The Use of Mobile Social Presence

Five focused studies explore the ways that context sharing in mobile environments affects communication, creating rich, new experiences and increasing feelings of social presence.

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Telecommunication innovations have provided people increasingly richer means to share their experiences with each other. For most of recent history, this communication was tied to a particular place—phones were fixed in homes or offices, and people sent letters to a specific location. Now mobile phones connect to people no matter their location, which has brought new possibilities to share live experiences instantly across great distances. As mobile phones become sensing and media capture devices, they can ambiently share a user's environment with others. This mobile context sharing creates new, rich experiences that can increase feelings of social presence as well as enhance and inspire future communications.

We set out to understand how people can share experiences using a mobile phone and how context sharing in mobile environments affects communication and feelings of presence. We began with a study on location- and activity-sharing, which explored how people currently share context in mobile phone calls, along with a study on how life boundaries impact availability and communication. Using this information, we created three context-sharing applications as probes to investigate how additional context information would change the ways participants communicate with, and feel connected to, their strong-tie relations.

We found many similarities in participants' use of motion, music, and photo context information as well as implications for the design of new mobile communication applications. We believe that these studies provide a human-focused view of mobile context sharing—one that encourages rich communications and relies less on automatic inference.

Studies

Our studies employed methods that we have developed over years of researching mobile communication. Because communication happens out in the world, our studies relied heavily on field research methods. We recruited participants of different ages, ethnicities, education levels, and occupations. For each probe study, participants used our applications on their primary mobile devices so that we could understand how they integrated our technologies into their lives. During the studies, participants completed voice mail diaries nightly to recount their experiences. We also conducted in-person final interviews for a better picture of the role context played in their interactions.

The studies employed qualitative affinity analysis with direct participant quotes as the analysis items. Some studies also employed quantitative analysis of usage logs. We believe that these methods accurately reflect real-world use while fitting into a rapid evaluation process.

Mobile Use Today

To understand existing mobile use, we studied participants' context-sharing and boundary maintenance behaviors. These studies let us

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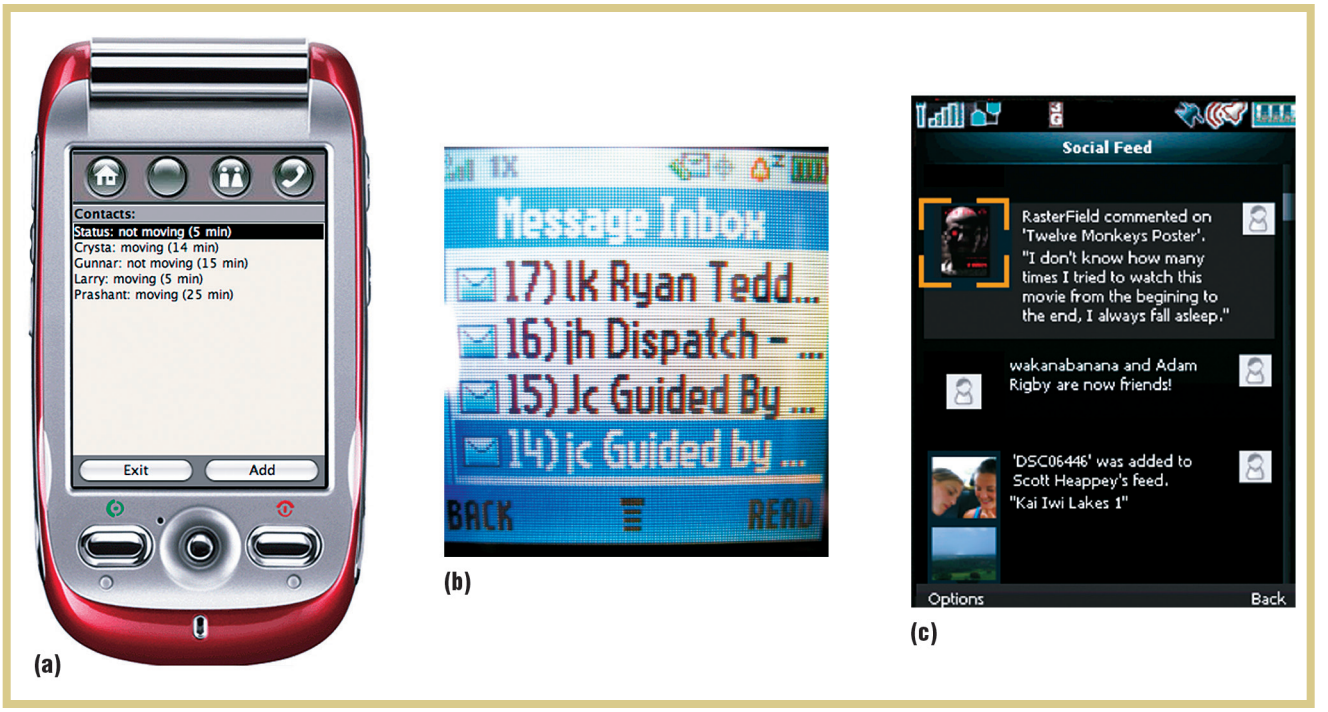

