MANAGING THE PARADOXES OF MOBILE TECHNOLOGY

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This article reports on a large-scale, international focus group study that examined the experiences of mobile technology users in Hong Kong, Japan, Finland, and the United States. It identifies eight central mobile technology paradoxes that shape user experience and behavior, suggests possible design features that relate to the experienced paradoxes, and discusses how these features could be better managed.

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*T*HE MOBILE PHONE HAS ARGUABLY evolved into the first truly personal computer. It combines communication and computing capabilities with mobility and personality. Unlike desktop or even laptop computers, the mobile phone is typically always with its user. It is rarely separated from its owner, and it is in use, or ready for use, all the time. Users develop deep relationships with their mobile devices (Kopomaa, 2000; Rheingold, 2002; Lyytinen and Yoo, 2002). Of course, they use them to perform utilitarian tasks, but, increasingly, they also use them as personal expressions of their identities. As technology transcends many facets of users' lives, expectations about service capabilities clash with performance in reality. Users' experiences with technology are paradoxical.

The positive and negative impacts of mobile technology are conceptually inseparable and grow in strength with new releases. New designs of handsets and service functions are continuously introducing new capabilities and improving performance on some dimensions (Schlosser, 2002; Balasubramanian et al., 2002; Jarvenpaa et al., 2003; Urbaczewski et al., 2003; Dekleva, 2004; Frolick and Chen, 2004; Jarvenpaa et al., 2005). But new capabilities often negatively affect user experience on other dimensions. Pogue (2005a) reviews a newly released mobile phone that offers a number of advanced features, including a high-resolution digital camera, a business card scanner, speech recognition, TV and video display, built-in Trans Flash memory cards, and others, and concludes:

> The trouble is, all of these features saddle the poor little device with a complexity that will boggle even the veteran cell fan. Just looking up your own phone number requires eight button presses.

The idea that technology is paradoxical and behaves paradoxically has been noted before (see, e.g., Mulgan, 1998). For the purpose of this article, we define paradox as *a situation, act, or behavior that seems to have contradictory or inconsistent qualities.* Arnold (2003), in his review of prominent philosophies of technology, points to Heidegger as the source of the position that our world is enframed by technology, in an ambiguous but not in a determined way. Heidegger claims that (communication) technology destroyed distance by destroying closeness, that technology didn't bring people closer together but merely created a condition wherein everyone is at the same

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time close and far, independent of geographical distance. Easterbrook (2003) argues that the technologies that brought progress have also created economic and social paradoxes that increasingly challenge people in their individual and social lives.

In a more business-oriented approach, Handy (1994) makes the case that the ability to manage paradoxes is key to corporate success in today's high-tech world. Similarly, Mick and Fournier (1998) describe a postmodernist consumer society in which consumers are confronted by multiple and conflicting consequences from the consumption of products that provide them with both new freedoms and new forms of enslavement. Among the information systems researchers, Orlikowski (1991) and Chinn (2001), for example, discuss the paradoxical nature of information technology (IT). In an article debating IS research directions, Robey and Boudreau (1999) call for efforts that explicitly address the ambiguities resulting from IT rather than eliminate contradictions for methodological convenience.

In the present article, we discuss manifestations of paradoxes with regard to this technology. To better understand the contradictory and ambiguous reality of mobile technology use, we conducted an international focus group study in which we examined the larger question of the value mobile devices and services really offer to their users. Specific research questions included the following:

- Why and how do people use mobile devices and services?
- What value do mobile device users perceive in their personal and professional lives?
- What frustrates or frightens the users?
- How have mobile solutions influenced their lives — how do they interact and spend time with colleagues and friends?

After analyzing the user experience, we discuss the design and use features that relate to the paradoxes and their management.

RESEARCH STUDY

We conducted 33 focus group sessions comprised of 222 urban mobile device users in four highly developed countries with a high penetration of mobile technology devices. The sessions were held in the metropolitan areas of Helsinki (Finland), Tokyo (Japan), Hong Kong (China), and Austin, Texas (United States) from January to October 2001. As a qualitative research method, focus groups use the interaction among participants to reveal shared reactions, issues, experiences, and opinions on the topic of the study. Sessions are recorded and transcribed to produce qualitative data that can be analyzed for theoretical or applied purposes by using, for example, the grounded theory method (Strauss and Corbin, 1998). This research followed the commonly accepted guidelines of focus group research (Krueger, 1994; Fern, 2001).

For the purpose of this article, we define mobile technology as handheld IT artifacts that encompass hardware (devices), software (interface and applications), and communication (network services). Because they are so intertwined, it does not make sense to disentangle device, interface, and applications when studying how mobile services create value for users. Our definition includes mobile phones, portable digital assistants, and integrated wireless enterprise solutions such as the popular handheld BlackBerry™. Advanced mobile phones provide mobile Internet access via 3G networks. However, wireless laptops and other WiFi- or Bluetooth-enabled devices were not considered for this study because they depend on short-range network signals, which strongly limit their mobility.

All 33 focus groups were urban based, but they varied in age, gender, culture, and economic standing. For each focus group we selected voluntary members who were considered representative of a social group that was meaningful for this study. Within groups, we sought group members homogeneous in educational background and social status. Across groups, we sought to represent diversity and included a variety of user profiles that could be considered a fair approximation of general mobile technology users, albeit not representative in a statistical sense. The groups ranged from ten-year-old girls and boys to adults in various professional and age groups.

When possible, focus groups occurred in familiar and relaxed settings (e.g., someone's home or a restaurant of their choice). In other cases, behavioral labs and meeting rooms on a local university campus were used to run the session. Locally hired moderators who had previously acted in similar roles ran the focus groups. The main role of the moderators was to facilitate productive discussions among group members. Anonymity was maintained in data collection and analysis procedures and was conveyed to members to encourage more open and truthful discussion. The focus group discussion

questions were made as broad as possible to ensure open forums. The open-ended approach naturally uncovered issues that were salient to the individuals in the group without biasing the members toward specific issues the researchers thought were important. For example, we never used the word "paradox" or any other term that could have led participants to talk about experienced tensions from using technology; nor did we ask them explicitly to tell us about their strategies for dealing with the challenges and complexities that arose from using mobile technology.

