Jerry L. Waller. Awareness of Cellular E911 and its Relationship to Perceptions of Privacy Among University Students, Faculty, and Staff. A Master's Paper for the M.S. in I.S degree. April, 2006. 75 pages. Advisor: Barbara M. Wildemuth

Abstract: This study describes a survey of the students, faculty, and staff of the University of North Carolina at Chapel Hill regarding awareness of E911 and LBS technologies on cellular phones and how this awareness relates to perceptions of privacy. Responses to the survey showed generally low awareness of E911 and LBS technologies, but also revealed unexpected privacy distinctions. Some respondents viewed their cellular phones as private, but not the conversations or text messages. Other respondents were just the opposite, viewing their conversations and text message as private, but not the phones. Though LBS can broadcast a cellular phone's location anytime the phone is powered on, even those users that appear to control their privacy the most tend to leave their phones on for long periods of time, indicating either a lack of awareness regarding location privacy, or a lack of concern.

Headings:

Enhanced 911

Location-Based Services

Cellular Phones

Privacy

AWARENESS OF CELLULAR E911 AND ITS RELATIONSHIP TO PERCEPTIONS OF PRIVACY AMONG UNIVERSITY STUDENTS, FACULTY, AND STAFF.

by
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A Master's paper submitted to the faculty
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INTRODUCTION:

Walk around the campus of the University of North Carolina at Chapel Hill on any given day, and a seemingly endless stream of people can be seen—and heard—talking on their cellular phones. Cellular phones and related technologies have burgeoned in the last ten to fifteen years, and are arguably the most prolific form of ubiquitous computing in the world today (Clarke & Furnell, 2005). It is not uncommon for new cellular phones to offer email and internet access, as well as the capability to send and receive text messages. In other words, cellular phones represent a fundamental shift in the way people communicate, and their capabilities are not just limited to casual communication.

Of the nearly 190 million calls to 911 made in the United States each year, it is estimated that over 50 million are made via cellular phone (Squeo, 2005). Enhanced 911, or E911, is a system of technologies that broadcasts the approximate location of a caller to emergency medical services (EMS). The idea behind the technology's implementation is that, since more and more people are using cellular phones as their primary telephone service (and are by definition mobile users), there is an increasing need to provide location-based information about any caller who needs to utilize the service (Federal Communications Commission, 2006). During the spring of 2005, emergency medical personnel were summoned to an accident at the R.B. House Undergraduate Library on the campus of the University of North Carolina at Chapel Hill. Because no specific location information was delivered electronically, they ended up going to the wrong

library, and it took several more minutes before they determined the error and arrived at the correct location. Fortunately, the situation that day was not life-threatening, but it illustrates the usefulness of location disclosure during an emergency.

An EMS can utilize E911 to assist callers who are unaware of or unfamiliar with their location, or who are too frantic to provide adequate location information, and there are numerous examples of situations just like this where the technology might have been used to save lives (National Emergency Number Association, 2005). Since location-based information is relayed to a public safety answering point (PSAP), the emergency dispatcher can provide the location of the call with varying degrees of accuracy, depending on the location-determining technologies used by the cellular carrier and the individual cellular phone (Federal Communications Commission, 2006). Theoretically, as location-determining technologies improve, it will be possible to isolate the latitude and longitude of an originating call to within a few meters.

Since land-line calls to 911 are tied to a specific telephone number—and hence a specific location—it is extremely easy for an EMS system to display the address of an incoming call. While this capability is still not available everywhere in the United States (Squeo, 2005), it has created the expectation that E911 will work similarly. Since the goals and values of EMS are to provide rapid response to emergencies, it logically follows that this includes an accurate idea of where an emergency is taking place. The Emergency Medical Services webpage for the state of Alaska, for example, establishes that their goals are to (among others): “establish a comprehensive, coordinated system of emergency medical services that …assures citizens and visitors easy access to services [and] …expedites initial response” (Alaska Emergency Medical Services Program,

2003). It is especially easy to see how E911 technologies could benefit visitors to any area who have much less certainty regarding their location than local residents.

Because E911 caller location information can be processed and stored via geographic information systems (GIS), it is extraordinarily easy to annotate each call with a wide variety of information. Time of day, type of incident, gender, age, and any number of other categories can be used to create a digital repository of information regarding incidents. These databases of information could potentially be shared by EMS's across the country and around the world, as well as by epidemiologists to produce incredibly accurate statistical models of disease and other public health issues, including bioterrorism (Wofford, Heuser, Moran, Schwartz, & Mittelmark, 1994).

The FCC mandated that cellular phone manufacturers and cellular service providers achieve a 95% penetration rate for E911 equipped mobile phones and transmission capabilities by December 31st, 2005 (Federal Communications Commission, 2006). But because this mandate was made without recommendations for implementation or financing (Squeo, 2005), cellular service providers have chosen to utilize the new technologies for other commercial purposes. In order to help support the costs of E911 implementation, cellular phone manufacturers and service providers are slowly implementing location-based services (LBS) (Rao & Minakakis, 2003). Though LBS is not as widespread in the United States as it is in Europe or Asia, the approximately $6.37 billion in LBS revenue that Western European cellular providers were estimated to see by the end of 2005 virtually guarantees that its time in the United States is coming, with or without the general awareness of the public (Cleary, 2001). LBS is fundamentally an advertising mechanism, and it works in part by piggybacking on

the technologies implemented for E911. Based on a cellular phone's location information, advertisements customized to the user's approximate geographic coordinates can be sent to it (Di Pietro & Mancini, 2003). Other services, such as hotel and restaurant guides and "people finder" services (Rao & Minakakis, 2003) can also be implemented because of LBS. These sorts of applications obviously raise privacy issues, though agreement on these issues is not universal (Barkhuus & Dey, 2003).

Because an E911/LBS enabled cellular phone can measure and broadcast the user's location anytime their phone is powered on, it is technically possible for the location information to be monitored on a real-time basis or stored in a geographic information system for further analysis. This opens up a host of potential privacy issues, and balancing the need for increased location awareness for emergency purposes with user privacy preferences will require an understanding of the public's awareness of these technologies. The questions this study intends to address are: how aware of E911 are campus users of cellular phones, and how is this awareness related to overall perceptions of cellular phone privacy? The scope of this study includes a survey of the general campus population of the University of North Carolina-Chapel Hill and how private they perceive their cellular phones to be, as well as questions addressing their awareness of E911 and LBS. While a number of surveys have been conducted dealing with perceptions of privacy and the internet, e-commerce, and mobile phones in general, there have been no surveys conducted that attempt to measure perceptions of privacy as they relate to E911 capabilities. It is hoped that the answers to these questions will contribute to the body of research regarding informed consent and an understanding of the privacy issues that go along with it.

LITERATURE REVIEW:

The history of privacy in the American legal system begins with the common-law concept of the curtilage (Curry, 1997). The curtilage, as defined by the Oxford English Dictionary, is:

> A small court, yard, garth, or piece of ground attached to a dwelling-house, and forming one enclosure with it, or so regarded by the law; the area attached to and containing a dwelling-house and its out-buildings. (Oxford English Dictionary, 2006)

The curtilage was thought of as the core of a landowner's property, and was where personal matters of all sorts were conducted. It can be imagined that the boundaries of the curtilage—for example a wall—represented the physical boundary of what was understood to be publicly visible. Whatever took place within the curtilage was the property owner's business and, as a consequence, private.

The U.S. Constitution itself says nothing about privacy. However, privacy as a legal right in the United States began its explicit definition in an 1890 *Harvard Law Review* article entitled "The Right to Privacy," written by S.D. Warren and Louis Brandeis, where it was defined as the “right of the individual to be let alone” and “the right to one’s personality” (Warren & Brandeis, 1890). Privacy has since been interpreted by the Supreme Court of the United States as a “penumbral” right, or one implied by the language of the First, Fourth, Fifth, Ninth, and Fourteenth Amendments (Onsrud, Johnson, & Lopez, 1994).

The strongest arguments for the notion that technology threatens privacy revolve around the idea that the curtilage—the sphere of privacy once bounded by physical walls—is diminishing. Technology allows planes to fly over walls, or telescopes to make distant objects visible. “Autonomous technology," as a concept, is like the 21st century equivalent of technological determinism. It is the belief—whether conscious or not—that technology is destined to advance and improve, almost of its own volition. This idea may seem innocuous at first glance, but when autonomous technology is taken for granted by a court system as it makes decisions and sets precedents, the means for the modern curtilage’s further diminishment are laid out well in advance of their actual implementation. Autonomous technology shrinks the curtilage by "making visible what was previously not" (Curry, 1997). Add to this the fact that what is considered to be "of the public record" differs depending on the state (Jain, 2003), and that local, state, and federal governments sell individuals’ data to private companies (Onsrud et al., 1994). Thus the curtilage can seem very small indeed.

Private companies, like Equifax, Trans Union, and Experian, buy census data, state and local government data, and tax records (Monmonier, 2002). They in turn sell the aggregated data to other private companies:

> Individuals who participate in interactive cable and Electronic Funds Transfer (e.g., automated teller machines, automated clearinghouse services, point of sale transfers, and credit cards) are presumed to do so on the understanding that information will be selectively sold for marketing applications…. (Goss, 1995)

There is nothing stopping them from doing so without gaining the express approval of the individuals whose information they are selling. As things currently stand, "[t]here is no

comprehensive federal privacy statute that protects personal information held by both the public sector and the private sector" (Jain, 2003).

The literature regarding user perceptions of online privacy is extensive, and includes data collected from many editions of the Harris Poll (Taylor, 2002), as well as from the Georgia Institute of Technology's Graphic, Visualization, and Usability (GVU) Center (Graphics, Visualization & Usability Center, 2006). The Harris Poll (Taylor 2002) broke respondents up into 3 privacy categories. Privacy fundamentalists, who account for 26% of the population, are those who "feel that they have lost a lot of their privacy and are strongly resistant to any further erosion of it". Privacy pragmatists show some concern for their privacy, but appear willing to trade it for other benefits; they represent about 64% of the population. The remaining 10%, the privacy unconcerned, are labeled as having minimal anxiety or concern about personal privacy. The GVU surveys indicated that privacy preferences depend upon the medium used (Hoffman, Novak, & Peralta, 1999). Electronic media, in particular, were shown to correlate to higher privacy concerns compared to traditional media (Hoffman et al., 1999). Hoffman et al, also stated that concern over the secondary use of personal information strongly discourages consumer participation online, and that 80% of GVU's respondents did not want their personal information resold by websites to other businesses (Hoffman et al., 1999). This clearly suggests an underlying desire to maintain control of personal information, but does not specifically address how, why, or when users would want to do so.

Adams (1999) began to explore these questions by generalizing three of the factors that affect users' privacy perceptions: how sensitive they believe the information

to be; who receives their information; and how their information is used. The effect the information receiver has on privacy preferences was also observed by Lederer, Mankoff, and Dey (2003) who say that a user's privacy preferences vary depending on who the inquirers are. In other words, information that a person feels is appropriate to transmit to their doctor may not be considered appropriate for the individual's supervisor at work. The information has not changed, only the party to receive it, and thus the shift in privacy preferences. Adams (2000) also stressed the importance of users' perceptions of privacy, stating that privacy has varying degrees of sensitivity, and suggested that technology makes it more difficult to judge privacy tradeoffs because the user is often unaware of who is "watching" or how their data is ultimately used (Adams, 2000). In the case of cellular phones and location-aware technologies, it can be very difficult to realize that anyone is even monitoring a user's movements because the technology is dependent upon nearly ubiquitous location sensing and transmission to a remote provider. Because of their increased proliferation, and the changing features available in the newer digital models, cellular phones are fast becoming the most monitored technology on the planet.

Rice and Katz (2003) reported that the popularity of cellular phones is surpassing that of television sets, that there are now more mobile phone subscribers worldwide than landline, and that 95% of all nations have cellular networks in operation. If each of these phones were capable of location sensing and broadcasting, then there would be hundreds of millions of users whose movements could be tracked with a high degree of accuracy. The data gathered in such a scenario certainly has valuable applications for researchers in social science and epidemiology (among others), but the potential for abuse and exploitation are present as well.

Schilit, Hong, and Gruteser (2003) recognized the potential of wireless location technologies to intrude upon privacy, while Rao and Minakakis (2003) point specifically to the potential for the "unauthorized resale of personal information, intrusion and theft of customer databases, and the unauthorized use of lost or stolen mobile devices" (p. 63). Schilit et al, discussed the likelihood of location spam, and the risk of embarrassment and economic damage that may result from misused location information. They used the examples of a diet doctor who frequents fast food restaurants, or the employee passed up for promotion because of frequent visits to a drug rehab clinic, but they could just as easily have used the example of a politician who spends too much time in the red light district, or any number of other scenarios where people are guilty of being in the "wrong place" with no evidence of any misconduct whatsoever. Additional privacy concerns were expressed by Snekkenes (2001), who realized that sensitive location data could be collected any time a cell phone is on, and as such the "…breach of location privacy may be considered very invasive" (p. 50). Minch (2004) recognized the potential for intrusive location-based marketing, and predicted the aggregation and disclosure of user location information for marketing purposes. These are not just hypothetical situations, either, for scenarios like them have already begun to surface.

For example, over 4 million South Koreans now subscribe to services that allow them to monitor the location of others, or disclose their own location to friends and family (Moon & Reinhardt, 2005). One particular service allows individuals to track another consenting person or child and view the last five hours of their movements (Moon & Reinhardt, 2005). Xora (www.xora.com), a business based in Mountain View, CA, lets employers track the location and movement of their employees with specially

issued cellular phones. In January 2006, a blog was able to purchase the cellular phone records of former U.S. Presidential candidate and former Supreme Allied Commander of NATO General Wesley Clark (Aravosis, 2006) from one of a number of data brokers "…devoted to exploiting phone numbers, calling records and even the locations of unsuspecting subscribers for profit" (Dell, 2006). Clearly, there is a connection between cellular phones and location monitoring, but how have these technologies made their way into the phones?

