Revisiting the Visit: Understanding How Technology Can Shape the Museum Visit

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ABSTRACT

This paper reports findings from a study of how a guidebook was used by pairs of visitors touring a historic house. We describe how the guidebook was incorporated into their visit in four ways: shared listening, independent use, following one another, and checking in on each other. We discuss how individual and groupware features were adopted in support of different visiting experiences, and illustrate how that adoption was influenced by social relationships, the nature of the current visit, and any museum visiting strategies that the couples had. Finally, we describe how the guidebook facilitated awareness between couples, and how awareness of non-guidebook users (strangers) influenced use.

Keywords
Electronic guidebook, museum, visitor behavior

INTRODUCTION

The last few years have seen a new focus on the possibilities of individual and collaborative applications in homes and public spaces. This presents a new challenge for the field of Computer Supported Cooperative Work (CSCW), which is to understand the "work" on which individuals wish to coordinate, communicate and collaborate when they are away from the "workplace." It also presents a new opportunity for the field: to understand how issues that have influenced the field such as adoption and awareness "play out" among individuals seeking to engage in shared activities.

In this paper, we describe how a guidebook designed to promote a shared experience shapes people's interactions with each other in the context of their museum visit. The data is based on a study of the system in use by the general public that has not been previously reported. We found that participants reported using the technology for four different kinds of activity: shared listening, independent use, following each other, and checking in on their companion. Further, participants described their ability to adopt the technology for any of these activities as being influenced by the technology, their companion, the presence of other people, existing strategies for visiting museums, and the nature of the current visit. We describe how the technology was used to facilitate awareness, and how awareness shaped technology use. The paper begins with a discussion of guidebooks and collaboration, the guidebook we designed, and the study we conducted.

DESIGNING TECHNOLOGY FOR PUBLIC SETTINGS

Museums have employed portable electronic guidebooks for many years, going back at least as far as the late 1950s when Acoustiguide developed a tour of Eleanor Roosevelt's home using reel-to-reel tape players [3]. They continue to be the subject of research and development, with recent work typically focused on the use of portable computers (e.g., [1, 9]). In spite of this long history, electronic guidebooks still raise many design challenges.

One design challenge for audio-based guidebooks is the physical delivery of content. Use of open speakers is convenient but only suitable in settings where additional noise is not a problem, such as interactive and children's museums. In other settings, such as art museums, undue noise may be disruptive, so audio content is usually delivered through earphones. However, the use of earphones brings another feature of the museum visit into relief: the presence of companions. With many headsets, companions can be seen but not easily heard; as a result, audio guidebooks can isolate visitors from their companions [20].

Since museum visits are frequently social in nature [18, 23], it is not enough to design a usable and useful system for individual visitors. The design challenge becomes, in part, a question of understanding what visitors want to share when they visit museums. While research has begun to explore this space (e.g., [11, 18, 23]), questions of what visitors do together in museums remain. Naturally, these questions also raise the issue of how best to facilitate and support sharing between visitors.

Our system, *Sotto Voce,* is a guidebook designed to support

social interaction between visitors and their companions. The project has been through three design-evaluation iterations. The first evaluation established that visitors, without prompting, integrated audio clips played through open air into their interactions [26]. Based on these findings, we designed a mechanism that enabled visitors wearing headphones to be able to share audio content in a similar (but not identical) way. We evaluated this mechanism, which we call *eavesdropping*, in a second study [4]. This led to the third study — the subject of this paper. In the first two studies we invited people to try the technology in a historic home setting during a closed day when they were alone in the house. While this provided us with rich insights, the purpose of the third study was to see how the technology fared under "real" museum conditions.

Some of the issues involved in designing a shared-listening system can be illustrated by considering them in relation to the extensive work on media spaces [8]. Media spaces help people to coordinate by providing them with media channels that promote awareness and communication. Many media spaces have both audio and video components, although some studies argue that audio-only media spaces can be both usable and useful [22]. Indeed, Thunderwire [2] and Voice Loops [24] are two examples of audio-only systems that provide support for activity coordination.

Sotto Voce can be described as a content-centered audio media space, one that allows two visitors to coordinate their playing of audio descriptions. Like Thunderwire and Voice Loops, *Sotto Voce* relies on the use of audio to promote awareness and a shared experience. Indeed, we report findings that some people used the sounds they heard through *Sotto Voce* for awareness, much like the reports that Thunderwire users knew that people were working when they heard typing. However, unlike Thunderwire and Voice Loops, *Sotto Voce* does not provide a mechanism for talking through the system. Rather, it provides shared context through technological sharing of content, with the intent of facilitating interaction in the "open air channel." This is made possible by the fact that visitors are not usually as far apart as the users of Thunderwire or Voice Loops. More precisely, the visitors are not tethered to fixed, widely-separated locations such as desks or consoles. Instead, *Sotto Voce* users have a high degree of local mobility [6], a freedom to explore and move around the museum space while remaining relatively co-located.