Figure 1. Probe applications. (a) The motion presence application lets users see the amount of time that contacts have been in a place or transitioning between places. (b) The music presence application provides a feed of artists and titles of music that friends have recently played. (c) The photo presence application shows the photos taken, comments posted, and social connections between contacts.

examine behavior without introducing new technology and served as a guide and inspiration for our future designs.

Location and activity sharing. Our first study analyzed instances of location and activity sharing in mobile phone calls.[1] Each of our seven participants recorded their calls for seven days using phones that offered single-touch recording using a hard key on the outside of the phone. We ensured that participants received permission ahead of time from those they talked to and gave them the option to not record a call or to delete it afterward if they decided not to share it with us.

To understand participants' location and activity disclosures in their everyday communication, we transcribed each of the 352 disclosures during the study, then annotated them with contextual details from the recordings and interviews. Details included the disclosure's location (home, work, mobile), the time of day, the day of the week, the contact's relationship, the physical distance, and the point in the call when the disclosure occurred.

We derived annotation techniques from conversation analysis constructs. For example, to describe location and activity disclosure placement, we used concepts such as openings and closings of conversations, turns, and sequences.[2,3] We used statistical-analysis methods to find patterns in the data and qualitative techniques to find themes in the data,[4] building an affinity diagram modeled on grounded theory.

Seams. Our second study in real-world context sharing focused on the boundaries between people's work, home, and community lives.[5] We shadowed four participants for a day, from breakfast until after dinner, and observed how they handled communication interruptions from their professional and personal contacts. At the day's end, we conducted semistructured interviews to supplement our observations and asked participants to call a voice mail nightly for five evenings to answer questions about their communications and interruptions on those subsequent days.

Probes

Building on knowledge from our location- and activity-sharing and seams studies, we created functional technology probes to investigate the use of ambient contextual information. We focused on areas of context sharing that we observed were the most frequent including social awareness, availability management, and helping others. Figure 1 shows all three applications.

Motion presence. In the location- and activity-sharing study, we found that our participants shared a good deal of context information with each other during their everyday communications. This rich context combined with

a history of learning about each other through previous disclosures gave participants behavior models of members in their close social network. However, we also found that they were often unsure of the transition points between activities, which led to hesitation about initiating communication.

To help people find these points, we created our first probe: a context-enabled phone book centered on motion.[6] As Figure 1a shows, in the interface next to the contacts' names, users could see whether their close friends or family members were currently stationary or moving between places. We used the mobile phone's transitions between cell towers to track movement, so the application worked indoors and without the power constraints of GPS. We explicitly chose not to share place names since users often express concern about others knowing their location.

Ten participants used this application for two weeks. These participants included three groups of couples in various stages of their relationships and a group of four male friends recently out of college. They used the modified phone books on their primary phones for the study's duration, called us nightly to answer voice mail questions, and participated in a short interview after the first week and a longer interview at the study's end.

Music presence. For the music presence study, we were interested in how participants would respond to an environmental cue—in this case, the music that close friends and family were playing. Participants used a plug-in on their home computers that automatically uploaded metadata of the music they were playing to the Web site Last.fm. Their friends received text messages of each song played, thus turning their short-message service (SMS) inboxes into feeds of music presence from their connections. Throughout the one-week study, most participants turned off the ringer on their incoming text messages to avoid being disturbed by the updates. The inbox then became a destination to visit to learn about music being played (see Figure 1b).