Cellular phones have advantages over landline phones and the internet for notifying authorities of an emergency because of their mobility (Rice & Katz, 2003), and E911 technologies provide the ability to transmit a caller's location when that caller is using a cellular phone. The impetus for the technology's development and implementation was a 1996 Federal Communications Commission (FCC) mandate that required all cellular service providers to progressively improve their capabilities in location identification for the express purpose of identifying a cellular phone's location during an emergency call to 911 (Corwall, 2002). One means cellular service providers have of identifying location is through triangulation, whereby a cellular phone signal's distance is measured from three separate cellular towers (Cleary, 2001). The other is through the use of small global positioning system (GPS) signal receivers within the phones themselves. The GPS enabled cellular phone is able to acquire its approximate latitude and longitude and broadcast that information to a public safety answering point (Federal Communications Commission, 2006). Phase I of the FCC's E911 Rules require cellular service providers to provide PSAPs with the phone number of the cellular phone that made the call, as well as the location of the nearest cellular tower (Federal

Communications Commission, 2006), while Phase II requires carriers to provide the PSAP with the latitude and longitude of the caller (Federal Communications Commission, 2006).

While adoption of E911 services will undoubtedly save time and lives, not every EMS has been able to take advantage of it. Approximately 200 counties in the United States did not have basic 911 service as of early 2005, and it is estimated that only 41% of PSAPs can currently locate 911 calls from cellular phones (Squeo, 2005). Rural areas, in particular, are subject to technical limitations of the system: triangulation of a phone's signal becomes much more difficult since most cellular towers are only located alongside interstates or other major highways (Squeo, 2005).

The introduction of E911 technologies that rely on triangulation, GPS, or a hybrid version in cellular handsets has helped pave the way for the creation and distribution of LBS that take advantage of the same infrastructure (Rao & Minakakis, 2003). LBS are services "where knowledge of the location of an object or individual is used to personalise [sic] the service" (Snekkenes, 2001, p.48). LBS-equipped cell phones are recognized as an up and coming medium for advertising, with the potential for Amazon.com-style ads customized to a cellular phone user's location (Rao & Minakakis, 2003). The ad revenue they are expected to generate for mobile phone providers is predicted to run into the billions of dollars (Cleary, 2001), and perhaps as much as $20 billion by the end of 2006 (Minch, 2004). Considering that Clarke and Furnell (2005) say that cellular phones are now "the most common IT device" in the world with an estimated user base of 1.5 billion, it comes as no surprise that Barkhuus and Dey (2003),

citing Ljungstrand, state that LBS is poised to become the most prevalent form of context-aware computing in the world.

Cell phone usage itself is extremely high among youth, with cell phones regarded by them as an “everyday necessity” (Wilska, 2003). In 1998, 90% of Finnish 16-24 year-olds had access to at least one cell phone, and in 2001 over one third of Finnish 7-10 year olds had a personal cell phone (Wilska, 2003). This represents an extraordinarily high rate of adoption among a user group so young. While numbers from other countries may not be as remarkable as those from Finland, the age groups defined still show an incredible trend for cellular phone adoption among youth. In 2005, for example, Clarke and Furnell established that 15-24 year-olds in the United Kingdom had the most significant cell phone penetration rate of any age group at 86%, and Kinzie (2005) cited Student Monitor marketing research revealing that around 90% of U.S. college students had cell phones.

While there is some evidence that users perceive their cell phones and text messages as private (Häkkilä & Chatfield, 2005), there is conflicting information regarding how and if users perceive their *location* to be private. In 2003, Barkhuus and Dey (2003) found that “people, in general, are not overly concerned about their privacy when using [LBS]” (p. 3), especially if they perceive the service to be useful. Barkhuus and Dey’s study was of hypothetical services, however, and as such may not be the best at determining real-world privacy preferences. Their observation is supported somewhat by Beckwith’s 2003 study of ubiquitous data collection technologies in a nursing home, wherein it was observed that residents and family members believed the technology kept them safe though they did not understand how it worked. However, Beckwith (2003) put

it best—and got to the crux of the location privacy debate—when he postulated that users can not offer informed consent when they do not comprehend the way a technology works, or when they forget about its existence. As he observed, "…users do not always understand the extent or methods of data collection and thus cannot adequately evaluate privacy issues" (p. 43). In other words, informed consent requires that the user understand the technology and the kinds of information it discloses, as well as to whom the information is disclosed and at what times. Only when users are able to understand the kinds of data gathered and the implications of its disclosure can they be expected to make an informed decision regarding their own privacy.

In their survey of user privacy control techniques, Chen and Rea (2004) stated that one of the best ways for users to maintain anonymity is to substitute fraudulent information for their own personal information. This sentiment is echoed in studies by Consolvo et al, (2005), Schilit et al, (2003), Snekkenes (2001), and Di Pietro and Mancini (2003), who all advise that technologies allowing users to anonymize or "blur" their location should be an optional feature on their cellular phones. The biggest weakness to this approach is that it is extremely difficult, if not impossible, for a cellular phone user to provide fraudulent personal information about him or herself: the cellular phone is always tied to its owner's account (Chen & Rea, 2004).

Enhanced 911 offers a great deal of promise when it comes to saving lives, but its capabilities appear to be misunderstood by the public. A presentation by Nortel Networks to the 1999 Emerging Technologies Symposium stated that 65% of cell phone users believe their wireless service provides 911 location identification equal to that of land lines (Patel, 1999). Frequent use of the word "pinpoint" by the popular media may

also contribute to a misunderstanding of the technology's capabilities. A search of Academic Search Premier on February 6, 2006 of the words "E911" and "pinpoint" anywhere in the document text returned 67 results. Three documents chosen at random all used "pinpoint" when describing E911's location capabilities (Locating Emergency Calls, 2004; Albanesius, 2004; Moore-Thorpe & Sykes, 2005), highlighting the confusion associated with E911's accuracy.

The literature shows that electronic media tend to correlate to higher privacy concerns. Because cellular service providers have begun to implement LBS in order to help pay for E911-related costs, there exists a network for nearly ubiquitous monitoring and data capture. However, are cellular phone users aware of the technologies' capabilities, and do they have enough information to offer informed consent? No prior studies have addressed the connections between E911 awareness and perceptions of privacy, and it needs to be determined what relationships if any exist between them. Following is a discussion of a survey conducted on E911 awareness and privacy perceptions of cellular phones, offered to help build upon the data regarding ubiquitous computing and informed consent.

METHODOLOGY:

On February 28th, 2006, an invitational email was sent to the campus mass email listserv, which reaches all 30,000+ members of the campus community including faculty and staff. The text of the email invited any interested party to follow a link to a survey on modern phone technology hosted by SurveyMonkey.com. The survey (see Appendix C) was composed of several sections. The first included demographic questions pertaining to campus affiliation, gender, and age. Several of the questions were modified from those found in the GVU surveys (Graphics, Visualization & Usability Center, 2006), as well as the survey conducted by Häkkilä and Chatfield (2005). The survey also included a series of questions related to cellular phone ownership, in particular the respondent's cellular service provider and their phone's manufacturer. Other questions about usage patterns and how private they felt their cellular phones to be were presented in order to establish a baseline of privacy preferences. Finally, questions regarding E911 and LBS were asked to help gauge respondent awareness of these services. The data were first reviewed with SurveyMonkey.com's own web-based system, but downloaded and converted to an Excel spreadsheet and further analyzed with SAS 9.1. Descriptive statistics were calculated and relationships among the responses were examined. Statistical significance of these relationships was determined at the $p<.01$ level using the Pearson chi-square.

RESULTS:

Between February 28th and March 3rd, 2006, 1546 people responded to the survey. This was about a 5% participation rate from the approximately 30,000 members of the university community. As Figure 1 shows, the largest majority of respondents were staff, followed by undergraduates, graduate students, and faculty, respectively. A small minority self-identified as "other," and only nine respondents skipped the question. Women as a whole represented 71.2% of the respondents. Figure A1[1] (Appendix A) shows the breakdown of respondent gender by affiliation.

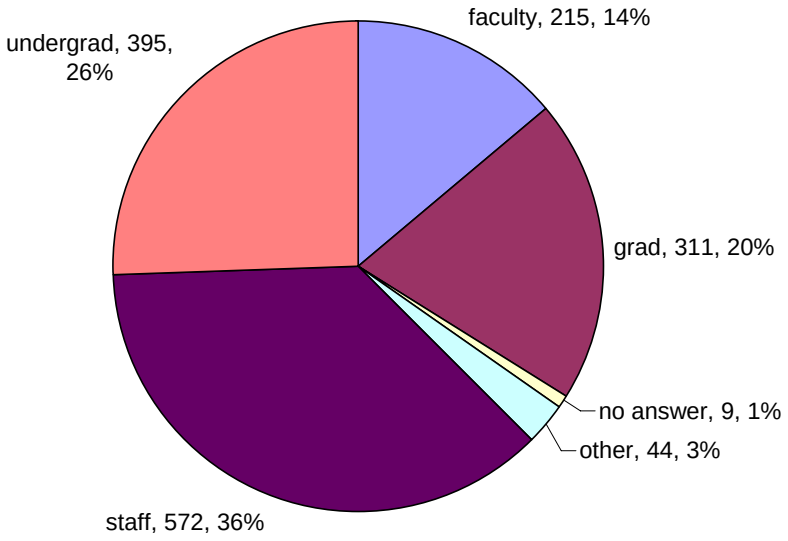

Figure 1: Participants by Affiliation

[1] Figures and tables labeled with a letter and a number are available in the appendix specified by the letter.

Just over half of the respondents were in the 18-30 age groups, and most of the rest were between the ages of 30 and 60 (Figure 2). The second figure in Appendix A shows the distribution of ages by university affiliation.

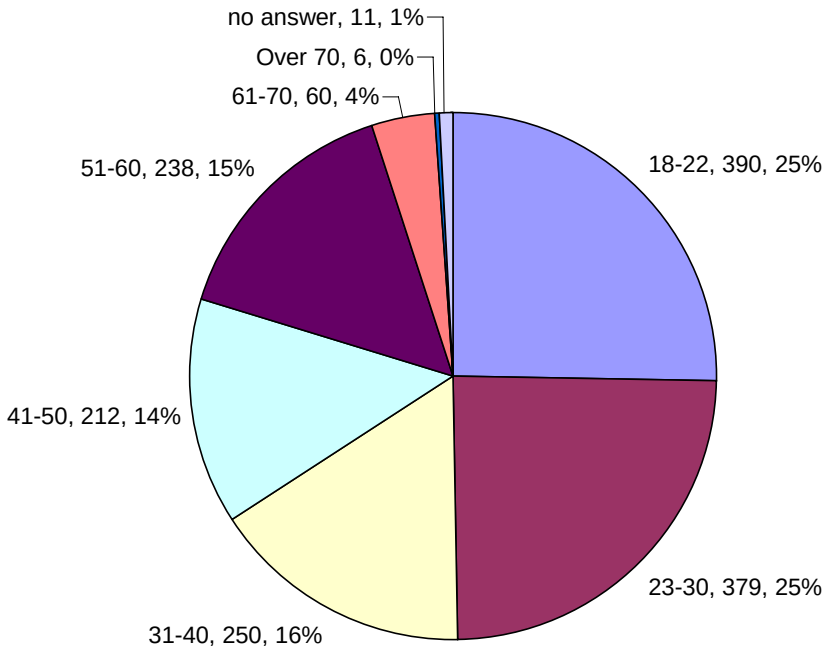

Figure 2: Age of Participants

Almost two-thirds of the respondents described themselves as having used cellular phones for four or more years, while eight percent said they did not currently use a cellular phone, and six respondents did not answer the question (Figure 3).

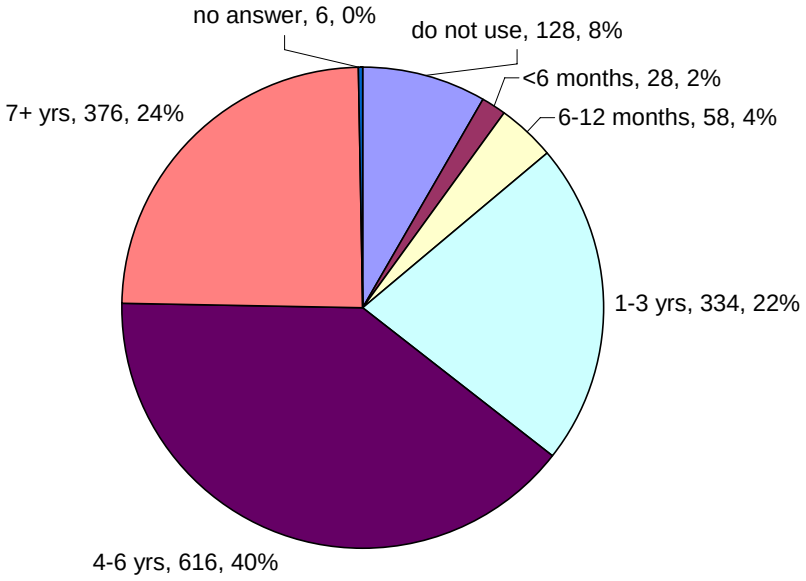

Figure 3: Length of Cellular Phone Usage

While almost half of the respondents stated that their primary reason for owning a cellular phone was for social reasons, just over one-third chose security as their primary reason (Figure 4). Analyzing the reasons for ownership by gender (Table B2, chi-square=82.39, $p<.0001$) reveals an interesting distinction. While social is still the number one reason for ownership in both cases, security had many more female respondents than expected and far fewer male respondents.

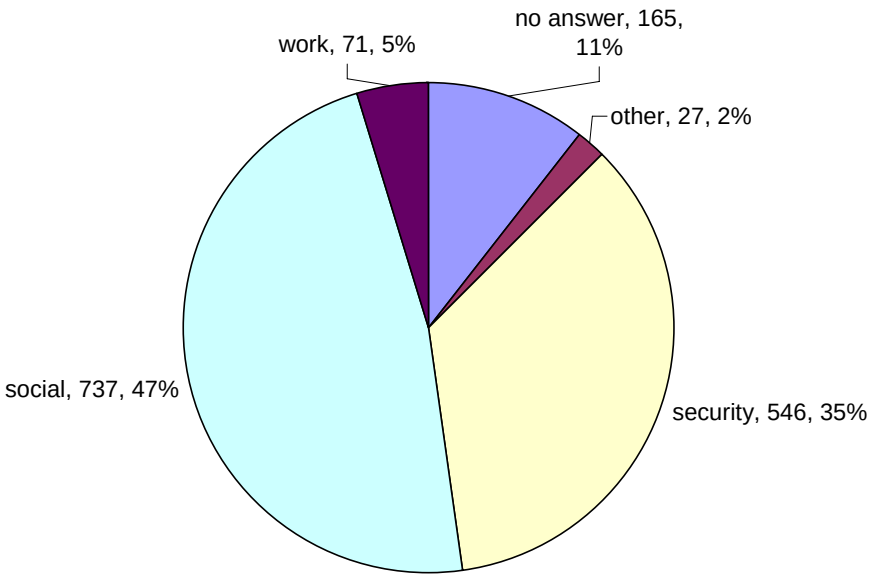

Figure 4: Primary Reasons for Ownership

When reason for ownership is analyzed by university affiliation (Table B3, chi-square=298.42, $p<.0001$), security is the primary reason for ownership chosen by far more faculty and staff than expected. Far more undergraduates and graduates than expected chose “social” as their primary reason for ownership.

