

Welcome to the Wireless World: Problems Using & Understanding Mobile Telephony

Leysia Palen

University of Colorado, Boulder

Marilyn Salzman

U S WEST Advanced Technologies

INTRODUCTION

Wireless telephony adoption is on the rise in many parts of the world (Cahners In-Stat Group, 2000), with recent technological innovations continuing to enhance the capabilities of the technology (McGinity, 1999). The market is extremely competitive. Service providers and wireless handset manufacturers, therefore, are faced with the challenge of designing wireless services and handsets to retain customers.

Because wireless technology is becoming a mass-market commodity, new novice, tentative, and price-sensitive customers continue to shift the nature of the user base. In fact, at the time of this study, U.S. service providers typically subsidized the handset prices to lower entry costs, losing money initially with the hope of long-term retention to recoup the outlay and generate profits. With the objective of increasing overall retention, one-year contracts, which often included an initial thirty-day grace period, were also common. Thus, the first thirty days were critically important to users and to service providers alike. We found that during this initial period, novice users struggle to understand the technology, how it fits into their lives, and if its benefits exceed its costs. Simultaneously, service providers strive to provide a positive customer experience so that their new users will be retained long-term.

It was within this context that our study was conducted. Our work was initiated by requests by a service provider to investigate handset usability issues. It was important that the handsets they acquired from manufacturers be well designed, because they were subsidizing the handsets, and because the handsets were perceived as playing an important part in the early customer experience. Therefore, we set out to explore handset usability in depth, while also taking the opportunity to look beyond the handset at other factors affecting the early customer experience.

This chapter reports on a study of novice users and the problems they faced using and understanding basic wireless telephony service during the first 6 weeks after adoption. We found that new users typically have poor comprehension of mobile telephony that continues to persist into at least the second month of use (and, we predict, continues well

beyond) (Palen, Salzman & Youngs, 2000). We also found that using service-based technologies like wireless telephony extends beyond a need for users to understand the hardware and software alone. In addition to the hardware and software attributes of the technology, features of the network and marketing communications directly affect how users perceive their handsets to function. In this chapter, we present particular findings about ergonomics, feature use, company communications, and bill design within an overall framework that describes wireless service from a user's perspective. This framework comprises four attributes of the wireless telephony technology system: hardware, software, network, and bizware.

Related Work

Published studies addressing mobile telephony use and usability issues are only now emerging; some existing work illustrates why it is important to look beyond the hardware and software of the technology to understand the user experience.

Helyar (2000) reports on the results of a usability study of wireless internet service for telephone handsets. Although the study was a traditional laboratory one with emphasis on the handset and services, Helyar found that issues beyond the immediate technology affected its usability. He notes that uncertain costs and billing cycles was a source of apprehension for subjects, and that users were confused by the computer jargon-influenced instructions. However, because this was a laboratory-based study, Helyar was not able to predict how these issues impacted user behaviors and attitudes over time.

Vincent-Vainio-Mattila and Ruuska (1998 and 1999) adapted Beyer and Holzblatt's (1998) contextual inquiry (CI) techniques to the study of mobile technology. Using this ethnographic approach, they and other Nokia researchers have gathered information about user needs, behaviors and practices by shadowing users in real situations. They have had success in using these techniques to inform the design of mobile technology.

METHOD

Our Approach

Our methodological objective was to situate our inquiry in the real activities of novice users, while studying them longitudinally to cover a wide range of naturally occurring user experiences. To this end, we employed three different data collection techniques that we hoped would provide convergent information about users' experiences and their communicative practices.

Our data collection and analysis approaches were in the qualitative tradition of the social sciences, where we tried not to limit our observations by a pre-defined issue space. We attempted to cast a broad net in our inquiries. Additionally, our analysis was grounded in the data, such that the attributes of usability that we describe in this paper emerged from the data itself.

We conducted multiple in-depth and open interviews over the course of the 6 weeks immediately following service acquisition. To understand the context of use, we grounded our questions in information that subjects reported in voice mail diaries, a technique we adapted from a paper-based diary study approach (Rieman, 1993). To tie these observations to frequency of telephone use as a characteristic of communicative practice, we collected data on actual calling behavior.

As stated, the findings about communicative practice and evolving attitudes about mobile telephony use are reported elsewhere. In this paper, we describe what we believe to be a set of attributes that address more comprehensive thinking about wireless telephony usability. We do this through illustration of our own findings.

Subject Selection

Nineteen people participated in the study. Subjects were recruited within the few days following their subscription to mobile telephony service. Only about 1 out of 10 people contacted fit the criteria and was able to participate. Subjects received monetary compensation for their time. One subject, S12, dropped out of the study mid-way, but the partial data for her are used where appropriate.

With one exception, participants were first time users of mobile services; that is, prior to this purchase they had not subscribed to any other mobile telephony service. We did make one exception by including a subject who had previous mobile phone experience, but had special access and safety needs thought to be important to the investigation (Subject 13; see Table 1). They were all geographically proximal to the researchers to allow for frequent interviews. Although gender, age, profession, socio-economic status, etc., was not experimentally controlled, our population was varied across these dimensions. The following table describes in some detail subjects' occupation and lifestyle attributes. A range of professions and domestic situations are represented in this subject pool.

