Ambient Social TV: Drawing People into a Shared Experience

Gunnar Harboe, Crysta J. Metcalf, Frank Bentley,
Joe Tullio, Noel Massey, Guy Romano
Motorola Labs
1295 E. Algonquin Rd., Schaumburg, IL 60196
{gunnar.harboe, crysta.metcalf, f.bentley, joe.tullio, noel.massey, guy} @motorola.com

ABSTRACT
We examine how ambient displays can augment social television. Social TV 2 is an interactive television solution that incorporates two ambient displays to convey to participants an aggregate view of their friends' current TV-watching status. Social TV 2 also allows users to see which television shows friends and family are watching and send lightweight messages from within the TV-viewing experience. Through a two-week field study we found the ambient displays to be an integral part of the experience. We present the results of our field study with a discussion of the implications for future social systems in the home.

Author Keywords
Social television, interactive television, social presence awareness, ambient displays, field trial

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Although Internet use is gaining importance, TV watching is still the primary recreational activity of American adults, accounting for half of all leisure time [7]. Although there is great social potential in TV watching as a shared activity and a topic for conversation [20], at least half of all people usually watch alone [10].

Many technologies coming out of the interactive television (iTV) field, such as Video-On-Demand and Personal Video Recorders (PVRs), focus on providing personalization and greater individual control. They cater to viewers as isolated individuals, and fragment audiences further [16].

However, in recent years 'social television,' the idea of using communication technology to connect TV viewers, in order to create remotely shared experiences around TV content, has received much attention. Proponents of this idea see television as a social experience capable of reinforcing bonds in strong-tie relationships. TV programming can provide the common, shared experience that serves as a basis for socialization, even for groups who are already fairly close [29]. Social television systems typically integrate some combination of text chat, voice chat or video chat with TV programming, and use presence to provide awareness of the status and context of other users of the system [5, 9, 15, 23]. These efforts tie into earlier CMC work on telepresence and co-viewing, but come at the design and research questions from a different angle.

In previous work we noted that users of social television systems would benefit from features that indicate favorable times for shared viewing [15]. One solution is to use always-on ambient displays to let users be aware of when others are watching TV. From a research standpoint, we can then examine how this kind of awareness helps or encourages people to get in touch through their social televisions, and in particular, how it is used to initiate and escalate communication sessions. As no extended field trials of social television systems have been reported to date, these important issues remain largely unexplored.

In this paper, we present results from a two-week field study of Social TV 2, an experimental social television system that incorporates an ambient display component to provide awareness of remote viewers. Two groups of five households participated, with the members of each group comprising an existing social circle. In addition to standard social television functionality, Social TV 2 incorporates ambient displays in order to keep users aware of the participation of their friends and family. We found that the ambient displays proved to be a defining component of the system. The displays were effective indicators of good times to use Social TV 2, increased participants' awareness of others' TV-viewing schedules, and encouraged participation in the system. This participation often began as a glance at the ambient display – a quick check on the status of a participant's social network, but would frequently escalate to deeper or more extended communication. In this way, participants began treating TV watching as a fundamentally social activity. Thus, the

CHI 2008, April 5–10, 2008, Florence, Italy.

Figure 1: The Social TV 2 system in use. The ambient orb is visible in the upper left, above the television.

addition of ambient displays helped to fulfill the design objectives of the system.

In the following sections, we describe the design of our Social TV 2 prototype, which we then put in the context of existing work in both the social television and ambient display literature. We outline unanswered questions that led us to initiate this work and describe the mixed-method approach to our field study. We then present our results, describing how the ambient devices functioned as traditional presence displays and as components of a more complex communication system. Lastly, we show how these findings bear on other social applications in the home, and outline our future goals for social television research and design.

SOCIAL TV 2

Social TV 2 follows Social TV, the system previously described in Harboe *et al.* [15]. It is a prototype system that allows remotely located friends and family to experience some of the benefits of sitting next to one another on the couch and watching a TV program together (Figure 1). To provide this experience, we supplement typical TV functions with two additional features: TV presence information, and the ability to send and receive lightweight messages. The features were selected to specifically investigate people's behaviors at the boundaries of the social television experience, as they begin and end their interactions, rather than the details of how they acted while fully engaged in the communication experience.

The prototype is implemented as a PC application running on top of GBPVR[1] media center software. The system uses on-screen displays to communicate which of the user's friends or family ('buddies') are currently watching, what they are watching, and what they have watched in the past.

[1] http://www.gbpvr.com/

The laptop running the Social TV 2 software is connected to a television, and all interaction with the system is performed with a standard remote control. For our field tests we chose to use a TiVo® remote that had several keys relabeled to correspond to the features of our system.

TV Presence

A key requirement for encouraging participation in social television is the ability to make users aware of when their friends and family are logged into the system and watching programs on TV. This information can be viewed from an on-screen buddy list (Figure 2). The deployed system has two presence states: 'watching TV' and 'away'. The 'away' state is intended to inform buddies that a user is not currently watching TV. It is set automatically when the TV is turned off or when no interactions with the system are detected for some time after a program has ended. Users can also disconnect from the social component of the system if they wish to watch TV in privacy, and will then appear to others to be 'away.' However, in this state many of the features of the system are disabled, preserving a 'see and be seen' information reciprocity.