Sotto Voce is also a mobile technology. Mobility and the collaborative use of mobile technologies have also been a focus of recent CSCW interest (see for example, [6, 13, 17, 21, 25]). However, *Sotto Voce* differs from these in two ways. First, *Sotto Voce* is limited in use to a particular setting, the museum. Findings presented show that the setting shaped how the technology was adopted and used. Second, the length of interaction with the technology was much shorter—visitors typically used it for less than half an hour. The length of engagement with the technology influenced how it was designed by requiring us to make the technology as intuitive as possible to adopt.

Additional issues arise when the system is compared to other collaborative technologies for public settings. For example, Benford et al. [7] have designed a number of technologies to support Inhabited TV, a blending of broadcast television with Collaborative Virtual Environments (CVEs). In one of their experiments ("The Mirror"), the television show was displayed directly in the CVE with the intent of stimulating participant interaction. Our study findings are analogous in that they show that shared guidebook content did create interaction between the visitors. (Of course, the museum interactions were considerably enriched by additional resources such as the visitors' control over their content playback and the objects themselves – including those without descriptive content [4].)

One other feature of Inhabited TV has a salience for *Sotto Voce*. In their discussion of challenges for Inhabited TV, they observe that in their first experiment, a public poetry performance, the poetry reading was masked by the sound of audience members talking loudly among themselves. In the immersive CVE, social conventions about the relationship between an audience and a performer were lost. In contrast, our findings show that conventions were not ignored by participants when they used *Sotto Voce*; further these conventions influenced how they adopted the technology. These conventions came from the presence and potential presence of strangers as well as the study participants' own strategies for visiting museums. That is, visitors plainly remain part of a larger social context as well as their own within-group social context.

Electronic guidebooks offer the opportunity to explore a number of research challenges in computer science, and as such, a number of research projects have been carried out. Many of these have focused on exploiting sensing and location awareness technologies, to explore ubiquitous computing concerns (see, e.g., [1, 9]). *Sotto Voce* differs from these, and other commercial efforts, in its focus on supporting interaction among visitors.

THE SYSTEM: *SOTTO VOCE*
The design of *Sotto Voce* was primarily motivated by the collaborative and communicative needs of visitors. Through the visitor studies literature, our own observations of museum visitors, and our experience with a previous electronic guidebook, we knew that many visitors wish to be able to listen to descriptive information together and share their reactions [26]. However, at the same time, visitors generally want control over their experience. Consequently, the design strikes a balance between these (as well as other) concerns.

In the rest of this section, we describe our system prototype, focusing on the features that are relevant for this paper. The system and its design rationale are presented in more detail elsewhere [4].

Guidebook User Interface
Sotto Voce is implemented on a handheld computer with a color touchscreen display – the current prototype uses the Compaq iPAQ™ 3650. Each visitor obtains information about the objects in a room through a visual interface based
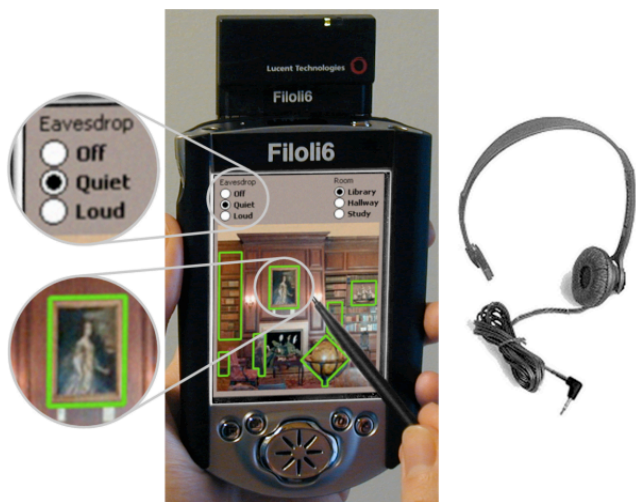
Figure 1. Electronic guidebook and headset.

on imagemaps. The interface shows one complete wall in a given room (Figure 1, center); visitors rotate through the four walls of each room using a hardware navigation button and switch rooms using software radio buttons. To play an audio description of a given object, the visitor taps the object in the imagemap. Targets are not continuously highlighted, and not all of the objects have audio descriptions associated with them; when a tap fails to hit a target, the guidebook briefly highlights all of the available targets (Figure 1, lower left), a technique we call *tap tips* [5].

Eavesdropping

Sotto Voce supports synchronized sharing of descriptive audio content between pairs of visitors. The audio content is presented through headsets to reduce the impact on others in the environment. Since our goal is to enhance co-present interaction, the system does not support audio communication between the paired visitors themselves.

