Participants*

Luis (mid-30s, born blind) loves sailing, lives on a sailboat, and fluent with technology.

Ray (mid-30s, nearly born blind) became totally blind at age of three. He is a martial arts instructor and a counselor for people with blindness.

Meg (early-20s, born blind) is a recent graduate from university and living with a lovely guide dog.

Carol (late-60s, born blind) worked as a typist and in data entry for more than 20 years. She enjoys talking with her siblings (whom are also living with blindness) over the phone.

Table 1: Short background description of participants.

* We have used pseudonyms for all participant names.

Understanding How Audio Mediates Experiences of Reminiscence for People Living with Blindness

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Abstract
There has been a growing attention in design and HCI on how technology could be designed to support experiences of reminiscence on past life experiences. Yet, this research has largely overlooked people living with blindness. We present preliminary findings from an ongoing field study with 9 participants living with blindness to understand their experiences of reminiscence. We specifically report on the role of audio recordings as key materials our participants drew on to mediate their experiences of reminiscence. Findings are interpreted to explore opportunities for audio-based interactive technology to better support their practices of capturing, storing and reflecting on the past.

Author Keywords
People with Blindness; Interaction Design; Audio.

CSS Concepts
Human-centered computing~Human computer interaction (HCI); User studies.

Introduction and Background
Material possessions play important roles in mediating people's experiences of reminiscing on past life experiences and reflecting on the future [2]. As technologies have become widely adopted, people's practices have extended due in part to growing

Carl (mid-60s, gone blind) was a video camera operator (for films) and loves photography. He lost his sight 15 years ago, yet he still works as a passionate photographer.

Jessie (late-20s, born blind) loves music and is training to become a music therapist.

Janet (late-60s, born blind) worked as a special education instructor for visually impaired people for many years.

Frank (early-70s, born blind) is **Carol**'s blind sibling who always liked the sound of boats and cars. He enjoys going on boat trips and listening to audio books.

Rob (early-60s, gone blind) became totally blind in his 30s. He is a technology counselor for people with blindness; and, he loves technology and traveling.

Table 1 (cont'd): Short background description of participants.

amounts of personal data archives [8,13,17]. There are calls in the HCI community to develop alternative approaches that enable people to interact with their personal data in reflective ways (e.g., [5,9]). Research has highlighted the value of re-experiencing digital data from the past (e.g., emails, sounds, photos on social media) to support experiences of reminiscence [6,10,14,16]. Yet, this body of work has largely focused on fully abled populations. It is necessary to include more diverse populations. We aim to open up an area that has not received much attention to date: people who are living with blindness.

The majority of HCI research related to people living with blindness focuses on overcoming practical challenges, such as spatial navigation (e.g., [1]) and usability (e.g., [7]). Little research has explored how technologies could be designed to enrich other important aspects of blind people's lives, such as experiences of reminiscence. In our view, supporting such technologically mediated experiences for people living with blindness requires their participation. This commitment is reflected in work by Bennett et al. [4]—beyond engaging people with blindness by "practicing empathy", it is essential to engage this population through direct participation in design. Relatedly, Lefeuvre et al. [12] argue that a *solution* that is "developed with sight in mind" can often be a "burden to use." These authors foreground the critical need to consider the *capabilities of* people living with vision impairment in the design of new technology.

Our research takes a modest step toward contributing to this intersection through an ongoing field study with people living with blindness. Our work aims to investigate how they draw on their digital possessions to mediate their experiences of reminiscence in their own unique ways; and, how findings can inspire new designs that support their practices of reminiscence.

Methodology

A total of 9 blind participants were interviewed (see Table 1). We conducted semi-structured interviews in participants' homes, lasting between 100-180 minutes. Interview questions aimed to develop an understanding of each participant's orientations toward their cherished material and digital possessions which represent their self or past life experiences. Our research goal is to develop a baseline for understanding opportunities that can inform the formulation of future participatory workshops. During the interviews, participants gave us a tour of where these artifacts were kept in the home, followed by a tour of participants' digital possessions. We asked them to describe their valued digital possessions. We explored their strategies for keeping these things and how they triggered reflective experiences. 17 hours of interviews were recorded and transcribed. Data were organized into themes in weekly meetings. Meetings were also held with researchers outside of the project to challenge our assumptions and corroborate themes in the data. The same participants will be revisited for future participatory design sessions to co-create new technology concepts that could support their practices. Next, we present one major theme from our ongoing research.

Findings

Participants kept various cherished possessions that connected to past memories. Participants also had diverse collections of digital possessions, such as audio, video, electronic journals, and digitalized letters, which

Figure 1: Participants' recording devices. **Frank**'s audio book reader with radio and GPS (Top), **Carl**'s digital audio recorder (Middle) and **Meg**'s smartphone (Bottom).

were kept on personal devices, in social media, and across cloud storage platforms.

Across all participants, we found that audio files emerged as the primary type of digital possession that they cherished and revisited. In this paper, we focus on this specific theme from our ongoing research. Participants frequently created and interacted with audio files to capture and revisit life moments. For example, **Ray** mentions that "the voice recording software [on smartphones]" enables him to "have the same luxury" of "[keeping] the memories alive" as a blind person. **Luis** noted that "audio recordings [for people with blindness] are like photographs for [people with sight]", which "serves like a reminder" for memories as the recordings are played.