Users can change to the same program that their buddy is watching from the buddy list. Additionally, whenever the channel is changed, a list of buddies who are also watching that program is displayed as part of the transient channel information banner.

Ambient Devices

While Social TV 2's on-screen display provides presence awareness on the television, we wanted another means to convey this information when the TV wasn't on, or when users were in a different room and unable to see the TV. We chose to use two separate displays capable of communicating information unobtrusively, visible from anywhere in a room, and which would fit in as household objects. The system has two different display devices to meet these needs (Figure 3).

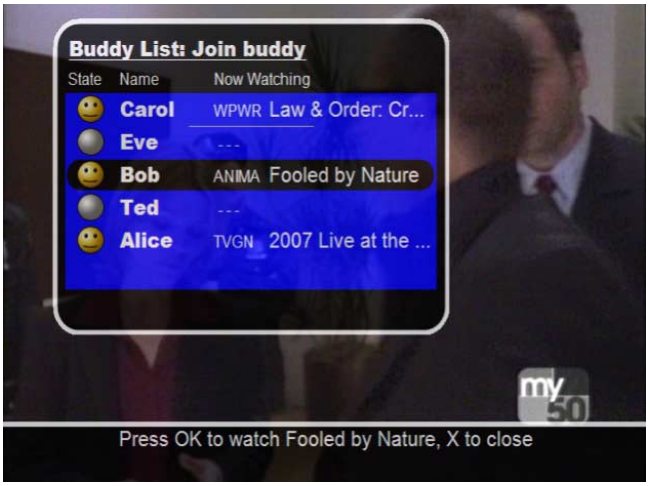

Figure 2: The Social TV 2 on-screen buddy list.

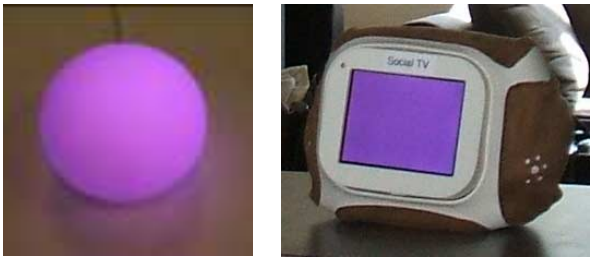

Figure 3: The orb and Chumby devices displaying a purple color (more than one friend is watching TV).

As our primary ambient display, we chose the Ambient Orb, a color changing lamp from Ambient Devices,[2] and configured it to display the current number of buddies watching television. Different colors are used to indicate whether one (blue), more than one (purple), or no other buddies (yellow) are currently watching TV.

The orb was connected via serial cable to our prototype, and therefore had to be placed close to the TV. As people often spend much of their time outside of the living room [1], we wanted to include a second display for times when users could not see the primary ambient display. The Chumby[3] is a WiFi-enabled internet appliance with a 3.5" LCD color display Though we would have preferred to use a second orb, the Chumby provided faster updates and more reliable wireless reception than the orb's pager-based network alternative. We wrote a Flash widget for the Chumby that follows the color of the living room orb in near-synchronization (within 15 seconds).

Besides providing information about the number of buddies online, we wanted to use the displays to attract users to the system when a friend or family member invited them to watch a show with them. To signal this, we designed the displays to pulse slowly between the current color and black. We did not want the flashing to be too distracting, but wanted users to notice it so that they could come to their televisions if they desired.

Messaging

We provided no voice or freeform text communication features. However, users can send 'suggestions' to invite a buddy to watch their current show together. If the buddy accepts the suggestion, the system automatically changes the channel to that program.

When two or more buddies are watching the same program, the prototype allows them to send messages to each other. In the first round of this study, the system allowed only three expressions, in the form of graphical thumbs-up, thumbs-down, or 'shout-out' emoticons. After this deployment, we received feedback that our participants wanted to send a wider variety of messages. Therefore, for the second group, we implemented a new feature that replaced the generic 'shout-out' message with approximately 20 pre-determined messages such as "How is this show?", "This sucks!", or "Call me". A number of possible replies are available ("Good!", "Bad!", etc.), as well as the thumbs-up and thumbs-down emoticons.

[2] http://www.ambientdevices.com/

[3] http://www.chumby.com/

RELATED WORK

Social Television Systems and Studies

The idea of communicating and sharing awareness through the television set has been explored by a number of different researchers. However, social television systems as yet remain confined to labs and limited trials. AmigoTV, described by Coppens *et al.* [9], was an early social television system that included presence, a buddy list, invitations, emoticons, and voice chat, but no facilities for indicating presence while offline. Telebuddies, by Luyten *et al.* [21], takes a different approach to the challenge of drawing users into the experience, using a friend-of-a-friend profile of interests and social relationships to match users with suitable communication partners. A more comprehensive review of social television systems can be found in Harboe *et al.* [14].

Geerts [14] and Baillie *et al.* [2] conducted user studies of AmigoTV, both of them lab experiments comparing voice communication to other modalities. Weisz *et al.* [29] and Regan and Todd [24] examined groups or pairs of friends and strangers using text chat while watching videos or TV together. Similarly, Oehlberg *et al.* studied groups of friends and acquaintances watching television, both in collocated groups and connected via an audio link [23]. Finally, In Harboe *et al.* we examined friends and family watching TV in a voice chat setting; this in the participants' homes rather than the lab [15].

