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## A Model of Attitudes toward the Acceptance of Mobile Phone Use in Public Places

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### Abstract

Since the first commercial launch of cellular telecoms by NET in Tokyo Japan in 1979 and the launch of the NMT system in Denmark, Finland, Norway and Sweden in 1981, the mobile phone has undergone continual incremental innovation for changing market needs. This study investigates the factors affecting the attitudes towards the social acceptance of mobile phones in public places and how this attitude affects its usage. Theories on innovation and technology acceptance were reviewed, and studies relating demographic factors to technology acceptance were examined. A model was proposed relating the usage frequency and attitudes towards acceptance of mobile phone in public places to demographic factors, such as country, age, education, gender, and work status. A survey was conducted among mobile phone users, and the sample consisted of 1079 respondents in the United States, France, Italy, Turkey, and Finland. A structural equation model was developed to analyze the survey data. Results of the analysis indicate that the attitudes about mobile phone use in public places depend on country, and age factors. This attitude in turn significantly affects the usage frequency of mobile phones. In addition, usage frequency also is affected by gender and work status. Implications of the findings for both academicians and practitioners are discussed.

Keywords: Attitudes about Mobile Phone Use, Simultaneous Relationships, Demographic Factors, Mobile Phone Voice Messaging, Mobile Phone Text Messaging

## 1. Introduction

### 1.1 The Use of Mobile Phones across Countries

The mobile phone is the most widely spread technology with a fast diffusion rate (Kim, 2005). Mobile phones have brought about improvements in the quality of life (Choi et al., 2007), and new commercial relationships, such as mobile banking (Ratten and Ratten, 2007), and mobile customer relationship management (Moedritscher and Mussnig, 2005), offering customers mobile messages with incentives for business, and providing customers with instant access to service information. The mobile phone has been in continual incremental innovation (Hacklin, Raurich, and Marxt, 2005) to meet changing market and customer needs.

In 1978 NTT DoCoMo launched the first commercial mobile phone service in Japan. Since then, the total number of mobile phone subscriptions in the world had reached 3 billion by July 2007 (Green, 2007). In the United States the number of mobile phones reached 233 million in 2006 (Central Intelligence Agency, 2008). In the same year, 466 million mobile phones were in use in the 27-country European Union and 461 million were used in China (Central Intelligence Agency, 2008). Mobile phone penetration varies by country, with some countries having no mobile phones and over 30 countries having a penetration rate of more than 100% (Wallace, 2006).

Mobile service adoption varies in different countries. Asia, and especially Japan, leads with NTT DoCoMo's i-mode. This service has garnered 45 million subscribers since its first introduction in 1999, although only about 7 million of these are outside of Japan and none are in the U.S. (Bradley and Sandoval, 2002; NTT DoCoMo, 2008). South Korean is

another Asian country with significant mobile services (Shim, 2005). Europe follows Asia in mobile services, although it leads the U.S.

## 1.2 The Case of NTT DoCoMo

In 1996, Koji Oboshi, president of NTT DoCoMo, foresaw that the demand for new mobile phones would soon peak. Mobile phones with new capabilities and services would need to be developed so consumers would trade in their old mobile for a new, improved one. (Bradley and Sandoval, 2002). Koji saw the future of wireless lay in non-voice, or data, communications. In 1997, NTT DoCoMo worked on a new service called i-mode (information mode, a 2G/3G mobile-Internet platform) to offer mobile Internet service to customers over their mobile phones (Kodama 2002). NTT DoCoMo started the i-mode service in the beginning of 1999. By collaborating with internet service providers (Jonason and Eliasson, 2001) and companies such as Sony Computer Entertainment and Sun Microsystems, improvements and new features were made to the phones (Kodama 2002). Mobile phones with i-mode had attracted 40 million users in Japan by the end of January 2004. However, the diffusion of i-mode overseas has been slow. Hung and Yeh (2007) suggested that different competitive climate overseas was part of the reason.

## 1.3 Research Problem

Another reason for the different diffusion rates in different countries may be the difference in the regulatory and cultural environments. According to Rogers (1995), an individual's decision to adopt an innovation is not instantaneous but a process that occurs over time. An innovation is more readily accepted if its perceived adoption risk is low, and these perceived risks are related to its relative advantage, compatibility, complexity, trialability and observability. The Technology

Acceptance Model (TAM) was proposed by Davis, Bagozzi, and Warsaw (1989) to model how users come to accept and use a technology. An individual's actual use of a new technology is affected by his or her behavioral intention to use, which is in turn affected by the individual's attitude towards the new technology. This attitude to new technology is affected by two key variables: perceived usefulness, and perceived ease of use of the technology; both of which can be affected by external variables. Some of these external variables include psychographic factors such as user involvement (Jackson, Chow, and Leitch, 1997), self-efficacy (Davis, Bagozzi, and Warshaw, 1989), or demographic factors such as education (Agarwal and Prasad, 1999), age (Yang, 2005), gender (Venkatesh and Morris, 2000) and experience (Kim, 2008; Venkatesh and Davis, 2000). The model was later extended to include the effect of social influence (Venkatesh and Davis, 2000; Venkatesh, Morris, Davis, Davis, 2003), and social norm is an important element in affecting user acceptance.