From a given visitor's perspective, eavesdropping works as follows. If visitor A selects an object in the guidebook, he or she always hears the associated audio clip. If A is not playing a clip, but visitor B is, then A's device plays B's audio clip. Put more simply, clips are never mixed and A's selections always have priority on A's device. This implies that if A decides to play a clip by tapping on an object, A's device stops playing any eavesdropped audio and plays A's clip as requested. It also implies that if both A and B are listening to their own selections and A's clip ends, then A will begin to hear exactly what B is hearing – A will hear the remainder of B's clip and not the clip in its entirety.

Each visitor can control the volume of eavesdropped clips relative to the volume of personally-selected clips using software radio buttons (Figure 1, upper left). The eavesdropping volume can be set to "Loud" (same volume for both), "Quiet" (reduced volume for eavesdropping), or "Off" (no eavesdropping audio).

Audio playback is synchronized using an IEEE 802.11b wireless local-area network. Since the audio content on each device is identical, the devices simply send and receive control messages ("start playing clip 4," "stop

playing clip 12"). Synchronization enables a visitor to place a companion's reactions (talk, laughter, gestures, etc.) in an appropriate interactional context.

Audio Content

Fifty-one objects in three rooms have audio descriptions. The length and structure of the audio descriptions are specifically designed to provide frequent and natural opportunities for visitors to take conversational turns [26].

Visitors wear modified telephone headsets with a single, over-ear earphone (Figure 1, right). We chose this configuration to maximize ease of use, extended-wear comfort, and the ability to converse with companions while minimizing sound leakage [14]. To distinguish between personally-selected and eavesdropped audio, we apply a small amount of reverberation to the eavesdropped audio content and support different relative volume levels (the default setting, "Quiet," was generally used by visitors).

METHOD AND PARTICIPANTS

We studied our device in use at Filoli, a Georgian Revival historic house located in Woodside, California (http://www.filoli.org/). With the permission of the management, we took our technology to the house on four consecutive "open days." In the remainder of this section we describe how we recruited people, the methods we used, and our subsequent data analysis.

Recruiting

We advertised our study using signs located at the visitor center and inside the house. We knew none of the potential participants prior to meeting them at the house. Moreover, potential participants were unaware of the study and the technology prior to visiting Filoli. Inside the house, visitors were approached by a "recruiter" who was positioned outside the first room described by the guidebook. The recruiter waited for pairs of visitors to approach the room and then decided whether to ask them to participate. Our decision to ask visitors to participate was based on several factors including whether they seemed to have time for the study (i.e., those not rushing through the house), and whether they had any visible physical impairments that would have made using a handheld difficult (such as a cane which required one of their hands). Over the course of the four days, we recruited 47 people (one group of four, one group of three, and 20 groups of two) to use the guidebook. This recruitment represents about a 40% success rate (that is, about 60% of the people approached declined our offer).

As an incentive to participate in this study, we offered people the use of the technology. (Visitors to Filoli receive a free paper guidebook, but no audio guide is currently available.) In addition, we sometimes explained to visitors that they would be able to see a part of the house that was off-limits to the general public. The latter often served as the initial hook, although after using the technology, many visitors seemed equally as enthusiastic about the guidebook as the opportunity to see a "private" space in Filoli.

Methods

Once recruited to the study, participants signed a consent

form and filled out a short questionnaire on basic demographic information and their museum and technological experience. The recruiter then introduced the visitors to the interviewer. The interviewer gave the visitors a guidebook, a headset, and a microphone (which we used to record their conversations during their use of the guidebook and afterwards in the interview). The interviewer then gave a brief tutorial (approximately two to three minutes) on how to use the guidebook including the eavesdropping feature.

After the tutorial we asked the visitors to resume their visit to Filoli and to find us when they had completed the three rooms contained in the guidebook (in the sense that they returned to their initial activity, this study is similar to that conducted by Cheverst et al. [9]). During their exploration of two of the three rooms, we used video cameras to record their interactions with each other, the guidebook, and (on some occasions) with other visitors and pairs of guidebook users. We also used the guidebooks as logging devices; each tap and press the user made was recorded by the guidebook. Visitors typically took 15 to 20 minutes to complete their visit.

After the visitors finished touring the specified rooms, the interviewer invited the visitors to enter the private part of the house for an interview that lasted between 10 and 30 minutes. The interview covered a number of topics, using a semi-structured interviewing protocol. In addition to asking about their experience with the guidebook in general and the eavesdropping feature specifically, we also encouraged the couples to tell us about their typical museum experience including their current visit to Filoli. By asking about their current visit, both with and without the guidebook, we were able to establish whether they were regular museum goers, and sometimes whether they had a particular "method" for touring. Being in the middle of a tour, visitors often had fresh experiences to discuss and a ready baseline for reflecting on their own behavior.