All these studies were based on single-session events. None of them looked at the process by which a shared viewing experience is initiated or how the systems are used over time. However, Boertjes has announced a prolonged in-home study of a social television system called ConnecTV [5], and we await those results with interest.

Building on this existing work, we are extending the social television concept by including additional facilities for offline awareness of TV presence information. In addition, we are presenting results from the field that that throw light on the real-world use of television-based sociability, and which suggest design considerations for future social television systems.

Social Awareness Systems for the Home

Hindus *et al.* created and evaluated a number of social and communication systems, with varying levels of media richness, for the home [18]. They note that consumers wanted devices with multiple communication modes.

In the context of domestic video calling over the TV, Hemmeryckx-Deleersnijder and Thorne integrated an

awareness component that displayed images automatically captured from the environment [17]. In their scenario, they seek to provide background awareness and help negotiate conversation engagement.

De Ruyter *et al.* compared different degrees of peripheral awareness of remote friends (displayed as video) while watching a shared TV program [27]. The system in their study only supported awareness while in a shared viewing session. Markopoulos *et al.* provide an overview of other awareness systems [22].

Evaluation of Ambient Displays

While the ambient display literature contains a wealth of design examples, it contains few reports of field evaluations. CareNet [8], a combination ambient/interactive display for elder care, arrived at a number of useful findings for the design of effective ambient displays for the home. Rowan *et al.* showed how an ambient display can foster connectedness and promote communication between elders and their adult children [26]. In addition to these studies, other researchers have shown how ambient displays can maintain a sense of connectedness between friends and loved ones [12, 28]. The Whereabouts clock [6] shows how simple location and messaging capabilities can enhance connectedness and allow family members make inferences about each others' activities using their existing knowledge of one another. In this work, we build on these findings to demonstrate how ambient displays can be designed into a larger social application to promote use of that system and fulfill its goals of strengthening social bonds.

METHODS

In the design of our field study, we were interested to see whether the ambient displays met our design goal of encouraging social television participation during those periods when a participant's friends and family were also using the system, if it led to other forms of communication, and how it would ultimately affect the feelings of connectedness between our participants. Striving to understand these patterns of behavior is an essentially qualitative question, and our approach was largely exploratory. We ran two separate in-home trials. Five households were recruited for each trial, and each trial lasted 14 days.

Recruitment

Participants were recruited using an independent recruiting agency that was instructed to find social groups in which the various household members were mutual friends, and all had strong ties with one another. The actual relationships between the recruited households varied (Figure 4). In both trials there was a central 'hub' (A1, B1), a person who knew and recruited all the other participants, but there were also at least two households who were more peripheral, without strong ties to the rest of the group. In both trials the

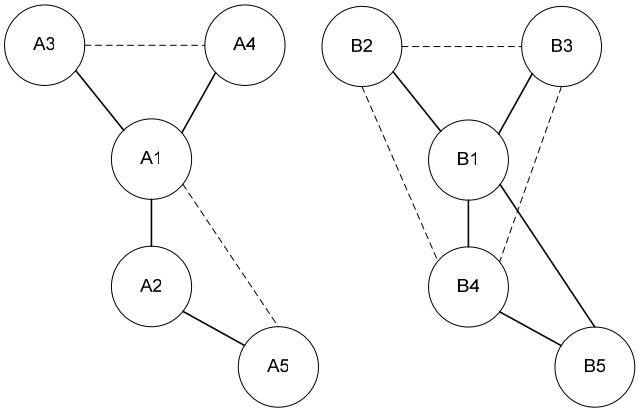

Figure 4: Social ties between households in our field trials. Dashed lines represent acquaintances.

central hub was a woman, and the four friends she recruited female. However, in each group some of the husbands knew each other, and in the second group two of the husbands were best friends.

Group A, our first group, consisted of four couples living in their own households, two with (very young) children. The fifth participant was recently engaged, but still living with her parents and brother. Ages of the main participants ranged from 26 to 33. A2 and A5 are sisters, and A3 is the cousin of A1's husband. A5 was not friends with anyone else in the study except her sister, and A3 and A4 knew each other only tangentially from having attended the same parties.

In Group B, our second group, all five nuclear families were living in their own households, and all five households included teenage children. Ages of the main participants ranged from 46 to 53. B1 was very close friends with B2 and B4, and knew B3 and B5 well. Again we had a pair of sisters: B4 and B5, but B2, B3, and B4 only see each other at the parties of mutual friends, and B5 did not remember ever meeting B2 and B3.

While there were some husbands in both groups who knew each other well, and some of the teenage children in Group B knew each other, their relationships, for the most part, mirrored those of our female main participants. Thus, we had a number of different kinds of relationships represented in the two social groups, but neither group was uniformly tight-knit.

Deployment

For each household, the Social TV 2 system was installed in the room participants reported as being the most common place for watching TV. As mentioned earlier, Groups A and B received slightly different versions of the software, as a result of an iterative design process on the basis of Group A's feedback. Each household was given one orb and one Chumby. We asked participants to place the Chumby in any part of their home where they spent a significant amount of time or passed by frequently. Six participants put it in the

kitchen, two in a hallway, and one in a bedroom. The last Chumby malfunctioned and was not used. Participants were given a brief (20 minute) introduction to the system and its features, and a phone number for technical support that they could call at any time. We asked each participant to use the system the way they would if they were not in a study, and explained that they did not have to use every feature, or any feature, unless they wanted to. Other household members were also welcome to use the system, and generally did so.