TABLE 1: Subject Description

Subject	Age (yrs) & Gender	Occupation & Important Lifestyle Attributes
S1	46-55 Female	<i>Artist, doctoral student, and clinical therapist.</i> Commutes 30 miles to private art studio a couple of times/week, where there is no wireline phone. Shares home with adult roommates but has own phone line.
S2	16-25 Female	<i>High School student.</i> Newly licensed driver. Drives long distances around metro area for sports activities. Shares mobile phone with mother. Lives at home with two parents & older brother.
S3	46-55 Male	<i>Full-time church pastor.</i> Office in the home, with a dedicated business line. Works daily outside office in multiple places. Spouse & two teenage children at home.
S4	16-25 Female	<i>Community college student, part-time retail employee for small shop.</i> Work and school schedule varies daily. Lives with partner who works regular business hours.

S5	56-65 Female	<i>Part-time non-profit club manager; church organist; church janitor.</i> Lives with spouse and one adult son. Uses pager to be on-call as club manager. Church she cleans does not have wireline phone.
S6	26-35 Female	<i>Homemaker and mother of two; Part-time computer system administrator.</i> Just returned to work. Lives with spouse who works regular work hours, and two toddlers.
S7	46-55 Male	<i>Construction sub-contractor</i> Works on site at multiple locations per week. Spouse stays at home with toddler.
S8	46-55 Male	<i>Engineer.</i> Lives with spouse who works regular hours; spouse also has her own mobile phone.
S9	36-45 Female	<i>Dental Assistant.</i> Lives with spouse who works regular hours; spouse also has his own mobile phone.
S10	36-45 Female	<i>Meteorologist.</i> Lives alone. Travels and calls frequently to her large family who lives 2 hours away.
S11	66-75 Male	<i>Retired barber; Part-time model and law firm courier.</i> Lives alone. Modeling and courier work is on an on-call basis, which requires immediate attention.
S12	36-45 Female	<i>Homemaker; Student; Small-business owner.</i> Lives with spouse and teenage son.
S13	46-55 Male	<i>Retired. Works frequently outdoors on his large property while in his wheelchair.</i> Uses phone for safety and accessibility purposes. Lives with life partner; she works part-time out of the home.
S14	16-25 Female	<i>Professional Housekeeper, Mother of two young children.</i> Works multiple locations throughout week and coordinates childcare with her mother. Lives with two toddlers and husband, who works regular hours outside home.
S15	26-35 Female	<i>Mother of four children under 10; Homemaker.</i> Husband works regular hours outside home.
S16	46-55 Female	<i>Professor.</i> Lives alone. Commutes by bus or car 30 miles to work most days of the week. Uses mobile phone in lieu of physical presence in office.
S17	56-65 Male	<i>Engineer.</i> Shares a car and mobile phone with wife.
S18	36-45 Female	<i>Full-time contracts administrator; part-time rodeo teacher; professional rodeo rider.</i> Lives with roommate who is a student. Travels to shows, works outside in evening on ranch.
S19	46-55 Male	<i>Consultant.</i> Commutes 30 miles to city office by bus. Uses mobile phone to retrieve home office calls in his city office. Lives with spouse and teenage son.

Interview Data

Three interviews were conducted with each subject, lasting 1-2 hours each. The interviews were open-ended such that central issues were discussed with everyone, but professional and personal factors that were unique to each subject could emerge, be explored, and documented. Most interviews took place in our office location, although when possible, some interviews were conducted in people's homes. Family members were invited to participate in the discussion when they were actively involved in some aspect of acquiring, using or paying for the mobile phone.

The first interview was designed to capture the "out of the box experience." This interview was scheduled immediately after the subjects acquired the telephone handset,

but before they used their phones. Subjects were asked to explore their handsets (and other materials if they desired) as though they were at home doing the activity. Some subjects wanted to consult a friend or family member at a certain point; we documented only the extent to which subjects worked on the phones themselves, following up later on their collaboration with others. Subjects were also free to place phone calls to friends to test their phones, or to customer service to get help. We provided no direct assistance, but did encourage subjects to do what they would normally do to seek help.

The second interview took place approximately two weeks after acquisition and focused on the changes in behavior and use over that period. At this and the subsequent meeting, changes to the handset settings were noted. The third interview took place after users received their first mobile phone bills, about 4 to 6 weeks after service acquisition. This interview also focused on changes in behavior and included a discussion centered on the interpretation of their bills and the calling behavior documented therein. All interviews were videotaped.

Voice Mail "Diary"

To capture mobile phone activity as well as discoveries and insights subjects had about their newly acquired phones, we instituted a variation on the "diary" method of data collection (Rieman, 1993). Instead of having subjects record activities on a paper diary, we invited subjects to call in to a dedicated voicemail line and talk about their experiences. They could call in from any phone. In the interest of minimizing any bias, we never suggested they use their mobile phone for this purpose. This was an optional activity, but subjects were given \$1 for every day they called in, even to report that they did not use their phones that day. Although experimental, this method turned out to be a successful way of capturing activity that is very transient. On average, subjects called in about 1 out of every 2 days, although variance was high. These data were also important for reminding subjects during interviews about certain activities that could then be queried further. All diary reports were transcribed verbatim.

Calling Behavior Data & Phone Bills

Actual calling behavior data was collected via the network for approximately the first four months of use. The subjects also provided copies of their phone bills.