Analysis
We used several techniques to gather and analyze the data from this study. In this paper, we focus on findings from the interview data. The interviews were designed to optimize the ability of the participants to tell us what they thought of the guidebook and how it affected their experience. As such, the interviews relied on a semi-structured interview guide. In addition to focusing on eliciting answers to specific questions, the interviews were intended to draw out the thoughts and impressions of the users' experience with the guidebook.

Participants
In the previous section, we described how we recruited the participants for this study. In this section, we discuss some of the demographics of the participants.

Participants were asked to select an approximate age by checking an appropriate age range. Although historic houses are thought to attract older visitors, 53% were under 50; in fact, 21% were under 30. The other 47% ranged in age from 50 to over 70.

It was not just the participants' ages that varied. They also had a variety of different backgrounds, careers, and relationships with their companions. Most participants came from California and nearly all were residents of the United States, but two were visiting from England. Their occupations also varied. Participants included a flight attendant, an architect, a student, a meteorologist and a housewife. Some of the pairs were friends, others were family, and some were short-term acquaintances. Of the 47 participants, 13 were men; one man used the guidebook alone.

For the rest of this study we will refer to visitor pairs by an assigned number. P1 represents a pair of visitors. P11-12 refers to a group of three. P11 is a pair of visitors that shared eavesdropping guidebooks, while P12 used a guidebook by himself. P23-24 refers to a group of four, who used the guidebooks in two pairs but toured together as a group of four.

REVISITING "THE VISIT"
The data we collected from the interviews supports vom Lehn et al.'s assertion that museum visits contain many rich practices [23]. In our study, visitors integrated the guidebook and its functions into their activities. The guidebook both shaped the visitors' activities by providing various information and features, and made it possible for the visitors to appropriate its functionality in the pursuit of these activities.

In this section we describe four activities in which visitors engaged while using the guidebook: shared listening, independent use, following, and checking in. In many cases, the visitors used the guidebook for more than one of these activities, although their interview comments often focused on the activities that seemed most salient to them (typically what they perceived as their dominant activities, which should not be interpreted as the entirety of their activities). In addition to describing these activities, we highlight how social features of the paired companions and of the public, historic home setting influenced visitors' guidebook use.

Shared Listening
Sotto Voce is designed to facilitate interaction among companions. One of the primary ways it achieves this is by allowing paired companions to listen to the other's guidebook as well as their own by using the eavesdropping feature. We call this activity *shared listening*. Characteristically, shared listening occurs when a pair has their devices set to eavesdropping; states of shared listening could last a relatively long time —some couples reported listening to each other for the entire visit— or just a few minutes. (We will describe shorter periods of listening-in, and unidirectional listening in later sections).

Previous studies of our guidebook have shown that shared listening can facilitate conversations. The guidebook enables shared listeners to engage in mutual conversation by giving them activity cues – information about what and when to talk to their companion [4, 26]. This study reinforces these previous findings and extends our understanding of visitors' social motivations to engage in

shared listening activity. For example, P13 described shared listening as "the best" and volunteered that they never turned the eavesdropping off. They described two reasons for engaging in shared listening: a desire to learn about their companion's interests and to enrich their conversations. The desire to learn about their companion's interest stemmed from the fact that one person was familiar with the house, while the other was new to it. The new person listened to what the familiar person selected, while the familiar person found it interesting to discover to what objects the new person was attracted.

Visitors were aware of how the guidebook's information enriched their conversations. As one pair described "we were more selective about our conversation. It was more about objects, paintings, and furniture, rather than 'wouldn't you like to entertain in that room?'" A similar experience was reported by P3 who felt they had more in-depth interactions in the rooms with the guidebook because the guidebook content gave them more to talk about.

Shared listening also had the effect of bringing paired visitors closer together socially. For example, P9 experimented with shared listening and described a feeling of togetherness expressed in the following quote: "that's what I liked about it, to be– to, to know that we're listening to the same thing but not have it, you know, everybody in the whole room, so that was really fun." For this couple, *Sotto Voce* reinforced their social bond by giving them a shared secret, one that simultaneously bought them closer together and distinguished them as a group apart from all other visitors.

While observational data was useful in determining when the eavesdropping was facilitating visitor interaction, the interviews have been particularly helpful in understanding the cases where it did not. Visitors proved to be quite articulate in their expression of the relevant factors. In the remainder of this subsection, we provide some illustrative examples.

While paired visitors who engaged in shared listening may have felt distinguished from their fellow museum-goers, they did not lose an awareness of others in the public setting. Specifically, some couples who engaged in shared listening described not talking because of the presence of other visitors (as observed by [23] also). As P13 explained, "We talked a little bit, of course, when we were the only ones in the room, but if there had been other people in the room we would have been quiet."