Data Collection

We used multiple methods for data collection, including interviews, usage logs, and voice mail diaries.

There were three sets of semi-structured interviews for each household. The initial interview lasted about half an hour and was used to collect background information. In a phone interview after the first week, lasting between 15 and 30 minutes, we gathered data about the participants' use of and reactions to the prototype during the first week. And the final interview, lasting from an hour to an hour and half, was structured to collect more detailed information on a number of topics. Whenever possible, we asked other household members to participate in the interviews. We recorded a total of 22 hours of interview data, but much of the material falls outside the scope of this paper.

We logged all interactions with the system, in order to document actual usage and to allow us to examine interesting incidents in detail later. The logs, then, provide support for some of the events described in the interviews. Cameras or sensors in the home would have been useful to put the system use in context, but we felt this would be too intrusive and technically complex for this study.

Instead, voice mail diaries were used to collect information on behaviors we could neither log nor directly observe, and which we were afraid would be forgotten prior to the interviews. We devised questions about behaviors surrounding the ambient presence/awareness features, communications with other people in the study, and their reactions to, as well as use of, the various features. So that the questions would not influence our participants' behavior in advance, the participants were given 14 sealed envelopes, one for each day of the study, each containing that day's questions. Thus, participants had the questions in front of them as they provided their feedback. Participants left 3 hours and 41 minutes of voice mail messages in total.

Analysis

From the log data we extracted some basic measures of system use (Table 1). Given the small scale and non-experimental design of the study, we did not attempt further statistical treatment of the quantitative data.

The bulk of the analysis was instead qualitative, using a variation of the affinity diagram method. We reviewed the interview and voice mail data, and extracted observations, statements (which we transcribed) and behavioral descriptions relating to ambient presence and awareness. These items were printed out as sticky notes.

Activity	A	B
TV watched, connected (hrs)	154.27	180.77
TV watched, disconnected (hrs)	21.81	0.34
Buddy list views	185	390
Joined show through buddy list	62	160
Emoticons sent	59	120
Canned messages sent	N/A	185

Table 1: Aggregate usage data by group.

Then, working as a team, we put these items together into groups or categories, a process of "comparison, contrast, and integration" [19]. To efficiently organize the data we used an affinity-like post-it chart [4]. Here we followed Bernard: As the categories were identified we would "pull all the data (that is, exemplars) from those categories together and compare them, considering not only what [items belong] in each emerging category but also how the categories are linked together" [3]. The patterns that emerged from this analysis process form the basis of the results that follow.

RESULTS

Our analysis identified several themes around the effect and effectiveness of our ambient displays. We first discuss their basic ability to communicate presence information, and then go on to talk about how they functioned as part of the larger Social TV 2 system. Throughout, we use quotes from the interviews and voice mail diaries to illustrate each particular theme in our participants' own words.

Effectiveness as Ambient Displays

In considering how the ambient information interacted with the other components of the Social TV 2 system, the orb and Chumby would only be relevant if they actually functioned as ambient displays. Fortunately, they did.

Noticing and interpreting the displays

Our participants saw and noticed the changing colors of the orb, and by and large understood what they signified. B3: "I notice when the color's on, whether it's purple or blue, I know that someone else is actually on the system." In fact, several participants commented on the orb consistently drawing their attention. B1 mentioned in the final interview that "every time I passed by, a thousand times a day, I would look to see what color it was." Only one participant, B4, could not account for the meaning of the different colors. When asked if she knew what they signified, she answered: "[My daughter] does, I don't."

The pulsing signal that the ambient devices sent when a suggestion was received was less widely understood. Many

participants confused pulsing with just changing colors. For example, B3 said "I'm not sure if it was pulsating or just changing purple to blue, to purple to blue […] I honestly don't know…" This may partly have been a problem of terminology. More substantially, at least part of the reason for the confusion was that few participants saw the pulsing happen. Most invitations were sent to people who were already watching TV, and who accepted or declined them before they had a chance to notice the ambient devices pulsing. Another likely contributing factor was the subtlety of the signal: "I love the orb, but when it flashes, I wish it flashed a different color or did something crazy. I can't tell when it's flashing sometimes." (A2)

A number of participants reported that they were less aware of the Chumby than of the orb. As B3 said: "I think it's kind of a non-entity, the Chumby." A few different factors appeared to contribute to this. In daylight, the Chumby's small LCD screen was only clearly readable from certain angles, so participants were unable to see it from some areas of the room where it was installed. In a few households, the Chumby was redundant because participants could also see the orb from most places where they could see the Chumby. Finally, the Chumbies used were pre-production models prone to technical glitches and service interruptions, so for nearly all of the participants the Chumby did not work properly for parts of the study. Nevertheless, the Chumby played an important part of the experience for certain participants: For example, A1 told us "Since I had [the Chumby] in the kitchen it was just while I was cooking…it was like 'oh, I wonder who's on.' "

Placement

As noted by others [8, 26], we found that the ambient displays needed to be located where they would frequently be seen. B1 mentioned, "The physical positioning in my house [for the Chumby] was the perfect spot, because I spend most of my day in the kitchen when I'm home." In two households, participants chose locations for the Chumby where they rarely spent time or passed by. "The orb was a lot more helpful than the Chumby. […] Because we're down here more." (B2) A5 did not regard the displays as particularly useful. This may have been the result of physical context, as both were put in her brother's bedroom. When we asked her if she ever saw the orb go purple when she wasn't watching TV, she replied "Uh, no, because if I was in that room, I knew I'm gonna be watching TV."