FINDINGS: ATTRIBUTES OF WIRELESS TELEPHONY

Mobile telephony use is affected by four factors of the technology: hardware, software, "netware," and "bizware."

Hardware. In mobile telephony, the handset, battery and charger comprise the hardware component, with the ergonomic issues that all hardware devices face.

Software. Menus and display based controls comprise the handset s software.

Netware. We refer to netware as the basic mobile telephony service and special services (e.g., advanced versions of call forwarding) that a provider makes available. The type of service analog or digital is also included in this category.

Bizware. Finally, we define bizware as the details of the service agreement, including calling plan, sales policies, and customer care.

Below, we highlight some of our findings within this framework.

Hardware

We found that subjects attributed behaviors that originate outside the scope of their telephone handsets to the usability of the handsets themselves. These largely include problems that might emerge as an outcome of poor signal coverage, such as not being able to place a call. Additionally, consequences of business practice, such as policies for assessing minutes of talk time (also known as minutes of use, or MOU), often conflicted with information independently provided on the handset.

Findings for handset hardware pertained to button size, antenna extension, volume control, battery charger, etc. Of note were the findings about a dial shuttle, or thumb-wheel, on the side of a commonly used handset. Using the dial shuttle to navigate through the feature menus was difficult for new users. The dial shuttle is spun with the thumb of the left hand or a finger on the right hand, moving the cursor up or down through a list of feature menus. It also can be depressed like a button to select a feature in a menu, an action that is not obviously afforded by the shape of the wheel itself. More problematic was that the primary feature menus can only be accessed if the wheel is *first* depressed. The wheel is then spun to move through the list of feature menus. To see the options in a feature menu, the wheel is pushed once again. Therefore, navigating through the feature set requires an alternating series of pushes and spins, with a "push" initiating the navigation.

Trying to push the dial shuttle frequently resulted in unintended menu selections. Furthermore, because of the way the menu structure is laid out, if a user spins the wheel first and then pushes the button, he or she can inadvertently dial a pre-programmed number. One subject, S11, who was very unsure about the operation of the dial shuttle and even more unfamiliar with the computing-related concept of "menu trees," frequently did this, even after six weeks of use.

Because the pushing action of the dial shuttle takes some time for users to discover, many do not discover it without specifically reading the manual or calling customer service. Although providing assistance to users through a customer service function is important and good, it is not a solution for problems that are outcomes of poor design. Customers are frustrated when they cannot figure out basic functionality by themselves, and the service provider suffers from the high costs of telephone support.

Exacerbating this usability problem, we found that novice users do not necessarily know that the software features exist; therefore, they do not even know to look for them! For example, some subjects told us that they inadvertently learned about the dial shuttle operation after calling customer service for another reason: to ask for their mobile phone telephone numbers. (The finding that subjects did not know their new telephone number is a separate "bizware" usability issue and discussed later in the chapter.) Expecting that the customer service representative would refer to records to find their telephone numbers, the representative instead told them that it was available as a software feature on their phones. The customer service representative walked these subjects through the steps of finding their phone numbers, which included pushing and spinning the dial shuttle. It was at this time that these users not only learned their phone number but also discovered the many other features available on their handsets as well.

Another problem subjects encountered was discovering how to change the earpiece volume, which was controlled directly by a dial shuttle or buttons on the side of the phone. Earpiece volume also could be changed via software menus; however, controlling volume this way required users to interrupt their call, look at the screen, and navigate the menus. Consequently, subjects often suffered through phone calls set at inadequate volumes because they did not know how to easily change the volume *during* a call. Furthermore, this problem was not isolated to single incidents but instead spanned long periods of time. Subjects kept inadequate volume level settings for days or weeks because they did not know how to change them.

Software

We define software as features on the phone that were accessed via menus displayed on a small screen. Our interviews (including inspections of subjects' phone settings) and diary reports revealed which software features were used by the most users; they also enabled us to determine roughly when users first used the features. We observed how situated actions lead to the discovery of features, and how this discovery of (or lack thereof) affected subjects' experiences with the phone. We also saw that some potentially helpful features failed to be used simply because of the location in the menu structure. We discuss examples of these here.

Most commonly used features included the Save/Program Numbers feature, Ringer Volume, and Earpiece Volume, although earpiece volume took some time to discover. From a service provider's perspective, discovery and ease of use of all of these features are critical, as they help users to feel comfortable with their phone service and to use it effectively.

The Save/Program Numbers feature, which allows users to store telephone numbers in the handset phone book, is an example of a feature that was discovered and valued by many users early on. It was used by many subjects (74%) by, or during, the first meeting (immediately after acquisition) and by 89% of the subjects by the end of the study, leaving 11% (or 2 subjects) who never discovered the feature. In some cases, discovery was a result of exploration: on the most commonly used phone, the phone book appears when users spin the dial shuttle, making it easy to find. In other cases, the phone book s

discovery was a direct result of calls to customer service concerning how to use the phone or service. In either case, users who discovered this feature reported that it was particularly useful for saving numbers they might otherwise have forgotten, as well as for placing calls quickly.