Each focus group session lasted from about ninety minutes to two hours and was conducted in the local language. Finnish, Japanese, and Chinese session transcripts were translated into English before we began coding and analyzing the data. From the data emerged central paradoxes that shaped user experience as well as some situational factors, different purposes for using mobile technology, and strategies that users developed to cope with challenges. Initially, we identified 23 paradoxes; however, after crosschecking the literature and several iterations of regrouping data and labels, we arrived at eight paradoxes that seemed both fundamental and specific to mobile technology.

MOBILE TECHNOLOGY PARADOXES

Our findings suggest conceptualizing the phenomenon of mobile technology usage experience from a context-based and process-oriented perspective (Orlikowski, 1993). The process of experiencing mobile technology from the user's perspective is depicted in Figure 1; it shows the main concepts that emerged from our data and the relationships that indicate significant interactions between them. Among the focus group participants, voice communication clearly dominated the usage profile, followed by data services such as e-mail, Web browsing, and text messaging. Other informational and transactional services were only moderately used on a regular basis.
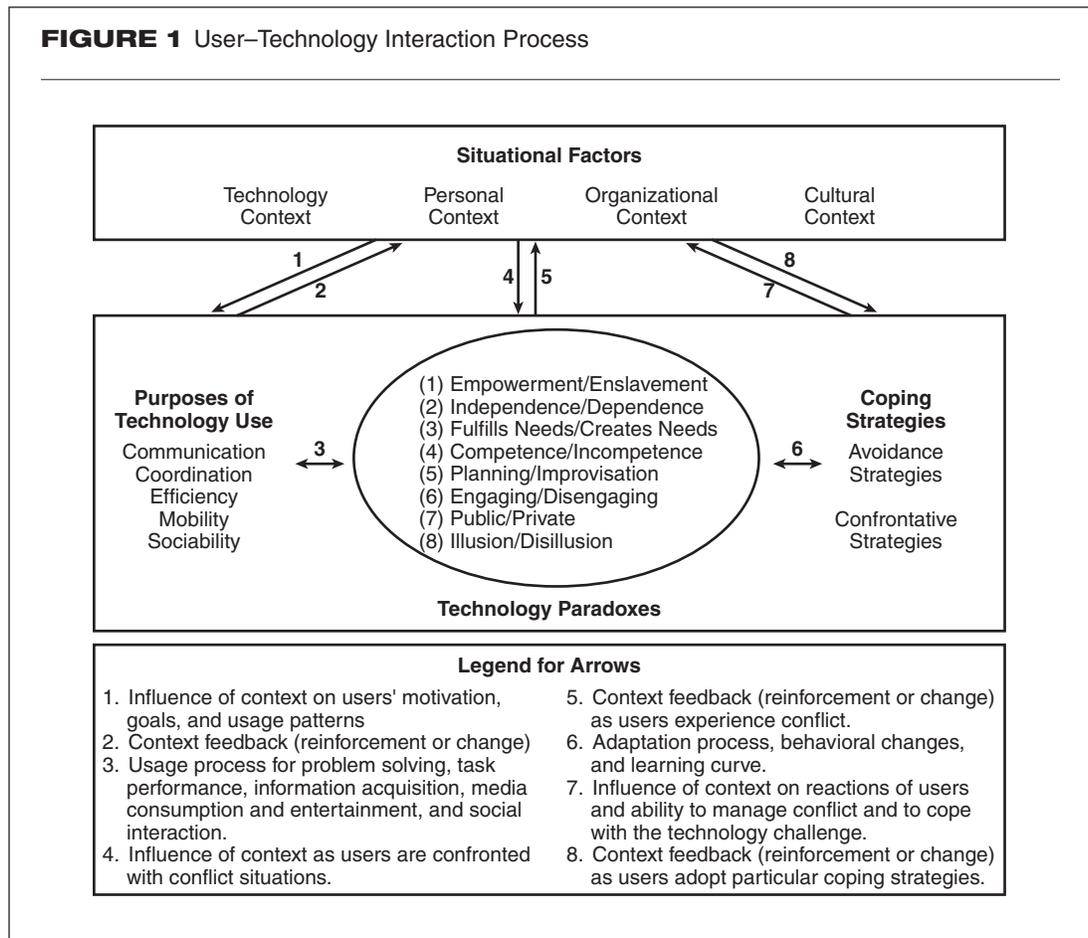
Although users almost universally acknowledged that mobile technology had improved their lives in terms of convenience, flexibility, connectedness, and new freedoms of choice, it became apparent that their overall experience was, to a large extent, determined by conflict situations they had encountered. By conflict situations we mean circumstances that prompt users to take actions whose consequences clash with their original intentions or expectations. The process model in Figure 1 does not explain why and how consumers decided to acquire mobile technology. Mobile technology penetration rates approach or exceed 100 percent in the four countries selected for this study. In societies where most people between 16 and 60 own mobile devices, adoption decisions relate more to switching and upgrading models than to becoming first-time users. Hence, the adoption decision is treated as an exogenous prior event in this article.

The actions and experiences of mobile technology users depend on situational and contextual factors (see Figure 1). The given technology, social (personal or organizational), and cultural contexts influence users' motivations, goals, and usage patterns when using mobile technology for a particular purpose (arrow 1). Technology factors include the particular composition of the service portfolio to which a user subscribes, the complexity of devices and applications in use, and the frequency and intensity of mobile technology use. Social context refers to the user's personal basic social unit; that is, for example, whether the person lives with family or alone. It also distinguishes between in-group and out-group communication and differentiates the varying personal experience levels of users with regard to mobile technologies. Social context also refers to organizational factors such as organizational structure and organizational policies and practices that determine the role of mobile technology in the firm. This includes how a company regulates the use of mobile technology. For example, some companies mandate the use of mobile technology for some jobs. Whether technology usage is mandatory or voluntary influences how employees use and perceive it.

Cultural context refers to cultural differences, for example, between individualistic societies (e.g., Western countries such as the United States and Finland) and collectivist societies (e.g., Asian countries such as Japan and China). Another important cultural factor relates to technology use among different age groups (youth versus adult culture).