Figure 5 is a graph of respondents' cellular service providers. The data for creating this graph were cleaned in order to correct spellings, and answers from the 27 respondents who listed two or more service providers—or stated they did not know their service providers—were not included. Verizon has 36% of the respondent market, Cingular 26%, Sprint 14%, and Alltel 13%, with the other service providers making up the remainder.

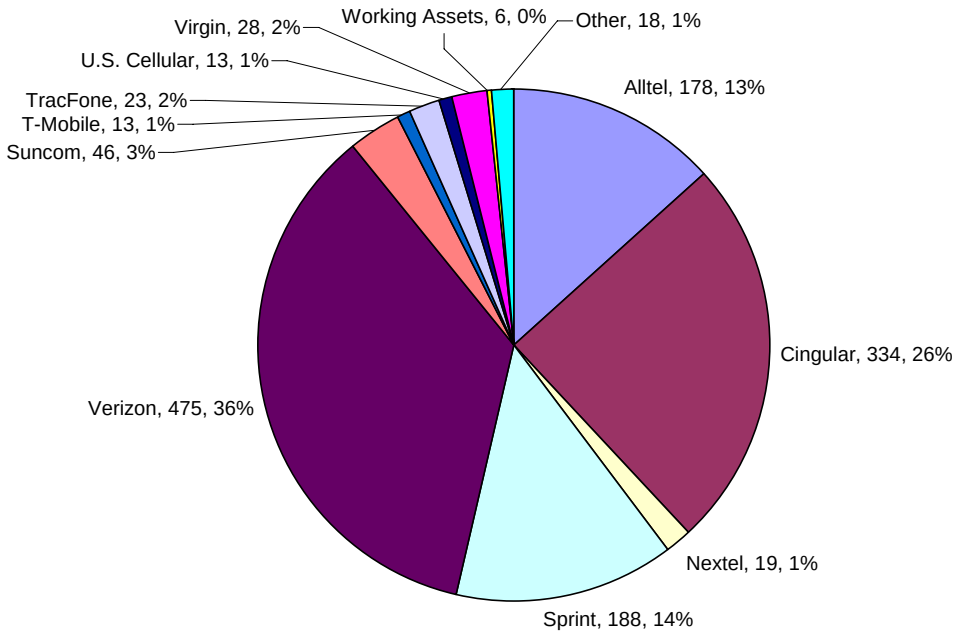

Figure 5: Graph of Cellular Service Providers

As with the service provider data, the cellular phone manufacturer data were also cleaned of unusable responses (*n*=131). Figure 6 shows the four most common cellular phone manufacturers were Motorola, Samsung, Nokia, and LG. These four represent 25%, 18%, 18%, and 17% of the respondent market, respectively.

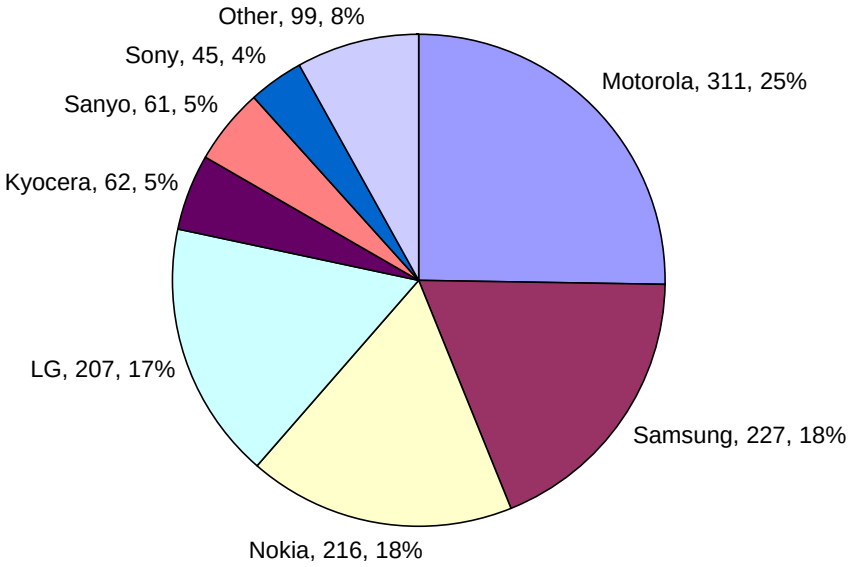

Figure 6: Graph of Cellular Phone Manufacturers

Because LBS are only available on the newer digital phones, it was especially important that respondent awareness of phone type be sampled. As Figure 7 illustrates, well over half of the respondents reported having a digital cellular phone. Over a quarter responded that they did not know what type of cellular phone they had. Because 85% of respondents indicated they obtained their cellular phone between 2002 and 2006 (Figure 8), the likelihood the phone is a digital location-capable model increases substantially.[2]

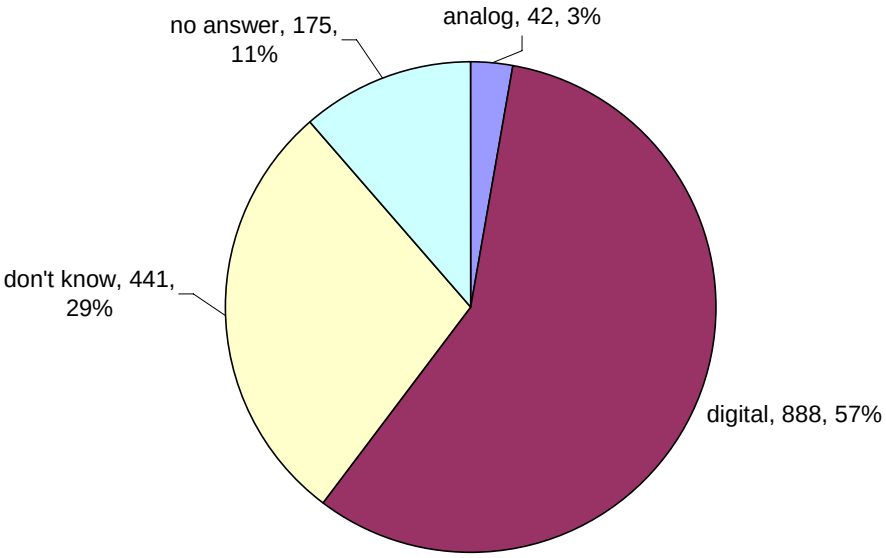

Figure 7: Awareness of Phone Type (Digital or Analog)

[2] See http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-03-20A1.pdf for information on Sprint's estimates for 100% digital phone market penetration.

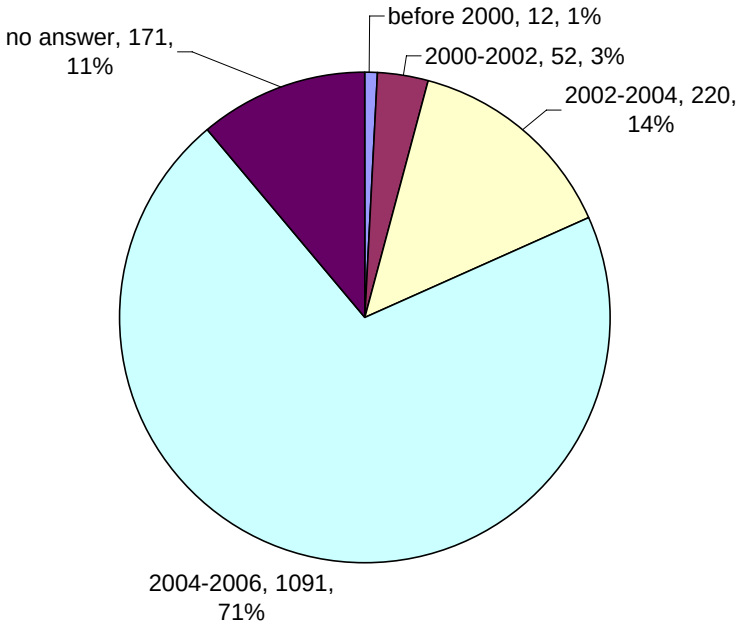

Figure 8: When the Phones Were Purchased

Crucial to determining any links between respondent privacy preferences and awareness of location-sensing technologies were the answers to questions 12-16. Because LBS only work when the phone is on, question 12 (which asks how many hours a day the respondents left their cellular phones on) was used to establish an estimate of how many hours a day a user's location could be determined. As Figure 9 shows, over 60% of respondents leave their cellular phones turned on more than 10 hours a day. An additional 7% leave their phones on at least 7 hours a day, and only 12% responded that they leave their cellular phones off unless they are using them.

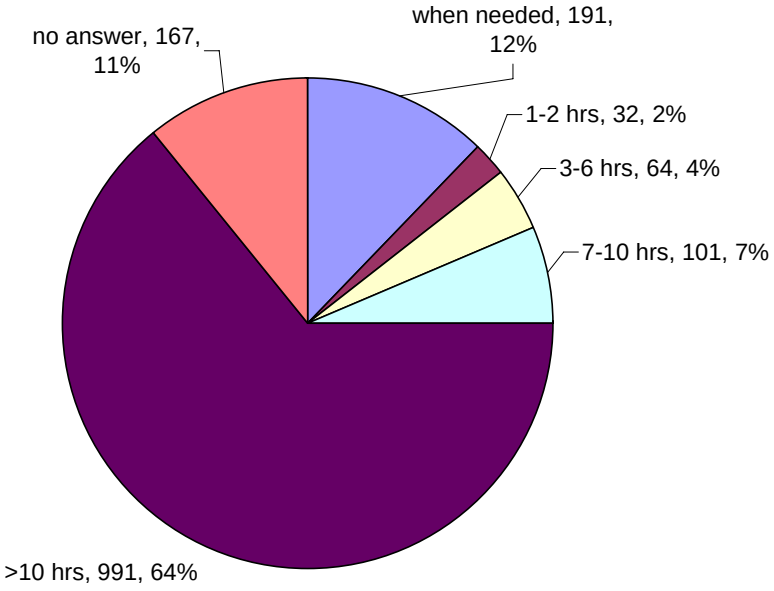

Figure 9: Hours per Day the Cellular Phone is On

Questions 13-16 focus more specifically on the privacy preferences of the respondents. As Figure 10 shows, 68% of respondents would be somewhat or very unlikely to have their cellular phone number published in a directory with their name.

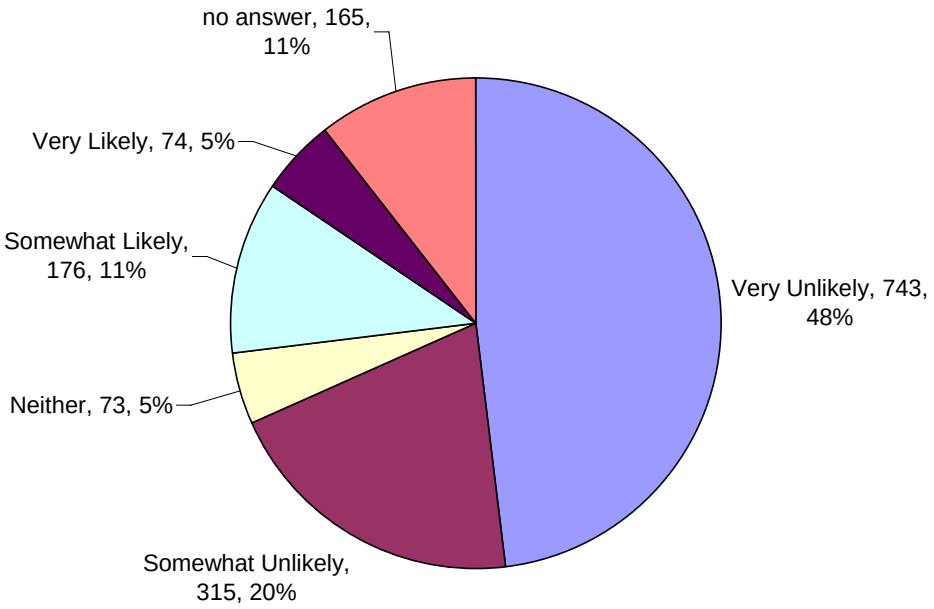

Figure 10: Likelihood of Listing Name and Cell Number in Directory

Question 14 (which asks how often the respondents let other people borrow their cellular phones) was intended to evaluate privacy attitudes towards the respondents' cellular phones. Implications of this question are limited, however, due to the fact that so many individuals have their own cellular phones. The information revealed by it should only be taken into consideration within the context of the other three questions. For example, while 58% of respondents stated that they rarely or never let someone else borrow their cellular phones (Figure 11), only 47.5% of respondents perceive their individual phones as "very private" or "private" (Table 1). Fifty percent and 44.5% of respondents view their phone conversations and text messages, respectively, as "very private" or "private".

