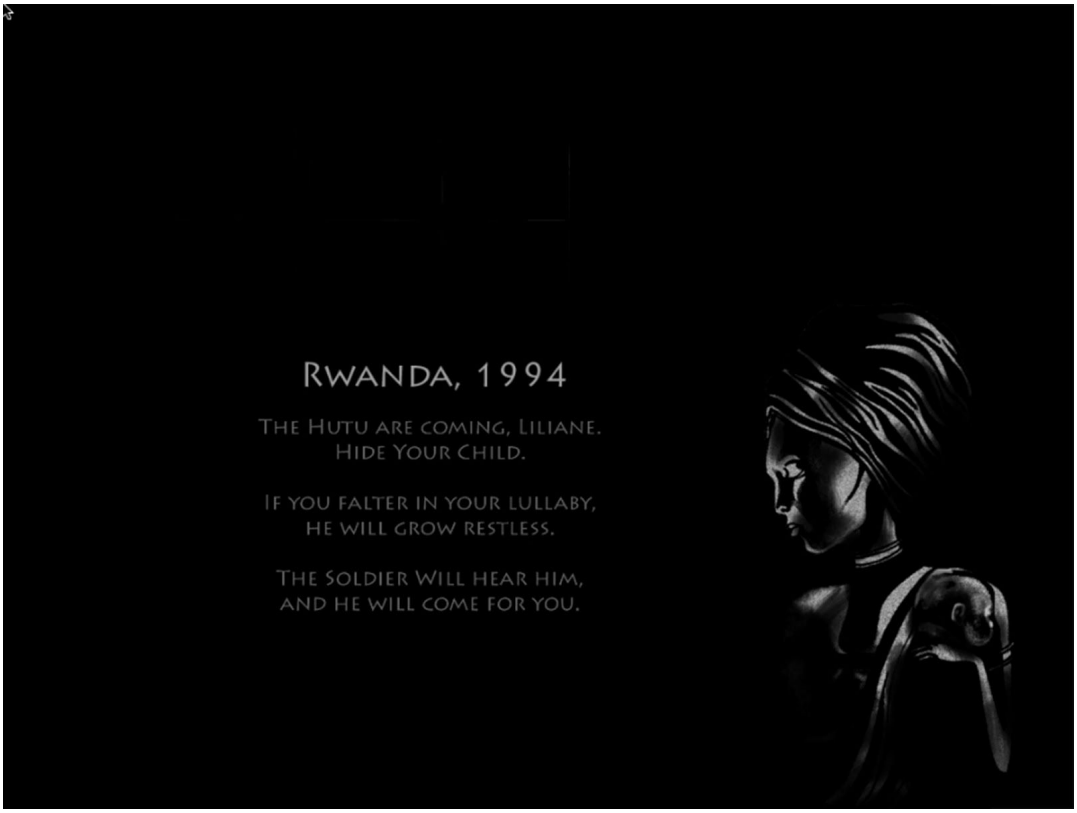
We constrained the scope of this study to three games that were designed for educational purposes or to raise awareness about social problems (Burak, 2012). Fate of the World® and Hush® involved social problems, and Salamander Rescue was educational. We describe each game in order to situate the discussion of how digital interview technologies were used to understand the experience of sound in these rich media environments.

Fate of the World®. Fate of the World® (FOTW) is a strategy game that immerses players in a "real social and environmental impact of global climate change over the next 200 years" (Red Redemption, 2013). Players are positioned as leaders of a fictitious global organization charged with implementing policies that address a number of critical environmental problems in areas like northern and southern Africa. FOTW uses a turn-based system in which players are presented with a set of cards and must make choices during each turn (see Figure 1).

Players face complex goals that encourage social, economic, and human development to improve the environment. The game's interface is two-dimensional, with players moving between multiple screens to spend resources and make decisions. Sound effects accompany many of the interactions and players' mouse clicks. Background music also accompanies gameplay.

Figure 1
An Array of Cards in Fate of the World® from which the User Chooses.

Figure 2
The Setting within the Hush® Game.



Hush®. Hush® uses procedural rhetoric to prompt students to challenge "existing social and cultural positions" (Bogost, 2007, location 43) and, in the process, promote social change. Antonisse (n.d.), the creator of Hush®, describes it as "an experimental game in which you play a young mother trying to calm her crying infant with a lullaby." Hush® raises awareness of the genocide in Rwanda by providing players with an "aural and visual ambience" (Bogost, 2008, page 1) to situate play (see Figure 2).

Players type letters that appear on the screen with the correct timing, even as they hear the ambience of soldier's footsteps, gunfire, and the sounds of people dying. Game visuals are extremely simple and muted and therefore, intensify the importance of the game's sound. Missing letters results in the baby crying louder, which in turn affects the game length and the likelihood of winning or losing. Longer gameplay intensifies the story, and the player hears increased gunfire, sounds of people being mortally wounded by slicing machetes, and the cries of people suffering.

Salamander Rescue. Salamander Rescue (SR) is a game-based approach to science learning (Liu, Rosenblum, Horton, & Kang, 2014). In SR, players must identify what is causing the salamanders to die on an island. The game is a 3-D virtual environment with a lab and an outdoors that contain a lake with the salamanders, trees, a small building, bridges, and three, in-game scientist characters. Players access an on-screen tablet computer where they read information from the scientists, take readings from the lake, manage the list of tasks they must perform before proposing a solution to the problem, and access reference information about the game (see Figure 3). Players enter an immersive 3-D environment with 3-D characters, sound effects, and background music. Some in-game interactions are paired with sound while others are not. Gameplay takes a significant amount of time to complete, as players must

Figure 3
The User's Onscreen Tablet Computer in the Salamander Rescue Game.

Figure 4
ScreenFlow™ Software Showing the Record Window.