Other couples who engaged in shared listening activity expressed a motivation to do so because it matched their usual way of visiting a museum together. For one husband and wife pair, P24, using the eavesdropping mode seemed to fit their natural practice. As the husband described, "We sort of have a ten foot rope, an invisible rope attached to the two of us, so the eavesdropping was perfect." And as his wife went on to explain, their museum visiting practice is also influenced by the presence of other people in the room: "We try not to talk at...well because we don't want to be distracting to other people, we do use a little bit of sign language, hand signals."

Sensitivity to others in the room was not the only factor motivating couples to minimize their talk. P19 also self-reported a desire to minimize talking while using the guidebooks, because of the guidebook's audio. They both reported sometimes prioritizing the guidebook's audio over talking which supports an earlier finding that whether or not visitors were engaged in shared listening activity, their talk was organized around their listening activity with the guidebook's audio descriptions [26].

In fact, some visitors expressed a feeling of becoming absorbed into the listening activity. As P19 described "I wasn't asking her too much, I was trying to push my buttons as fast as possible ... I was focusing on getting the little stories out." Couples cited their reasons for becoming so activity focused on external time constraints for their visit as well as a curiosity about the guidebook's informative descriptions. On reflecting on her activities with the guidebook and her companion, one member of P19 characterized her physical activity as "go and then come" in the sense that she spent time examining objects alone and then returning and talking with her companion. This data corroborates prior findings about the activity contour of listening to an audio description where conversation both sets up for and reflects back on the listening to an audio description [26].

Independent Use
Several visitors reported switching off the eavesdropping feature either temporarily or entirely. Not all visitors come to a historic house to engage in social interaction, so it is not surprising that social factors (primarily, but not exclusively, among the paired visitors) heavily influenced the decision to adopt this mode of guidebook activity. Here, we give a few examples in which visitors articulated some of the factors relevant to their experience.

The degree of social closeness between the paired visitors impacted their decision to use the guidebooks independently. Predictably, we found cases where weak social links made shared activity less interesting. For example, two couples (P1 and P20) who were only acquaintances switched off the eavesdropping feature and reported leaving it off for almost their entire visit. One member of P1 recalled that partway through the first room, "that's when we said, 'let's turn this thing [eavesdropping] off.'" Turning off the eavesdropping seemed to fit their visiting mode which they described as "we were more or less going on our own." In the case of P20, one person continued to select objects from the guidebook, while the other stopped using the guidebook entirely, expressing a preference to "wander and be less structured."

Individual preferences and personal museum visiting practices influenced others to engage in independent guidebook use. Again, situations arose that made shared activity unlikely, because the visitors were predisposed to independent activity. For example, one member of P10 reported turning off the eavesdropping feature momentarily because she "just wanted to do it myself." P18, experienced museum visitors who knew each other well, turned off the eavesdropping feature, citing their

established museum visiting strategy as the cause. They described that while visiting a museum, "We don't really stick together much," and "he'll usually be five or six rooms ahead of me, or vice versa." To illustrate their independent visiting style further, they told us of a case where they had gotten lost in a cathedral because they were so far apart. This led to a revision in their strategy which involved determining in advance how easy it would be to get lost and factoring that in to determine how far apart they would allow themselves to get! Given their visiting needs, it is hardly surprising that the eavesdropping feature was perceived as bringing them too close together; as one put it "he was nipping at my heels ... I wanted to get back to my own program."

In at least one case, additional factors overrode both individual preferences and established museum visit practices. P11, part of a group of three (P11-12), elected to use the guidebook together because they felt that they talked when they visited museums. Moreover, they had the feeling that P12's museum visiting strategy was solo, saying, "He's always miles ahead of us." However, during the post-use interview, they reflected on their day's visit in general and decided that while they do often talk at museums, "We weren't really talking that much this morning." Here, the visitors' interactional practices that had been established that day predisposed them to continue with the same kind of visit. In other words, although their selection was based on their beliefs about how they normally visit museums, their guidebook use was predominantly shaped by their museum visiting mode on that particular day.

The fact that visitors engaged in independent guidebook use did not mean that they had entirely independent visits. That is, independent guidebook use did not preclude the visitors' conversational interaction. Couple P16 reported engaging in independent guidebook use for extended periods of time without it interfering with their ability to talk to each other during the visit. They described using several communicative strategies to accomplish this: instructing each other ("oh listen to this"), pointing out an object when they thought their companion might be listening, and waiting for the other to select a description so they could initiate a conversation upon its completion. In some cases, visitors' desire to interact overcame additional social factors as well as their lack of coordinated activity. For example, P2, a daughter and her mother's friend, self-reported turning off the eavesdropping feature for most of their visit. They partly explained this as due to the potential for embarrassment – one member compared her *current guidebook and headset* to "my little girl who's five has her CD [head]sets and when she wants to talk to us she starts yelling ... so I was afraid I would start talking really loud (laughs)." Yet, despite this, they continued to obtain information from the guidebook and reported some talking (e.g., "we were laughing about that one story, though.")