Decisions to use mobile technology in different situations for different purposes provide accumulative context feedback over time, which can change or reinforce those contexts (arrow 2). Purposes of technology use include communication (voice and data), coordination (tasks and people), and sociability (family, friends, and colleagues). But regardless of the specific purpose, eventually and recurrently, technology use will create conflict situations

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FIGURE 1 User–Technology Interaction Process

Situational Factors

Technology Context   Personal Context   Organizational Context   Cultural Context

1 2 4 5 8 7

Purposes of Technology Use

Communication
Coordination
Efficiency
Mobility
Sociability

3

Technology Paradoxes

(1) Empowerment/Enslavement
(2) Independence/Dependence
(3) Fulfills Needs/Creates Needs
(4) Competence/Incompetence
(5) Planning/Improvisation
(6) Engaging/Disengaging
(7) Public/Private
(8) Illusion/Disillusion

6

Coping Strategies

Avoidance Strategies

Confrontative Strategies

Legend for Arrows

1. Influence of context on users' motivation, goals, and usage patterns
2. Context feedback (reinforcement or change)
3. Usage process for problem solving, task performance, information acquisition, media consumption and entertainment, and social interaction.
4. Influence of context as users are confronted with conflict situations.
5. Context feedback (reinforcement or change) as users experience conflict.
6. Adaptation process, behavioral changes, and learning curve.
7. Influence of context on reactions of users and ability to manage conflict and to cope with the technology challenge.
8. Context feedback (reinforcement or change) as users adopt particular coping strategies.

for the user, although the specific nature of the conflict may differ between, for example, maintaining social relationships and performing business tasks (arrow 3). Obviously, not every task or event in the user–technology interaction process will generate paradoxical situations, but sooner or later users universally experience conflict. Furthermore, users are unable to eliminate tension with the technology. Repeatedly, users run into conflict situations that are shaped by technology paradoxes. Again, context-dependent (arrow 4) conflict situations arise from paradoxes that are inherently and systemically linked to technology use.

The repeated confrontation with paradoxically behaving technology significantly affects the total user experience. Reinforcing or modifying context feedback is generated as users experience conflict (arrow 5). A direct response to the challenges presented is the development of behavioral strategies to help users better cope with these conflict situations (arrow 6). We identified a number of coping mechanisms that can be broadly classified into two categories: avoidance and confrontative coping strategies. The

former refers to user strategies that try to minimize interaction with the technology and the latter describes strategies that are based on negotiating with technology. The particular reactions of users and their ability to manage conflict and cope with the technology challenge are once more influenced by situational context factors (arrow 7). Context feedback is generated as users gain experience with coping strategies (arrow 8). In the following sections, we elaborate on the technology paradoxes faced by the mobile users in this study.

The Empowerment/Enslavement Paradox

New freedoms of choice from mobile technology use surfaced as a highly salient issue across all types of users. Nearly everyone praised new possibilities related to the 24/7, "always on" nature of mobile technology. Permanent connectivity allows people to take charge anytime, wherever they are, whether it concerns business, family, or friends. This newly found freedom definitely empowers users. But the very same connectivity prevents users from creating

and maintaining distance from others. "The fact that you have to interact with these devices is bad," explained one participant. It has become difficult to get away from people with whom you would presently rather not communicate. An elderly woman reminisced about old times,

> … when we did not have any of these technologies. Doing any kind of job was really hard back then. I can tell you that the cell phone really is a tremendous safety and access device. But I should be controlling it, not it controlling me.

The unpredictability and uncertainty of if and when a call may come and demand unwanted attention counteract the power that users derive from the technology:

> I am in a dilemma that I cannot leave my cell phone at home, but just the fact that I am always connected is stressful.

> Availability all the time! This is not what we humans were made for. And with GPS [global positioning system], it feels like the last piece of privacy has been taken away.

Some users had a pretty good sense of the power they could exert but also anticipated that it could backfire in just the same way:

> The mobile is great for controlling other people, like your wife and kids, for example. That would be pretty good if I had the choice to decide who knows where I am and where I have been.

> Life has become so un-free. The mobile even rules kids' lives.

Many users reported great pressures and felt forced to respond to the technology, whether or not they wanted to. Some feared that they had become slaves to the machine.

The workplace was another area where the empowerment/enslavement paradox manifested itself on a regular basis. Most professionals welcomed the introduction of mobile technologies in their companies. They appreciated increased productivity, more flexibility, and more efficient ways to coordinate tasks and people. However, the same tools that empowered them in their jobs in so many ways also took away long-cherished freedoms in others. Besides "less personal time," study participants frequently cited increased work pressure, closer monitoring and supervision, and the inability to separate and keep distance from work. Participants expressed displeasure having to play multiple roles at all times, especially having to constantly switch between family and work roles.

> Sometimes while driving, I feel like instead of relaxing, I should be more productive, like calling people back, calling my customers back. Sometimes it's good that people I am working with can reach me 24 hours, 7 days a week. Sometimes, however, it might be destructive; it makes me feel I should be working more than I am.

> I think there would be a problem if I turned my walkie-talkie off. My boss doubts that I'm working properly if he can't reach me. Yes, and he'll be very angry if he can't get ahold of us. It's very important to react promptly.

> In our business, schedules are pretty tight. If you are on your vacation and your project is not done … this is not something that you are able to do anymore. Whenever I am about to take a vacation, my boss tells me to keep my cell phone and pager on. To me this is not a vacation at all.

Not surprisingly perhaps, a few participants expressed the need for presence management, including features beyond caller ID that would allow them to screen incoming calls more effectively and thus regain some control over their availability to others.

Some participants expressed concern that the device manufacturers were deliberately trying to tie their customers to their specific product designs. Thus, if you want to enjoy the freedoms their technology promises, you will be bound to a particular company, either through long-term service contracts or intricate design logics:

> If you buy, for example, a [name of a specific manufacturer] phone, you will get so used to their interface logic. So after that, it becomes very hard to switch to another manufacturer's design logic. They lock you in after you have chosen your first model.

The Independence/Dependence Paradox
"My cell phone does everything," said one focus group member. More independence through mobility was a freedom enjoyed by the participants of our study. But it became clear that the power to connect independent of

*M*issed calls attain a more meaningful status than most answered calls.

space and time created a new form of dependency that invariably coexists with independence. Or, as one of our participants described, "Always being available results in lack of independence. It is like having an electronic ankle chain." Although the resultant independence/dependence paradox could be considered just a special case of the previously described empowerment/enslavement paradox, it warrants its own category because this particular aspect was almost universally acknowledged as an issue with which users were struggling. Some denied technology dependency, or at least qualified it, but most found it quite difficult to break the "always on" habit they had acquired and admitted quite bluntly that they had become dependent on total connectivity:

> You can always leave your mobile at home, though I never do.