Another feature, Ringer Volume which controls how loud the phone rings was used by 37% of the subjects by the first interview, 74% by the second meeting, and 84% by the third meeting. Although an important feature for people to know about early on, the ringer volume controls are modal and hidden deep within the menus, requiring users to discover this feature through trial and error. In fact, several subjects reported searching for this feature immediately following or in anticipation of the phone ringing in a publicly inappropriate situation. Interview data and usage patterns also suggest that, after discovering this feature, users grew to rely on it to support the usage of the phone in a variety of contexts with different ambient noise levels and in different social settings.

Earpiece Volume was another feature that needed to be salient early on, but was only gradually discovered by our subjects. Use after purchase was low at 11%, and only slightly higher (16%) at 2-3 weeks. At the final interview, about 6 weeks after acquisition, only 47% of the subjects had discovered it. Many of the remaining subjects complained about volume level without knowing it was adjustable.

Backlight is the feature that controls the illumination of the small telephone screen in low light conditions, which users encountered when using their phones in a variety of real world situations. 37% of our subjects increased the duration of the backlight. They found that when using their phones at night or in dimly lit places, the default time was not long enough. Furthermore, it was the very experience of using their phones in low light that led most to discover the existence of the adjustable Backlight feature.

In addition to learning which features were used by subjects, our investigation also clarified how some features were used in relation to other information provided by the service provider. For example, we found that subjects thought that the Minute Counter was initially helpful, but later discovered that the service provider's tally was in conflict with the handset readout. In this case, the handsets' Minute Counters used different rules than the provider for tallying minutes of use, and the handsets did not provide subtotals that were meaningful within the context of common service plans (e.g., subtotalling minutes based on time of day or weekday vs. weekend). Consequently, when subjects called an automated service that reports number of minutes used, some were quite concerned that the number was different than what was reported on their handsets. Furthermore, subjects tended to rely on the information from their own handsets foremost and expressed a growing sense of mistrust of the service provider's numbers as a result of this conflicting information.

Netware

Netware encompasses the type of mobile telephony service (digital or analog); special calling plan services like call waiting, call forwarding, and other provider-specific services; and calling area coverage and coverage consequences on call placement.

Type of Service. We found that the difference between analog and digital service was unclear to most subjects; in fact, most did not know what kind of service they had. All subjects in this study had *only* digital service (the only option with their service provider). When subjects owned dual mode phones (phones that can switch between digital and analog service), they seemed to be further confused by the meaning of analog and digital signal.

A dual mode phone will switch to analog mode when digital signal is weak, even if a caller is in his or her home area. Because subjects did not know that their service provider dealt only in digital service, they did not then realize that whenever they were in analog mode, they were automatically "roaming" and incurring additional charges. (The concept of roaming, which was a source of significant confusion for subjects, is discussed later in this section). Consequences to this usability issue were unexpected charges, which led to additional calls to customer service for explanation, according to subjects' self-reports.

Service Coverage Areas. We found that most subjects did not understand the factors that affect service coverage and call quality. Specifically, new users did not understand the relationship between digital coverage quality and these factors:

- Geographical terrain
- Calling inside a building versus outside
- Building composition materials
- Calling near a window when inside
- Call load or traffic as it is affected by time of day
- Use of phone antenna

Furthermore, several subjects did not see that there were signal indicators on their handset screens, nor know how to interpret them.

A poor understanding of the natural limitations of wireless telephony service led subjects to incorrectly attribute problems to the service provider's quality of service. Subjects also blamed their handsets for operating poorly, wondering if a low battery limited reception or if their handset was otherwise defective.

For example, S4 (who has a single digital mode phone that cannot switch to analog) describes her experiences when trying to place a call in a building:

I was [at school], and my phone kept cutting out and it kept saying that ah- the call failed, and then it said that the call was lost. So I am little bit frustrated with that because I thought it would be, ya know--I've seen other people use phones in a building and theirs works fine and mine just cut out. And so I was a little mad that I had to go outside of the building to use it. (S4).

What S4 did not recognize was that other successful calls she witnessed may have been made on analog-supported phones; or perhaps the calls were placed when near a window,

or at a time of day when calling traffic was low. In the next example, S6 understands that signal quality is affecting her placing calls, but still wonders if this is somehow related to the operation of her handset:

"I was using my phone today but I had quite a bit of trouble. I didn't get any calls today and when I got home I had 6 messages on the machine, and it was in analog roam all day no matter where I was. No, actually that's not true. When I left the school that I was working at I'd be in regular mode, but at the school I was in analog mode, which is ridiculous: [these are local schools].. So I am definitely having a problem with the phone. Trying to figure out you know why it's doing that " (S6)

These particular usability problems can affect customers' confidence in the operation of their handsets as well as the quality of the service provided by the phone company.

Special Network Services. Wireless telephony service providers can offer a variety of special network services, including call routing, voice messaging, and data services. These special services can be used to encourage customer loyalty, to increase revenue, and to attract new customers.

Our research revealed that appropriate service assignment is highly important for the success of network services. However, we also found that striving for good matches between customers and services can be at odds with sales goals. In many business organizations, salespeople are typically rewarded by their volume of sales and are given additional incentives for assigning special services. Furthermore, because the sales function is often out-sourced to a third party business, salespeople fail to feel the downstream effects of an inadequate sales interaction. From a salesperson's perspective, there is little incentive for taking the time to develop a deep understanding of a customer's needs or to explain ways to effectively manage the service. Indeed, they may not even know enough about the service to assign it to appropriate customers.