Following
Several couples reported having engaged in an activity where one person followed the other's activity by using the guidebook in eavesdropping mode. This was often characterized by one person dedicated to operating the guidebook, and the other person exclusively eavesdropping. The person "driving" the object selection on the guidebook the room was "followed" by the eavesdropping listener. Following focused on operating the guidebook, and should not be equated with the visitors' processes of selecting which objects they viewed during their museum experience. Although a number of couples reported similar following behaviors, they also described a variety of different technical and social options to achieve this type of visit experience.

P22, a mother-daughter couple, explained that the daughter turned the eavesdropping feature off while her mother left it on and used it to listen in. As the daughter said. "She had to eavesdrop on me, and I was controlling." Beyond their technical decision, P22 also made a social decision. The mother observed that her daughter would check to ensure that both parties had heard her selection. Based on these decisions, they self-reported having engaged in the following activity for "pretty much the whole way."

By contrast, other couples that described the following type of usage did not report any kind of technical decision to turn off one guidebook. For example, P7 explicitly reported leaving themselves connected, but also described a form of following behavior. In particular, one member of P7 reported that "she did the work. I did the listening. It was great." She later explained that "[My companion] did most of the functioning." They also self-reported having a very engaged visit. As one member put it "We like that you could be interconnected."

During the interview, the listener in P7 also offered a potential explanation of why she in particular liked the eavesdropping feature: "it works if you have somebody that's not as comfortable with [the guidebook technology] as the other person." Although expressed in general terms, this may have been her personal reason for following, since she also commented on her lack of technological experience at other times during the interview.

However, despite any lack of experience with technology P7 did report using the device in at least one way during the interview. She described using her own guidebook to switch walls. She explained that she did this so that "I saw, you know, on my screen as well as what she was doing."

The listener in P5, a father-son pair, also commented on his lack of technological inexperience to explain his following behavior. The adult son explained, "he directed mostly, I just listened." They did not describe how they had their guidebooks configured. Instead, they described their following behavior as coming from their initial adoption practices. Specifically, when asked why they selected this approach, they explained, "I was totally satisfied with what was going on," and "that's the way we first did it so we just continued to do it that way."

One other couple also described a form of following activity. Notably though, when one member of the couple changed the configuration of the other person's guidebook the following activity was disrupted and subsequently repaired. In this case, P15 a mother-daughter couple had

been engaged in following – the daughter was selecting objects in the guidebook, and her mother "listened to a lot of what she was listening to." The practice was made explicit when the daughter turned off her mother's eavesdropping function. But, as the daughter explained, "she didn't like that, and so she turned it back on." In this case, turning off the eavesdropping feature revealed their following practice.

Checking In
The final use of the guidebook that couples described was to "check in" on their companion. Checking in was typically a short activity, but one that was focused on updating or maintaining some type of shared context with their companion. In other words, with its eavesdropping feature on, the guidebook provided individuals with a resource to coordinate their actions with the actions of their companions. Participants described three reasons for checking in: to elicit information about their companion's state, to find out whether their companion was listening to descriptions of specific objects, and to monitor (a longer-duration type of checking in).

Several couples described using the eavesdropping to check in and get information about the "state" of their companion. For example, one member of P17 described the eavesdropping: "it was helpful if I was done, to find out where [companion's name] was." In addition to coordinating the completion of the guidebook tour, a number of couples also coordinated their movement from one room to another (also seen in, e.g., vom Lehn's observations of museum visiting practices [23]). In fact one member of P18, the highly experienced, largely independent museum visiting couple, reported "I was curious as to when he was ready to move on to the Study."

The second kind of checking in that was reported to us focused on objects. In one case, P8 described an instance where her companion, her husband, had mentioned an object. Curious about the object, she turned her eavesdropping on and checked what was playing on his guidebook. As she put it "I turned it on, to see, cause he had said something [about an object]. I turned it on to see what he was listening to."

One member of P6 described another type of checking in akin to monitoring. In her case, she was checking in on her husband. Specifically, she pointed out an object and then turned on the eavesdropping feature, later recalling that "I wanted my husband to hear it so in order for hi– for me to know that he got it right." Her desire to check in on her husband came from the fact that he had suffered a stroke. Part of their on-going rehabilitation was to encourage him to undertake various activities, and she viewed the guidebook as part of that. So she used eavesdropping "because I wanted him to do it for himself. He should do it for himself ... it's a marvelous learning tool."