Acceptability of form factor

The majority of our participants liked the form factor of the displays. We received numerous comments such as "I love the orb" (B5), and "I like the orb, I like the Chumby… the colors and the blinking" (A2). A3 and A4 both called the orb "cool" and B4 said it was "neat." Even when the novelty of the system wore off and some participants were saying that interacting with the on-screen application was a "chore" (B5), their enjoyment of the orb continued to the end. It should be noted that the acceptance wasn't universal; A1's husband complained that the orb did not go with their décor, but "if it was a little bit smaller I think it would look fine."

Drawing Users into Communication

Although the ambient devices provided effective social presence, our participants felt that the orb and Chumby would not be useful by themselves without the rest of the information the Social TV 2 system provided. "It would be pretty, but I couldn't see what people were doing," said A3. B1 commented that "There'd be no reason to have an orb and then I can't turn it on and see who it's connected to." A2 thought that without the additional information of who was watching, and what they were watching, "it would be a tease." Balancing this, several of our participants said that at times they were just interested in learning that a friend was at home and available, not specifically whether he or she was watching television.

We saw further evidence that the ambient information did help to involve them in the social television experience. Many of our participants told us of occasions when they turned on the TV because the orb indicated that others were watching. For example, A2 told us "as soon as I come into the house or I wake up or come into the room, that's the first thing. It draws my attention, and the first thing I do is turn on the TV." In a voice mail, A3 told us that the orb "has made me a little bit more aware, makes me want to, when it does change colors, to see which of my buddies are on."

In some cases the participants switched on the TV just to see who was there, then turned it off. However, more often they would contact or be contacted by one of their friends, or simply go on watching the TV show. A2 told us that she would turn on the TV "just to see who's on, and then most of the time we would all end up watching the same thing." This usually involved exchanging lightweight messages: "Find out what other people are watching, flip to what they're watching, and then talking to some of the people to throw comments out." (B3)

In a number of cases, the people who described watching TV with their buddies and messaging them were people who were doing similar things prior to the study. For example, the sisters A2 and A5 told us that they often watched TV shows together, and A2 mentioned receiving a text message from her sister while they were both watching the season finale of *Gilmore Girls*. Regarding our system, she said: "The first thing I do is see what my buddies are watching, and then I tend to sometimes watch what they're watching and then give suggestions or thumbs up or down depending on how I feel toward their program."

Interestingly, people who *used* to watch TV with others remotely found themselves doing so again once the Social TV 2 system was in their homes. B1 told us how, years ago, she and her close friend B2 would "watch *Saturday Night*

8:01:48 PM	B5 watching TV, B1 turns TV on
8:06:24 PM	B5 joins B1 at *Desperate Housewives*
8:07:00 PM	B1: "How are you?"
8:08:38 PM	B5: "Good!"
8:09:05 PM	B1: 👍 [thumbs-up]
8:09:18 PM	B5: 👍 [thumbs-up]
8:10:20 PM	B5: "I really like this!"
8:17:26 PM	B1: "Call me!"

Table 2: Sample interaction sequence from logs.

Live together," while they talked on the phone. However, they haven't done anything like that since their children were little. Until they participated in this study:

> "I noticed the orb was blue, so I knew somebody had their television on, and sure enough, it was [B2's household]. And I knew that her husband's at work and her kids were at school, so I deduced it was [B2]. And so without even saying 'Who's there?' I immediately went to her channel, which was *Oprah*, and I sent her a thumbs-up. And then she thumbs-upped me, and then two seconds later I said [to myself], 'This is dumb!' And then [I called her, and] we had a whole conversation."

In this story, we can see that the ambient display serves to initially draw the participant into an interaction which then becomes progressively deeper, culminating in a direct voice conversation. This is a pattern we can see repeated with different variations in the logs (Table 2).

It should be pointed out that although turning the TV on in response to the orb was one of the most commonly reported behavior patterns in our study, some participants did not have a desire to turn on the television and dig deeper into the presence information. B3 said: "[The orb is] kind of interesting, but once again, what do I care if somebody is watching TV?"

Other participants *were* curious, but had little interest in talking about it. B2's husband said he would "turn it on just to see what they're watching, and then probably send them a message saying that 'it sucks' or something." To put this in context, he rarely socializes around TV content anyway; although B1's husband is his best friend, he has only once been over there to watch TV, for a Super Bowl party.

Meeting the Goal of Connectedness

Our participants reported that when they saw the ambient colors, they found themselves thinking about the fact that others were watching TV. In some cases this translated into a feeling that they could "know what's going on," (B2's husband) with others in the study. Said A3: "I still think the orb is kinda the coolest part of the whole thing because it's really neat to see it change color and then know that something is going on on the other end to cause it to do that." The husband of A1 said: "Even before I turned on the TV, I knew that someone was on there." B1 put it this way: "I liked the different colors, I liked coming in the house and saying 'oh, someone's home watching TV too now.' I don't know, it was like a friendly feeling, like someone else is home and I'm not the only one home tonight."