For this preliminary study, we recruited one social group consisting of four college-aged friends. They used the system for a week and participated in nightly voice mails and a final interview at the end of the week.

Photo presence. Our final study involved photo and video sharing within strong-tie networks. For this study, TileFile, a mobile and Web-based media-sharing platform, let users automatically upload media from their phones to share with close friends and family. Interaction with the application revolved around a social feed that showed newly captured media and comments from contacts (see Figure 1c).

The 10 participants consisted of three strong social groups of friends and family who knew each other well and had previously shared media in the past six months. Participants used the application on their primary phones for three weeks, calling a voice mail system nightly and participating in a final semistructured interview on their application use.

As in previous studies, we transcribed portions of the voice mails and final interviews that were relevant to our research and conducted an affinity analysis to find themes in the data.

Findings

As we completed these studies, we noticed several themes in how our participants used the shared contextual information. The broadest theme centers on how participants used shared information in conjunction with other social information to infer richer context. We also observed participants using the information to share their experiences with others and to feel connected to people and events in other places. Often, the shared information became a conversation topic in later communication.

TABLE 1
Inferences made by participants in each study.

Study	Inferences made
Motion presence	Location, activity, availability, destination, time to destination
Music presence	Location, activity, availability
Photo presence	Location, activity, people present

Context-Driven Inference

The data from our mobile use studies shows that participants shared a great deal of context in everyday communication. In the first study, we found that in 71 percent of phone calls, participants disclosed location or activity information including current activities or places that they planned to go in the near future. In our technology probes, participants regularly used prior knowledge along with the context data to interpret the information and infer rich behavior. Table 1 summarizes the inferences we observed in these studies. Participants used this knowledge for activity planning including managing availability, getting more time at their current activity, and discovering opportunities for in-person interaction.

Availability. Because availability was a key focus of related work (see the "Related Work in Mobile Social Presence" sidebar), we wanted to see how participants moderated their availability in daily life, both with and without context-sharing technology. To most participants, availability was a variable concept. A person wasn't strictly unavailable or available, but rather available for different people or purposes on different devices with varying levels of interruption to his or her current activity. Mobility has heightened these problems because phones are no

Related Work in Mobile Social Presence

The area of mobile presence has become quite active. Much research in this field attempts to take sensor inputs and infer rich presence information such as mode of transportation, availability, and activity. Joseph Kaye and his colleagues' system, although focused on the desktop, is similar to ours in that it shares a simple intent that the receiver can interpret with existing social knowledge.[1]

Researchers at Intel have focused on location sharing, creating the Reno system, which lets users request others' location information.[2] While not ambient, this system allowed others to verify their current thoughts on another's activities.

Commercial systems such as ZoneTag[3] and Radar[4] investigate the use of mobile photo sharing and lightweight visual communication to create a sense of shared visual presence.

Work on microcoordination by Rich Ling and Birgitte Yttri focused on how people share location information when determining when and where to meet.[5] Alexandra Weilenmann and Peter Leuchovius also studied the behaviors of location sharing for availability.[6] (For an explanation of microcoordination, see the "Perceptual microcoordination" section in the article.)

In reviewing the existing research, we saw a lack of general understanding of current location- and activity-sharing practices as well as a lack of rich data on the use of context-sharing systems in daily life. We also saw many mobile context-sharing systems focused on availability, which we believe is one important use of these applications but only scratches the surface.

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longer tied to particular places with set schedules and functions. Today, when calling a mobile phone, the caller often interrupts the recipient, then asks questions such as "Are you on the road or still in the office?" (Aaron) or "Do you have a couple of minutes right now?" (Dave). (Pseudonyms substitute participants' names.)

In the seams study, we observed participants' strategies for determining whether a contact was available or a call was important. Kevin told us that he'll always answer calls from his wife while traveling because they have an understanding that only emergency calls should be made in these cases. Mike chose to use email for an urgent request when the recipient was on the phone and could respond to his email faster than a voice mail that he'd have to retrieve later.

We see rich-presence systems as a way for people to determine how and when to contact a person, augmenting the knowledge they already have about the other person with the new presence information. Because of the rich context that's shared as a natural part of existing communication, participants in each of our probe studies often knew approximately when close friends and family were available, and the applications gave them details on the actual transition times.