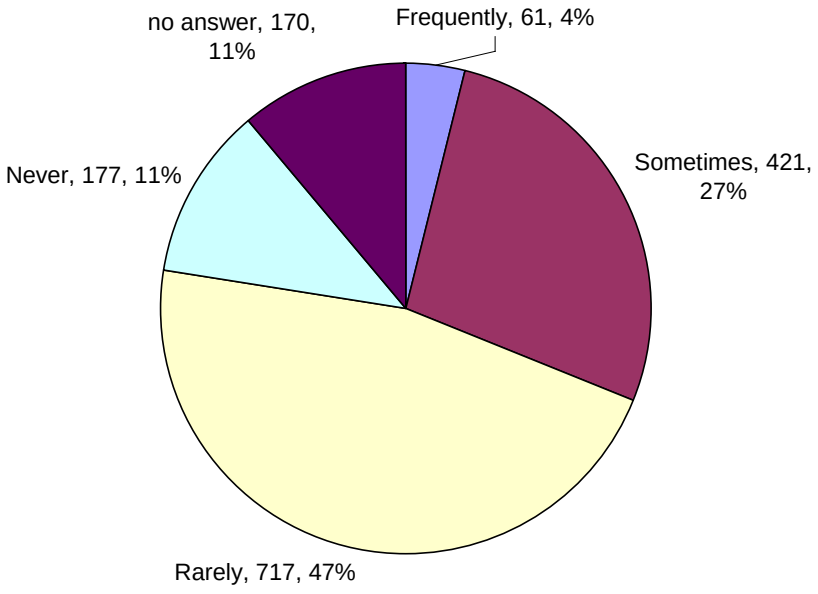

Figure 9: Frequency of Loaning Phone to Others

Table 1: Privacy Perceptions of Specific Communications

	Privacy Perception Level									
Item:	Very Private		Private		Somewhat Private		Not Private		No Answer	
Cellular Phone	239	*15.5%*	494	*32.0%*	501	*32.4%*	136	*8.8%*	176	*11.4%*
Phone Conversations	307	*19.9%*	481	*31.1%*	471	*30.5%*	112	*7.2%*	175	*11.3%*
Text Messages	270	*17.5%*	418	*27.0%*	323	*20.9%*	149	*9.6%*	386	*25.0%*
Total	**816**	***52.8%***	**1393**	***90.1%***	**1295**	***83.8%***	**397**	***25.7%***	**737**	***47.7%***

To further the evaluation of privacy perceptions and cellular phones, question 16 asked respondents to select those things they have done while using their cellular phones. Considering the current emphasis on identity theft, the percentage of respondents who admitted giving out their credit card numbers and social security numbers was very surprising. Forty-nine percent of respondents stated they had given out their credit card numbers while on their cellular phones, while 25.8% had given out their social security numbers. Although "personal medical information" can be interpreted in many different ways, it was still unexpected to find that 36.2% of respondents had disclosed some form of it while on their cellular phones (Table B28).

Since the primary focus of this study is awareness of E911 and its relationships to perceptions of privacy, it was helpful to determine how many participants had dialed 911 on a cellular phone. Table 2 shows that 27.6% of the 737 respondents who own cellular phones had done so. In fact, analysis of the results shows that, of those who dialed 911 on their cellular phones, far more than expected listed "security" as the primary reason for ownership (chi-square=1525.85, $p<.0001$).

Table 2: Primary Reason for Ownership by Cell Phone Calls to 911

	Primary Reason for Ownership											
Called 911 on Cell	Social		Security		Work		No Answer		Other		Total	
Yes	210	13.6%	177	11.5%	28	1.8%	0	0.0%	11	0.70%	426	27.6%
No	518	33.5%	363	23.5%	41	2.7%	2	0.1%	15	1.00%	939	60.7%
Unsure	9	0.6%	5	0.3%	2	0.1%	0	0.0%	1	0.10%	17	1.1%
No Answer	0	0.0%	1	0.1%	0	0.0%	163	10.5%	0	0.00%	164	10.6%
Total	**737**	**47.7%**	**546**	**35.3%**	**71**	**4.6%**	**165**	**10.7%**	**27**	**1.80%**	**1546**	**100.0%**

Questions 21 through 24 of the survey ask specifically about respondent awareness of E911 and LBS. It is very important here to note that there is a distinction between awareness of cellular E911 capabilities, and awareness of a cellular E911 symbol. While a cellular phone's owner may know that it is E911-equipped, they may not know what the E911 symbol looks like, if indeed the phone has one at all. The overwhelming majority of respondents, 73.9%, either did not know or were not sure if their cellular phones were E911-equipped (Table 3). While 14.4% of the respondents stated that their phone was E911-equipped, only eight percent stated they knew what the E911 symbol looked like.

Table 3: General E911 and LBS Awareness

	Yes		No		Don't Know		No Response	
Is your cell E911 equipped?	223	*14.4%*	87	*5.6%*	1056	*68.3%*	180	*11.6%*
Do you know what the E911 Symbol Looks Like?	124	*8.0%*	812	*52.5%*	421	*27.2%*	189	*12.2%*
Do you know what the LBS Symbol Looks Like?	152	*9.8%*	852	*55.1%*	358	*23.2%*	184	*11.9%*
Do you know how to turn off LBS?	145	*9.4%*	895	*57.9%*	319	*20.6%*	187	*12.1%*

When analyzed by gender (Table B5, chi square=68.12, $p<.0001$), a lower proportion of females and a higher proportion of males either did not know or were not sure if their cellular phones were E911 equipped. A higher proportion of 18-22 year olds responded that they were aware their cellular phones were E911 enabled, and of all the age groups they showed the highest awareness of E911. A much lower proportion of 41-50 year olds responded they were aware of E911 availability on their cellular phones (Table B6, chi-square=98.45, $p<.0001$). An analysis of these results by university affiliation (Table B7; chi-square=75.27, $p<.0001$) reveals that the undergraduate group (closely tied to the 18-22 age group for obvious reasons) showed the highest proportion of awareness.

A particularly interesting question is whether or not a respondent's cellular service provider had any bearing on E911 awareness. Table B8 (chi square=1213.82, $p<.0001$) shows that Verizon and the "Other" category both had higher than expected "yes" responses, while Cingular had much lower. Analyzing the service providers by whether or not respondents were aware of an E911 symbol (Table B9, chi-square=1128.16, $p<.0001$) showed that Verizon respondents had higher than expected "yes" responses, while Cingular, Sprint, and Other had higher than expected respondents who answered "don't know". Analyzing the results by LBS symbol awareness (Table B10, chi square=1213.26, $p<.0001$), showed that Verizon and Sprint had higher than expected "yes" responses, while Cingular had significantly less "yes" responses but higher than expected "don't know" responses. Table B11 (chi-square=1195.61, $p<.0001$) compares service providers to perceived knowledge of turning LBS off. Verizon and Sprint again had higher than expected "yes" responses, while Cingular had significantly

less. Cingular also had more “don’t know” responses than expected, and along with Alltel had more “no” responses.

If E911 awareness is instead analyzed by cellular phone manufacturer, the data reveal more interesting information. LG scored much higher than expected in the “yes” category, while Motorola, Samsung, and Nokia scored much higher than expected in the “don’t know” category (Table B12; chi square=708.51, $p<.0001$). Analyzed by knowledge of the E911 symbol (Table B13, chi-square=648.11, $p<.0001$), LG had higher than expected “yes” responses, while Motorola and Samsung had higher than expected “don’t know” responses. Regarding manufacturer and awareness of any LBS symbol (Table B14, chi-square=726.40, $p<.0001$), Samsung scored much higher than anticipated in the “yes” category, while Motorola, Nokia, and LG scored much higher in the “no” category. Table B15 (chi square=701.53, $p<.0001$) shows the analyses of respondents who were and were not aware (or not sure) of how to turn off LBS. Samsung again had many more “yes” responses than expected. Motorola, Nokia, and LG again had more “no” responses than expected. In fact, Motorola also had more “don’t know” responses than expected.

Perhaps one of the best ways to help gauge how perceptions of privacy relate to awareness of E911 and LBS is to run a chi-square test of reported privacy preferences against respondent data of E911 awareness. It would stand to reason that those respondents who are aware of the capabilities of LBS technologies but wish to control their privacy would be the least likely to leave their cellular phones on for long periods of time. Recall that with the newer digital cellular phones, location information can be broadcast anytime the phone is powered on. Table 4 (chi-square=1617.67, $p<.0001$)

indicates that likelihood of cell number and name publication are related to the amount of time one's phone is left on. There were far more "very unlikely" responses than expected from those who turn their cellular phones on "when needed", and many less "somewhat likely" and "somewhat unlikely" responses than expected. By comparison, there were significantly more "somewhat unlikely", "somewhat likely", and "very likely" responses than expected from those respondents who stated they leave their cellular phones on for more than 10 hours at a time.

Table 4: Likelihood of Cell Number and Name Publication by Hours per Day Cell Phone is On

	Likelihood											
Hours per Day	Very Unlikely		Somewhat Unlikely		Neither		Somewhat Likely		Very Likely		No Answer	
>10 hrs	488	31.6%	234	15.1%	57	3.7%	147	9.5%	65	4.2%	0	0.0%
7-10 hrs	47	3.0%	29	1.9%	8	0.5%	13	0.8%	4	0.3%	0	0.0%
3-6 hrs	38	2.5%	22	1.4%	2	0.1%	1	0.1%	1	0.1%	0	0.0%
1-2 hrs	20	1.3%	5	0.3%	0	0.0%	7	0.5%	0	0.0%	0	0.0%
When Needed	150	9.7%	24	1.6%	6	0.4%	7	0.5%	4	0.3%	0	0.0%
No Answer	0	0.0%	1	0.1%	0	0.0%	1	0.1%	0	0.0%	165	10.7%
Total	**743**	**48.1%**	**315**	**20.4%**	**73**	**4.7%**	**176**	**11.4%**	**74**	**4.8%**	**165**	**10.7%**

This relationship is borne out again in Table 5 (chi-square=1673.56, $p<.0001$) which shows that cell phone loaning is related to the amount of time one's phone is left on. There are many more "never let others use my cell phone" responses in the "when needed" row than expected, while there are more "frequently let others use my cell phone" responses than expected in the ">10 hours" column.

Table 5: Cell Phone Loaning by Hours per Day Cell Phone is On

	Loaning									
Hours per Day	Frequently		Sometimes		Rarely		Never		No Answer	
>10 hrs	57	3.7%	359	23.2%	496	32.1%	76	4.9%	3	0.2%
7-10 hrs	1	0.1%	24	1.6%	57	3.7%	19	1.2%	0	0.0%
3-6 hrs	1	0.1%	14	0.9%	41	2.7%	8	0.5%	0	0.0%
1-2 hrs	0	0.0%	6	0.4%	18	1.2%	8	0.5%	0	0.0%
When Needed	2	0.1%	17	1.1%	105	6.8%	66	4.3%	1	0.1%
No Answer	0	0.0%	1	0.1%	0	0.0%	0	0.0%	166	10.7%
Total	**61**	**4.0%**	**421**	**27.2%**	**717**	**46.4%**	**177**	**11.5%**	**170**	**11.0%**

Respondent opinion of cellular phone privacy was also related to the hours per day the cellular phones were left on, as shown in Table 6 (chi-square=1473.60, $p<.0001$). There are, for example, more “very private” responses than expected in the “when needed” row, but there are also even more “not private” responses than expected in the “when needed” row, indicating that different respondents have quite different perceptions of cellular phone privacy.

Table 6: Perception of Cellular Phone Privacy by Hours per Day

	Phone Privacy									
Hours	Very Private		Private		Somewhat Private		Not Private		No Answer	
>10 hrs	160	10.4%	377	24.4%	373	24.1%	78	5.1%	3	0.2%
7-10 hrs	19	1.2%	38	2.5%	30	1.9%	13	0.8%	1	0.1%
3-6 hrs	11	0.7%	29	1.9%	19	1.2%	5	0.3%	0	0.0%
1-2 hrs	5	0.3%	5	0.3%	18	1.2%	4	0.3%	0	0.0%
When Needed	44	2.9%	45	2.9%	59	3.8%	36	2.3%	7	0.5%
No Answer	0	0.0%	0	0.0%	2	0.1%	0	0.0%	165	10.7%
Total	**239**	**15.5%**	**494**	**32.0%**	**501**	**32.4%**	**136**	**8.8%**	**176**	**11.4%**

Table 7 shows a relationship between perceptions of the privacy of conversations and the number of hours per day one’s phone is on (chi-square=1475.94, $p<.0001$).

Respondents who stated their phone conversations were “not private” were more likely than expected to respond that they turn their cellular phones on only when needed, and much less likely to respond that they leave their phones on more than ten hours a day. Surprisingly, there were fewer “when needed” responses than expected, and many more “>10 hours a day” by those answering that they believe their conversations are “private.”

Table 7: Conversation Privacy by Hours per Day

	Conversation Privacy									
Hours	Very Private		Private		Somewhat Private		Not Private		No Answer	
>10 hrs	228	14.8%	370	23.9%	333	21.5%	56	3.6%	4	0.3%
7-10 hrs	19	1.2%	35	2.3%	35	2.3%	11	0.7%	1	0.1%
3-6 hrs	13	0.8%	20	1.3%	23	1.5%	8	0.5%	0	0.0%
1-2 hrs	8	0.5%	4	0.3%	15	1.0%	5	0.3%	0	0.0%
When Needed	38	2.5%	52	3.4%	64	4.1%	32	2.1%	5	0.3%
No Answer	1	0.1%	0	0.0%	1	0.1%	0	0.0%	165	10.7%
Total	**307**	**19.9%**	**481**	**31.1%**	**471**	**30.5%**	**112**	**7.2%**	**175**	**11.3%**

Table 8 indicates a relationship between perceptions of text message privacy and the number of hours one’s phone is on (chi-square=697.31, $p<.0001$). Those who stated that their text messages were “not private” were more likely than expected to turn their phones on only when needed. Respondents stating that they consider their text messages “private” were less likely than expected to only turn their cellular phones on when needed, and much more likely than expected to leave them on more than ten hours a day. Even those responding “somewhat private” to text message privacy were somewhat less likely to turn their phones on only when needed, and much more likely to leave their phones on more than ten hours a day. Most surprisingly of all, perhaps, is that there were more “very private” responses than expected by those who leave their cellular phones on more than ten hours a day.

Table 8: Text Message Privacy by Hours per Day

	Text Message Privacy									
Hours	Very Private		Private		Somewhat Private		Not Private		No Answer	
>10 hrs	208	13.5%	344	22.3%	257	16.6%	87	5.6%	95	6.1%
7-10 hrs	18	1.2%	25	1.6%	23	1.5%	16	1.0%	19	1.2%
3-6 hrs	12	0.8%	15	1.0%	17	1.1%	8	0.5%	12	0.8%
1-2 hrs	3	0.2%	6	0.4%	7	0.5%	5	0.3%	11	0.7%
When Needed	28	1.8%	27	1.8%	19	1.2%	33	2.1%	84	5.4%
No Answer	1	0.1%	1	0.1%	0	0.0%	0	0.0%	165	10.7%
Total	**270**	**17.5%**	**418**	**27.0%**	**323**	**20.9%**	**149**	**9.6%**	**386**	**25.0%**

The next several tables show the relationships between privacy perception and awareness of whether the phone is E911 equipped. The first, Table 9, looks at perceptions of text message privacy. Those respondents who stated that their text messages were "very private" (Table 9; chi-square=532.71, $p<.0001$), were more likely than expected to say that their cellular phones were E911-enabled. Those perceiving their text messages to be "private" and "somewhat private," however, were much more likely than expected to be unsure of their phone's E911 abilities.