An example that illustrates these challenges is call routing service sales. Call routing service allowed all calls placed to one's home or office number be routed to one's cell phone instead. This enables users to distribute only one telephone number and receive their calls anywhere. In general, call routing services between wireless and wireline telephones are highly successful services for those for whom the services are a good match. In our study, many subjects found these services extraordinarily convenient because they allowed them to receive their calls anywhere, without having to wait at a wireline phone. These services also freed them from having to manage which phone number (home, work, mobile, or both) to distribute.

However, some subjects signed up for these services not fully understanding them. Thus, they neither understood which version of the call routing service was best suited for their life-styles and communication needs, nor even how to use the service. As a result, these users experienced difficulty in managing communications on the road, at work, or at home. For example, one user (S7) wanted his calls routed to his wireless phone only when his wife was not at home to pick up the calls. Unfortunately, he had not selected

the call routing service best suited to his needs and he did not understand how to manage the service he had selected (e.g., turning it on and off). When S7 found that he was receiving his wife's calls while he was at work, and that she could not receive calls at home, he decided to keep his wireless phone off most of the time to keep the calls from being re-routed. This caused him to question the value of having a cell phone at all:

"The other thing that I'm still trying to get done, and I am having a lot of difficulty is the getting the service that hooks my connect my - routes my home phone calls to my cell phone [turned off]. It's really a drag, because I have to have my phone turned off, if [my wife] is at home and wants to get phone calls, which really kind of what's the word? cancels the points of having a cell phone. (S7)

Determining the characteristics for good service assignment and carefully explaining that service to customers, therefore, are clearly important usability challenges for service providers. Consequences of this failure to communicate with customers at time of sale means more calls to customer service downstream to either seek an explanation of the service, or to have it disabled or removed. It can also mean that users fail to use their mobile phones as they otherwise might, especially if they have to habitually keep their phones turned off to avoid problems with their special services.

Long Distance & Roaming. Although long distance is not a new concept to people, new users are confused about when various charges apply for long distance and roaming. For example, about one-third of our subjects incorrectly thought they were charged for incoming long distance calls. Because new users are uncertain of cost structures and unsure of long distance operation, they tend to err on the side of conservatism by limiting long distance phone calls to prevent unexpected costs, a finding consistent with Helyar (2000). The bill is often the first time the relationship between their calling behavior and charges are clarified for users, which happens about one month after acquisition.

In particular, we found that the concept of "roaming" was difficult for new users to comprehend, and was often confused with long distance calls. Roaming occurs when a person is outside their home coverage area and makes or receives a call that a different service provider local to that area handles. Many subjects had very poor understanding of this; in fact, their comprehension was so confused as to be indecipherable by the researchers at times! In most cases of confusion, subjects understood roaming to be a function of the destination or origination of phone calls, not a function of the location of the mobile phone and the user. So, a call to or from an area outside one's home area would be considered a "roaming" call, hence the confusion with long distance. Other subjects erroneously thought that "roaming" was the state of the phone "looking for signal," and so was not associated with any potential calling charges. One unfortunate consequence of this interpretation could mean a surprisingly high phone bill for the unsuspecting user.

The following examples show how subjects confused long distance and roaming, and how other aspects of service were also sometimes confused as a result. In the first example, S1 was probably trying to put her dual mode phone into digital mode only to

avoid roaming charges when she was in analog-only coverage areas. In addition to demonstrating a poor understanding about how coverage works (by incorrectly referring to nonexistent "satellites" and "roam service"), she also confuses a free long distance benefit of the service provider toll-free in-state calls with roaming. Although roaming would prevent S1 from making toll-free in-state calls, she incorrectly equates long distance calling with roaming:

"I called customer service and learned how to put my phone on only picking up your satellite so that I could call anywhere in the state for free. And then I came up to [a town in the mountains] today and I couldn't get any service so I went back in under "Network" [features] and figured out how to put my phone back on analog roam. ... I like having this option and when I [come] back down [from the mountains], I will probably put my phone back on, just having [the phone company's] roam service." (S1)

In the next two examples, both S8 and S18 also equate long distance and roaming:

(A Single Digital Mode Subscriber) "I tried to make a long distance call out in Los Angeles to see if I could get through to [my wife at home in Colorado] and it wouldn't work, which I don't know if that's a digital thing or a [service provider company] thing. But it's- I'm getting more anxious to turn this thing over to a digital/analog so that you can hopefully get a roaming connection long distance with your cell phone otherwise it's kind of worthless." (S8)

S18 demonstrates her confusion between long distance and roaming by using these concepts interchangeably:

"Catching you up on all the goings on of the weekend: I was out of town again for the weekend, so I didn't call you because you know those BIG roaming charges that scare me to death. ... Sorry to report four days in one day, but I was out of town and those good long distance charges just, you know, make me nervous." (S18)

In addition, one-third of subjects thought that they might be charged for incoming long distance calls. For example:

"I am actually kind of wondering whether I like to answer long distance calls or not. Because if I am paying for the long distance call even though they are calling me, [I'd prefer to use] my home phone. So I don't know. Maybe that's not true. Maybe I am not paying for it, they're paying for it, like it's supposed to be. But anyway, that would be a good question probably for the phone company..." (S6)

The effects of these misunderstandings on mobile telephone use can be considerable if left unchecked, with new users hesitant to make and receive certain calls in fear of incurring high charges. In some cases, calls do actually incur higher charges (when

roaming, for example), but without users feeling certain about these conditions, they cannot fully trust the usability of their phones. In summary, although users are familiar with the concept of long distance under the wireline model, they confuse it with the concept of roaming under the wireless model, and therefore, do not understand how and when they will incur long distance charges.