In the motion presence study, Harold told us about trying to reach his friend George: "I knew he was going to work, but I wasn't sure if he got there already, and I saw that he was not moving for 12 minutes. So judging by that, I'm getting that he was already at work, so I didn't bother calling him." In the music presence study, Sara used the fact that a friend had started playing music on her home PC to determine that she was home and thus available: "I was looking at her [music updates] to see when she'd gotten back from going out." Participants in the photo presence study were able to infer context such as when friends or family were at work or traveling and who was around on the basis of the photos they posted. Participants easily made context, location, and availability inferences by combining presence information and prior knowledge of contacts' lives, all without the privacy concerns of sharing their absolute locations.

The sharing of current and future location and activities is a part of everyday life and is increasing as peo-

ple's schedules become more varied. We have seen that the process of inferring rich presence is often dependent on knowledge only the recipient possesses and believe that it's best left to the individual to interpret contextual data. Systems that exploit people's existing contextual knowledge let those close to the sharer make better decisions.

Perceptual microcoordination. In addition to using cues to determine availability, participants in all of our studies used contextual presence to coordinate their daily activities.

Manual coordination can be complicated and require many phone calls as participants converge on a location. Participants in our first study often called each other to coordinate with statements such as "Call me when you get there" (Erin), "I'm right in front of La Strada" (Aaron), and "Where are you at? I'm walking down Milwaukee" (Erin).

The seams study found similar behaviors, including calling to arrange rides, planning schedules, and asking others where they were or when they would arrive. These interactions are called *microcoordination*. Such coordination is often disruptive and can be illegal in locations that don't allow phone calls while driving. Mobile presence systems can help people manage their everyday coordination tasks in a less disruptive, more natural way. We call such interaction *perceptual microcoordination*.

In the motion presence study, we saw participants using the time-in-motion information to determine when their friends and family would arrive at a given place, often extending their current activity as a result. "If you knew someone was going to pick you up, you could see if they were actually on their way or if they were running late" (James). Another participant used this contextual inference to get more time at work: "If she didn't leave yet, that means I can go do whatever I'm doing, like at work stay later."

By inferring location from status, participants could coordinate activities. "He's not in class. He's moving; he must be on his way home. I need milk!" (Beatriz). In the music presence case, Sara saw that her friend was playing music on a Friday night. She inferred that her friend was bored and was able to contact her and make plans.

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In these examples, small pieces of context helped make planning and coordination much simpler, without requiring additional phone calls and interruptions. Perceptual microcoordination allows coordination to occur in the background and doesn't become the active center of communication. This less disruptive, more opportunistic way of coordinating helped our participants flow more naturally between daily activities.

Constant awareness. Because this technology allows continual connection, new forms of communication become possible. With the cell phone, people can share experiences with others while an event is still occurring. In our location- and activity-sharing study, participants discussed changing aspects of their environment with others on the call in real time—for example, "Now I'm on the train; I wasn't before" (Erin) and "I'm in the cab right now" (Genevieve).

Mobile presence services increase awareness. With mobile devices, people can connect to others' rhythms and activities throughout the day, not just when they're explicitly communicating. Our photo presence study demonstrated this sense of connectedness: "Everybody else can just follow you throughout the day, and it's pretty much effortless; you can just keep people close to you knowing what you're doing, having a piece of where you are and having a look at what you're seeing, without having to write messages or send pictures to all these people" (Gail). In this same study, participants viewed photos to feel connected to another place: "I'm away from home right now, and it was fun to view photos from my friends at home" (Ida).

In the motion presence study, George became aware of friends going out after work: "I checked [the application] when I got out of work and before I went out just to see what everyone else was doing." James used the application to see whether a friend of his was stuck in the same traffic he was. Because traffic was so congested that cars weren't moving for several minutes, his friend's status reported "not moving," and James knew that his friend must be in traffic as well and felt a bit of camaraderie.

Other uses of constant awareness revolved around safety. One participant in the motion presence study worked late at night, and her partner would check the phone to see that she was okay and moving between places when she should be as a part of her job. Just seeing someone in motion was often enough to prompt a feeling of connectedness: "I've been working a lot, and I'm not with [Ebony], so I've been looking at it just to see the motion on the phone" (Farisa). This connection and awareness didn't require any active communication yet served to remind them of each other and reassure one of the other's well-being.

In addition to the availability and coordination mentioned above, the music presence application offered participants a constant awareness of each other's music. This often led to

later communication in person or over instant messaging including both positive and joking comments about song choices.