While B1 knew all the other participants in her trial, that was not true for the others. Participants on the periphery of the group could only imagine what it would be like to use the system with people closer to them. For example B5, who expressed dismay with the system overall, said "it's a love connection. You have feelings for these people and you care more. My parents could be blue, my sisters could be pink, orange, green." While B3 did not find the orb useful during the study, when she was asked if she would be more interested if the orb was telling her about different people, she answered:

> "Oh, yeah, yeah, yeah. Probably. If it's somebody I was closer to. […] It's almost like a communication light bulb. You know what I mean? Like the fire bell goes off, and 'Ding, ding, ding!' If I saw that, I'd be 'Hmm, Dad's watching,' or, I feel like 'Hmm, I'm connecting with somebody.' It sounds so stupid, but maybe you're connecting with somebody."

Inference and Learning about Presence

Despite the fact that our ambient displays only showed three colors, our participants were able to combine the information conveyed with previous social knowledge in order to draw rich inferences about the other people in the study. In some cases it inspired them to leaps of imagination, like when B2's husband saw the orb turn blue when someone turned the TV on at 2 am: "I just figured somebody was watching, maybe fell asleep on the couch, maybe some guy got thrown out of the bedroom for the night." At other times the speculations were more mundane, as when B1 looked at the orb one morning: "The orb was yellow and no one was on, so I'm assuming everyone was already at work." This statement also exemplifies another use our participants found for the ambient information: Whether or not someone was watching TV was used as a proxy for whether they were home. Naturally, the presence information in the buddy list was a helpful supplement to the ambient devices for this purpose. A5 put it this way: "It'd be interesting when I'd be on at night, like 'Oh, let me see if she's on. Is she watching TV, is she home, is she out?' So that was one way to know, 'Yeah, she's home, she's watching TV.' "

We saw evidence that over the course of the study, our participants learned more about each other's viewing habits, and used that knowledge to interpret the ambient signals with more confidence, guessing who might be on at any given time. Most of our participants knew little about the TV viewing habits of the rest of their group before the study commenced. To take just one example, A1 was only able to make general guesses about her friends' viewing habits when the study started. At the end, on the other hand, she told us: "Yeah, I think as the two weeks progressed I kinda had a feel; like on Fridays I know [A4] works from

home so, like, this past Friday the light was blue, and I was like 'the only person who's going to be watching TV right now is her.' So I kinda got a feel. Late night would be [A5], daytime would be [A3] because of the kids."

By allowing participants to leverage their existing knowledge of one another to learn more detail about their viewing habits, the ambient information conveyed by Social TV 2 became more powerful. Participants were soon able to use the orb to glean (with some degree of uncertainty) information that they had initially needed to look up in the buddy list. One indication of the meaning that our participants attributed to the ambient devices' output is the power the displays had to puzzle them. When B1 sat down to watch TV on a rainy evening, she noted to her surprise that no one else was logged on: "The oddest thing, it's a nice night to be in… and not one person is on Social TV tonight!"

Presence seemed to lead to an expectation that someone who was watching TV was available for interaction. Unfortunately, our participants were often disappointed. B2 told us in a voice mail: "We've not really heard back from people, the orb is blue, I don't know if they're getting them or if they're just not sending back or what the problem is." In the phone interview she said that when people weren't responding, perhaps "they just wanted to watch their show, and they were ignoring you." B1 said that when she notices the orb turning blue or purple and turns on the TV, she felt like "they're on for a few minutes, we say hello, and then someone turns it off or they have to go."

DISCUSSION

An Integral Component of Social TV 2

If we consider the ambient devices in isolation, they appear as fairly ordinary displays for peripheral presence awareness. And indeed, the results show that they successfully functioned as such. This, along with the fact that the orb, at least, was on the whole so well liked, goes some way towards validating our design, but it is not by itself a particularly novel finding. Far more interesting are the ways in which the ambient devices and the other Social TV 2 features interacted. Our findings reveal and hint at a number of interesting behaviors emerging, and these are particularly relevant to the design and understanding of future social systems in the home.

Our system was designed so that the ambient devices only worked while the Social TV 2 client remained connected to the network. And as we have noted, people, in general, liked the ambient lights, both because of the information they provided and for the aesthetic appeal. Although the design of our study didn't allow us to conclusively test this, it does seem to indicate that the ambient devices would therefore encourage people to stay logged on, and serve as a reminder, if they ever do leave, to return as soon as possible, thereby ensuring the presence conduit remains open.

The orb and the Chumby were effective at conveying when other people were watching TV, and this allowed our participants to be aware of others' availability even when their own TV sets were turned off and they were engaged in other activities. In this way, it reduced the risk of an opportunity for interaction going by unnoticed.

Together, these effects expand the interface between the system and the environment. For one thing, the chances of making contact are greatly increased. Also, the social television experience is no longer something that only takes place during the time you are actually watching TV. The ambient devices keep users engaged with the system while they go about other activities, thereby creating an 'out-of-the-box' social experience.

Multiple Levels of Engagement

Our findings indicate that while it extended the social experience beyond the TV, the awareness provided by the ambient displays also helped draw our participants into the television experience and encourage them to use the system. This result supports previous efforts to use peripheral social awareness to lower the barriers to communication [17, 11].