In this research we analyze the impact of demographic factors on attitude to accept mobile phones socially, and how this attitude in turn affects the usage of mobile phones. The attitude of users towards the social acceptance of mobile phones is an important compatibility factor (Rogers, 1995). It is also an indication of the influence of social norm on the usage of mobile phone. The social acceptance of mobile phones can be culturally specific, and differ across countries. In addition to age, gender, education, experience, we also analyze the effect of country on attitude and usage.

The purpose of this study is to explore the effect of these demographic factors on the attitudes toward the social acceptance of mobile phones, and how the attitudes in turn affect actual usage of mobile phones. The attitudes toward social acceptance is examined in terms of the acceptance of

mobile phone use in public places and social situations, where the prohibition of use could be the result of government regulations, a specific business's rules, or local customs. As mobile phones may be used for voice and text messaging in public, we investigate how the attitudes toward the acceptance of mobile phone use in public places, as a latent construct, might be observed in terms of individual attitudes toward the acceptance of voice and text mobile communication in public places. The perceived user attitudes toward acceptance are measured in two aspects: (i) attitudes toward the acceptance of mobile phone voice messaging in public places, and (ii) attitudes toward the acceptance of mobile phone text messaging in public places.

To assess these relationships, a survey was conducted among university students in the United States, France, Turkey, Italy, and Finland. From an academic point of view, this study enriches our understanding of mobile phone attitudes and usage behavior, and their relationship to demographic factors. From a practical point of view, the study helps us to understand the needs and perception of each group of users. Providers might design mobile phone plans, promotion and marketing suitable to the needs of different user groups. In the following sections, we review the literature on mobile phone use and develop our model, describe the methodology of the study, present the results and limitations of our study, discuss the implications of the findings and suggest possible directions for future research.

## 2. Theories on Acceptance of New Technology

In 1962, Rogers introduced the theory on the diffusion of innovation (Rogers, 1995). Here diffusion is described as "a process by which an innovation is communicated through certain channels over time among the members of a social system." In this process, the individual "passes from gaining initial knowledge of the innovation, to forming an attitude toward the innovation, to

making a decision to adopt or reject, to implementation of the new idea, and to the confirmation of this decision.” During this process, the new technology is evaluated against various criteria or attributes, in order to reduce uncertainties involved in replacing the existing one with a new one. Some of these uncertainties may arise related to the perceptions of the innovation’s relative advantage, compatibility, complexity, trialability and observability. According to Rogers, people’s attitude toward a new technology is a key element in its diffusion.

The Technology Acceptance Model was proposed by Davis et al. (1989) to model the factors affecting a user’s acceptance of a new technology. TAM is an extension of theory of reasoned action (TRA), proposed by Ajzen and Fishbein (1975), to explain and predict the behavioral intention and actual behavior of people (Legris, Ingham, and Collette , 2003). In TRA, an individual’s actual behavior is affected by his or her behavioral intention, which is in turn affected by the individual’s attitude towards the behavior, as well as the individual’s subjective norm. The individual’s subjective norm is affected by his or her normative beliefs and motivation to comply, while the individual’s attitude toward behavior is affected by his or her beliefs and evaluations.

Similar to TRA, in the Technology Acceptance Model, an individual’s actual use of a new technology is also affected by his or her behavioral intention to use, which is in turn affected by the individual’s attitude towards the new technology. However, this attitude to new technology is affected by two key variables: perceived usefulness, and perceived ease of use of the technology; both of which can be affected by external variables.

Some of the external variables included demographic factors. For example, Agarwal and Prasad (1999) found that age, gender, education, experience directly or indirectly affect attitudes, usage, and satisfaction of information systems. Porter and Donthu (2006)

developed and tested an extended version of the Technology Acceptance Model to consider demographic factors. They found that age, education, income and race are associated differentially with beliefs about the Internet, and that these beliefs influence a consumer's attitude toward and use of the Internet. Yang (2005) explored how Singaporeans are influenced to adopt the M-commerce. TAM was applied to examine factors affecting Singaporeans' attitudes toward this emerging mobile technology and applications. It was also found consumer innovativeness, past adoption behavior, technology cluster adoption, age, and gender affect their adoption behavior. Results from multiple regression analyses further reveal that male respondents tend to perceived M-commerce favorably.