> For me, switching off my mobile is not difficult at all, if I can turn it to silence mode. But it's difficult for me to completely switch it off.

> No problem, as long as it is only for a short while.

> If I am not on night shift it's okay for me to switch it off at night, but I can't switch off my phone at work. I'm a production assistant in a TV station and I work in different locations. Everyone contacts me via my cell phone and it is the only connection between my boss and me.

> I even use my mobile phone at home. I guess I'm too lazy to go to the living room to pick up a call.

> I never turn my phone off. The day is ruined if you forget it home.

> I carry the battery charger with me all the time. I keep a charger in my car also. [And another person adds] I actually have several chargers.

> I can't go out without my mobile phone. It's always on and always with me. You can't just switch off your phone; people wonder where you are.

Being cut off from her usual mobile services, one participant experienced withdrawal-like symptoms, which fortunately went away after some time:

> Once I went on a trip to [nearby] Macau without my cell phone. Whenever I heard a ringtone I thought someone is calling me. I got so tense and thought it was my phone. But on the second day of the trip, I started getting used to living without a cell phone and I actually found it very relieving.

Once people get used to being always on, it causes them great discomfort when they need to disconnect, even if it is only temporarily. Most users loath turning off their devices for fear they may miss an important call. Missed calls attain a more meaningful status than most answered calls. The mere chance that someone may have tried to communicate something significant is given substantial consideration despite the fact that most of those calls turn out to be noncritical or outright trivial. This leaves users in a state of constant anticipation for some elusive messages that may never get sent. The possibility of failing to immediately respond to either a great opportunity or some emergency is perceived as a great threat, although it is understood, from a rational perspective, that the odds are rather small that an event with significant consequences would be passed over because of a missed call:

> My friends don't bother to leave messages on my answering machine. I have to have my phone turned on or in silent mode to know when they call.

> Sometimes when I forget to bring my cell phone, I feel very uncomfortable.

> I won't shut down my cell phone even during lectures, but I'll switch it into silence mode. I keep my cell phone on because I want to know when somebody calls me. I can tell from the caller ID.

> I don't turn it off even on the plane.

> Switching off the phone makes me feel so tense. I always worry if I missed any calls. What if someone called me and I didn't know?

> I'm looking at my cell phone at every chance I get.

> When I turn it off, my only concern is about the children … that I cut the connection with them.

I don't like turning the service off. I can turn the ringer off, but I don't like turning the service off.

Although "there was life before these gadgets," for most users, mobile technology has become part of their lives, for better or worse. Many agreed that "life without cell would be terrible" and that "once you get one you don't know how to live without it." Besides not having connectivity, people were afraid of losing or misplacing their devices, which routinely store irreplaceable contact information:

> When I was in Korea for half a year some time ago pretty much everyone had pagers or cells. It felt odd because I did not bring mine. Now, I would not give it away anymore. It has become important for me to know that I can easily contact people. It is good to know that you can reach people if you want to.

> One can't live without a cell phone. If you lose it, you lose all your contacts. The cell phone has become part of my life. At my age [teenager], we don't stay at home much, but spend most of our time on the street. It's just impossible to be without a cell phone, or else no one can reach you.

> It's always with me. If I lose it, I'll lose not only the phone, but also the information stored on the SIM card [address book]. People rarely use pens to write down phone numbers anymore. We depend much more on our mobile phones now. You may ask others to call you, so that you can store their number without having to write it down or enter it manually into the mobile.

> A rancher friend of mine was going mad because he left his PDA at a friend's house and he could not reach him for a couple of days. All his contact numbers were on it. When you rely on technology that much, it is hard to live without it.

In one interesting case, a father revealed that his son leaves his mobile at home when he goes out so that he can regain his independence. "My son doesn't feel like bringing his cell phone when he's out. He claims that his cell is too unfashionable. But I think that's just an excuse. If he doesn't have his phone with him, I can't reach him." To which someone else

The Fulfills Needs/Creates Needs Paradox

Mobile technology "has taken simplicity out of our lives," commented one participant. Our data clearly shows that technology really is providing a solution to many problems that benefit mobile connectivity, but, at the same time, it has also caused a whole range of new problems, problems that users didn't have before or didn't perceive having. This can be as trivial as the new need of always "having to carry a bag that holds the mobile" or "the battery runs down quickly," but often it creates much more intricate needs. The irony that solutions create problems did not go unnoticed. One person urged, "It is very important that users think about what specific need a particular service is really satisfying," and someone else wondered, "if adding more services is really productive. Every time they add something, people have problems." Paradoxically, the same feature that fulfills a user need creates another one. Mobility fulfills the need for more security because it allows people to stay in touch — for example, parents with their children when they're out, spouses with each other when one goes on a road trip, or elderly people with caretakers if they encounter difficulties at home and can't reach the regular phone — but ironically this newfound security seems to create a new sense of vulnerability, as people fear, "what if I lose it?" Similarly, there was general agreement that "using a really posh cell phone makes it more likely that it will be stolen" and that mobile banking fulfills a great need "but creates some serious security issues."

A new need for privacy was recognized by a number of participants. This need arose because the devices had fulfilled the user's need to be able to talk in public places. Once users experienced situations in which they had a conversation in public that they really didn't mean to share with anyone, and certainly not with random bystanders, they realized that going public with mobile communication creates a new need for privacy:

> There is always somebody hearing what I am talking about on the phone. People around you hear you.

> I mean, is it safe to do any kind of banking over the phone? You got to say all the information aloud, even the secret

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Other examples illustrated how the use of a new competence can compromise another.

word. People can get your credit card number easily.

Most prevalent, however, were cases where users had taken an active step to fulfill a perceived need, only to find out that this same action created a new need. Sometimes this new need was simply wanting more of the same; that is, wanting more than they had previously felt the need for (e.g., more minutes than the current service plan allows). Sometimes it was wanting to add something similar, but something they didn't know they needed before (e.g., an additional device accessory or another data service). For some users, an action created the need to undo it or compensate for an unexpected side effect of it. Never reaching contentment, several users admitted that, as soon as one need is taken care of, they move on to find new needs they would like to have addressed.