Bizware

Bizware refers to the non-technical components of mobile telephony, including calling plan agreements, service provider-specific business policies, sales communications, customer service communications, marketing promotions communications, manuals and other information resources, and phone bills. Bizware quickly emerged as a prominent factor in the usability of wireless telephony for our subjects. Bizware issues--most of which we did not anticipate--emerged from our grounded, longitudinal approach to the investigation.

Calling Plan Agreements. Agreement plans specify how much "airtime" (in minutes) one has to use over the course of typically a month. Calling plans vary within and across providers: different levels of airtime minutes are available, and airtime can be distributed across "peak" and "non-peak" times.

For novice users, deciding what calling plan to buy can be a challenge. Plans are usually arranged by total number of airtime minutes per month: the greater the minutes, the greater the price. There are three buying strategies users employ: selecting by price, selecting by amount of airtime minutes, or finding some balance between the price and amount of minutes. All but three of our subjects opted for the lowest price plan. Most of these subjects appeared to select on the basis of price. As novices, they seemed to want to gingerly enter the market without incurring too many costs.

As a consequence of selecting by cost, users constrain their number of airtime minutes. This, in turn, means that they must fit their communicative practice to these imposed limitations (or incur much higher costs for surpassing the limit). In contrast, selecting by minute plan allows users to fit the technology to their communicative practice. However, even though the latter arrangement would seem desirable, subjects reported some difficulty in anticipating their calling time in terms of minutes over a month. Although people may be accustomed to managing their long distance calls by amount of minutes, anticipating one's own calling behavior over the span of a month with a new technology is not familiar.

Subjects who selected by cost were concerned about exceeding the number of minutes in their plans; some over-constrained their calls and used far less than their plans allowed. Only two subjects who selected by price surpassed the calling minute limitation. The three subjects who selected their plans by number of minutes (and who did not select the minimum price plan) used far less minutes than their plans allowed.

Tracking customers for the first cycle of service yielded this information about calling plans and early behavior. Failure to target a suitable calling plan is a usability issue that

affects the customer experience, and can in turn affect a customer's relationship with the business provider. We hypothesize that because novices are uncertain about how their actual calling behavior will match with their calling plans, they initially constrain their calling to avoid expensive surcharges. This might mean that customers do not explore uses of their phones that they might otherwise. Furthermore, customers may settle in to this pattern for the long-term.

Provider-Specific Calling Plan Policies. Provider-specific calling plan policies yield additional information users must assimilate and incorporate into their calling behavior. Our investigation revealed that if these policies were not understood during the sales transaction, there was little opportunity for subjects to learn about them later on.

For example, "peak" and "non-peak" calling times are decided by the service provider, and might vary from conventional wireline peak times. In particular, the subjects' service provider's non-peak times were restricted to weekends. The service provider actually defined weekends by the clock and calendar: midnight Friday to midnight Sunday. However, subjects did not know about this policy. Some assumed that the weekends would follow actual clock and calendar time, but others used their experiences from wireline telephony to assume that weekends started at 5pm (or 7pm) on Fridays and ended some time on Sunday or even Monday. Because non-peak minutes are often given generously in service plans, users could potentially use the more precious peak time minutes during a time they incorrectly thought was non-peak.

Other policies could benefit users, but it is a problem when the users do not know about them. For example, one-third of the subjects did not know that all in-state calls were toll-free. Additionally, one-third did not know that the first minute for incoming calls was not charged against their minutes of use, and half of the subjects did not understand the benefits of this policy — they would not be penalized for wrong numbers or other nuisance calls. Even if a service provider is doing a reasonable job in conveying information to most of their subscribers, novices are a special population that needs additional assistance assimilating this variety of new information that differs from older models of wireline telephony.

Promotions & Marketing. Special promotions by marketing divisions create expectations for users that might affect their phone use. For example, the subjects' service provider had offered a special promotion to them by offering free weekend minutes. In this promotion, the offer meant that substantial non-peak airtime minutes were included as part of the plan. However, the meaning of "free" was not clear to all subjects, resulting in significant impacts on calling behavior. For example, one of our subjects erroneously thought that his calls were free of charges on the weekend, specifically long-distance charges (which were not free). Acting on this, he saved calls to his brother (who lived out-of-state) for the weekend, deliberately using his wireless phone rather than his wireline phone. Upon receipt of his phone bill, he discovered the long distance charges.

Why might this have happened? Further investigation of this issue revealed that there were three different connotations of the word "free" communicated by the service

provider through promotions or in the literature. In addition to "Free Weekend Minutes," there was "Toll-Free In-State" calling, and "First Incoming Minute Free."