Table 9: E911 Awareness by Text Message Privacy

	Text Message Privacy									
E911?	Very Private		Private		Somewhat Private		Not Private		No Answer	
Yes	58	*3.8%*	344	*22.3%*	38	*2.5%*	26	*1.7%*	26	*1.7%*
No	16	*1.0%*	15	*1.0%*	23	*1.5%*	14	*0.9%*	19	*1.2%*
Don't Know	193	*12.5%*	323	*20.9%*	260	*16.8%*	107	*6.9%*	173	*11.2%*
No Answer	3	*0.2%*	5	*30.0%*	2	*10.0%*	2	*0.1%*	168	*10.9%*
Total	**270**	***17.5%***	**418**	***27.0%***	**323**	***20.9%***	**149**	***9.6%***	**386**	***25.0%***

Table 10 focuses on perceptions of cellular phone privacy. Those respondents who felt that their cellular phones were "private" and "somewhat private" had more

“don’t know” responses than expected when it came to their phone’s E911 abilities. Those who answered “very private” and “private” also had more “yes” answers regarding E911 awareness than expected.

Table 10: E911 Awareness by Cell Phone Privacy

	E911 Aware									
Phone Privacy	Yes		No		Don't know		No Answer		Total	
Very Private	46	*3.0%*	15	*1.0%*	175	*11.3%*	3	*0.2%*	239	15.5%
Private	87	*5.6%*	20	*1.3%*	383	*24.8%*	4	*30.0%*	494	32.0%
Somewhat Private	68	*4.4%*	38	*2.5%*	388	*25.1%*	7	*50.0%*	501	32.4%
Not Private	19	*1.2%*	13	*0.8%*	102	*6.6%*	2	*0.1%*	136	8.8%
No Answer	3	*0.2%*	1	*0.1%*	8	*0.5%*	164	*10.6%*	176	11.4%
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***	**1546**	**100.0%**

Chi-Square=1297.90, $p<.0001$

Regarding phone conversation privacy (Table 11), there were more “don’t know” answers than expected from those respondents who felt their conversations were “very private”, “private”, and “somewhat private”.

Table 11: E911 Awareness by Conversation Privacy

	Conversation Privacy									
Awareness	Very Private		Private		Somewhat Private		Not Private		No Answer	
Yes	60	*3.9%*	71	*4.6%*	70	*4.5%*	20	*1.3%*	2	*0.1%*
No	19	*1.2%*	23	*1.5%*	32	*2.1%*	13	*0.8%*	0	*0.0%*
Don't Know	224	*14.5%*	381	*24.6%*	364	*23.5%*	78	*5.1%*	9	*0.6%*
No Answer	4	*0.3%*	6	*0.4%*	5	*0.3%*	1	*0.1%*	164	*10.6%*
Total	**307**	***19.9%***	**481**	***31.1%***	**471**	***30.5%***	**112**	***7.2%***	**175**	***11.3%***

Chi-Square=1305.70, $p<.0001$

DISCUSSION:

This study surveyed the various members of a specific university and as such is limited to that group of people, as well as those who chose to respond. Anyone with an email account at the University of North Carolina-Chapel Hill can choose not to receive mass campus emails, and those who have opted out will not be represented. Any generalization of the findings, therefore, should proceed with caution.

It was welcome—albeit surprising—to see that so many members of the university staff took part in the survey. They, as well as university students, are included in the findings. Their participation represented over one-third of all respondents, and overall participation was far greater than expected. As a whole, the results of the survey indicate a cellular phone-savvy university population. Even most of the undergraduate respondents have been using cellular phones for several years, and this presents a good opportunity to evaluate privacy perceptions as they relate to E911 and LBS awareness. It should not be assumed, however, that familiarity with a cellular phone equals familiarity with its technology or how it works. This hearkens back to Beckwith's (2003) concern regarding technology and informed consent. If users do not know how E911 and LBS work, or they forget those "services" even exist, then they can not offer informed consent.

The first question in this study then becomes: are the survey respondents familiar with cellular phone technologies? The answer is borne out in part by the data showing

that almost one-third of respondents were not aware if their phone was digital or analog. Considering that well over three-quarters of all the respondents reported acquiring their cellular phones since 2002—when digital phones began to dominate the marketplace—this lack of awareness is the first piece of evidence that the majority of campus users do not fully understand their cellular phone's technological capabilities.

The second factor to be addressed was the primary reason for cellular phone ownership. "Social" was the most frequently-occurring primary reason, though security was the primary reason for over a quarter of the women. In fact, there was a strong correlation between those who chose security as their primary reason for ownership and those who had dialed 911 on their cellular phones. There were also strong relationships between the primary reason for ownership and age and university affiliation. As the age groups became older, a higher proportion of respondents chose security as the primary reason for ownership. This finding is paralleled in the higher rates of security as the primary reason for ownership in the faculty and staff, since they would typically be older than the student population.

Let us turn, next, to the respondents' understanding of the cellular phones they use. The fact that almost three-quarters of the respondents either did not know or did not think that their cellular phones were E911 equipped is very substantial evidence that awareness of the technology is not widespread. Because most cellular phones manufactured since 2002 have been E911-enabled, and approximately 85% of respondents purchased their phones between 2002 and 2006, it is even highly likely that those respondents who stated that their cellular phones were not E911 equipped were mistaken. The fact that 79.7% of the respondents either did not know or were not sure

what the E911 symbol on their cellular phones looked like also supports the idea that there is a general lack of E911 understanding. The same can be said about LBS symbols. Nearly 90% of the respondents professed they did not know or were not sure what their cellular phone's LBS symbol looked like, or whether they could even turn the service off. This may have much to do with the lack of standard symbols, however. In fact, the survey question should not be interpreted to mean that an E911 symbol or an LBS symbol exists for every type of phone.

Respondent age and cellular service provider do appear to have a bearing on E911 and LBS awareness. Undergraduates and the 18-22 year old age group both report more E911 awareness than expected. Verizon customers were more likely to be aware of E911 than expected and—along with Sprint—more likely than expected to recognize their phone's LBS symbol. It is unknown whether Verizon and Sprint promote these services more than other providers, and more research is required to help understand the reasons for these differences.

While Barkhuus and Dey (2003) did not discover a great deal of concern about privacy as it relates to LBS, it should be noted that their study was of hypothetical services. It is entirely likely that their findings would not apply to future nuisances like location-based spam. Users having to sort through potentially hundreds of unwanted text messages would quickly grow tired of dealing with the problem. Other research suggests instead that electronic media correlate to higher privacy concerns, and that only about 12% of web users in the GVU surveys felt that their browsing and personal information should be sold to third parties (Hoffman et al., 1999). It would stand to reason, therefore, that users of another electronic media device—the cellular phone—would not want their

personal data resold to third parties. The results of the UNC-Chapel Hill survey, however, indicate that most people are not even aware that the infrastructure for gathering this data is already in place.

The next bit of evidence suggesting a general lack of understanding of E911 and LBS technologies can be found in the amount of time most study participants leave their cellular phones on. Over two-thirds of respondents leave their cellular phones on more than seven hours a day, and most of those leave it on for more than ten hours a day. This means that, should these cellular phones be location-enabled, over two-thirds of the respondents could have their location data collected several hours a day whether they wanted it to be collected or not. The group of respondents that come closest to fitting the "privacy fundamentalist" definition, those who answered survey questions 13-15 (likelihood of name and number publication; frequency of letting others use their cellular phone; how private they consider their cellular phone, phone conversations, and text messages) with "very unlikely", "never", and "very private", respectively, would seem to be the least likely to leave their cellular phones on for long periods of time. This prediction would only hold true, however, if this group of respondents was aware of E911 and LBS technologies and had some familiarity with how they worked. Those respondents who were "very unlikely" to have their name and cellular phone numbers published were, in fact, much more likely than expected to leave their cellular phones off most of the time (Table 4, in the results section above). The same holds true for those responding that they never let anyone borrow their cellular phone (Table B16), and those who responded that their cellular phones were "very private" (Table B17). This is not the case, however, with those respondents who view their phone conversations (Table

B18) and text messages (Table B19) as “very private”. On the contrary, they are more likely than expected to leave their phones on for *more* than ten hours a day. Indeed, there does appear to be some evidence that those who only turn their cellular phones on when needed are more concerned with controlling access to their personal information, but what can explain the discrepancies among these responses?

The desire to keep personal information such as name and cellular phone number from being published is likely to be the result of telemarketing fears, and as such may help to predict just how unwelcome location-based marketing may be in the future. Keeping the cellular phone turned off may be one way of avoiding telemarketer calls altogether and thus could be one reason why some respondents only turn their phones on when needed. This perception could also explain the strong relationships with viewing the phone itself as private and never letting anyone else use it. These respondents may tend to view the device itself and access to it as more private than the conversations and text messages for which it is used.

Häkkilä and Chatfield (2005) established that users tend to perceive their cellular phones and text messages as private, but they focused more on the text messages themselves and as such did not address any differences between perceived device and content privacy. In their study, 82.3% of the respondents felt that cellular phones were private devices. That percentage is significantly larger than the one found in the UNC-Chapel Hill study, but their sample size was much smaller (119 respondents), younger (over 90% of their respondents were under the age of 30), and from different nations (Finland and Australia). Almost half of the UNC-Chapel Hill study’s participants perceive their cellular phones as “very private” or “private”, and slightly less than that

perceive their text messages as “very private” “or private”. Clearly, these distinctions and the reasons behind them are areas for further research and investigation.

In all cases, the majority of the survey’s respondents preferred to leave their phones on ten or more hours a day. So while there is a relationship between the expressed level of privacy and the percentage of respondents who choose to turn their phones on only when necessary, the vast majority of them appear to be unaware of how LBS technology can monitor their locations.

CONCLUSION:

Clearly, there is a lack of awareness—even among cellular phone users—when it comes to E911 and LBS technologies in cellular phones. Simply speaking, the vast majority of respondents to the survey had little to no idea what the services were.

The most important finding of the survey may be that there are two fairly distinct groups of cellular phone users: those who consider the phones more private than the content (conversations and text messages), and those who consider the content more private than the phones. This "digital privacy divide" is somewhat of an enigma, and will certainly benefit from additional research.

It is entirely possible that, as the youngest generation of cellular phone users matures, they will begin to show more preferences for security over convenience. Whether or not location privacy becomes an issue for them is contingent upon increased awareness of location-sensing technologies and the potential (and enacted) consequences of location privacy intrusions.

Consumers should become more aware of the different kinds of location-sensing technologies used in E911 and LBS equipped cellular phones and how they differ in transmitting their locations to the cellular service provider. One way to help improve awareness is to have standardized E911 and LBS symbols. Service providers and the federal government should allow the sale of cellular phones that allow the user to turn off all location-sensing technologies, and not just LBS as in some models. Consumers need a platform for making informed privacy decisions, and should be given clear alternatives

for opting out of any gathering of data about their locations. As technologies become more transparent and government policies and commercial offerings become more flexible, consumers of cellular phones can be empowered to shape this technology in ways that prevent unwanted privacy intrusions.