The checking in activities described above appear to have had (according to the participants) a fairly short duration. Two couples described longer checking in activities. These resemble reports of monitoring activities, such as those described by Heath and Luff in their study of London Underground controllers [16].

One couple, P3 described checking in on his companion because he did not want to lose the awareness of where she was while he went and did something else. In this case, one member of P3 wanted to take pictures of a different room than the one he was currently in with his companion. While he was taking pictures, he continued eavesdropping so that he would have information about what his companion was doing. He added that without the ability to listen to his companion's activities, he felt that he would have hurried to finish taking pictures sooner in order to return to her.

Another person, one member of P23, also described a checking in activity of some duration. In this case, the wife left eavesdropping on and reported long periods of checking in on her husband, in addition to pursuing her own object selection. However, she used eavesdropping to wait until he had listened to objects she had already heard and then she would engage him in conversations about those objects. This came as a complete surprise to him during the interview ("now I know why you knew about the books at the same time"), although it clarified for him why she had known the descriptions to which he was listening.

DISCUSSION
In the previous section we presented four activities people reported engaging in during their visit: shared listening, independent use, following and checking in. In addition to describing each activity, we highlighted the role of the guidebook, the companion, museum visiting strategies and strangers in shaping that activity. In this section, we re-examine two key CSCW questions in light of this study: adoption and awareness.

Guidebook Adoption
CSCW research has long known the difficulties of groupware technology [15]. *Sotto Voce* potentially faced both groupware and individual adoption challenges. In this section we describe how visitors adopted features of the technology, especially the groupware features. We then discuss how paired visitors could adopt different features of the guidebook and still have collaborative experiences. We begin by addressing one general adoption challenge for guidebook technology in any historic home, namely, visitor demographics.

Typical visitors to historic homes (older middle-aged women) tend to have little technological experience. Our study revealed that the "typical" historic house visitor had not used handheld technology before, but this made no difference to successful adoption. In fact, although some of the strongest and most repeated comments about lack of technological experience came from visitors in this demographic, some of the most enthusiastic interview comments came from these same people. Their enthusiasm sprang from both individual and group use features of the guidebook.

Most visitors (45 out of 47) enjoyed the visual object selection and audio clip features. Typical comments about visual selection focused on how it is easier to select an

object from a picture than to determine which object is being described in a text narrative. Typical comments about the audio focused on the clarity of the voice and the short length of the clips. These features made the guidebook desirable to use. P18, the experienced museum-going couple who had toured many houses and buildings, thought the guidebook was one of the best, if not the best, they had ever used.

This high rate of adoption, and visitor enthusiasm, was particularly gratifying in light of the demographic challenge we anticipated. It also suggested that the guidebook software was robust enough to ensure a pleasant experience – no small challenge in itself. Finally, successful adoption suggested that after little instruction, typically lasting between two and three minutes, the guidebook was easy enough to use that almost everybody found a way of incorporating it into the visit.

The adoption of the groupware feature of the guidebook – the eavesdropping – was more sensitive to social features of the visit and the setting. Specifically, our findings suggest three factors influencing whether and how couples would adopt the eavesdropping: the social relationship of the couple, the nature of the current visit, and whether or not the couple has a typical museum visiting strategy.

The social relationship between the paired visitors influenced the use of eavesdropping. Those who were merely acquaintances self-reported that they adopted the guidebook fairly independently, which included turning off the eavesdropping for some time during the visit. However, once the system was configured for independent use, all but one person in these acquaintance-only pairs continued to use the guidebook.

One pair of acquaintances also said that they would use the eavesdropping if they had a different type of social relationship. When asked about their reason for independent use, P2 offered "if we were a couple, like your mom and dad might wanta do it together." Comments like this suggest that their relationship as acquaintances influenced how they used the eavesdropping and that a different social relationship could have resulted in eavesdropping being used more.

Another influence that was offered during some interviews was the nature of the current visit prior to using the guidebooks. Although P11 (the group of three) self-selected who would share guidebooks based on their sense of who likes to talk with each other in museums, they also described their visit in the house that day as being fairly independent, and they reported the continuation of the independent pattern with the guidebooks. Another factor in eavesdropping use was whether couples had strategies for visiting museums together. Couples with defined strategies often explained not just their initial adoption, but also their continued use of the eavesdropping feature in those terms. For example, P18's museum visiting strategy consisted of independent exploration while retaining some sense of their companion's location (to avoid getting lost). They self-reported turning eavesdropping off during independent exploration while turning it on for checking in. P24 self-

reported that the use of eavesdropping fit their "invisible rope" museum strategy. They used eavesdropping as a resource to achieve a shared experience. P7, while not having such a strongly defined strategy, also used eavesdropping and explained that when they went to museums they valued their interactions with each other. The eavesdropping allowed them to preserve those interactions, while providing more information about objects on which they could base their conversations.