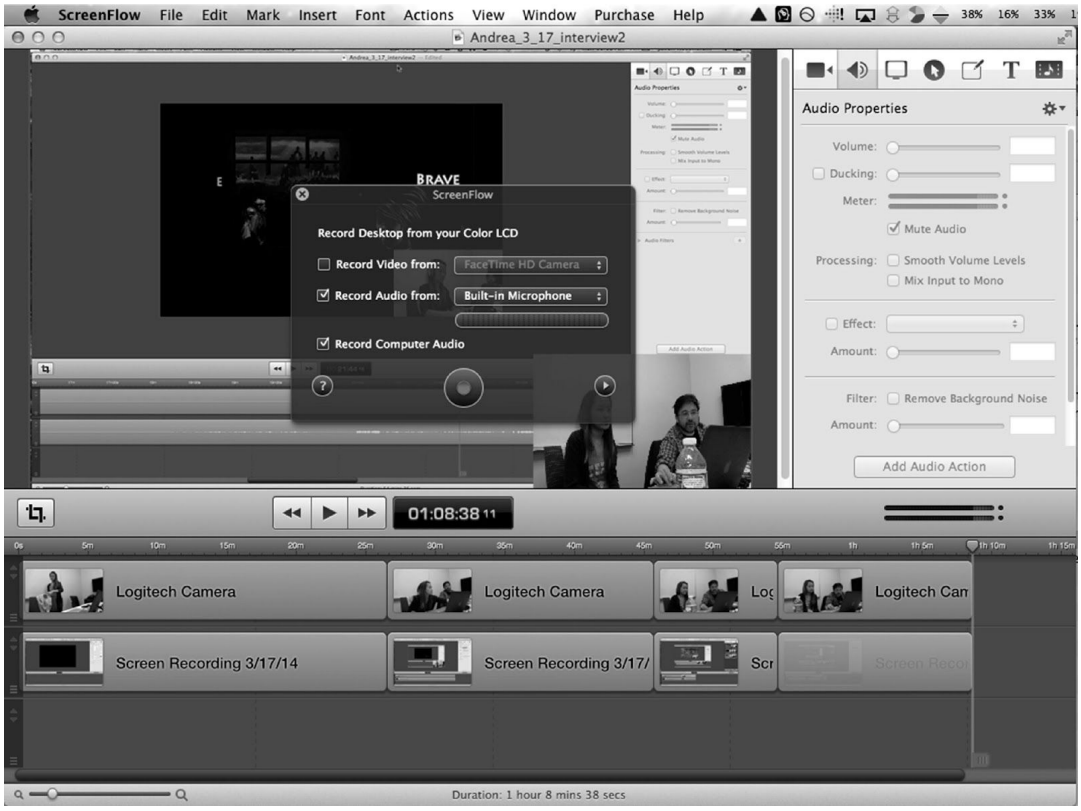


Table 1
Mobile Digital Research Recording Lab Technologies

Technology	Role in phenomenological interviewing
2011 Apple® Macbook Pro® (Computer A)	Participant gameplay computer. ScreenFlow™ recorded webcam video of participants, interview audio and screen recording.
One-terabyte SSD hard drive (see Figure 5, Hard drive A)	Installed on Computer A as the primary harddrive. SSD technology optimized for recording speed. One-TB required to store research video data.
2013 Apple® Macbook Air® (Computer B)	Researcher computer. ScreenFlow™ recorded backup webcam of participant and backup interview audio.
Two video webcams (see Figure 5, Webcams A and B)	Recorded participant's facial expressions and gestures.
Two mini table tripods	Mounted to the video webcams. Each tripod was positioned on either side of the participant.
Two boundary microphones (see Figure 5, Microphones A and B).	One microphone connected to each computer. Recorded interview data.
iPhone® camera lens adapter	Adapts an iPhone lens enabling close-in recording of the participant's computer screen.
Floor-standing tripod	Mounted to the iPhone with camera lens adapter.
One 2-TB external hard drive with Apple Lightning® interface	Saved backup copies of the interview recordings once sessions ended. Attached to Computer A.
One 1-TB external hard drive with USB 3.0 interface (see Figure 5, Hard drive B)	Saved backup copies of the interview recordings once sessions ended. Attached to Computer B.
One pair, noise-isolating over-the-ear headphones	Worn by participants during gameplay to isolate game sound from ambient environmental sounds.
One USB hub	Connected multiple USB devices to Computer B.
One portable mouse	Enabled participants to use a standard mouse, instead of the laptop's touchpad.
One rolling cart	Enabled me to transport research equipment.

repeatedly move about the island to interact with characters, test the water in the lake, and analyze information.

Mobile Digital Recording Research Lab for Phenomenological Interviewing

Each of the games studied used sound in markedly different ways. Therefore, it was critical that players be able to play each game and discuss the subtleties of what they heard and for us to clarify their descriptions. In order to accomplish this, we designed a mobile research lab that enabled participants to play games while we audio and visually recorded gameplay and engaged in interviewing. We used ScreenFlow™ software available for the Apple® Operating System to record what displays on a computer screen. It compiled multiple audio and video channels from participants' recorded a) gameplay (video of the computer screen), b) facial expressions during gameplay (video of the participant's upper body), and c) oral reflections during gameplay (digital audio; see Figure 4). Table 1 lists the mobile lab technologies and their purposes.

Figure 5 shows the layout of the mobile digital recording research lab. The participant and interviewer sat next to each other, each with a laptop, webcam with tripod, microphone, and an external hard drive. A tripod with a camera mount for my iPhone® 5S was placed near the participant. The interviewer sat close enough to guide the participant if he or she became "stuck" while playing the game and, in doing so, maintained the participant's personal space.

As the participants played on Computer A, ScreenFlow™ recorded and consolidated the participant's computer gameplay, participant facial expressions and gestures, video input from the webcam, and the audio interview conversation through the boundary microphone – all attached to Computer A (see Figure 6). For backup redundancy, another instance of ScreenFlow™ on Computer B recorded and compiled participant expressions and gestures from another webcam and the interview audio from another boundary microphone, both attached to Computer B. An iPhone 5s was placed on a tripod behind the

Figure 5
Mobile Digital Recording Research Lab.