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APPENDIX A: FIGURES

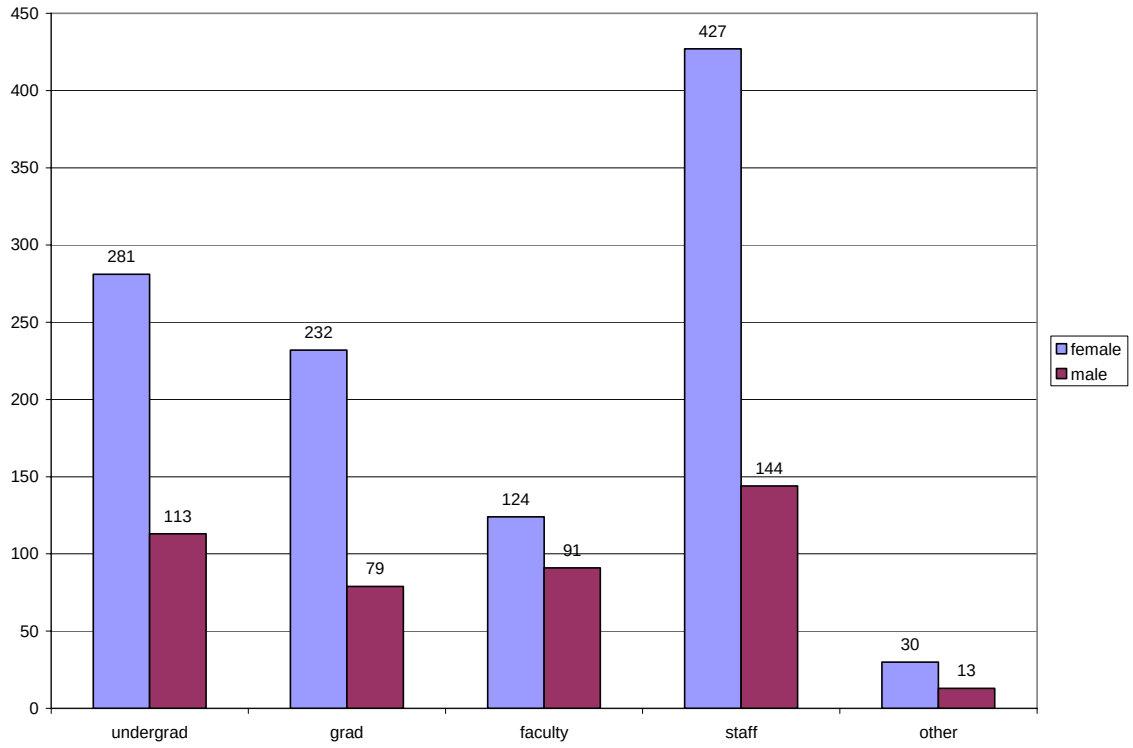

Figure A1: Respondent Gender by Affiliation

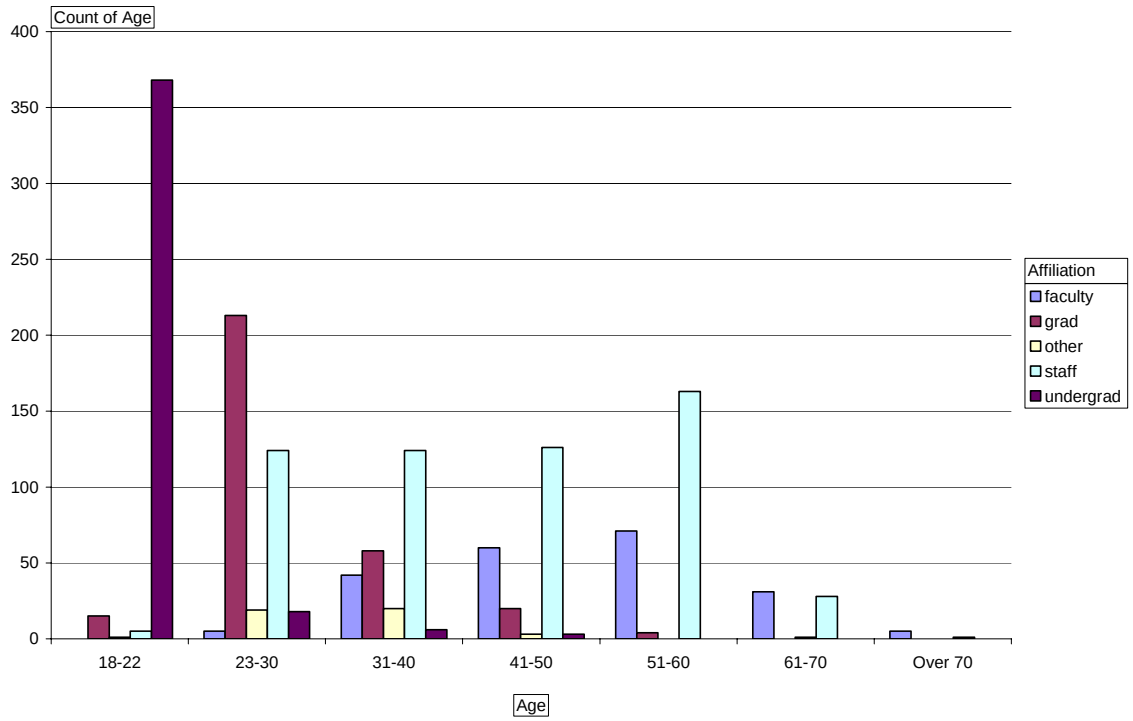

Figure A2: Distribution of Age by University Affiliation

APPENDIX B: TABLES

Table B1: Primary Reason for Ownership by Age

	Reasons for Ownership							
Age	Social		Security		Work		Other	
18-22	295	*21.4%*	74	*5.4%*	1	*0.1%*		
23-30	240	*17.4%*	95	*6.9%*	9	*0.7%*	10	*0.7%*
31-40	88	*6.4%*	101	*7.3%*	19	*1.4%*	8	*0.6%*
41-50	48	*3.5%*	118	*8.6%*	17	*1.2%*	2	*0.2%*
Over 50*	64	*4.7%*	156	*11.3%*	25	*1.8%*	6	*0.4%*
No Answer	2	*0.1%*	2	*0.1%*	0	*0%*	1	*0.1%*
Total	**737**	***53.5%***	**546**	***39.6%***	**71**	***5.2%***	**27**	***2.0%***

Chi-Square=365.36, $p<.0001$

***"Over 50" is a combination of age categories to improve chi-square validity.**

Table B2: Primary Reason for Ownership by Gender

	Reasons for Ownership									
Age	Social		Security		Work		Other		No Answer	
Female	514	*33.3%*	441	*28.5%*	34	*2.2%*	16	*1.0%*	89	*5.8%*
Male	220	*14.2%*	104	*6.7%*	36	*2.3%*	10	*0.7%*	71	*4.6%*
No Answer	3	*0.2%*	1	*0.1%*	1	*0.1%*	1	*0.1%*	5	*0.3%*
Total	**737**	***47.7%***	**546**	***35.3%***	**71**	***4.6%***	**27**	***1.8%***	**165**	***10.7%***

Chi-Square=82.39, $p<.0001$

Table B3: Primary Reason for Ownership by University Affiliation

	Reason for Ownership									
Affiliation	Social		Security		Work		Other		No Answer	
Undergrad	292	*18.9%*	76	*4.9%*	4	*0.3%*	2	*0.1%*	21	*1.4%*
Grad	188	*12.2%*	86	*5.6%*	7	*0.5%*	4	*0.3%*	26	*1.7%*
Faculty	50	*3.2%*	100	*6.5%*	30	*1.9%*	4	*0.3%*	31	*2.0%*
Staff	185	*12.0%*	266	*17.2%*	29	*1.9%*	13	*0.8%*	79	*5.1%*
Other	21	*1.4%*	16	*1.0%*	1	*0.1%*	3	*0.2%*	3	*0.2%*
No Answer	1	*0.1%*	2	*0.1%*	0	*0.0%*	1	*0.1%*	5	*0.3%*
Total	**737**	***47.7%***	**546**	***35.3%***	**71**	***4.6%***	**27**	***1.8%***	**165**	***10.7%***

Chi-Square=298.42, $p<.0001$

Table B4: Primary Reasons for Ownership by Cellular Calls to 911

	Primary Reason for Ownership									
Called 911	Social		Security		Work		No Answer		Other	
Yes	210	*13.6%*	177	*11.5%*	28	*1.8%*	0	*0.0%*	11	*0.70%*
No	518	*33.5%*	363	*23.5%*	41	*2.7%*	2	*0.1%*	15	*1.00%*
Unsure	9	*0.6%*	5	*0.3%*	2	*0.1%*	0	*0.0%*	1	*0.10%*
No Answer	0	*0.0%*	1	*0.1%*	0	*0.0%*	163	*10.5%*	0	*0.00%*
Total	**737**	***47.7%***	**546**	***35.3%***	**71**	***4.6%***	**165**	***10.7%***	**27**	***1.80%***

Chi-Square=1525.85, *p*<.0001

Table B5: E911 Awareness by Gender

	Awareness of E911									
Gender	Yes		No		Don't Know		No Answer		Total	
Female	145	*9.4%*	49	*3.2%*	801	*51.8%*	99	*6.4%*	1094	*71%*
Male	74	*4.8%*	38	*2.5%*	254	*16.4%*	75	*4.9%*	441	*29%*
No Answer	4	*0.3%*	0	*0.0%*	1	*0.1%*	6	*0.4%*	11	*1%*
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***	**1546**	*100%*

Chi-Square=68.12, *p*<.0001

Table B6: E911 Awareness by Age Group

	Awareness of E911									
Age	Yes		No		Don't Know		No Answer		Total	
18-22	80	*5.2%*	10	*0.7%*	278	*18.0%*	22	*1.4%*	390	*25.2%*
23-30	54	*3.5%*	18	*1.2%*	278	*18.0%*	29	*1.9%*	379	*24.5%*
31-40	32	*2.1%*	15	*1.0%*	167	*10.8%*	36	*2.3%*	250	*16.2%*
41-50	18	*1.2%*	20	*1.3%*	144	*9.3%*	30	*1.9%*	212	*13.7%*
Over 50	37	*2.4%*	24	*1.6%*	187	*12.1%*	56	*3.6%*	304	*19.7%*
No Answer	2	*0.1%*	0	*0.0%*	2	*0.1%*	7	*0.5%*	11	*0.7%*
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***	**1546**	***100.0%***

Chi-Square=98.45, *p*<.0001

Table B7: E911 Awareness by University Affiliation

	Awareness of E911									
Affiliation	Yes		No		Don't Know		No Answer		Total	
Undergrad	82	*5.3%*	11	*0.7%*	277	*17.9%*	25	*1.6%*	395	*25.6%*
Grad	41	*2.7%*	19	*1.2%*	223	*14.4%*	28	*1.8%*	311	*20.1%*
Faculty	23	*1.5%*	16	*1.0%*	144	*9.3%*	32	*2.1%*	215	*13.9%*
Staff	70	*4.5%*	36	*2.3%*	380	*24.6%*	86	*5.6%*	572	*37.0%*
Other	5	*0.3%*	5	*0.3%*	31	*2.0%*	3	*0.2%*	44	*2.9%*
No Answer	2	*0.1%*	0	*0.0%*	1	*0.1%*	6	*0.4%*	9	*0.6%*
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***	**1546**	***100.0%***

Chi-Square=75.27, $p<.0001$

Table B8: E911 Awareness by Cellular Service Provider

	Awareness of E911									
Provider	Yes		No		Don't Know		No Answer		Total	
Verizon	101	*6.5%*	20	*1.3%*	348	*22.5%*	7	*0.5%*	476	*30.8%*
Cingular	42	*2.7%*	22	*1.4%*	275	*17.8%*	1	*0.1%*	340	*22.0%*
Sprint	35	*2.3%*	15	*1.0%*	159	*10.3%*	0	*0.0%*	209	*13.5%*
Alltel	35	*2.3%*	14	*0.9%*	128	*8.3%*	5	*0.3%*	182	*11.8%*
SunCom	2	*0.1%*	6	*0.4%*	38	*2.5%*	1	*0.1%*	47	*3.0%*
Other	4	*0.3%*	6	*0.4%*	87	*5.6%*	0	*0.0%*	97	*6.3%*
No Answer	4	*0.3%*	4	*30.0%*	21	*1.4%*	166	*10.7%*	195	*12.6%*
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***	**1546**	***100.0%***

Chi-Square=1213.82, $p<.0001$

Table B9: E911 Symbol Awareness by Cellular Service Provider

	Awareness of E911 Symbol									
Provider	Yes		No		Don't Know		No Answer		Total	
Verizon	55	*3.6%*	274	*17.7%*	137	*8.9%*	10	*0.7%*	476	*10.8%*
Cingular	23	*1.5%*	208	*13.5%*	105	*6.8%*	4	*0.3%*	340	*22.0%*
Sprint	17	*1.1%*	124	*8.0%*	68	*4.4%*	0	*0.0%*	209	*13.5%*
Alltel	21	*1.4%*	106	*6.9%*	48	*3.1%*	7	*0.5%*	182	*11.8%*
SunCom	2	*0.1%*	32	*2.1%*	12	*0.8%*	1	*0.1%*	47	*3.0%*
Other	2	*0.1%*	57	*3.7%*	37	*2.4%*	1	*0.1%*	97	*6.3%*
No Answer	4	*0.3%*	11	*0.7%*	14	*0.9%*	166	*10.7%*	195	*12.6%*
Total	**124**	***8.0%***	**812**	***53.0%***	**421**	***27.2%***	**189**	***12.2%***	**1546**	***100.0%***

Chi-Square=1128.16, $p<.0001$

Table B10: LBS Symbol Awareness by Cellular Service Provider

	Awareness of LBS Symbol									
Provider	Yes		No		Don't Know		No Answer		Total	
Verizon	81	*5.2%*	282	*18.2%*	104	*6.7%*	9	*0.6%*	476	*30.8%*
Cingular	9	*0.6%*	232	*15.0%*	97	*6.3%*	2	*0.1%*	340	*22.0%*
Sprint	36	*2.3%*	117	*7.6%*	56	*3.6%*	0	*0.0%*	209	*13.5%*
Alltel	14	*0.9%*	115	*7.4%*	47	*3.0%*	6	*0.4%*	182	*11.8%*
SunCom	1	*0.1%*	35	*2.3%*	11	*0.7%*	0	*0.0%*	47	*3.0%*
Other	7	*0.5%*	56	*3.6%*	33	*2.1%*	1	*0.1%*	97	*6.3%*
No Answer	4	*0.3%*	15	*1.0%*	10	*0.7%*	166	*10.7%*	195	*12.6%*
Total	**152**	***9.9%***	**852**	***55.1%***	**358**	***23.1%***	**184**	***11.9%***	**1546**	*100.0%*

Chi-Square=1213.26, $p<.0001$

Table B11: Awareness of the Ability to Turn LBS Off by Cellular Service Provider

	Awareness of Turning LBS Off									
Provider	Yes		No		Don't Know		No Answer		Total	
Verizon	65	*4.2%*	309	*20.0%*	93	*6.0%*	9	*0.6%*	476	*30.8%*
Cingular	11	*0.7%*	237	*15.3%*	90	*5.8%*	2	*0.1%*	340	*22.0%*
Sprint	40	*2.6%*	115	*7.4%*	53	*3.4%*	1	*0.1%*	209	*13.5%*
Alltel	21	*1.4%*	116	*7.5%*	38	*2.5%*	7	*0.5%*	182	*11.8%*
Other	6	*0.4%*	63	*4.1%*	27	*1.8%*	1	*0.1%*	97	*6.3%*
SunCom	1	*0.1%*	34	*2.2%*	12	*0.8%*	0	*0.0%*	47	*3.0%*
No Answer	1	*0.1%*	21	*1.4%*	6	*0.4%*	167	*10.8%*	195	*12.6%*
Total	**145**	***9.4%***	**895**	***57.9%***	**319**	***20.6%***	**187**	***12.1%***	**1546**	***100.0%***

Chi-Square=1195.61, $p<.0001$

Table B12: E911 Awareness by Cellular Phone Manufacturer

	E911 Awareness									
Manufacturer	Yes		No		Don't Know		No Answer		Total	
Motorola	40	*2.6%*	21	*1.4%*	247	*16.0%*	3	*0.2%*	311	*20.1%*
Samsung	30	*1.9%*	9	*0.6%*	187	*12.1%*	1	*0.1%*	227	*14.7%*
Nokia	30	*1.9%*	23	*1.5%*	161	*10.4%*	2	*0.1%*	216	*14.0%*
LG	55	*3.6%*	7	*0.5%*	142	*9.2%*	3	*0.2%*	207	*13.4%*
Kyocera	14	*0.9%*	2	*0.1%*	44	*2.9%*	2	*0.1%*	62	*4.0%*
Sanyo	9	*0.6%*	8	*0.5%*	44	*2.9%*	0	*0.0%*	61	*4.0%*
Sony	8	*0.5%*	5	*0.3%*	32	*2.1%*	0	*0.0%*	45	*2.9%*
Other	16	*1.0%*	5	*0.3%*	77	*5.0%*	1	*0.1%*	99	*6.4%*
No Answer	21	*1.4%*	7	*0.5%*	122	*7.9%*	168	*10.9%*	318	*20.6%*
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***	**1546**	*100.0%*

Chi-Square=708.51, $p<.0001$

Table B13: E911 Symbol Awareness by Cellular Phone Manufacturer

	Awareness of E911 Symbol									
Manufacturer	Yes		No		Don't Know		No Answer		Total	
Motorola	29	*1.9%*	180	*11.6%*	96	*6.2%*	6	*0.4%*	311	*20.1%*
Samsung	20	*1.3%*	124	*8.0%*	81	*5.2%*	2	*0.1%*	227	*14.7%*
Nokia	13	*0.8%*	136	*8.8%*	63	*4.1%*	4	*0.3%*	216	*14.0%*
LG	29	*1.9%*	125	*8.1%*	48	*3.1%*	5	*0.3%*	207	*13.4%*
Kyocera	8	*0.5%*	33	*2.1%*	19	*1.2%*	2	*13.0%*	62	*4.0%*
Sanyo	5	*0.3%*	40	*2.6%*	16	*1.0%*	0	*0.0%*	61	*4.0%*
Sony	4	*0.3%*	29	*1.9%*	12	*0.8%*	0	*0.0%*	45	*2.9%*
Other	7	*0.5%*	61	*4.0%*	30	*1.9%*	1	*0.1%*	99	*6.4%*
No Answer	9	*0.6%*	84	*5.4%*	56	*3.6%*	169	*10.9%*	318	*20.6%*
Total	**124**	***8.0%***	**812**	***52.5%***	**421**	***27.2%***	**189**	***12.2%***	**1546**	***100.0%***