Many participants described a tradition of making audio recordings prior to the existence of smartphones and digital recorders. **Ray** decided to "carry a tape-recorder" to capture memories over the years. **Carol** kept and re-listened to analog cassette tapes that she had captured memories and ambient audio on from over a decade ago. **Janet** also described her practice of re-listening to audio recordings; occasionally she still "[takes] them out of the drawer and [listens]" to the recordings of her wedding from 45 years ago. It became clear that the type of audio that participants captured and revisited could be placed in two categories: *ambient* and *focused*.

Ambient Sound

Recordings of ambient sound were often used by participants to capture the emotional feeling and atmospheric timbre of an experience as a whole. **Frank** described going on boat trips and making many recordings that capture a diversity of sounds on tour. He "replays [the recordings] over and over, just like a sighted person can look at a picture and get the feeling of it". **Janet** described a similar practice of recording ambient sounds on her travels. She remembers and revisits the past through "[ambient] sound, as opposed to visual things". **Ray** wears 'video glasses' that, when activated, record the audio of anywhere he goes. When **Ray** is fighting in a martial arts tournament, he sets the video glasses aside and records the sound to "remember what happened during the tournament." It became clear that *ambient sound* recordings support participants' practices of actively reconstructing memories of scenes, events, and experiences. Our participants noted that ambient sound recordings were more "multi-directional" and could trigger a diversity of memories and associations to emerge depending on the tonal qualities they focused on when listening to them.

Focused Sound

In addition to documenting the atmospheric qualities of a physical environment, participants also captured *focused sounds* to commemorate a close social relationship. **Meg** described the focused sounds she captured of her beloved, now departed, guide dog snoring. She revisits "listening to it when [she] miss her [guide dog]". **Janet** shared her experience when a voice triggers strong reminiscence of her now departed brother. In reflecting on listening to her brother's voice on a digital video she possesses, she says the voice "really helped [her] remember him when [**Janet**] heard his voice." Similarly, **Carl** shared his perspective in remembering memories through sound. He points out that the auditory process of evoking feelings is different in comparison to the visual, and that a voice plays an important role in the process for blind people. **Carl** described how his devices' screen reader's "synthesized"

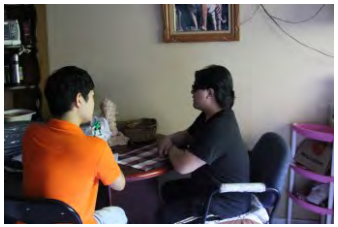

Figure 2: Field study interviews with participants **. Most interviews took place at or around each respective participant's home.

** We have consent from participants to use photo images in the public dissemination without distortion.

voice never resonates well to elicit the associated memory. In contrast, he described how human voice, especially one's inner voice or a loved one's voice, can richly mediate reflective experiences.

Conclusions and Future Work

We have described findings from an ongoing field study focused on how blind people draw on audio recordings to mediate their practices of reminiscence. Participants desired to interact with audio that captured the ambient, atmospheric qualities of the environment an experience unfolded in. We found that revisiting *ambient audio* could trigger a range of reflections as participants actively reconstructed memories from the trail of background noise, vocal murmurs, and the environment's timbre. Participants captured *focused audio*, such as the unique tonal qualities produced by a person's voice or other remarkable sounds (e.g., **Meg**'s case of guide dog snoring). These practices are inventive and could be better supported by technology.

There is an opportunity to design systems that could enable participants to have a centralized digital repository where audio recordings could be stored and re-visited. This could enable recordings to be combined with other forms of metadata to create more socially or environmentally-oriented ways of interacting with audio archives. For example, location history data could be integrated with audio to allow people to explore *ambient sound* recordings that were captured around the same geographical area, but across different times in one's life. By combining this design direction with explorations into forms, controls, and interactivity uniquely designed for and with people living with blindness, new audio technologies could be created that are better reflective their values and desires.

There is also an opportunity to explore how interactions with *focused sound* could be better supported. For example, recent advances in voice assistant technologies make it possible to increasingly personalize their tone, timbre, and vocal qualities [11,15]. It is interesting to consider the extent to which it would be possible to train and develop 'voice modules' based on pre-existing recordings of loved one's voices and apply them to other forms of data. In response to **Carl**'s statement on the lack of resonance his screen reader's voice has, could it be possible to replace it with a voice seemingly similar to a loved one? Or, the voice agent of a loved one read back a cherished book in audio form? Or a letter or email written from the past? Clearly this design direction would need to be approached with care and critical consideration of how authentic such representations could be and if this is a future that people living with blindness would design.

Previous works have shown how important it is to include the people who are designed for in the process of designing future things [3,12]. In our future work, we plan to develop design workshops to probe on the opportunity areas in direct collaboration with our participants. Our longer-term goal is to develop a series of design exemplars that enable people living with blindness to better draw on their personal data as resources for reflecting on the past based on their own unique capabilities, desires and practices.

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