The Competence/Incompetence Paradox

The ability to do anything, anytime, anywhere gives mobile technology users a whole set of new competencies. It allows them to do things they couldn't do before. It enables them to do things more efficiently and effectively than they could before. As people use their newly acquired, technology-enabled competencies to perform new tasks or perform tasks more efficiently and effectively, they soon experience a new sense of incompetence. Seemingly simple services turn out to be hard to use and newly gained efficiencies tend to be limited in scope and actually cause inefficiency at a higher level. The idea that a newly obtained competence lowers another, directly related competence or makes users experience incompetence, whether real or just perceived, emerged from our data in several different contexts. The most apparent case relates to situations in which users explore new device functions or try out new application services in the expectation of becoming a more competent user, only to be confronted with unexpected difficulties that leave them feeling less competent than before. Such less-for-more bargains were reported frequently across groups:

> I've used some of these [name of a mobile service operator] services, like getting address info via SMS [short message service]. But I couldn't remember the syntax to get the service to work for me. On weekends at my cottage I was some-

times trying to figure out how to get the results of the Formula 1 car races, but it was just too difficult.

> WAP [Wireless Application Protocol for Internet browsing] is entirely useless. After one week of trying, it was still too difficult to use. I thought I know something about IT and that I could use these services on my phone, but I was not able to do that.

> I won't be able to use all of the functions offered. In addition to the ones with so many features, I think it's necessary to offer a simple one for elder people.

> I don't use it [mobile banking] because I don't want to be worried about me making mistakes.

Other examples illustrated how the use of a new competence can compromise another. The new competence of talking on the phone while driving can make someone a bad and possibly dangerous driver. The new competence of using mobile text communication methods can negatively affect language competence. Relying on electronic memory may be detrimental to one's own memory. Using mobile technologies in meetings may give users better information but may be distracting and actually weaken their performance, thus, making them less competent participants in the meeting:

> I used to remember a lot of phone numbers from memory.

> It is unbelievable when people just drive and talk to their cells.

> Turns and lane changes are problematic when I am on the phone.

> SMS is impoverishing the language. It's a threat to language especially for young people.

> [Using mobile devices] can also be distracting in meetings.

In many ways, particular mobile services themselves turn out to be much less competent than expected when applied in varying situations and are often outright incompetent when used in ways that are only slightly different from the prescribed user instructions. In either case, mobile technology competencies are too often too narrow in scope and incapable of adapting to specific user environments to be of

much value. This leaves the user with the impression that the technology itself is incompetent or, worse, it makes users themselves feel incompetent as they struggle to make effective use of it.

Poor design or technical limitations such as small screen size, tiny input keys, or network constraints can render a service ineffective and make it look incompetent. On the other hand, complicated usage logic or incomprehensible behavior of a service diminishes self-efficacy and tends to create a sense of user incompetence:

> The screen of the cell phone is too tiny. It can't display enough information. I've tried, but it's useless. The cell must be bigger, it uses a lot of battery, and the display is too small. Some services are so slow that there is no real benefit.

> I would use mobile banking services if they were better.

> In my opinion, it feels funny to read long e-mails on a small cell.

> It would be nice if my phone worked more globally. Every time I go to the States my phone becomes useless.

> I used a flight arrival information service twice, but it gave me odd information. That was enough for me. I haven't used it since.

> I ordered a couple horoscopes, but it was not that interesting, so I just tried the service once. I tried to make an air ticket reservation … I did not like it.

Similarly, tools that are meant to offer users new competencies often break down when used in daily activities and create just the opposite effect. Designed to increase the efficiency of communication and coordination tasks, some services actually produce inefficiency when put to work:

> I don't think it can really support Internet services. For example, I don't think using a cell phone for e-mail is any good. It's too hard to type. If it takes me such a long time to write an e-mail, why not just give the recipient a call instead?

> It is interesting that it takes more time to write an SMS that says, "I am five minutes late," than to call and tell it.

> It increases your rush … when you are always available, you make more appointments, even when you are on the move.

Both e-mail and mobile phone calls have disturbed efficient working. … I do two minutes of something and then comes something else that disturbs my concentration. Concentrating on just one task at a time is not possible anymore.

The Planning/Improvisation Paradox

Mobile technologies can be employed as effective planning tools, allowing people to better coordinate meetings and plan work and social activities. One user, for example, said:

> I use the mobile to be polite and call to tell when I am five minutes late or I may check if the other person is really there where I am supposed to pick him up. … It is used for being polite and checking things.

Users can prepare schedules in advance, then update and refine them, independent of time and location, and provide involved parties with additional information as they go along. This should result in more efficient planning and less unproductive time. In practice, however, the opposite occurs all too often. Knowing the powers mobile technologies bestow on their owners, people tend to spend less time and effort working out schedules and, instead, rely more on the technology that allows them to make up for lack of preparation with continuous improvisation. Some users welcomed this new flexibility that makes "life more unplanned because you can plan on the spot," and found it liberating that "you don't have to make arrangements in advance anymore if you don't like." To some extent, technology substitutes for planning rather than augmenting it.

Moreover, some people seem to lose the skill to plan ahead and simply "are not able to make appointments in advance anymore." Several participants described situations in which vague planning of a meeting led to numerous changes and improvisations, resulting in extra coordination efforts, modified agendas, and, in the end, increased lateness, leading to less time spent together:

> Even at parties, people come at their own time now and it's become impossible to get everybody together at the same time. I think about like those welcoming toasts that we used to have, for example. You simply can't have everyone around at the same time anymore.

Poor design or technical limitations such as small screen size, tiny input keys, or network constraints can render a service ineffective and make it look incompetent.

Although mobile technologies are designed as instruments for supporting control, they can create chaos if improperly used.

In the past, I used to schedule the meeting time and meeting point in advance when I had a date with friends. But now, I usually make up a rough meeting time, then call up my friend and confirm the exact meeting time with the cell phone when I am about to arrive.

Technology has been changing people's behavior. It used to be socially unacceptable to be late, without a reasonable excuse. But now being late is almost expected; it has become the norm. It is acceptable as long as you update your party on your whereabouts and report how you are progressing toward the meeting, even if you are arriving late or not at all. What is unacceptable, however, is not having a mobile phone and thus being out of reach. Forgetting the mobile at home or running out of battery have become inexcusable faux pas that can easily result in social exclusion. Another consequence of this emerging improvisation culture is the erosion of social conventions regarding acceptable calling times:

It has [for example] become easier to get ahold of a married friend. Since he answers his cell phone, I can call him in the middle of the night without giving any consideration to his family members.