Venkatesh and Davis (2000) extended the Technology Acceptance Model to TAM2. User acceptance was found to be significantly influenced by social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use) TAM2 was empirically supported with longitudinal test data collected regarding four different systems at four organizations, two involving voluntary usage and two involving mandatory usage.

Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) by reviewing eight models on user acceptance. The UTAUT aims to explain user intentions to use an information system and subsequent usage behavior. The theory holds that four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are direct determinants of usage intention and behavior. Gender, age, experience, and voluntariness of use are posited to mediate the impact of the four key constructs on usage intention and behavior. The eight models reviewed are the theory of reasoned action, the Technology Acceptance Model, the

motivational model, the theory of planned behavior, a model combining the Technology Acceptance Model and the theory of planned behavior, the model of PC utilization, the innovation diffusion theory, and the social cognitive theory. UTAUT was empirically tested and found to outperform the eight individual models.

### 3. A Model of Attitudes toward Mobile Phone Use in Public Places

As suggested by Venkatesh et al. (2003), social influence is one important determinant of usage intention and behavior. Therefore the attitude of users about the social acceptance of mobile phones in public places and their use in public places will be important in affecting usage intention and behavior. In addition, demographic factors such as gender, age, experience, education, are posited to affect this attitude toward social use of mobile phones and usage behavior (Agarwal and Prasad, 1999; Porter and Donthu, 2006; Yang, 2005). As indicated by the case of NTT DoCoMo i-mode (Kodama 2002, Jonason and Eliasson. 2001), which has been accepted in Japan more readily than in other countries (Hung and Yeh, 2007), we posit in our model that country is an important factor in affecting both the attitude of acceptance and usage behavior. In particular our model examines how country as a factor affects attitude and usage frequency, in addition to other demographic factors such as age, gender, experience and education. Figure 1 shows the model we propose. In the model, the attitude of users is affected by users' demographic factors, specifically country, age, education, work status, and gender. In turn the attitude of users affects users' usage frequency of mobile phones.

Insert Figure 1 here

### 3.1 Attitudes about Mobile Phone Use in Public Places

The popularity of mobile phones has resulted in their increasing use in public places. People may communicate with one another through mobile phones anytime in public places, such as restaurants, sidewalks, restrooms, and public transportation.

The use of mobile phones in public settings also caused the establishment of “simultaneous public and private spaces” (Ling, 2004). Many individuals consider the mobile phone an extension of their physical selves (Campbell, 2007), and symbolic representatives of individual identities. According to Turner, Love and Howell (2008), mobile phone users differed in the extent to which they feel comfortable making and receiving calls in different social contexts, and are less annoyed by others using mobile phones in locations where they themselves feel most comfortable making calls. Researchers found that an individual in a social situation might have three types of responses to a mobile phone call (Weilenmann and Larsson, 2001). The individual might move away from the social situation, remain in place but removed from the social engagement, or stay engaged socially. Murtagh (2001) noted that people try to create a private space in a limited public space when receiving mobile phone calls.

In many public places, people around the mobile phone users may be annoyed by the use of the mobile phones (Ling and Haddon, 2003). Common complaints included disturbance and irritation of the quietness caused by the loud talk and the ringing of mobile phones in public places. Mobile phone users engaging in this behavior were regarded as discourteous, intrusive and arrogant. In addition, people were concerned about the use of mobile phones in public places that might divert attention or caused danger. To limit improper uses, several solutions have been suggested, including imposing penalties, asking users to exercise self-discipline, posting notices in

public places, providing structured guidelines on websites, and providing patrons with a list of areas in which use is permitted (Lever and Katz, 2007).

Most of the complaints about mobile phone use in social settings focused on the loud talking and ringing associated with the voice functions of mobile phones. Compared with voice messaging, text messaging offers a less intrusive form of communication in public places. Short Message Service (SMS) or text messaging with mobile phones has become a preferred means of communication (Faulkner and Culwin, 2005). The total figures for text messages sent in the United Kingdom in 2003 was 20.5 billion, and text messaging was viewed as a warm, personal, and cost-effective way to communicate. In France for example, a study of mobile phone use among the population shows that 89% of the people under 40 send text messages but only 47% of those over 40 send text messages (Observatoire Societal du telephone mobile, 2005). Text messaging may have a different impact in social settings than voice communication because it is less intrusive than voice. Thus both voice messaging and text messaging are important uses of the mobile phones.