We can generalize the steps reported by our users (and corroborated by the logs): the participants become aware of their friends' availability through the ambient devices, turn on their TV (thereby themselves showing up as available to the other participants), look at their buddy list, and either join what one of their friends were watching or suggest that their friend join them. Once they were viewing together, they would usually send messages or emoticons, and sometimes this would culminate with a phone call. From this idealized flow, we can define different stages of interaction (Table 3). This can be viewed as an extension of Eggen *et al.*'s three interaction states [13].

We can see that as we move down the levels, the user becomes progressively more engaged with the experience, going from peripheral presence awareness to immersive participation through a number of intermediate levels. Part of the reason for this is that at each stage, the user has access to more detailed information. This is similar to a "ramping interface" model of information design and interaction [25], and allows users to drill down to the level they are interested in. In particular, each step provides *more specific* presence and *richer* contextual awareness. The ambient device provides only aggregate presence, and only conveys that a TV is on. The buddy list shows presence per household, and what they are watching. By watching the same thing, common ground is established, and by communicating it is possible to identify the other person at an individual level. However, the most interesting thing to note may be that as users become more deeply engaged, they also become increasingly present to, and eventually connected to, their buddies.

Interaction	Information amount	Presence specificity	Context detail	What others experience	Degree of participation
Noticing ambient display	Bite	Aggregate buddy list (+inferences)	TV is on/off	No presence info	Peripheral awareness
Viewing buddy list	Snack	Aggregate household (+inferences)	The program(s) being watched	TV is on/watching program	
Co-viewing program			Shared viewing context (common ground)	Sharing the viewing experience	
Exchanging lightweight messages	Meal	Aggregate household or individual	Reactions to show, responses to messages	In contact, communicating	
Talking on the phone	Feast	Individual	Two-way audio stream	Rich conversation	Full involvement

Table 3: Different stages of interaction with the system, along with some notable characteristics.

Users can move freely between the various interaction levels, as their needs and interest dictate. However, each stage provides impulses that encourage deeper engagement, playing on such traits as curiosity and desire to express opinions, and guides users towards the ultimate state of live conversation, which here takes the form of phone calls.

Improving the Quality of Time Spent Watching TV

We see that the ambient information is intimately bound up with the social functionality available on the TV. Although our participants found the ambient data interesting in the context of the Social TV 2 system, the information would be nearly meaningless on its own; "a tease." If the ambient displays extend the social television experience outside of the TV set, the other features help users interpret the ambient signals and provide the information with a purpose. They make it actionable.

Furthermore, as social presence information is made actionable through the TV, turning on the TV becomes redefined as a social act: "*Even before I turned on the TV*, I knew that someone was on there." Because the ambient devices provide users with at least peripheral awareness of their buddies' presence information, there is now an unavoidable social dimension to pressing that button, such as expectations of availability. And even if users should be oblivious, turning on the TV affects their buddies' ambient displays and presence view, making *them* aware. We saw this social consideration give rise to new behaviors such as turning on the TV when the ambient devices showed other people online.

The methods of our study do not allow us to say with confidence whether Social TV 2 caused our participants to watch more TV, or keep their TV on more. For that, a control condition would be required. Certainly some of our findings suggest that it might be the case. However, in light of the above, direct comparisons may not be particularly meaningful. To watch Social TV 2 is not merely to consume entertainment, but to engage in communication with friends and family that can bring you closer together, reaffirm social ties, and let you get to know each other better. The ambient displays provide a first point of contact for TV-based conversations, and help establish a social mindset around the very notion of television.

This insight suggests that different systems could use ambient displays to emphasize specific features, by preparing the user's frame of mind in advance of their active interactions.

CONCLUSIONS

In this paper we have presented results from testing a social television system with an ambient component for social presence. On the whole, our participants liked the idea of having the TV watching activities of their social groups represented in ambient displays. Presence information was understood and used as a proxy for who was home and available. More importantly, it worked to support the experience of communicating through the television.

Most social television research to date has focused on what happens once people are engaged in a social television experience. There has been little research into how such sessions would be initiated, and how they can be made to fit into the context of everyday activities. Our study addresses these issues: Designs based on ambient displays offer a credible answer, and our field study showed one such design to perform well in practice. Since the same concerns are relevant to a wide class of other in-home social systems, this finding holds more general interest.

FUTURE WORK

One of the most interesting questions raised by this study is how the addition of social awareness will affect pre-existing patterns of behavior around TV viewing. The effect is profound, and some simple examples are clearly evident in the data. However, we suspect that the altered social dynamic of TV viewing could have far more complex and subtle effects, especially as the presence awareness increases the visibility of TV viewing habits to oneself and

others. Understanding these changes in perception and behavior is a rich area for further research.

While our data collection provided a great deal of qualitative information on how participants used Social TV 2, we have no data on when participants were home, when they were in a room from which they could observe the ambient indicators, or who was using the system at any particular moment in time. This limits our ability to interpret the log data. In upcoming studies we plan to include a control condition, to provide a baseline against which changes in behavior can be detected.

We continue to iterate on the design of the Social TV prototype. Given the tendency of our participants to seek progressively deeper engagement and richer communication, we have now integrated support for voice and text chatting, and are currently preparing another field trial with these features included. We are also considering other form factors for the ambient devices, and changing the kinds of information these devices display. However, one change we are *not* going to make is eliminating the ambient information. Our findings spoke clearly to us about the attractive nature of ambient awareness, and we intend to keep using this feature to promote TV-based sociability.