In these cases, sharing presence in the mobile environment helped participants feel connected to each other and created a sense awareness of others. Ruth Rettie found that in desktop-based presence interactions, users often feel in touch with each other even when no explicit message is exchanged.[7] We've seen these behaviors amplified in the mobile context, inspiring feelings of connectedness from any location at any time on a personal device.

Shared Experience

Beyond offering awareness of someone else's activities, these technologies let people feel like they're part of experiences occurring at another place. One participant used the photo presence application to help coordinate her outfit: "I was trying to describe my outfit to her, because I didn't match at all, and I realized I could just take a picture of it and put it up on TileFile and you can see it. So that's what I did!" (Gail).

Dana, a participant in the motion presence study, always walked his dog with his girlfriend after work. When he was away on a business trip, he looked at his phone at that time to see his girlfriend go from "not moving" to "moving." Just by seeing this status change, he felt connected to that normally shared event. Participants in the photo presence study also used shared presence information to connect to specific events occurring far away. Eric told us that "there's something satisfying about the immediacy of [knowing that] right now, in California, my brother is doing this."

Our participants viewed parts of their friend's lives that were previously unavailable. Felicity enjoyed "being able to log on and see what [her friend] was doing, like when we were at work and couldn't talk." Finally, in our location- and activity-sharing study, we observed participants watching television shows together while talking on the phone. We see shared media watching as an important trigger for sharing experiences around content.

These context-moderated shared experiences let participants connect over a distance and feel a connection to others whom they couldn't physically be with at a given time. These windows into each other's worlds can strengthen relationships and build memories, much like face-to-face shared experiences. Promising new types of communication that allow sharing of experiences across distance are possible with mobile computing devices that capture context and media.

Persuasion to Communicate

Conversations about media and events in people's lives have strong social power, and we believe that systems should make it easy for people to initiate communication based on others' contextual information. As Bob, a participant in our photo presence study, said about commenting: "It shows that they were interested in what I liked. Took enough time out of their day to make a comment. For some people, this might brighten up their day."

The motion presence study also demonstrated the power of context as an impetus for communication. Events such as asking a spouse to stop for milk because he was on his way home, or calling friends when they went out, are examples of how simple cues can spark a conversation.

In our music study, participants chose particular music to get their friends' attention and persuade them to initiate communication. One participant started playing songs with her name in the title, hoping her friends would notice and say something to her. They did notice, and all commented about the event. In another instance, Bianca chose to play a song that a friend had recommended. The friend noticed and told us that seeing that song come up "was cool. I got her into that band. It's a good feeling."

Dean wanted to "call someone right as they listened to the song and say 'you just listened to that song, and it was awesome'" but never did because he felt that it would be "kind of weird" and not worth a whole conversation. Providing lightweight means to comment on media opens the possibilities for increased communication and affirmation from a person's social group.

On the basis of our observations, we believe that systems providing contextual content and allowing simple lightweight responses can help increase communication. We see these *ramping interfaces* as bringing users from ambient awareness (for example, presence updates) to lightweight communication (for example, emoticons or a thumbs-up) to deeper synchronous or asynchronous communication (for example, phone calls or instant-messaging conversations). Not every exchange will lead to a synchronous conversation, but a multitude of small, lightweight messages throughout the day can help people feel connected to each other.

The mobile phone is a unique medium for inspiring communication. By sharing more about ourselves with close friends and family, we create opportunities for deeper social understanding as well as increased communication around these details. As B.J. Fogg states, "Mobile phones will soon become the most important platform for changing human behavior."[8] We believe that one important change is

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strengthening understanding of others by increasing communication among strong-tie social connections.

Transmission of context can increase feelings of social presence[9] and enhance the richness of existing communications such as phone calls and text-messaging conversations. The additional information helps people interpret others' context to better plan and structure subsequent communication.

However, not all is as clear as it might seem. Researchers need to address privacy considerations in mobile social-presence applications and create an efficient management system. Also, constant awareness of friends and family might not always have positive outcomes. If friends learn that they have less in common than they thought, the technology might actually damage their relationships. People must be careful in determining which context to share.

As pervasive communications media evolve over time, context sharing will be a key piece in creating environments that connect people across distance and create rich shared experiences from any place, at any time.

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