Our data suggest that some paired visitors adopted different configurations of the individual and groupware features of the guidebook and yet still had a collaborative experience. Intuitively, one might expect groupware like this guidebook to be adopted symmetrically. By this, we mean that the technology would work only if both parties used the same features. However, as our participants demonstrated, asymmetric adoption is possible.

For example, the self-reported technologically inexperienced users (P5 and P7, for example) described initially leaving their more technologically experienced partner to work the guidebook while they listened and followed. In other words, they adopted the groupware feature of eavesdropping, while letting their partners use the individual features of the guidebook. This was even more explicit in couples such as P15 and P22; one member turned the eavesdropping off and the other continued to leave it on, yet they still talked. These examples illustrate that paired visitors could adopt features differently and yet still use the guidebook and the eavesdropping as a resource for sharing their visit.

Types of Awareness

It has long been recognized that awareness of others creates opportunities for collaboration. Our study findings suggest that awareness of companions also matters away from the office. Individuals reported having awareness and responding to their companions and also the presence of others.

Like previous studies of collaboration [10], we found that individuals reported using the eavesdropping to get the content and character of the companion's activity. Specifically, individuals reported using the eavesdropping to find out what objects their companions were listening to (content). They also used eavesdropping to determine whether their companion was listening to descriptions and where in the room their companion was, and whether they might be close to being finished (character).

Self-reported use of the guidebook also illustrates another form of awareness: the presence or potential presence of strangers in the room. As vom Lehn et al. [23] have observed, people react not just to their companions, but also to others around them. Our observations support their finding, but also suggest that visitors react not just to the presence of strangers, but also to the *potential* presence of others.

For example, P24 reported a general museum visiting strategy of using hand-signals instead of speech in order to accommodate the potential presence of other people not just today. Another couple, P2, commented that they were

concerned about talking loudly while using the guidebook because "people are walking around us." The interview did not clarify whether it was the actual or potential presence of other people that influenced them, but their comment illustrated how visitors were aware of other people.

While previous studies have often focused on the awareness colleagues need in order to collaborate, some studies have observed that people are aware of others around them. For example, Isaacs et al. [19] report that office colleagues used IM when they wanted to talk without disturbing others. Grinter and Eldridge [13] find that teenagers sometimes use SMS to avoid disturbing other family members. Similar to these findings, some of our study participants reported not wanting to disturb others in the museum, and that awareness affected how they behaved when using *Sotto Voce*. Unlike studies of offices and homes, the others in the museum were unknown to the couple. This resembles Goffman's idea of "decorum" which he described as in a front region where an audience may be present, individuals (a team) are likely to incorporate certain standards into their performance "while in visual or aural range of the audience but not necessarily engaged in talk with them" ([12], p107).

Strategies for technology adoption based on awareness of potential strangers have also been reported by Palen et al. [21]. Specifically, their study finds that people who had just purchased a mobile phone were sensitive to using it in public settings because they did not want to disturb strangers. However, the authors report that over time, those same mobile phone owners found that they did use it in public and worried less about disturbing others.

Comparisons of *Sotto Voce* with mobile phone use raise a number of questions. First, would sustained use of *Sotto Voce* cause individuals to change, or worry less, about the presence of others and report modifying their own guidebook behavior? Second, can users ever achieve sustained use? Unlike a mobile phone, *Sotto Voce* is a loaned and not owned technology, so it may never achieve enough use for people to evolve and adapt their behaviors based on extended "familiarity" with the technology. Finally, what kind of public space is a museum in general, and a historic house in particular, and how susceptible to change are the museum-specific variations of what Goffman describes as "decorum" (for example, the use of so-called "museum voice")? All of these questions will become increasingly important for CSCW as groupware leaves the office and enters public life.

CONCLUSIONS

In this paper we presented findings from a study of the use of a guidebook in a historic home. The guidebook facilitated four kinds of activity: shared listening, independent use, following and checking in. We described how the guidebook's individual and collaborative features were adopted, and how the adoption was influenced by factors including the social relationship of the paired visitors, the current visit, and strategies for visiting museums. We also discussed how the adoption of those features was up to each individual, and sometimes when

they adopted and used different features they still ended up having collaborative experiences. Finally, we showed that the guidebook facilitated awareness of companions, and its use was shaped by awareness of others.

Museums are a rich public space in which to examine technology. In addition to drawing a visitor base with a wide range of backgrounds and technology experience, museums also contain rich social conventions that shape and influence technology adoption and use. This paper has illustrated some of those conventions and how they influence the nature of collaboration away from the office.

ACKNOWLEDGMENTS

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