Too much improvisation causes disorganization. Although mobile technologies are designed as instruments for supporting control, they can create chaos if improperly used. Too much communication creates chaotic disturbances in people's physical space; receiving too much information leads to information overload; and messages are sent and ignored, which triggers more messages and corrupts social communication protocols. Senders no longer know which of their messages have been received and recipients lose messages in an uncontrolled fashion:

I attended a Formula One [car] race once and could not follow the race because I had to send SMS messages all the time.

Of course, I want more information but, on the other hand, we get too much information to deal with. It should be simpler. It can be damaging to your personal life.

Sometimes, I want to erase messages without having to listen to them. It is tiresome to have to listen to messages before you can erase them.

The Engaging/Disengaging Paradox

Mobile technology enables users to choose when to engage in a discourse and when to disengage. This desire to retreat from stressful environments, but at the same time staying involved, surfaced in several of the focus group discussions. For example, one participant expressed that:

People want to know what is going on, but on the other hand, they also want to be in the middle of a forest … meaning that once you have all these communication tools you want them to work in remote areas also.

Unfortunately, most people find it difficult to engage in parallel activities, to engage in something new without disengaging from something else. When calls interrupt a conversation (in the physical space), the caller will typically abruptly disengage from the current conversation and engage in a new one, often leaving others stranded. When driving, people make calls and engage in conversation while disengaging from their driving activity:

And in meetings, the call comes first. I am there in person … but it feels that it would have been better to call and not bother to come in person.

If I am talking on the phone while crossing the road, I am less aware of the traffic situation.

The most serious problem [with mobile technology] is your lack of personal attention, especially while driving. It is the most serious problem. It is a risk to yourself when you're in the car, but others' driving is a problem for us too.

The realization that mobile technologies "might be a detriment to other kinds of communication" was widely acknowledged. Communication patterns in the family home have been altered since the fixed-line family phone lost its role as the communication hub in the home:

The phone at home does not ring that much anymore since everybody has his own cell phone. When it does ring, it usually is somebody trying to sell us something. No one else calls our home phone anymore.

Although technology can support users in managing multiple virtual communication spaces, it cannot eliminate interference with activities in the surrounding physical space.

When family members, especially teenagers, develop their own personal mobile communication channels, they are prone to disengage from family life. "I would be even less home, if I didn't need to go home to read my e-mails [on the desktop computer]," conceded a young girl. Parents in the study generally thought that heavy use of mobile technology among teenagers is detrimental to family life and social interaction. Many users expressed concern that engaging with mobile communication technologies may lead users to disengage from face-to-face social activities:

> It decreases the time the kids spend with their friends. Even when they are together, they just use their mobiles and chat.

> They are teaching our daughter technology rather than content. The kids don't learn how to conceptualize anymore, only how to use tools. The new generation is not learning how to interact with others; they are learning to be disconnected — becoming antisocial.

> There are a lot of activities that I don't do anymore, like visiting my friends. I've noticed that I have not talked much with some people lately, because I use e-mail and SMS all the time.

> When I see someone with lots of pagers, phones, and other devices on them, I don't find it very nice. I wonder, who do you belong to?

The Public/Private Paradox

Mobile technology devices are usually considered personal tools for private communication. Users are able to set up their own personal virtual communication spaces anywhere, anytime. In the past, personal communication, voice or data, took place only in personal physical spaces such as the office or the home, where it was by and large possible to set and control an adequate level of privacy. Now, freed from spatial and temporal constraints, people are increasingly taking private conversations into the public space. This can create friction and interfere with other people's activities and privacy. When exchanging messages or talking, the conversing parties create virtual communication spaces. Although technology can support users in managing multiple virtual communication spaces, it cannot eliminate interference with activities in the surrounding

physical space. It is not just the noise and chatter that disturbs people. Overhearing calls that take place in public, often unintentionally, and hearing only one part of the conversation, makes people wonder about the missing pieces and the absent person. It involuntarily draws them into interpersonal exchanges that should be private but are happening in public.

At the same time, people assume different roles as they switch between physical and virtual space, displaying behaviors, gestures, and emotional states that may befit an ongoing virtual interaction but may appear out of place in the context of the present physical space:

> There is no peace on trains anymore, or in other public places — there is always someone talking on his mobile. It is disturbing.

> People talk just about anything, anywhere. On buses or at the airport, for example, people talk business all the time. It seems that industrial espionage would not be that difficult; people do not think that other people can hear everything.

> Other people's mobiles sometimes disturb in public places. For example, when someone writes SMS messages on the train — it is annoying. Keypad clicks bother me even more than ringtones.

> As far as manners are concerned, I prefer not to be forced to listen to someone else's private conversation. It breaks my concentration.

The Illusion/Disillusion Paradox

When users in our study acquired their first mobile devices or upgraded to newer models and services, they did so with certain expectations of partaking in joys promised and promoted. Whether these expectations were reasonable or unrealistic, people anticipated that their new gadgets would make their lives easier and enable them to do things they couldn't before. Users came away disappointed when they realized the new designs delivered only a crude approximation of perceived promises. Many users recounted frustration and disillusionment as they discovered that *anywhere* communication really means in some places and areas only, because limited coverage and dead spots seriously constrain connectivity. As one respondent lamented:

When I tried to send data from the Shinkansen [Japanese bullet train], the transmission was interrupted every time the train went through the tunnels.

Likewise, *anytime* communication is severely compromised by short battery runtimes:

If I don't use my phone, the battery will last for three days. But, if I use it a lot, the battery won't even make it through the day.

Of course, anytime also requires that the intended communication partners are available and willing to communicate. Lastly, *anything* barely covers voice communication, because many connections are unstable or of poor quality, and hardware and bandwidth limitations render access to Web sites and delivery of multimedia content inadequate. For example, one user thought:

… it is a great idea to make comics available over cell phones, but the screen is too tiny. It takes the fun away.