Toll-free calls meant that long distance charges are not incurred for in-state calling. It is this meaning of "free" that subjects seem most inclined to adopt and apply to other instances of "free." Note that airtime minutes were still docked against the calling plan for in-state toll-free calls. In contrast, "First Incoming Minute Free" meant that the first minute of an incoming call was not docked against calling plan minutes. Some subjects thought this special policy meant that the first minute was free of long distance charges. It was, in fact, free of long distance charges, but that was because there were no long distance charges for incoming calls! Some subjects thought that the "First Incoming Minute Free" therefore implied that the *other* minutes of an incoming call were not free, that they incur additional charges. This confusion was compounded by the belief held by some subjects that they pay for incoming long distance calls. Instead of perceiving this service as a benefit, some subjects assumed the worst.

This example demonstrates how promotional language can affect a user's relationship with their phone. Although promotions are usually the responsibility of marketing, their decisions can directly affect the usability of the technology they are trying to promote.

Sales & Customer Service. Sales and customer service desks are also often distinct organizationally. Salespeople are typically motivated to sell by volume. Often there is little time to adequately ascertain new users' comprehension of their new service. Furthermore, customers may in fact be told much of the information they need, but novices do not know what they need to know and retain.

We found that new users often are satisfied by the amount of information garnered during the sales call, only to learn how little they really understand after using their phone for a couple of days. Consequently, customer service received many inquiries about wireless telephony basics from our subjects. In the initial days after acquisition, subjects seemed to need explanations about how to use the special services they received, as well as confirmation of their wireless telephone numbers. Sometimes subjects would call when their phones behaved in an unexpected way. The following case is an example of how information received in the sales call was either not adequately conveyed or retained by customers. S5 and her husband did not remember receiving the special call routing service. They had received it as a free offer but, like other subjects, did not remember the details from the sales call. In fact, because the service was free, we believe that some subjects may have quickly agreed to it without understanding its implications. Because S5 did not have a name to put to her phone's behavior, she could not troubleshoot the problems she encountered by looking through the manual herself:

"My cell phone just picked up a call that came in, I mean, it came in for my home phone AGAIN just like the other day. I looked through the book, I can't figure out what's going on. I've tried to stop any call forwarding. I am going to keep looking but ah you know, I am really confused why it just comes right through from ringing on my phone from the house phone over to the cell phone." (S5)

Order Confirmation. Our investigation included an evaluation of all the paperwork that came with subjects' handset, including the purchase order. All subjects had their handsets delivered by mail. Because of the great deal of information imparted at the initial sales call, novice users need immediate confirmation of their order. However, our subjects found that certain details of order confirmation (like calling plan minutes and services ordered) did not come until the first phone bill, which arrives about one month after acquisition. Similarly, users needed a written reminder of their telephone numbers and did not think they received one. The number was, in fact, on the purchase order that came with the handset, but was listed as a string of numbers without dashes or spaces (e.g., 3035551212) and labeled as "Mobile ID Number," phone company nomenclature that means little to new users. Users who did not know about a software feature on their handsets that listed the unit's phone number had to call customer service to get their numbers.

Manual & Supplementary Materials. Our study also included an evaluation of how the manual and other supplementary materials were used. Mobile telephony has its own terminology that new users must learn, with much of this language appearing to the user for the first time in the manual and accompanying materials. Some of these terms are inherited computer lingo, which assumes computer experience. However, there were subjects even in our small subject pool who did not have a computer background. Words like scroll, icon, and select have found their way into manuals, for example, and were a source of confusion for some of our subjects. Helyar (2000) reports similar findings. Other new terms like analog, digital, roaming, airtime, etc. are often used to describe new and tricky concepts as though they are self-evident.

Phone Bill. The telephone bill is an important part for understanding wireless telephony, especially the first bill. Our subjects perceived the bill as their first opportunity to compare their calling behavior to real costs incurred, and to clarify and confirm calling plan details.

Our investigation revealed that formatting left some important information unclear to our subjects, which in turn led to follow-up calls to customer service. In particular, terminology and formatting masked actual calling activity, particularly with respect to weekend versus weekday calling. These problems also misled customers into thinking they were overcharged when they were not. Finally, the bill which subjects expected to explain their orders in absence of earlier confirmation did not communicate calling plan details comprehensibly.

We also found that subjects who purchased service under a promotional deal expected to find those promotional names clearly indicated in their bills; they were concerned when they couldn't easily identify those special deals. User struggles here clearly demonstrated that promotions created by marketing divisions also have to be reflected in customer bills. Socio-organizationally, however, this can be a challenge for service providers when these departments operate independently.

When novices acquire wireless telephony service, they have many questions and misconceptions. We found in this particular case that these concerns were not addressed

during the sales process, and were even exacerbated by the introduction of new concepts and choices in service. During the first month of use, customers are in a learning period during which they encounter particular problems that we have summarized here. In response, some customers call customer service, while others wait for the first bill for confirmation and clarification of their orders, and to help them understand their own calling behavior. Therefore, we found that an easily understandable bill is critical for customers not only for its standard financial purpose, but also from the perspective of crystallizing users' fledgling mental models of wireless telephony service. When the phone bill fails them, we found that users will call in to customer service, often after spending a good amount of time trying to decipher their bills. Even worse, incomprehensible bills fueled suspicion in several subjects that they were being overcharged by their service provider.