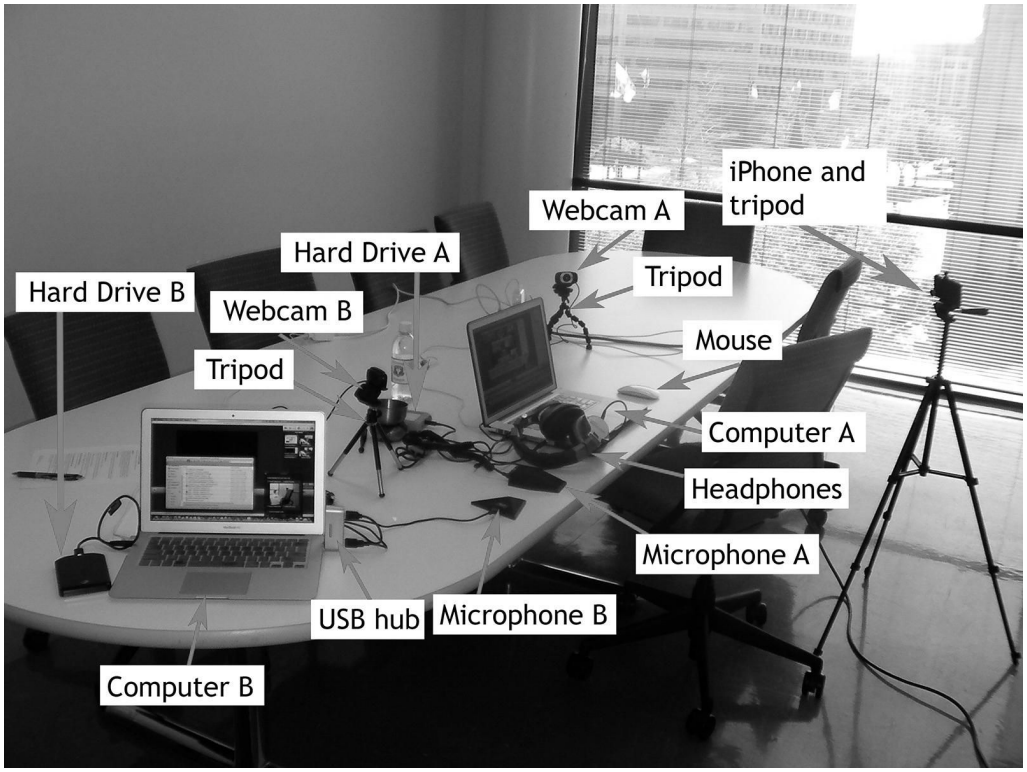
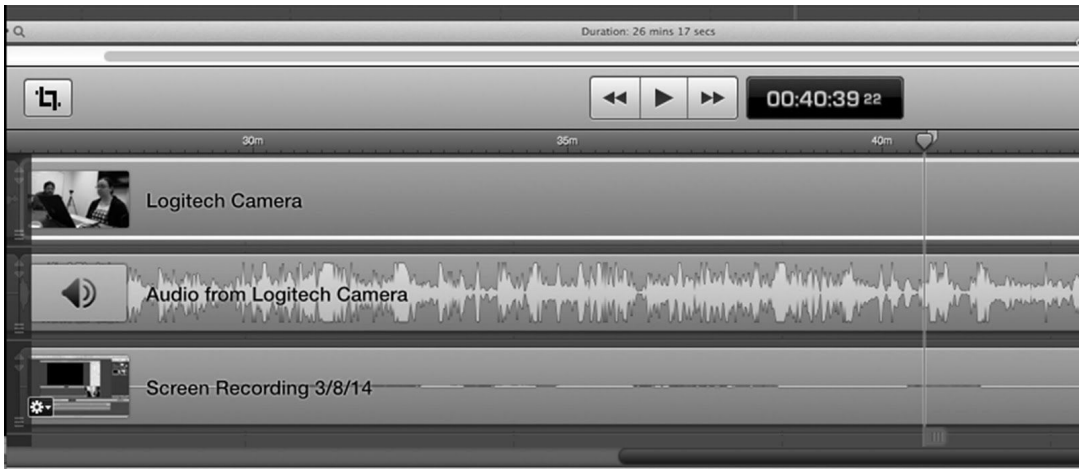


Figure 6
ScreenFlow™ Timeline View in which Computer Play, Participant Gestures, Expressions, Video, and Audio Are Captured in One File.

Figure 7
Image of the Separate Audio and Video Tracks in ScreenFlow™. Although ScreenFlow™ Labeled the Audio Track "Audio from Logitech Camera," the Audio Was Recorded using the Boundary Microphone.



participant, zoomed into Computer A's screen and recorded gameplay, which was later imported manually into ScreenFlow™ on Computer B to create a duplicate backup. The redundant setup on Computer B ensured no data loss.

Technology Affordances

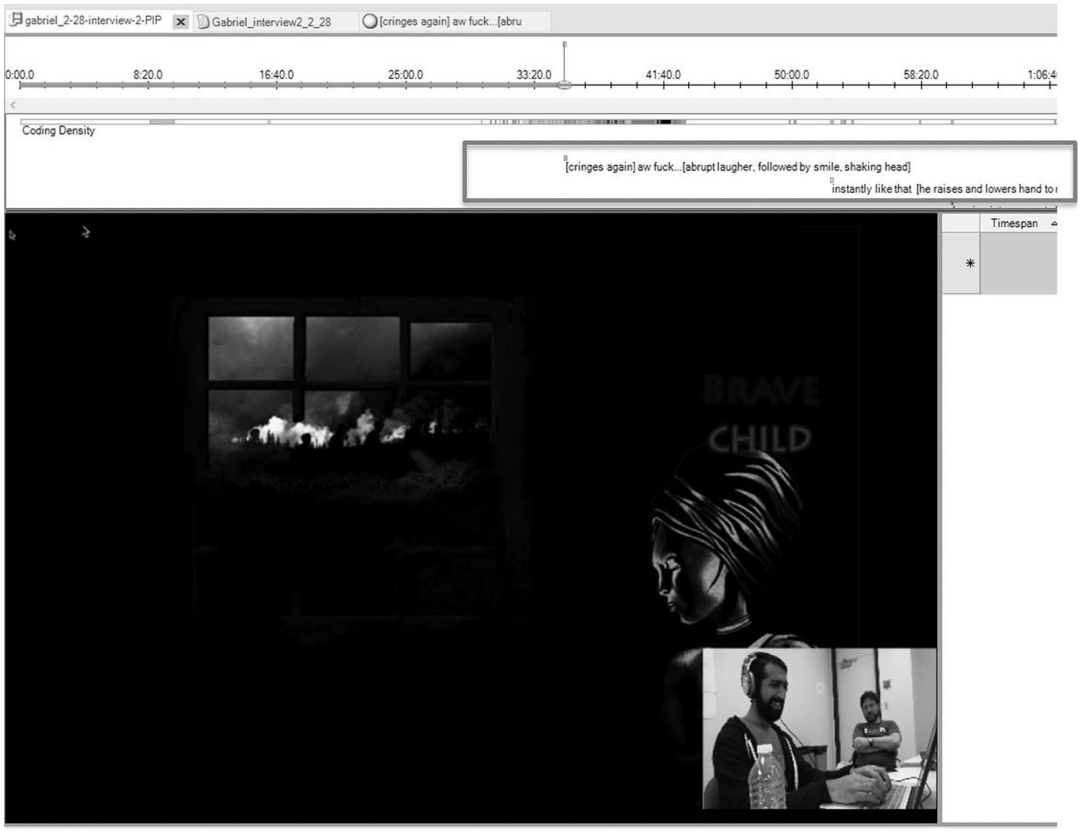
ScreenFlow™ provides an intuitive, multitrack graphical user interface (GUI) that separates the recording of audio, computer video, and external video (see Figure 6). The video timeline interface presents individual "tracks" for each channel of media, a common video editing interface. There are tracks for the gameplay screen recording, the webcam video of participant facial expressions and gestures, and the audio, recorded using a boundary microphone displayed as a waveform (see Figure 7).