Chi-Square=648.10, *p*<.0001

Table B14: LBS Symbol Awareness by Cellular Phone Manufacturer

	Awareness of LBS Symbol									
Manufacturer	Yes		No		Don't Know		No Answer		Total	
Motorola	23	*1.5%*	201	*13.0%*	83	*5.4%*	4	*0.3%*	311	*20.1%*
Samsung	55	*3.6%*	113	*7.3%*	58	*3.8%*	1	*0.1%*	227	*14.7%*
Nokia	14	*0.9%*	143	*9.3%*	57	*3.7%*	2	*0.1%*	216	*14.0%*
LG	22	*1.4%*	135	*8.7%*	46	*3.0%*	4	*0.3%*	207	*13.4%*
Kyocera	6	*0.4%*	39	*2.5%*	15	*1.0%*	2	*0.1%*	62	*4.0%*
Sanyo	11	*0.7%*	36	*2.3%*	14	*0.9%*	0	*0.0%*	61	*4.0%*
Sony	2	*0.1%*	29	*1.9%*	14	*0.9%*	0	*0.0%*	45	*2.9%*
Other	8	*0.5%*	63	*4.1%*	27	*1.8%*	1	*0.1%*	99	*6.4%*
No Answer	11	*0.7%*	93	*6.0%*	44	*2.9%*	170	*11.0%*	318	*20.6%*
Total	**152**	***9.8%***	**852**	***55.1%***	**358**	***23.1%***	**184**	***11.9%***	**1546**	*100.0%*

Chi-Square=726.40, *p*<.0001

Table B15: Awareness of the Ability to Turn LBS Off by Manufacturer

	Awareness of Turning LBS Off									
Manufacturer	Yes		No		Don't Know		No Answer		Total	
Motorola	25	*1.6%*	205	*13.3%*	77	*5.0%*	4	*0.3%*	311	*20.1%*
Samsung	44	*2.9%*	129	*8.3%*	53	*3.4%*	1	*0.1%*	227	*14.7%*
Nokia	16	*1.0%*	151	*9.8%*	47	*3.0%*	2	*0.1%*	216	*14.0%*
LG	23	*1.5%*	136	*8.8%*	44	*2.9%*	4	*0.3%*	207	*13.4%*
Kyocera	7	*0.5%*	39	*2.5%*	13	*0.8%*	3	*0.2%*	62	*4.0%*
Sanyo	11	*0.7%*	36	*2.3%*	14	*0.9%*	0	*0.0%*	61	*4.0%*
Sony	4	*0.3%*	29	*1.9%*	12	*0.8%*	0	*0.0%*	45	*2.9%*
Other	8	*0.5%*	69	*4.5%*	21	*1.4%*	1	*0.1%*	99	*6.4%*
No Answer	7	*0.5%*	101	*6.5%*	38	*2.5%*	172	*11.1%*	318	*10.6%*
Total	**145**	***9.4%***	**895**	***57.9%***	**319**	***20.6%***	**187**	***12.1%***	**1546**	*100.0%*

Chi-Square=701.53, *p*<.0001

Table B16: Reported Loaning of Cellular Phone by Hours per Day

	Loaning									
Hours per Day	Frequently		Sometimes		Rarely		Never		No Answer	
>10 hrs	57	*3.7%*	359	*23.2%*	496	*32.1%*	76	*4.9%*	3	*0.2%*
7-10 hrs	1	*0.1%*	24	*1.6%*	57	*3.7%*	19	*1.2%*	0	*0.0%*
3-6 hrs	1	*0.1%*	14	*0.9%*	41	*2.7%*	8	*0.5%*	0	*0.0%*
1-2 hrs	0	*0.0%*	6	*0.4%*	18	*1.2%*	8	*0.5%*	0	*0.0%*
When Needed	2	*0.1%*	17	*1.1%*	105	*6.8%*	66	*4.3%*	1	*0.1%*
No Answer	0	*0.0%*	1	*0.1%*	0	*0.0%*	0	*0.0%*	166	*10.7%*
Total	**61**	***4.0%***	**421**	***27.2%***	**717**	***46.4%***	**177**	***11.5%***	**170**	***11.0%***

Chi-Square=1673.56, *p*<.0001

Table B17: Perceptions of Cellular Phone Privacy by Hours per Day

	Phone Privacy									
Hours	Very Private		Private		Somewhat Private		Not Private		No Answer	
>10 hrs	160	*10.4%*	377	*24.4%*	373	*24.1%*	78	*5.1%*	3	*0.2%*
7-10 hrs	19	*1.2%*	38	*2.5%*	30	*1.9%*	13	*0.8%*	1	*0.1%*
3-6 hrs	11	*0.7%*	29	*1.9%*	19	*1.2%*	5	*0.3%*	0	*0.0%*
1-2 hrs	5	*0.3%*	5	*0.3%*	18	*1.2%*	4	*0.3%*	0	*0.0%*
When Needed	44	*2.9%*	45	*2.9%*	59	*3.8%*	36	*2.3%*	7	*0.5%*
No Answer	0	*0.0%*	0	*0.0%*	2	*0.1%*	0	*0.0%*	165	*10.7%*
Total	**239**	***15.5%***	**494**	***32.0%***	**501**	***32.4%***	**136**	***8.8%***	**176**	***11.4%***

Chi-Square=1473.60, *p*<.0001

Table B18: Conversation Privacy by Hours per Day

	Conversation Privacy									
Hours	Very Private		Private		Somewhat Private		Not Private		No Answer	
>10 hrs	228	*14.8%*	370	*23.9%*	333	*21.5%*	56	*3.6%*	4	*0.3%*
7-10 hrs	19	*1.2%*	35	*2.3%*	35	*2.3%*	11	*0.7%*	1	*0.1%*
3-6 hrs	13	*0.8%*	20	*1.3%*	23	*1.5%*	8	*0.5%*	0	*0.0%*
1-2 hrs	8	*0.5%*	4	*0.3%*	15	*1.0%*	5	*0.3%*	0	*0.0%*
When Needed	38	*2.5%*	52	*3.4%*	64	*4.1%*	32	*2.1%*	5	*0.3%*
No Answer	1	*0.1%*	0	*0.0%*	1	*0.1%*	0	*0.0%*	165	*10.7%*
Total	**307**	***19.9%***	**481**	***31.1%***	**471**	***30.5%***	**112**	***7.2%***	**175**	***11.3%***

Chi-Square=1475.94, *p*<.0001

Table B19: Text Message Privacy by Hours per Day

	Text Message Privacy									
Hours	Very Private		Private		Somewhat Private		Not Private		No Answer	
>10 hrs	208	*13.5%*	344	*22.3%*	257	*16.6%*	87	*5.6%*	95	*6.1%*
7-10 hrs	18	*1.2%*	25	*1.6%*	23	*1.5%*	16	*1.0%*	19	*1.2%*
3-6 hrs	12	*0.8%*	15	*1.0%*	17	*1.1%*	8	*0.5%*	12	*0.8%*
1-2 hrs	3	*0.2%*	6	*0.4%*	7	*0.5%*	5	*0.3%*	11	*0.7%*
When Needed	28	*1.8%*	27	*1.8%*	19	*1.2%*	33	*2.1%*	84	*5.4%*
No Answer	1	*0.1%*	1	*0.1%*	0	*0.0%*	0	*0.0%*	165	*10.7%*
Total	**270**	***17.5%***	**418**	***27.0%***	**323**	***20.9%***	**149**	***9.6%***	**386**	***25.0%***

Chi-Square=697.31, *p*<.0001

Table B20: Likelihood of Cell Number and Name Publication by E911 Awareness

	E911 Awareness									
Likelihood	Yes		No		Don't Know		No Answer		Total	
Very Unlikely	122	*7.9%*	50	*3.2%*	563	*36.4%*	8	*0.5%*	743	*48.1%*
Somewhat Unlikely	44	*2.9%*	14	*0.9%*	251	*16.2%*	6	*0.4%*	315	*20.4%*
Neither	12	*0.8%*	4	*0.3%*	57	*3.7%*	0	*0%*	73	*4.7%*
Somewhat Likely	25	*1.6%*	14	*0.9%*	135	*8.7%*	2	*0.1%*	176	*11.4%*
Very Likely	19	*1.2%*	5	*0.3%*	50	*3.2%*	0	*0%*	74	*4.8%*
No Answer	1	*0.1%*	0	*0%*	0	*0%*	164	*10.6%*	165	*10.7%*
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***	**1546**	***100%***

Chi-Square=1393.73, *p*<.0001

Table B21: Reported Loaning of Phone by E911 Awareness

	E911 Awareness									
Loaning	Yes		No		Don't Know		No Answer		Total	
Never	25	*1.6%*	16	*1.0%*	134	*8.7%*	2	*0.1%*	177	*11.5%*
Rarely	116	*7.5%*	39	*2.5%*	553	*35.8%*	9	*0.6%*	717	*46.4%*
Sometimes	69	*4.5%*	29	*1.9%*	320	*20.7%*	3	*0.2%*	421	*27.2%*
Frequently	12	*0.8%*	3	*0.2%*	45	*2.9%*	1	*0.1%*	61	*4.0%*
No Answer	1	*0.1%*	0	*0.0%*	4	*0.3%*	165	*10.7%*	170	*11.0%*
Total	223	*14.4%*	87	*5.6%*	1056	*68.3%*	180	*11.6%*	1546	*100.0%*

Chi-Square=1359.66, *p*<.0001

Table B22: Perceptions of Cellular Phone Privacy by E911 Awareness

E911 Aware	Phone Privacy: Very Private		Private		Somewhat Private		Not Private		No Answer		**Total**	
Yes	46	*3.0%*	87	*0.8%*	68	*4.4%*	19	*1.2%*	3	*0.2%*	223	*14.4%*
No	15	*1.0%*	20	*1.3%*	38	*2.5%*	13	*0.8%*	1	*0.1%*	87	*5.6%*
Don't know	175	*11.3%*	383	*24.8%*	388	*25.1%*	102	*6.6%*	8	*0.5%*	1056	*68.3%*
No Answer	3	*0.2%*	4	*30.0%*	7	*50.0%*	2	*0.1%*	164	*10.6%*	180	*11.6%*
Total	**239**	***15.5%***	**494**	***32.0%***	**501**	***32.4%***	**136**	***8.8%***	**176**	***11.4%***	**1546**	***100.0%***

Chi-Square=1297.87, $p<.0001$

Table B23: Perceived Conversation Privacy by E911 Awareness

Conversations	E911 Awareness: Yes		No		Don't Know		No Answer		Total	
Very Private	60	*3.9%*	19	*1.2%*	224	*14.5%*	4	*0.3%*	307	*19.9%*
Private	71	*4.6%*	23	*1.5%*	381	*24.6%*	6	*0.4%*	481	*31.1%*
Somewhat Private	70	*4.5%*	32	*2.1%*	364	*23.5%*	5	*0.3%*	471	*30.5%*
Not Private	20	*1.3%*	13	*0.8%*	78	*5.1%*	1	*0.1%*	112	*7.2%*
No Answer	2	*0.1%*	0	*0.0%*	9	*0.6%*	164	*10.6%*	175	*11.3%*
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***	**1546**	***100.0%***

Chi-Square=1305.69, $p<.001$

Table B24: Text Message Privacy by Awareness of E911

Phone Privacy	E911 Aware: Yes		No		Don't know		No Answer	
Very Private	46	*3.0%*	15	*1.0%*	175	*11.3%*	3	*0.2%*
Private	87	*5.6%*	20	*1.3%*	383	*24.8%*	4	*30.0%*
Somewhat Private	68	*4.4%*	38	*2.5%*	388	*25.1%*	7	*50.0%*
Not Private	19	*1.2%*	13	*0.8%*	102	*6.6%*	2	*0.1%*
No Answer	3	*0.2%*	1	*0.1%*	8	*0.5%*	164	*10.6%*
Total	**223**	***14.4%***	**87**	***5.6%***	**1056**	***68.3%***	**180**	***11.6%***

Chi-Square=532.71, $p<.0001$

Table B25: On-Cell Ordering by Age Group

	Order					
Age	Order		No Answer		Total	
18-22	240	*15.5%*	150	*9.7%*	390	*25.2%*
23-30	254	*16.4%*	125	*8.1%*	379	*24.5%*
31-40	114	*7.4%*	136	*8.8%*	250	*16.2%*
41-50	74	*4.8%*	138	*8.9%*	212	*13.7%*
Over 50	76	*4.9%*	228	*14.8%*	304	*19.7%*
No Answer	2	*10.0%*	9	*60.0%*	11	*70.0%*
Total	**760**	***49.2%***	**786**	***50.8%***	**1546**	***100.0%***

Chi-Square=165.00, p<.0001

Table B26: Credit Card Disclosure by Age Group

	Credit Card					
Age	Credit Card		No Answer		Total	
18-22	187	*12.2%*	203	*13.1%*	390	*25.2%*
23-30	230	*14.9%*	149	*9.6%*	379	*24.5%*
31-40	85	*5.5%*	165	*10.7%*	250	*16.2%*
41-50	43	*2.8%*	169	*10.9%*	212	*13.7%*
Over 50	39	*2.5%*	265	*17.1%*	304	*19.7%*
No Answer	2	*10.0%*	9	*60.0%*	11	*70.0%*
Total	**586**	***37.9%***	**960**	***62.1%***	**1546**	***100.0%***

Chi-Square=212.91, p<.0001

Table B27: Social Security Number Disclosure by Age Group

	SSN					
Age	SSN		No Answer		Total	
18-22	138	*8.9%*	252	*16.3%*	390	*25.2%*
23-30	171	*11.1%*	208	*13.5%*	379	*24.5%*
31-40	58	*3.8%*	192	*12.4%*	250	*16.1%*
41-50	15	*1.0%*	197	*12.7%*	212	*13.7%*
Over 50	17	*1.1%*	287	*18.6%*	304	*19.7%*
No Answer	1	*10.0%*	10	*70.0%*	11	*70.0%*
Total	**400**	***25.9%***	**1146**	***74.1%***	**1546**	***100.0%***