CONCLUSIONS

User comprehension of mobile telephony requires understanding new attributes not required of other stationary, non-service-based technologies. In addition, mobile telephony is still new, with all the imperfections in the conceptual use model that any new technology faces. Therefore, mobile telephony requires assessment beyond the laboratory. Had this investigation had been restricted to a one-time, laboratory investigation, our findings would have centered on the handset, with little to no understanding of the other areas of concern outlined here. Among other limitations, we would have not understood the sometimes complex interaction between the handset and service, and how this created a different class of comprehension problems. In addition, the importance of other factors such as provider plans, phone bills, and promotional language in comparison to handset design also would have been masked.

The four attributes of wireless telephony outlined here—hardware, software, network, and bizware—each must be understood by users to ensure proficient use. In enumerating these attributes, design improvements become much clearer. We describe some of these opportunities here:

- *Hardware.* Even with a limited sample of handsets, it was clear that hardware issues can result in significant problems. Controls that are hard to operate or controls that are accidentally activated can affect the user's satisfaction with the product, drive up calls to customer service, and ultimately result in lost revenue to the provider. Thus it is important that service providers evaluate the usability of the hardware they purchase from handset manufacturers. Furthermore, because users tend to misattribute handset problems as problems with their service and vice versa, usability data based on customer's verbal complaints can be misleading.
- *Software.* Our study illustrated how basic features such as ringer and earpiece volume can be hidden within and by the software interface, preventing their discovery. As with the hardware, it is clear that this negatively affected the user experience and could ultimately cost service providers. Making critical features salient is likely to ease difficulties early in user experience, reduce the learning curve, and help users integrate the technology into their daily lives.

- *Netware*. One apparent problem with netware (e.g., network services and roaming) is that it is hidden to the user. Another is that it often reflects the idiosyncrasies of the technology supporting it. The misconceptions users have about various aspects of netware are many; simplifying the conceptual model is of critical importance. Interestingly, some effective solutions can come from modifying other attributes of the technology such that netware functionality becomes invisible from the user's perspective. For example, flat rate programs can eliminate the need to even worry about the underlying network infrastructure that often drives roaming and long distance charges.
- *Bizware*. Confusion from bizware can stem innocently from historical practices and organizational structure of the service provider. Responsibilities that seem singular from the user perspective (sales and customer service) may in fact be distributed across the organization with little understanding of how one unit's activities affect another downstream. Therefore, addressing bizware usability improvements can be quite complex from the service provider's point of view, but could reap tremendous benefits in reduced costs and increased revenues.

A good fit between customer needs and type of service is also critical, and is an outcome of bizware practices. In our study, each customer had particular social, mobile, and communication needs that were the key drivers in how he or she realized the benefits of the phone, which we discuss at length in Palen, Salzman and Youngs (2000). When service plans were not suited to these needs, users suffered. Thus, we believe that achieving a good match between the user needs and the wireless services can go a long way to ensuring that new customers will make it through the early trial period, as well as achieve communicative practices that resonate with their lifestyles. When users are at odds with their phone or, worse, are afraid of incurring high costs because they do not understand fee schedules, they under-constrain use.

We have outlined four attributes of wireless telephony that we believe articulate the sources of user confusion with the technology. It is our hope that such a framework helps manufacturers and service providers to parse and categorize usability problems, as well as to understand cause-and-effect relationships between different attributes. We believe that this kind of information is critical in the development of strategies for offering *successful* wireless services, services that are useful and enjoyable for users and profitable for the wireless industry.

REFERENCES

- Beyer, H. & Holtblatt, K. (1998). *Contextual Design: Defining Customer-Centered Systems*. San Francisco, Morgan Kaufmann Publishers.
- Cahners In-Stat Group (2000). Cellular Market Goes Ballistic, '00 Subscriber Forecast. Report GW00-04SU.
- Helyar, V. (2000). "Usability Issues and User Perceptions of a First Generation WAP Service." Proceedings of the Workshop on Wireless World: Social, Cultural and

- Interactional Issues in Mobile Communications and Computing, University of Surrey, UK.
- McGinity, M. (1999). "Staying Connected: Flying Wireless, with a Net." *Communications of the ACM*, 42 (12), pp. 19-21.
- Nippert-Eng, C. (1996). *Home and Work: Negotiating Boundaries through Everyday Life*. The University of Chicago Press.
- Palen, L., Salzman, M. & Youngs, E. (2000). "Going Wireless: Behavior and Practice of New Mobile Phone Users." *Proceedings of the ACM CSCW 2000 Conference on Computer Supported Cooperative Work*, Philadelphia, PA, pp 201-210.
- Rieman, J. (1993). "The Diary Study: A Workplace-Oriented Research Tool to Guide Laboratory Efforts Collecting User-Information for System Design." *Proceedings of the ACM INTERCHI'93 Conference on Human Factors in Computing Systems*, p.321-326.
- V n nen-Vainio-Mattila, K. & Ruuska, S. (1998). "User needs for mobile communication devices: Requirements gathering and analysis through contextual inquiry." In C. Johnson (Ed.) *Proceedings of the First Workshop on HCI for Mobile Devices*, GIST Technical Report G98-1, Department of Computing Science, University of Glasgow, Scotland, p. 113-120.
- V n nen-Vainio-Mattila, K. & Ruuska, S. (1999), "Designing Mobile Phones and Communications at Nokia," in E. Bergman (Ed.) *Information Appliances and Beyond: Interaction Design for Consumer Products*, Morgan Kaufmann Publishers, San Francisco, CA.