It is possible to record multiple media tracks assuming sufficient a) hard drive storage, b) hard drive speed, and c) CPU power and memory capacity to create the recording. Pilot-testing the process on a Macbook Pro® computer revealed that it lacked sufficient computer memory and hard-drive space and speed. Computer A was upgraded with an internal one-terabyte, solid-state drive (SSD) hard drive and installed a total of 16 gigabytes of memory to ensure simultaneous capture of participant video at 30 frames per second (fps), interview dialogue, and high-resolution gameplay without jitter or other deleterious artifacts in ScreenFlow™. The total amount of space needed to store this study's videos exceeded 1.2 TB, so researchers also purchased a 7200 rpm, two-TB external hard drive to store all data, while keeping a copy of all data for current participants on Computer A. The Lightning® connection (an Apple® cable connector) on the external hard drive enabled speedy transfer of very large (20GB–60GB) files between Computer A and the external hard drive, enabling complete backups before leaving the research site.

Processing Interview Video for Nvivo®

We exported the consolidated tracks (see Figure 7) into a single MP4 video format file using ScreenFlow™'s export feature. Researchers then created a copy of the MP4 video to edit. Because much of the video contained gameplay without narration, we isolated only the parts with narration by deleting portions with no talk and then exported the narration as an MP3 audio file and submitted it for professional transcription. After checking the transcription for errors, it was imported into NVivo® with the original MP4 video recording. Thus, the transcript and ScreenFlow™'s consolidated video was this study's data. Video recordings provided a reference for relevant non-verbal gestures and facial expressions related to the participant's gameplay experiences. We coded facial expressions after matching the recorded transcript with the corresponding video. Figure 8 illustrates how the video and transcripts were integrated in NVivo®. In this example, Gabriel

Figure 8
Screen capture of NVivo® Software Showing Correspondence between Imported ScreenFlow™ Video and the Textual Transcription.

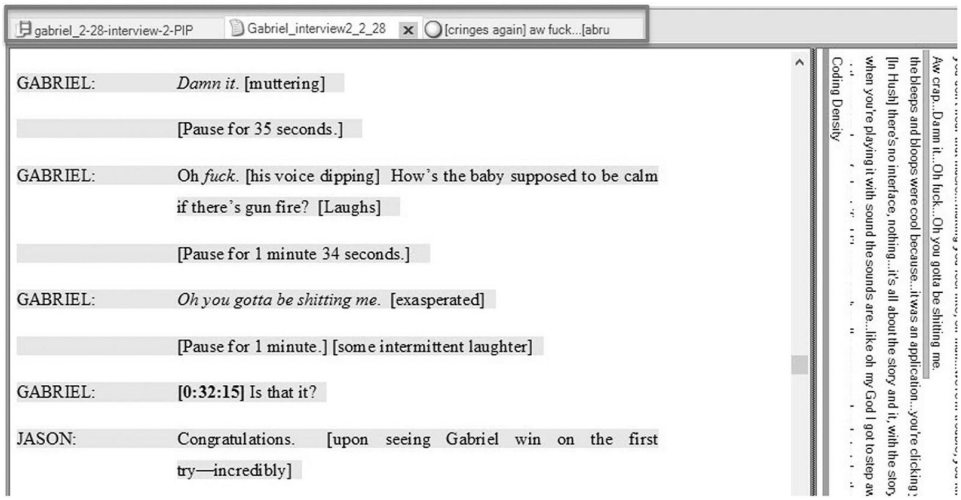


plays Hush®, and as he hears the sounds of gunfire and of people dying around him, while silhouettes of soldiers move in the background of the game, he cringes, uttering an expletive, "aw fuck…" as he misses letters as he attempts to type the word "Child." The box in the upper right of Figure 8 shows coding, in vivo, of the moments in the video where Gabriel cringes, with the words uttered and the expression presented. This coding process, recommended in the Van Kaam method outlined in Moustakas (1994), refers to identifying a single descriptive perspective on the phenomenon as identified in transcribed text as a discrete unit of meaning. Meaning units signify "the division of the whole of data into parts [that are] not carried out randomly, but with respect to the meaning that one sees" (Dahlberg et al., 2008, p. 243). Taking this perspective, we identified meaning units in the interview transcript and used the video footage to further explain and supplement the meaning units found. ScreenFlow™ was instrumental in the process to associate participant expressions with interview dialogue since the consolidated video used a "picture in picture" format such that both the gameplay and the participant's expressions are visible throughout the video.

The corresponding transcript (Figure 9) is also coded in vivo, using NVivo®. The box in the upper left around the three tabs in Figure 9 indicate multiple data views available in NVivo® to display the video, transcript, and coding "nodes." We coded compiled video data (e.g., [cringes again] aw fuck…[abrupt laughter, followed by smile, shaking head]) separately from transcription data but incorporated both into the data analysis process.

The research protocol for this study aimed to allow each participant to provide perspectives of their experiences of sound across each of the three sonically diverse educational games. Digital technologies enabled us to craft the interviews in ways to both elicit and record those perspectives. The physical setup, with

Figure 9
Transcription in NVivo®.



its redundancies, provided the needed hardware while the flexible ScreenFlow™ software enabled us to simultaneously record and intertwine multiple types of media from a variety of input sources including microphone, webcam and computer screen.

The Roles of Digital Recording Technologies in Data Collection and Analysis

We used these digital recording technologies in four distinct ways to support data collection and analysis. First, we captured participant expressions. Second, we encouraged stimulated recall during the interview. Third, we used a think-aloud process to guide participant feedback. Last, we replayed the interview post-session and verify steps taken during the interview.