In general, disillusionment regarding newly marketed wireless services was prevalent. "I think of WAP services [for browsing the Internet] as Tamogotchis for adults!" exclaimed one participant. Whether because of hardware limitations, clumsy user interfaces, slow or spotty connections, poorly designed services, or limited trust in these services, users perceived many of the new mobile services as inferior substitutes for similar wired Internet services or immature offerings that provided little or no value to them:

Games are great; that is, if you want to run down your battery!

We have GPS [global positioning system] in our car, but it doesn't feel useful at all.

A couple of weeks ago when I picked up my parents from the airport, I ordered an SMS service that delivered flight information to my phone. I guess the service worked, but the information that the flight was three hours late became known only 15 minutes before the scheduled arrival time at the airport.

There is a lot of advertising on these new SMS-based services. But how can you remember how to get these services to work? You have to remember a bunch of phone numbers, you have to remember the correct keywords, and also the right syntax … it is too difficult.

When adopting new mobile services, users were under the impression that they would enjoy an upgrade in service level or quality, but after using the new services, users felt they were quite inadequate for the given tasks and actually perceived a service downgrade. For example, the ability to access the Web with mobile phones promises a service upgrade, but the actual experience of struggling with small keypads and screens and slow connections creates the perception of a downgrade, especially when contrasted with the ubiquitously available wired Internet or wireless WiFi networks. Difficult-to-use interfaces and cryptic command syntaxes were also significant factors contributing to disappointment about new services:

I feel this Internet and mobile thing is like skis that are designed for classical style Nordic skiing and freestyle Nordic skiing. The middle way may not be the best — some services belong to the Internet and others will be mobile.

Since we have computer and modem everywhere, we don't need to use cell phones for Internet access. The screens are too tiny for using the Internet, and the connection is too slow. Keying characters in is not that difficult, but I cannot type fast. Three lines seem to be the maximum one can do at a time.

It's kind of strange to use a cell phone for Internet access. I've gotten used to using the PC for Internet access. I have a big color screen and other features too.

A few people pointed out that more communication does not necessarily mean better communication and that the ease of communicating with mobile technologies may have increased the quantity of communication but, at the same time, decreased its quality:

Compared to the time of letters and telegraphs, cell phones facilitate more communication. However, compared to a fixed-line phone, the content of the communication has become trivial. With a stationary phone, I would prepare myself mentally and call in a quiet environment, but with a cell phone, I end up calling without giving any thought.

Difficult-to-use interfaces and cryptic command syntaxes were also significant factors contributing to disappointment about new services.

My kids are connected too. At a recent school event, four out of six students and two out of four adults were all talking on the phone. I wonder how crucial these talks could have been.

System designs that align well with users' personal coping strategies will be more successful than designs that bank on the latest bells and whistles.

IMPLICATIONS FOR PRACTICE
Designs that Support Individual Coping Mechanisms

Better management of the resulting tension in the user–technology relationship emerges as a key challenge in designing mobile solutions. When users are regularly confronted with the different manifestations of technology paradoxes (as described previously) it impacts them not just on a functional level but also emotionally. When the technology works according to expectations, or beyond, users feel joyous, delighted, and empowered and experience a sense of belonging as they build social and professional relations. On the other hand, when it doesn't, they feel angry, frustrated, fearful, stressed, lonely, and depressed.

As a result, and in order to maintain emotional poise, users develop mechanisms to cope with technology paradoxes. As indicated in Figure 1, we identify a number of particular coping mechanisms that can be broadly classified into two categories: avoidance and confrontative coping strategies (Holahan and Moos, 1987). The former refers to user strategies that try to minimize interaction with the technology. Choosing to ignore, neglect, suspend, distance, or (in the extreme) abandon technology use are examples of avoidance strategies. Avoidance may be selective in terms of people, services, situations, and personal state of mind. Not calling people or not bothering with trying to figure out how to set up a new data service, for example, are common ways for users to deal with technology. Avoidance is a typical reaction when technology appears confusing or unreasonably demanding and occurs especially in situations where users are under stress or pressure. The increasing ubiquity of mobile communication contributes to user overload; that is, information and communication overload.

Other users, however, take a different route and confront technology when it behaves unexpectedly. Confrontative coping strategies describe user actions (and reactions) that aim at understanding and accommodating technology. These types of users spend effort learning how to use features and services and are willing to adjust their expectations as they better understand the possibilities and constraints of mobile technology. The user–technology relationship is seen as a partnership.

The particular coping mechanism that a user cultivates is a personal matter, but we suggest that device manufacturers and service providers can design products and services that better assist users with balancing technology paradoxes and thus also help them with developing more effective coping strategies. Users who are comfortably and confidently coping with technology are happier and, usually, better customers. In other words, users who deal better with technology paradoxes will engage more productively with mobile solutions and are more likely to develop more positive partnerships with mobile technology. Those customers are also more likely to increase usage, upgrade device models, try out new services, and generally spend more money on mobile technology.

Table 1 indicates possible directions for design solutions that can help bridge the main technology paradoxes and, thus, contribute to better supporting the various coping mechanisms users adopt. Although the development of detailed specifications for design solutions for both device technology and service applications is beyond the scope of this article, we argue that it is important to make systems available that put the user in control — systems that are easier to grasp and easier to manage.

System designs that align well with users' personal coping strategies will be more successful than designs that bank on the latest bells and whistles. This means different levels of capabilities and technical sophistication should be developed for different consumer groups. For example, seniors may prefer simple solutions and may be willing to pay for extra services and accessories that help them do away with small screens and keypads and complicated user interfaces.

Users are happy when their mobile devices act like reliable allies that don't miss important communications, don't reveal private information, improve their professional and social performance, protect them from unwanted requests, and provide them with joy, comfort, and security. Today's available technology can deliver those things only partially. When technology does the opposite of what is expected, the ally turns into an enemy and users are forced to renegotiate the relationship with their mobile partners.