Chi-Square=198.39, *p*<.0001

Table B28: Medical Information Disclosure by Age Group

	Medical Information					
Age	Medical		No Answer		Total	
18-22	156	*10.1%*	234	*15.1%*	390	*25.2%*
23-30	189	*12.2%*	190	*12.3%*	379	*14.5%*
31-40	94	*6.1%*	156	*10.1%*	250	*16.2%*
41-50	59	*3.8%*	153	*9.9%*	212	*13.7%*
Over 50	60	*3.9%*	244	*15.8%*	304	*19.7%*
No Answer	2	*10.0%*	9	*60.0%*	11	*70.0%*
Total	**560**	***36.2%***	**986**	***63.8%***	**1546**	*100.0%*

Chi-Square=76.94, *p*<.0001

Table B29: On Cell Ordering by Text Message Privacy

	Order					
Text Messages	Order		No Answer		Total	
Very Private	167	*10.8%*	103	*6.7%*	270	*17.5%*
Private	269	*17.4%*	149	*9.6%*	418	*27.0%*
Somewhat Private	191	*12.4%*	132	*8.5%*	323	*21.0%*
Not Private	66	*4.3%*	83	*5.4%*	149	*9.6%*
No Answer	67	*4.3%*	319	*20.6%*	386	*25.0%*
Total	**760**	***49.2%***	**786**	***50.8%***	**1546**	***100.0%***

Chi-Square=226.48, *p*<.0001

Table B30: Credit Card Disclosure by Text Message Privacy

	Credit Card					
Text Messages	Credit Card		No Answer		Total	
Very Private	135	*8.7%*	135	*8.7%*	270	*17.5%*
Private	208	*13.5%*	210	*13.6%*	418	*27.0%*
Somewhat Private	157	*10.2%*	166	*10.7%*	323	*20.9%*
Not Private	41	*2.7%*	108	*7.0%*	149	*9.6%*
No Answer	45	*2.9%*	341	*22.1%*	386	*25.0%*
Total	**586**	***37.9%***	**960**	***62.1%***	**1546**	***100.0%***

Chi-Square=177.27, *p*<.0001

Table B31: Social Security Number Disclosure by Text Message Privacy

	Social Security Number					
Text Messages	SSN		No Answer		Total	
Very Private	95	*6.1%*	175	*11.3%*	270	*17.5%*
Private	139	*9.0%*	279	*18.1%*	418	*27.0%*
Somewhat Private	115	*7.4%*	208	*13.5%*	323	*20.9%*
Not Private	26	*1.7%*	123	*8.0%*	149	*9.6%*
No Answer	25	*1.6%*	361	*23.4%*	386	*25.0%*
Total	**400**	***25.9%***	**1146**	***74.1%***	**1546**	***100.0%***

Chi-Square=121.26, *p*<.0001

Table B32: Medical Information Disclosure by Text Message Privacy

	Medical Information					
SMS Privacy	Medical		No Answer		Total	
Very Private	121	*7.8%*	149	*9.6%*	270	*17.5%*
Private	183	*11.8%*	235	*15.2%*	418	*27.0%*
Somewhat Private	150	*9.7%*	173	*11.2%*	323	*20.9%*
Not Private	43	*2.8%*	106	*6.9%*	149	*9.6%*
No Answer	63	*4.1%*	323	*20.9%*	386	*25.0%*
Total	**560**	***36.2%***	**986**	***63.8%***	**1546**	***100.0%***

Chi-Square=103.23, *p*<.0001

Table B33: On-Cell Ordering by Conversation Privacy

	Order					
Conversation Privacy	Order		No Answer		Total	
Very Private	180	*11.6%*	127	*8.2%*	307	*20.0%*
Private	288	*18.6%*	193	*12.5%*	481	*31.1%*
Somewhat Private	253	*16.4%*	218	*14.1%*	471	*30.5%*
Not Private	38	*2.5%*	74	*4.8%*	112	*7.2%*
No Answer	1	*10.0%*	174	*11.3%*	175	*11.3%*
Total	**760**	***49.1%***	**786**	***50.8%***	**1546**	***100.0%***

Chi-Square=212.73, *p*<.0001

Table B34: Credit Card Disclosure by Conversation Privacy

Conversation Privacy	Credit Card					
	Credit Card		No Answer		Total	
Very Private	141	*9.1%*	166	*10.7%*	307	*20.0%*
Private	224	*14.5%*	257	*16.6%*	481	*31.1%*
Somewhat Private	194	*12.6%*	277	*17.9%*	471	*30.5%*
Not Private	27	*1.8%*	85	*5.5%*	112	*7.2%*
No Answer	0	*0.0%*	175	*11.3%*	175	*11.3%*
Total	**586**	***37.9%***	**960**	***62.1%***	**1546**	***100.0%***

Chi-Square=141.78, *p*<.0001

Table B35: Social Security Number Disclosure by Conversation Privacy

Conversation Privacy	SSN					
	SSN		No Answer		Total	
Very Private	91	*5.9%*	216	*14.0%*	307	*20.0%*
Private	149	*9.6%*	332	*21.5%*	481	*31.1%*
Somewhat Private	141	*9.1%*	330	*21.4%*	471	*30.5%*
Not Private	19	*1.2%*	93	*6.0%*	112	*7.2%*
No Answer	0	*0.0%*	175	*11.3%*	175	*11.3%*
Total	**400**	***25.9%***	**1146**	***74.1%***	**1546**	***100.0%***

Chi-Square=78.5776, *p*<.001

Table B36: Medical Information Disclosure by Conversation Privacy

Conversation Privacy	Medical Information					
	Medical		No Answer		Total	
Very Private	129	*8.3%*	178	*11.5%*	307	*19.9%*
Private	209	*13.5%*	272	*17.6%*	481	*31.1%*
Somewhat Private	194	*12.6%*	277	*17.9%*	471	*30.5%*
Not Private	26	*1.7%*	86	*5.6%*	112	*7.2%*
No Answer	2	*10.0%*	173	*11.2%*	175	*11.3%*
Total	**560**	***36.2%***	**986**	***63.8%***	**1546**	***100.0%***

Chi-Square=121.80, *p*<.0001

Table B37: On-Cell Ordering by Phone Privacy

	Order					
Phone Privacy	Order		No answer		Total	
Very Private	119	*7.7%*	120	*7.8%*	239	*15.5%*
Private	314	*20.3%*	180	*11.6%*	494	*32.0%*
Somewhat Private	272	*17.6%*	229	*14.8%*	501	*32.4%*
Not Private	55	*3.6%*	81	*5.2%*	136	*8.8%*
No Answer	0	*0.0%*	176	*11.4%*	176	*11.4%*
Total	**760**	***49.1%***	**786**	***50.8%***	**1546**	***100.0%***

Chi-Square=220.64, *p*<.0001

Table B38: Credit Card Disclosure by Phone Privacy

	Credit Card					
Phone Privacy	Credit Card		No Answer		Total	
Very Private	91	*5.9%*	148	*9.6%*	239	*15.5%*
Private	237	*15.3%*	257	*16.6%*	494	*32.0%*
Somewhat Private	220	*14.2%*	281	*18.1%*	501	*32.4%*
Not Private	38	*2.5%*	98	*6.3%*	136	*8.8%*
No Answer	0	*0.0%*	176	*11.4%*	176	*11.4%*
Total	**586**	***37.9%***	**960**	***62.1%***	**1546**	***100.0%***

Chi-Square=142.14, *p*<.0001

Table B39: Social Security Number Disclosure by Phone Privacy

	SSN					
Phone Privacy	SSN		No Answer		Total	
Very Private	51	*3.3%*	188	*12.2%*	239	*15.5%*
Private	156	*10.1%*	338	*21.9%*	494	*32.0%*
Somewhat Private	164	*10.6%*	337	*21.8%*	501	*32.4%*
Not Private	29	*1.9%*	107	*6.9%*	136	*8.8%*
No Answer	0	*0.0%*	176	*11.4%*	176	*11.4%*
Total	**400**	***25.9%***	**1146**	***74.1%***	**1546**	***100.0%***

Chi-Square=86.1441, *p*<.0001

Table B40: Medical Information Disclosure by Cellular Phone Privacy

	Medical Information					
Phone Privacy	Medical		No Answer		Total	
Very Private	93	*6.0%*	146	*9.4%*	239	*15.5%*
Private	209	*13.5%*	285	*18.4%*	494	*32.0%*
Somewhat Private	212	*13.7%*	289	*18.7%*	501	*32.4%*
Not Private	44	*2.9%*	92	*6.0%*	136	*8.8%*
No Answer	2	*0.1%*	174	*11.3%*	176	*11.4%*
Total	**560**	***36.2%***	**986**	***63.8%***	**1546**	***100.0%***

Chi-Square=111.38, $p<.0001$

APPENDIX C: SURVEY QUESTIONS

1. What is your primary affiliation with UNC-CH?
   - undergraduate
   - graduate student
   - faculty
   - staff
   - other (alumni, postdoc, etc.)

2. What is your sex?
   - Female
   - Male

3. What is your age?
   - 18-22
   - 23-30
   - 31-40
   - 41-50
   - 51-60
   - 61-70
   - Over 70

4. How long have you been using cell phones?[3]
   - Less than 6 months
   - 6 to 12 months
   - 1 to 3 years
   - 4 to 6 years
   - 7 years or more
   - Do not use a cell phone.

5. What is your primary reason for owning a cellular phone? (select one)[4]
   - Social Reasons; contact with your friends, family, etc.
   - Security/Emergency Contact; if something happens, you can call help.
   - Work: my work requires me to have a mobile phone.

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[3] (Graphics, Visualization & Usability Center, 2006), modified for this survey.
[4] (Häkkilä & Chatfield, 2005), modified for this survey.

- Fun: music, games, interactive features.
- Image: personal expression, style.
- Information Access: internet, news, and wireless services.
- Something Else.

6. What are your secondary reasons for owning a cellular phone? (select all that apply)[5]
   - Social Reasons; contact with your friends, family, etc.
   - Security/Emergency Contact; if something happens, you can call help.
   - Work: my work requires me to have a mobile phone.
   - Fun: music, games, interactive features.
   - Image: personal expression, style.
   - Information Access: internet, news, and wireless services.
   - Something Else.

7. Who pays for your cellular service? [6]
(Please check all that apply.)
   - Self/Spouse
     Parents
     Work
     School
     Other
     Don't Know

8. Who is your cellular service provider?

9. Who is the manufacturer of your cell phone?

10. Do you have a digital or an analog cell phone?
    --Digital
    --Analog
    --I Don't Know

11. When did you obtain the cell phone you currently use?
    --2004-2006
    --2002-2004
    --2000-2002
    --Before 2000

12. How many hours a day do you leave your cell phone on?
    -I only turn it on when I need it.
    -1-2 hours a day
    -3-4 hours a day
    -5-6 hours a day

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[5] Ibid
[6] Ibid

-7-8 hours a day
-9-10 hours a day
-more than 10 hours a day

13. If given the option, how likely would you be to allow your cell phone number to be listed in a directory along with your name?
-very likely
-somewhat likely
-neither likely nor unlikely
-somewhat unlikely
-very unlikely

14. How often do you let other people use your cell phone?[7]
--frequently
--sometimes
--rarely
--never

15a. In general, how private do you consider your mobile phone?[8]
--very private
--private
--somewhat private
--not at all private
15b. In general, how private do you consider your phone conversations?[9]
--very private
--private
--somewhat private
--not at all private
15c. In general, how private do you consider your SMS, IM, or text messages?[10]
--very private
--private
--somewhat private
--not at all private

16. Which of the following have you done while on a cell phone?[11]
--please check all that apply

- Placed an order for a product/service.
- Given out your credit card number.
- Given out your Social Security number.
- Discussed personal medical information.

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[7] Ibid
[8] Ibid
[9] Ibid
[10] Ibid
[11] (Graphics, Visualization & Usability Center, 2006), modified for this survey.

17. Have you ever dialed 911 from your cell phone?
    -yes
    -no
    -I don't know/don't remember

18. (if yes) Were you connected with a person, or an answering system?
    -person
    -answering system
    -I don't know/don't remember

19. Was your call prematurely disconnected?
    -yes
    -no
    -I don't know/don't remember

20. (if yes) Were you called back?
    -yes
    -no
    -I don't know/don't remember

21. Is your cell phone E911 equipped?
    -yes
    -no
    -I don't know

22. Do you know what the E911 symbol on your phone looks like?
    -yes
    -no
    -I don't know

23. Do you know what the LBS (Location-Based Services) symbol on your phone looks like?
    -yes
    -no
    -I don't know

24. (if yes) Do you know how to turn off Location-Based Services?
    -yes
    -no
    -I don't know

25. Have you ever dialed 911 from on-campus?
    -yes
    -no
    -I don't know/don't remember

26. (if yes) Were you connected with a person, or an answering system?
    -person
    -answering system
    -I don’t know/don’t remember

27. Was your call prematurely disconnected?
    -yes
    -no
    -I don’t know/don’t remember

28. (if yes) Were you called back?
    -yes
    -no
    -I don’t know/don’t remember

29. Were you in a familiar location when you made the call?
    -yes
    -no
    -I don’t know/don’t remember

30. Please describe what you believe E911 services to be.

31. Please describe what you believe LBS (location-based services) to be.

32. Please add any comments here.

APPENDIX D: TEXT OF THE EMAIL SOLICITING PARTICIPANTS

My name is Jerry Waller and I am conducting research in Information Science at the University of North Carolina at Chapel Hill. I'm interested in how the campus population perceives and uses modern telephone services. If you have 5-10 minutes, please complete the survey, which asks you about how you use certain new telephone applications, or if you use them at all.

Your participation is voluntary. You may stop participating at any time. You may skip any question you choose not to answer for any reason.

Your answers are completely anonymous.

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to
IRB_subjects@unc.edu.

I welcome you to contact me with any questions, comments or concerns that you have at 919-XXX-XXXX or jlwaller @ email .unc.edu. You may also contact my advisor, Dr. Barbara Wildemuth, at 919-XXX-XXXX or wildem@ ils.unc.edu.

In order to access the survey, all you have to do is click on the following link:
http://www.surveymonkey.com/s.asp?u=947391676354

Thank you very much for your participation!
Jerry Waller

Approval IRB: Behavioral Institution Review Board
Date of Approval: 2/28/06
IRB Number: LIBS 05-111

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