Capturing Participant Expressions

Although the spoken word is critical to phenomenology research, it was also critical to capture gestures that accompanied participant expressions to understand and interpret participants' oral descriptions. Gestures, the speech that accompanies them, and the emotions they signify are inseparable (Merleau-Ponty, 2002). For example, upon seeing a gesture related to anger, Merleau-Ponty points out, "The gesture *does not make me think* [emphasis in original] of anger, it is anger itself" (p. 214, Kindle Edition). As Roseman, Wiest, and Swartz (1994) describe, "Expressions (e.g., lowering the brows in anger) are communications, voluntary or involuntary, that influence the social world when perceived by other organisms" (p. 216). Roseman et al.'s research reinforces the idea that people have similar ways of describing emotion. A phenomenological study by Sloan, Robinson, Scott-Brown, Moore, and Cook (2011) of animation of facial expression by student animators demonstrate that animators have similar ways of describing and interpreting facial expressions that convey emotion. Thus, because of the potential for people to elicit emotion while playing games, we decided to capture video footage of participant facial and body expressions to pair participants' emotions with their verbal descriptions. Video allowed opportunities to review the footage after the interview and capture otherwise fleeting emotions that would have been easily missed through observation during the interview session.

The 23 hours of video footage recorded for this study included video of participant gameplay (the computer screen) and facial expressions and other non-verbal cues such as hand gestures (the webcam of the participant's upper body). This video data supplemented the interview dialogue and was analyzed and coded (see Figure 8) alongside transcript data. We moved through video footage and watched for gestures or expressions, such as raising hands, smiling, and frowning. Although several people

Figure 10
Video of Participant Allow Captures of Facial Expressions and Body Gestures, Such as When Gabriel Plays Hush®.

maintained neutral expressions or minimal gestures while playing, others were very animated. One of these participants, Gabriel, vocalized and gestured his frustration as he was playing Hush® and having a hard time winning the game, saying: "Aw *CRAP*. [missing letters in the game]. This baby needs to shut up or we're in trouble. [half-jokingly, smiling a little] [Pause for 31 seconds.] *DAMN IT.* [muttering]." Note that words expressed loudly and with emphasis by participants were denoted in transcriptions with boldface and all-capitalized text. As Gabriel continued to play, he started to hear the soundtrack of the game intensify and began to cringe (see Figure 10).

As Gabriel continued to focus on timing his key presses in the game, he continued to cringe, eventually cursing as the intensity of the sounds increased. Gabriel's facial expressions captured on video, when paired with the sequence of gameplay, enabled us to make note of salient instances where gestures like cringing (see Figure 10) or pointing at the screen (e.g., see Figure 6) accompanied player utterances or were made without any corresponding narrative. Examples of recorded expressions like Gabriel's demonstrate the way in which a video record of participant expressions adds a valuable dimension to the data captured for phenomenological analysis. Most important, these data provide a more complete insight into the participant's experience while being immersed in the process of playing games or being interviewed about their experiences of play.

Encouraging Stimulated Recall

Stimulated recall prompts participants to recall their thinking around an event of some type. In Lyle's (2003) study, coaches were shown video of recorded sports play and asked to describe their thinking underlying critical decisions in the game. In Lyle's study, the participants self-identified the "decision-making incidents" they described, as opposed to researcher-chosen incidents. Video recording has a rich history of supporting stimulated recall during interviews in a variety of fields, from education to psychology and science learning, to help stimulate participant thinking, to describe interactions, and to explain auditory and visual cues (e.g., DeWitt, 2008; Henry & Fetters, 2012; Lyle, 2003; Putt, Henderson, & Patching, 1996). In educational games research, stimulated recall has been rarely used but can help participants recall what happened when they played a

Figure 11

Researcher Engages Sarah in Stimulated Recall by Re-playing a ScreenFlow™ Recording of Earlier Gameplay in Fate of the World® (Upper Left Video Area), While ScreenFlow™ Records a New Instance As She Answers a Researcher Question (Entire Area in Figure 11).

game and stimulate reflection of their play experiences (e.g., Liu et al., 2014).

During this research in the second and third interview sessions, each participant reflected upon our prior session's gameplay, adding additional thoughts that might deepen their prior descriptions of sound. This was also a critical opportunity to ask questions derived from studying the transcripts from the first and second interview sessions. Participants reviewed video clips from the prior session's recordings as a way to refresh their memory, to clarify participant statements from the previous interview, or to seek more depth in their gameplay descriptions.

For example, we neglected to ask Sarah a question about music in the first interview. In the second interview, the interviewer asked her to reflect upon her play as she viewed a video of her gameplay (see Figure 11). Watching this video stimulated Sarah to recall and describe her experience of music in the game in more detail than in the first interview. Note that pauses of two or more seconds were denoted with ellipses in the transcription:

INTERVIEWER: One question that I neglected to ask is what would happen to your experience with play with music cut out or [if] it were cut off?
SARAH: Oh, like I mentioned … the places that I mean, the presence of music and the absence of music is…that transition is definitely rough because you are starting to wonder like okay why…when is the music going to start again, right?
INTERVIEWER: Right.
SARAH: If had it always been quiet…
INTERVIEWER: Right.
SARAH: And then just hearing the sounds of your interactions on the screens…It's just, I don't know if it would take you into the game as much. I think the music definitely adds a lot. It, you know um, whether it's like a subconscious you know, emotional response or in this case you know this is very mellow flowy music, definitely keeps you very calm and in a place where you want to think.
INTERVIEWER: Mhm.

SARAH: Right? Um, and I think that, that's helpful.

Figure 11 shows how ScreenFlow™ recorded the replay of Sarah's compiled video from Interview 1 (for stimulated recall) while simultaneously recording new video of Sarah's facial expressions, body gestures, and audio during this second interview as she watches the replay. ScreenFlow™ was critical in allowing the participants and the interviewer to review prior gameplay to support stimulated recall while also recording new dialogue, webcam video, and the computer screen. Incorporating the technology for stimulated recall allowed clarification and confirmation of previous descriptions and thus increased the trustworthiness of my interpretation of participant experiences.