ACKNOWLEDGMENTS

We thank Ambient Devices, Inc. and Chumby Industries for providing the ambient devices, and Seonyoung Park and Elaine Huang for their contributions to the study and paper.

REFERENCES

1. Aipperspach, R., Rattenbury, T., Woodruff, A., Canny, J. (2006) A Quantitative Method for Revealing and Comparing Places in the Home. *Proc. Ubicomp 2006*.
2. Baillie, L., Fröhlich, P., Schatz, R. (2007) Exploring Social TV. In *Proc. ITI 2007*: 215–220.
3. Bernard, H.R. (1998) *Handbook of Methods in Cultural Anthropology*. Walnut Creek, CA : Altamira Press.
4. Beyer, H., & Holtzblatt, K. (1998). *Contextual design: Defining customer-centered systems*. San Francisco, CA : Morgan Kaufmann Publishers.
5. Boertjes, E. (2007) ConnecTV: Share the Experience. In *EuroITV 2007 Adj. Proc*.
6. Brown, B., Taylor, A., Izadi, S., Sellen, A., Kaye, J. (2007) Locating Family Values: A Field Trial of the Whereabouts Clock. In *Proc. Ubicomp 2007*.
7. Bureau of Labor Statistics (2006) American Time Use Survey. ftp://ftp.bls.gov/pub/news.release/atus.txt
8. Consolvo, S., Roessler, P., Shelton, B.E. (2004) The CareNet Display: Lessons Learned from an In Home Evaluation of an Ambient Display. *Proc. Ubicomp 2004*.
9. Coppens, T., Trappeniers, L. Godon, M. (2004). AmigoTV: towards a social TV experience. In *Proc. EuroITV 2004*.
10. Crispell, D. (1997) "TV soloists – Statistics on number of television sets owned in households from SRI Consulting's Media Futures Program", *American Demographics*, May 1997.
11. DeGuzman, E.S., Yau, M., Gagliano, A., Park, A., Dey, A.K. (2004) Exploring the design and use of peripheral displays of awareness information. *CHI 04 Ext. Abstracts*.
12. Dey, A.K. and DeGuzman, E.S. (2006) From Awareness to Connectedness: The Design and Deployment of Presence Displays. In *Proc. CHI '06*: 899–908.
13. Eggen, B., Rozendaal, M., Schimmel, O. (2003) Home Radio: Extending the Home Experience beyond the Physical Boundaries of the House. In *Proc. HOIT 2003*.
14. Geerts, D. (2006) Comparing voice chat and text chat in a communication tool for interactive television. In *Proc. NordiCHI 2006*: 461–464.
15. Harboe, G., Massey, N., Metcalf, C.J., Wheatley, D., Romano, G. (2008) The Uses of Social Television. In *Comput. Entertain.* 6, 1 (Jan 2008).
16. Harrison, C. and Amento, B. (2007) CollaboraTV – Making TV Social Again. In *EuroITV 2007 Adj. Proc*.
17. Hemmeryckx-Deleersnijder, B. and Thorne, J.M. (2007) Awareness and Conversational Context Sharing to Enrich TV Based Communication, In *Proc. EuroITV 2007*: 1–10.
18. Hindus, D., Mainwaring, S.D., Leduc, N., Hagström, A.E., Bayley, O. (2001) Casablanca: Designing Social Communication Devices for the Home. In *Proc. CHI '01*.
19. LeCompte, M. and Schensul, J. (1999) *Designing and Conducting Ethnographic Research*. Walnut Creek, CA : Altamira Press.
20. Lull, J. (1990). *Inside family viewing: Ethnographic research on television's audiences*. London: Routledge.
21. Luyten, K., Thys, K., Huypens, S., Coninx, K. (2006) Telebuddies: Social Stitching with Interactive Television. In *CHI 2006 Extended Abstracts*.
22. Markopoulos, P., de Ruyter, B., Mackay, W.E. (2005) Awareness Systems: Known Results, Theory, Concepts and Future Challenges. *CHI 05 Ext. Abstracts*.
23. Oehlberg, L., Ducheneaut, N., Thornton, J. D., Moore, R. J., Nickell, E. (2006). Social TV: Designing for Distributed, Sociable Television Viewing. In *Proc. EuroITV 2006*: 25–26.
24. Regan, T. and Todd, I. (2004) Media Center Buddies: Instant Messaging around a Media Center. In *Proc. NordiCHI 2004*: 141–144.
25. Rhodes, B. and Maes, P. (2000) Just-in-time information retrieval agents. *IBM Systems Journal* 39(3–4).
26. Rowan, J. and Mynatt, E. D. (2005) Digital Family Portrait Field Trial: Support for Aging in Place. In *Proc. CHI '05*: 521–530.
27. de Ruyter, B., Huijnen, C., Markopoulos, P., IJsselstein, W. (2003) Creating social presence through peripheral awareness. In *Proc. HCI International 2003*.
28. Vetere *et al.* (2005) Mediating Intimacy: Designing Technologies to Support Strong-Tie Relationships. In *Proc. CHI '05*: 471–480.
29. Weisz, J. D., Kiesler, S., Zhang, H., Ren, Y., Kraut, R. E., Konstan, J. A. (2007) Watching together: integrating text chat with video. In *Proc. CHI '07*: 877–886.