TABLE 1 System Design Options for Balancing Technology Paradoxes

Technology Paradoxes	System Design Needs	Possible Design Features
Empowerment/Enslavement	Presence management	Prioritizing messages Filtering messages Indicating availability status
Independence/Dependence	Presence management	Summarizing usage information Categorizing usage information Presenting behavioral information
Fulfills needs/Creates needs	Change management	Managing software upgrades Managing service changes Aiding system installation
Competence/Incompetence	Simplification, customization	Streamlining services Reducing complexity Differentiating device and service options Personalizing system configurations
Planning/Improvisation	Collaboration support	Synchronizing clock and event time Managing updates Sharing information
Engaging/Disengaging	Context awareness	Activity-based responses Relaying context information
Public/Private	Role management, location awareness	Choosing roles Sharing location information Place-sensitive user interfaces
Illusion/Disillusion	Context awareness, location awareness	Context-sensitive responses Location-sensitive responses Personalized interfaces

For system designers, however, these problems also offer opportunities to develop solutions that better suit user needs. Although offering better privacy protection and data security features is clearly necessary, adding context awareness is perhaps the most promising direction for helping users better manage their mobile interactions. This extends to location awareness, role management, and presence management. Location-aware systems would adjust their behavior depending on the user's location. That is, the system could distinguish between office, home, travel, leisure, and social contexts and filter and display data and voice communication and information differently. Role management allows the user to selectively act in different roles. For example, family and work roles could be assumed at different times, implying different prioritizations for message management. Presence management allows users to set different availability levels to different people, signaling different communication levels depending on users' present situation and pursuit. Better change management needs to be provided to help customers navigate through needed service upgrades and avoid unnecessary setups and system changes.

However, design tradeoffs between privacy and awareness and between awareness and disturbance have been recognized as fundamental in the computer science literature and are unlikely to be eliminated (Hudson and Smith, 1996). Nevertheless, features that increase context awareness can significantly reduce the gap between users' expectations and actual technology performance in mobile communication.

Implications for Organizational and Industry Practices

Besides individual user-level concerns, there are also significant implications to practice at the organizational and the industry level. From a technology management point of view, organizations must consider several important issues when adopting mobile technology. Mobile technology, often acquired by employees who bring their own devices to work, has contributed to a blurring of the boundaries between work and leisure. At times, this allows management to push for increased work productivity

*F*irms that are able to provide highly differentiated service solutions to different customers are positioned to extract extra profits from the marketplace.

from their staff, but this is often achieved at the cost of higher stress levels and lower employee satisfaction. Clearer rules that separate work from family activities and establish reasonable organizational communication protocols are needed. Such rules could be encoded formally by businesses as technology usage policies. They could also be developed informally as part of organizational culture.

When companies choose mobile solutions, it is crucial to consider cross-platform interoperability and upgrade compatibility, especially because mobile systems are increasingly deployed off premises where they need to interact with external technology. Proliferation of devices, application services, and vendors creates numerous implementation possibilities but also uncertainties about the long-term stability and viability of particular technology configurations. Data security is another issue that needs to be addressed, because large amounts of sensitive data are transmitted over wireless networks.

Regarding mobile service and commerce providers, several interesting business opportunities should be explored. Location-based services using the global positioning system (GPS) to determine the exact position of mobile users offer an entirely new way of interacting with customers. For example, a coffee shop chain could lead its customers to the nearest branch outlet when they feel a need for a cappuccino or a latté. If companies succeed in providing products and services just in time, when the need arises as consumers move around places, they may be able not just to attract new business but also to charge premium prices for providing the pleasures of instant gratification.

Underserved customer groups are another area that could provide profitable business. This includes services that are tailored for seniors, teenagers, minorities, homemakers, and other people with specific interests and needs. Firms that are able to provide highly differentiated service solutions to different customers are positioned to extract extra profits from the marketplace. New service innovations such as ad hoc wireless community support are also expected to become viable business opportunities. Supporting professional meetings — for example, with mobile technology that lets attendees who may have never met communicate and — coordinate with each other and the organizers could indeed be profitable, because there is a captive audience that already pays substantial registration fees. In fact, some technology conferences are already experimenting

with short-range mobile communication chips, which are typically embedded in the badges that registered attendees wear in the meeting space, to provide ad hoc network support to the conference participants.

In terms of industry trends, it is clear that growth rates for voice communication are slowing as more and more markets reach saturation. Rates for phone calls continue to go down and there are obvious limitations to how much more people can talk on the phone. Hence, mobile data services, including media and entertainment services, offer the greatest business potential for service providers. This explains the continuing investments in 3G networks and 3G-enabled devices. Whereas data sales in the United States still lag behind Asia and Europe, spending on data services has been growing swiftly and is expected to become the main source for revenue and profits for telecom operators by the end of the decade. It is hard to anticipate what services consumers will be willing to pay for, but a big advantage for telecom operators is that they have long-standing accounting and billing relationships with their customers, who have generally accepted the payment of a substantial fee for mobile services every month. Although mobile shopping turns out to be difficult in general, there are also a number of unanticipated mobile commerce successes.

When location, time, or mobility really matters, consumers are willing to order and pay for mobile services. This includes mobile betting (in some places) and downloading ringtones and ringbacks, a business that has already surpassed selling digital music downloads over the Internet. Once again, to really entice consumers to embrace mobile commerce, service providers will need to offer a more balanced user experience. Tools for better managing technology paradoxes will be an essential component of future mobile technology solutions.

CONCLUSION

Technology paradoxes are an intrinsic part of the user experience. Because users engage in closer and more personal relationships with mobile technology than with other forms of IT, they feel the impact of paradoxical technology behavior more strongly. Currently available mobile technology solutions offer only limited assistance for balancing paradoxes when they occur.

Although our empirical analysis was largely based on data collected in 2001, we believe the

paradoxes that we derived, and their implications, have remained remarkably stable over the years. Technology writer David Pogue, for example, in his recent product reviews of state-of-the-art mobile phones (Pogue, 2005a) and palmtops (Pogue, 2005b), corroborates this view. Users develop their own coping strategies to deal with conflict situations caused by technology. The results of these ad hoc strategies are mixed, however. We believe technology designers need to address the paradoxes their solutions create and better integrate technology affordances and user cognition.

This article offers initial steps in that direction, but more research is clearly needed to develop mobile solutions that allow users to effortlessly garner the benefits that technology produces, without succumbing to the detrimental side effects that also occur. Studies that examine the impact of particular design features on the effectiveness of user coping strategies could contribute to this endeavor. In general, linking people to people who have come together to a particular place and supporting relationships between people and places is emerging as an active area for research and product development (Jones et al., 2004). Another interesting area for further research concerns how mobile technology can be used to increase the effectiveness of improvisational approaches to organizational problem solving. ▲

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