Using Think-Aloud Method

In contrast to stimulated recall interview techniques, in which participants were prompted with video to recall or describe events, think-aloud techniques prompt people to describe their thinking about an event or process as they experience it (Lodge, Tripp, & Harte, 2000). A critical assumption of think-aloud processes is that "verbal reports are data" and are as valid as other forms of experimental data (Ericsson & Simon, 1980). Think-aloud is extremely relevant for phenomenology research studies that rely heavily upon a semi-structured interview process involving the use of open-ended interview questions to create a rich research data set about the phenomenon investigated. According to Lyle (2003), think-aloud techniques often involve the use of "structure[d], but relatively open-ended, questions posed to the subject as soon as possible after, or during, the viewing of [a video]" (p. 863). Like stimulated recall techniques, think-aloud strategies can involve, but do not require, video viewing to complete. During a think-aloud process, researchers typically provide participants with a task to perform and ask that they elaborate on what they think as the task unfolds, without asking intervening questions (Cotton & Gresty, 2006).

Researchers can intervene to help guide participants if they encounter problems completing a task (e.g., Margolin, Miller, & Rosenbaum, 2013). Yet, Cotton and Gresty (2006) caution, "Researchers are advised to give very general instructions, simply to 'think aloud,' and to verbalise 'everything that passes through your head'" (p. 48). Such directions contrast to guidelines from researchers who advocate for positioning the researcher as an active participant in the research process (e.g., Dahlberg et al., 2008). Nonetheless, think-aloud processes support inquiry into experiences playing games. In two studies of problem-solving processes during gameplay, researchers used a think-aloud protocol to gather data from student comments during 20-minute interview sessions about the strategies and problem-solving processes they used to make game decisions (Blumberg & Randall, 2013; Blumberg, Rosenthal, & Randall, 2008). Although these interviews were not phenomenological investigations, the purpose of the think-aloud protocol was to prompt students to unpack what were otherwise hidden mechanisms that guided their strategic thinking during gameplay.

In this study, once a game had been played and won or lost, the interviewer momentarily stopped recording the session in order to save the ScreenFlow™ recording file and restarted the ScreenFlow™ recording process to capture the think aloud interview and any new gameplay. First, participants talked about their immediate reactions to playing the game when asked, "What are some of your general thoughts about the game?" or "Tell me a little bit about your gameplay…what do you think of playing [the game selected]?" This step enabled participants to articulate their immediate thoughts (e.g., likes and dislikes) about the game. Sometimes, as with Sarah, participants described aspects of the game that were not germane to the research study but that contributed to the overall experience of play, such as, "…it was really confusing what the objective was…" However others, like Austin, recalled highly salient experiences of the game. After playing Hush®, Austin vented, saying, "Like the game was like REALLY heavy…it was just…I got really like… scared playing, playing through it." His response enabled a series of questions focusing upon this aspect of his experience. Once Austin described the facets of gameplay that contributed to his "heavy" and "scared" experience, the interviewer then began the think-aloud process in which participants viewed playback of the ScreenFlow™ compiled recording from their earlier play in that session, which contained a

Figure 12
Austin Thinking Aloud As He Watches His Earlier Gameplay in Fate of the World®.

picture-in-picture view of themselves playing the game (see Figure 12), to recollect aspects of their gameplay involving sound. As the video played, they were asked to think aloud about different aspects of their play and sound.

At one point in the interview, after Austin watched playback of a portion of the game video, the interviewer asked that he described out loud what was going on in his mind about the soldier's voice as he listened to it during the video replay.

> INTERVIEWER: Mm-hmm. What's going [in] your mind?
> AUSTIN: So, with his narration, it was…
> INTERVIEWER: Yeah, go ahead.
> AUSTIN: Kind of like… You kinda… I… The way I like, imagine it in my head, he's like a commander…commanding his soldiers…I mean, that's like through like the radio, I guess…And like to communicate, to like all the soldiers…And so that's… Yeah, so that's the image I got from that, like that kind of [muffly] sound…they used.
> INTERVIEWER: Uh-huh. So, for you, this dude was a character…
> AUSTIN: Yeah.
> Austin's think-aloud demonstrated that the sounds Austin described hearing defined a character in the game, which we confirmed through the interview.

Later in the interview, as Austin reflected on a piano lullaby he heard in the game, he also mentioned hearing singing from another character in the game and proceeded to relate the two occurrences with each other.

> AUSTIN: Yeah. It'll… It'll… Just, I think, 'cause the piano of the game, kind of correlate to a lullaby and so, her singing is kinda like… It IS the mother singing to the child…Kinda.
> INTERVIEWER: You mean, the piano playing?
> AUSTIN: Yeah, the piano began, and so I'm just kinda thinking of this like…lullaby. I just have this like kind of the word LULLABY in my head.
> INTERVIEWER: So, wait. So without even hearing the mother's voice, you were saying that the piano lullaby is reminiscent of...
> AUSTIN: Of…
> INTERVIEWER: The mother?
> AUSTIN: The mother singing.

INTERVIEWER: singing. Wow. Did you know that the mother actually does sing?
AUSTIN: I think… I think I HEARD it… she like hums it… I hear like, her humming. It's right… [Background game audio as INTERVIEWER forwards to the humming]. It's right here. It starts here anyway. It's like…
[Austin is humming the lullaby].
INTERVIEWER: Right. [acknowledging Austin's observation]
AUSTIN: I hear that. [Background game audio]

Austin's interview passage demonstrates how we incorporated Dahlberg et al.'s (2008) notion of bridling during the interview. Bridling is a process by which researchers can control the ways in which theoretical assumptions (in this case of sound in games) guide their interpretation of what people say and the ways they form interview questions. Researchers who choose to bridle should therefore consciously decide when to "tighten the reins" in order to prevent researcher assumptions from guiding the interview and when to "loosen the reins" in order to allow assumptions to influence or guide the flow of the interview. As Austin described the piano lullaby, he began to relate this aspect of the game to hearing the voice of the mother singing in the game. Because of the interviewer's background with sound and its use within games, he realized that the participant was connecting with a common sound design technique—using sound to lend dimension to game characters. The interviewer was surprised he made the connection between two seemingly unrelated instances of sound to describe the character of the mother. Since Austin already provided a detailed description of the voice of the commander (another game character), the interviewer explored this aspect of his experience further and asked the participant to clarify when he heard the singing in the game.

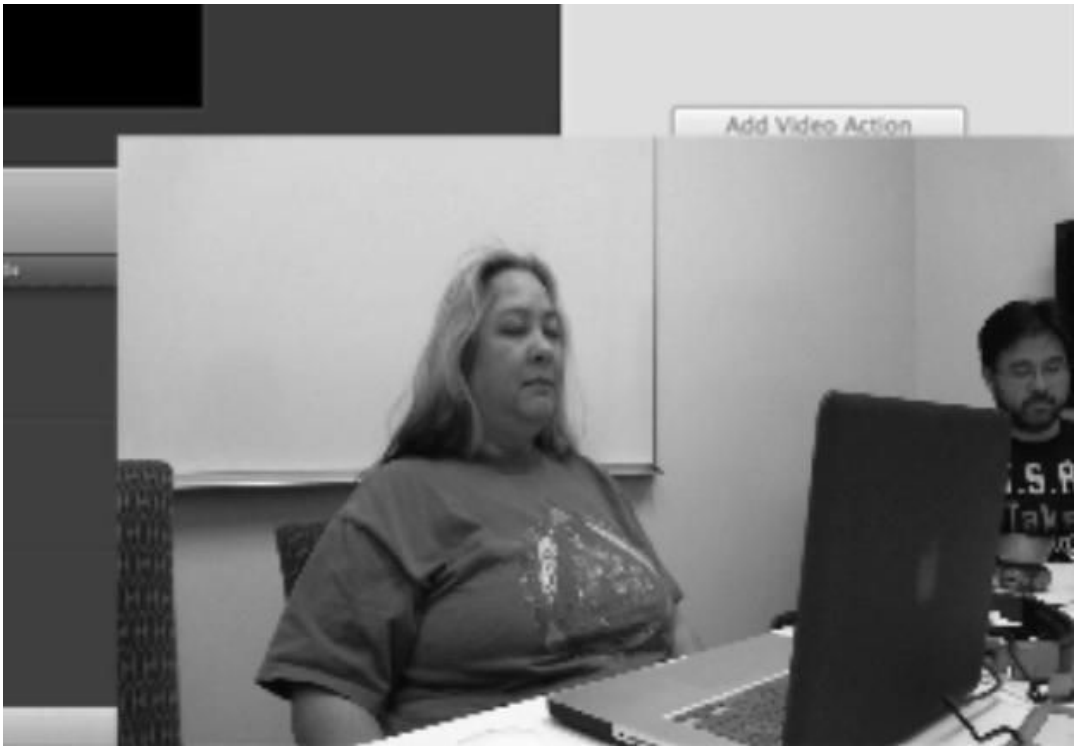
As participants reviewed recordings of their gameplay and spoke aloud about aspects of sound in the game during the interview, ScreenFlow™ enabled the interviewer to work with participants, such as Austin, in order to move through gameplay video in order to locate specific examples of sound. The interviewer's decision to identify, clarify, and follow-up on Austin's discussion thread is an example of bridling during the interview and allowing the interviewer's assumptions to guide the interview. The interviewer occasionally interrupted Austin as he spoke to ask clarifying questions about his experience, so as to clearly interpret the data. In order to do that, the interviewer would ask clarifying questions such as, "So when you're talking about…[the phenomenon]…I just wanna be clear…You're talking about [an aspect of the phenomenon]…Is that correct?" As Austin continues to watch his gameplay, the interviewer prompted him with questions such as, "What's going through your mind at this point?" In these examples with Austin, a think-aloud technique was applied in which the gameplay video was used to offer a point of reference for Austin to first recall a specific aspect of play and then to talk through his thoughts about his gameplay. Playing the clip and asking him to vocalize his thoughts thus enabled the researchers to make an important connection about how Hush® used sound to reflect the characters.

As with Austin and Sarah, participants made connections between things they heard in different parts of the game. The scrubbing tool to move back and forth through the video in ScreenFlow™ facilitated the process of finding phenomenologically relevant sections of video, which made it possible for participants to think-aloud and explain their thoughts about sound in the game. Using these structural and technical tools, we then incorporated phenomenological prompts and subsequently bridled researcher assumptions about the topic to deepen what could be learned about the phenomenon of sound from these participants' experiences.

Supporting Analysis and Verification

After each 60 to 120 minute interview, the interviewer wrote a research journal entry and studied the transcription and video from the session, making notes of critical points to emphasize in later analysis or to clarify or seek elaboration in a subsequent interview. The timeline view of the video (see Figure 7) made moving through the video convenient when we reviewed the transcript to see what the participant was referring to as they spoke. This review strategy enabled us to shape the format of the second and third interviews based on preliminary findings and to more readily locate

Figure 13
Donna Meditates at the Beginning of an Interview Session.



instances where participants described similar experiences of sound.

For example, in the post-interview analysis of Sarah's first session data, the interviewer revisited a moment she described seeing animated characters in FOTW move their lips but without making sound (see Figure 6).

> SARAH: This guy, yeah. See, how you can see the lips moving.
> INTERVIEWER: Yeah.
> SARAH: And no sound coming from the guy…I thought that maybe there was some kind of bug or maybe something was wrong or…You know…But, maybe it was, I don't know.
> [Video playback continues as Sarah and INTERVIEWER are talking. Sarah and INTERVIEWER both see another animated character move his lips.]
> INTERVIEWER: Ah, same with this dude.
> SARAH: Yeah….This guy is talking to me but I can't hear anything.
> INTERVIEWER: Mhm, okay, and you would have, you would have preferred that even though you don't generally like these backstory kinds of things? [Sarah previously expressed disinterest in the backstory in FOTW]
> SARAH: Yeah, but I mean at the same time, it did make me for a second wonder if I needed to turn up my volume or…something.

Figure 6 captures the moment in the post-play interview when Sarah literally points out the muted animated character on the screen in the original gameplay recording. During the analysis this reminded us of another place in the game with a similar animated character and muted sound—a fact that the interviewer did not remember when Sarah originally described her experience. During the second session, the interviewer used ScreenFlow™'s timeline feature to scrub back to the other game location to confirm the occurrence with her, explore an aspect of Sarah's experience of sound in games more fully, and highlight this dialogue as an important meaning unit in the analysis of data for this game.

We also used ScreenFlow™ in order to directly verify methods. For example, before each interview session, the interviewer engaged in a brief meditation with each participant (Moustakas, 1994) in order to bracket thoughts from activities prior to the session and to provide the participant a moment of silence. One participant verbally remarked that this experience was helpful in transitioning from driving through traffic to the interview. Easily replaying video enabled verification that each participant engaged in silent meditation, a critical step of the interview methods (see Figure 13).

Discussion

The digital technologies used in this phenomenological study of sound in games enabled the researchers to design an interview protocol that gave people time to play a game and listen to sound and then to review and describe what they heard. Each of the games presented players with a chance to become immersed in the experience of play. In order for participants to accurately describe their experiences of sound, they had to (a) play the game, (b) recall their experiences with sound, and (c) discriminate the ways in which sound impacted their play. This study used ScreenFlow™ to capture in-depth interview data in addition to gameplay video and video of facial expression and gestures.

A variety of interview strategies, including the use of think-aloud and stimulated recall processes, were used with a bridling strategy to manage interview prompts to create an interview dialogue, as participants viewed video of their gameplay. We used the software to connect their gestures and expressions to their verbal descriptions once the interview was completed. The ability to capture multiple types of data was critical to building the robust data set that was eventually analyzed using phenomenological methods to derive "essential meanings" that describe participant experiences of sound. The ability to simultaneously record multiple sources of data with one application made it possible to consolidate the recording of the participant's body with the participant's gameplay.

The additional ability of the software to simultaneously record the interview while also playing back previously recorded clips from the same project enabled people to watch their gameplay while continuing to be recorded during the interview. We used this comprehensive audiovisual record of the interview to shape subsequent interviews with the same participant, clarify assumptions, and verify activities during the interview. In turn, this allowed each participant interview to contain a "recording within a recording" of the interview session. As researchers, we were then able to easily parse and code this nested interview data for later analysis.

ScreenFlow™'s flexible audiovisual features, combined with the mobile digital recording lab, creates a computer-aided research system that is directly beneficial to qualitative researchers who rely heavily on participant descriptions or on observations of participant behaviors and interactions with technology. The digital research techniques described in this article contribute to the discourse on computer-aided research methods.

Phenomenological investigations require that participants expose otherwise internal dialogues and ways of thinking about complex and sometimes subtle phenomena. In researching experiences of gameplay, including a think-aloud component in the research process helped lend much needed structure to the phenomenological interview, particularly when combined with techniques like video-based stimulated recall. Stimulated recall techniques using video capture of computer gameplay as well as of dialogue and facial expressions can serve to remind gameplayers of salient moments in their play experience that may have been forgotten by the end of gameplay. Furthermore, think-aloud techniques in which participant viewing of recorded gameplay can be integrated during the interview session to provide insight into play experiences following periods of uninterrupted play. This same technique could also be readily applied in other studies in which it is important to elucidate participant cognitive processes or affective states, such as studying student experiences of engagement or teacher experiences of engaging students. Such a technique can simultaneously a) provide participants with ability to immerse into the experience prior to b) explaining what they were thinking during their experience and c) opening opportunities for the researcher to explore a facet of experience using

conventional in-depth phenomenological interview approaches.

There are multiple ways to use this technology in phenomenology studies that seek to understand phenomena by studying lived experience. For example, phenomenology studies of game experience in general, not just game sound, can benefit from studies in which participants first play and then immediately reflect upon their play through watching their gameplay recordings as done in this study. For example, in Mallon and Webb's (2006) game research, they could have used technologies such as ScreenFlow™ (or FRAPS® for PC environments) to record participant gameplay of the games studied. These recordings could have then been incorporated into the subsequent group discussions to help clarify points or to prompt participants to reflect upon certain aspects of play. Similarly, educational technology investigations, such as Cilesiz's (2009) study on adolescent use of Internet cafes, might benefit by incorporating real-time screen recording of adolescent computer use, using a think-aloud approach to prompt participants to talk the researcher through specifics of their experience using video examples.

Digital interview techniques, especially screen recording, playback and think-aloud protocols, can benefit non-phenomenological studies involving technology as well. For example, Kiili, Laurinen, Marttunen, and Leu (2012) recorded the screen activities and interactive dyad discussions as one video, much like we have described, which supported the researcher's analysis of students' online reading practices, strategies, and reading patterns. Playback with the students might have enabled member checking of analysis and results. In Veletsianos' (2009) study of virtual character expressiveness on learning and agent-learner interactions, the researcher examined different types of virtual pedagogical agents and asked participants to complete a pre and post-test activity, in addition to an open-ended interview protocol. Digital recording of participants viewing pedagogical agents could have been played for participants to deepen descriptions of their experiences during the open-ended interview protocol.

Limitations and Future Research

Certainly much can be learned from analysis of non-verbal interview data, and these types of screen recording technologies will become more sophisticated over time. The resource demands for fast, large-capacity hard drives, fast computer processors and recording redundancy may make our approach to in-depth phenomenological inquiry a challenge. However, the use of screen-recording technology ensured collection of a rich data set and, by doing so, provided a rich context through which to situate participant experiences of the phenomenon being studied.

There are risks inherent in using digital technologies in the interview process. The most obvious risk is data loss, particularly given the complexity of the technology system and the use of multiple sources to record media in this study. However, data redundancy in the design of this technology system with two separate computer systems and external, redundant data storage reduces this risk. Although this redundancy seems cumbersome, it was essential in retaining valuable interview data when ScreenFlow™ failed once to store any data on the computer in our study. Thus, the risk of data loss in this study was mitigated. However, this technology redundancy resulted in increased research technology costs.

Researchers must also comply with Institutional Review Board requirements in order to provide a detailed, secure process for storing all digital audio and video recordings. In this study, all participant data had to be encrypted or stored on password-protected devices. In addition, consent procedures allowed all participants to opt-in to allow recordings to be used for research purposes, as used in this manuscript. These risks were manageable compared with the benefits from being able to conduct in-depth, detailed phenomenological interviews.

The use of screen recording technologies enables phenomenology researchers a critical tool by which they can capture subtle data during the interview process. In research topics that involve computer-based systems, the screen recording technologies described in this article expand research capabilities for capturing and analyzing participant facial expressions or gestures as they use computer software. As a result, future research can use these systems in order to connect a) what people say and b) to how they express what they say c) to the choices they make while using software. These

affordances become critically useful for fields like game studies that might rely upon collecting data from participant gameplay. Likewise, educational technology researchers who seek to conduct qualitative studies of technology adoption might well benefit from the ability to record audiovisual data of technology use in addition to the "thinking aloud" choices that people make as they use educational software. Most important, the layered, multimedia data system, when used to capture participant expressions, encourage stimulated recall, guide think-aloud processes, and verify methods, supports future researchers in illuminating the lived experience of even more transitory and subtle phenomenon.

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