The construct of “attitudes toward the acceptance of mobile phone use in public places” is a latent construct that will be observed through two different ways. We hypothesize the following:

H1: The construct “attitudes toward the acceptance of mobile phone use in public places” can manifest itself in two ways: (i) the degree to which an individual accepts mobile phone voice use in public places, (ii) The degree to which an individual accepts mobile phone text use in public places.

### 3.2 The Effect of Attitude of Mobile Phone Acceptance on Mobile Phone Usage

According to Fishbein and Ajzen (1975), an individual's attitude towards the behavior affects his or her actual behavior. An individual's usage frequency of mobile phone use is affected by the individual's attitudes toward its social acceptance, or his or her attitude towards the acceptance of the use of mobile phones in public places.

Legris, Ingham and Collette (2003) reviewed studies conducted on the Technology Acceptance Model, and indicated that several researchers were able to find a relationship between attitude and usage behavior. For example, in an empirical study of 230 users of an information technology innovation, Agarwal and Prasad (1999) confirmed that attitudes affected intentions to use and actual usage. Bajaj and Nidumolu (1998), in testing a longitudinal model with statistical panel data, found that a positive attitude towards using an information system led to increased usage of the information system. They also found that past usage affected ease of use, which in turn affected the attitude towards using an information system. Porter and Donthu (2006) tested the effect of age, education, income and race on beliefs about the Internet, and attitudes toward and use of the Internet. They found that attitude toward Internet usage was significantly and positively correlated with Internet usage.

We propose the following hypothesis:

H2: Usage frequency of mobile phones is affected by attitudes towards their use in public places. A user with a more positive attitude on accepting mobile phone use in public places will use a mobile phone more frequently.

### 3.3 The Effect of Country on Attitudes of Acceptance and Usage of Mobile Phones

NTT DoCoMo i-mode (Kodama 2002, Jonason and Eliasson 2001) was successful in Japan but its diffusion in other countries was slow (Hung and Yeh, 2007). This suggests that country is a factor affecting attitude and usage. People in different countries differ in their social needs and also in their interpretations of appropriate social behavior. Ling and Haddon (2003) reported that mobile phone users in France, Germany, Italy, Spain, and the United Kingdom were least likely to leave their mobile phones on when attending plays or shows. Licoppe and Heurtin (2001) showed that French people, in order not to be disturbed, would adopt different strategies to avoid giving their private mobile phone numbers to others.

Kleinman (2006) compared the use of mobile information and communication technologies in cafés in France and the United States. Through participant observation and interviews, she found that cultural differences explained why mobile phones are not used as routinely in French cafés as they are in the United States. Individuals go to cafés in Paris to enjoy the ambiance and the company of friends. It is common for people to sit at tables at sidewalk cafés, “watching the world go by”. Although mobile phones are widely used in France, during Kleinman’s participant observation in August 2004, only once was a person observed talking on a mobile phone inside of a café. The inside of the café was almost empty except for one table, and most customers were sitting outside. Kleinman noted that in the United States, by contrast, people talked on mobile phones in restaurants, churches, concerts, often times ignoring the person next to them.

As discussed in the introduction, according to census data, the number of mobile phone users was 69 percent of the U.S. population at the end of 2005. In Europe, according to International Telecommunication Union (2005), the number of mobile phone users was 85.6 per 100 households

in 2003, with 90.96 in Finland, 101.76 in Italy, 69.59 in France. People in different countries use mobile phones at different rates. Thus we hypothesize the following:

H3a: Country affects attitudes toward the acceptance of mobile phone use in public places.

Individuals in different countries have different attitudes toward the acceptance of mobile phone use in public places.

H3b: Country affects the frequency of mobile phone use. Individuals in different countries have different usage frequencies.

#### 3.4 The Effect of Education on Attitudes of Acceptance and Usage of Mobile Phones

Rice and Katz (2003) found that education had a significant influence on mobile phone and Internet usage, and nonusers and mobile phone users were more educated than internet users and users of both media. Hodge and Treiman (1968) found that one's education affects one's social participation patterns. Users' education level might affect mobile phone usage and the attitudes toward the acceptance of mobile phone use in public places. Robertson, Soopramanien, and Fildes (2007), using survey data collected in the United Kingdom, found that households with members who are better educated and wealthier are less price-sensitive to Internet services and more ready to adopt the services. Porter and Donthu (2006) found that older and less educated individuals have lower perceived ease of use of the Internet, and a less positive attitude toward and use of the Internet. Dattee and Weil (2007), in analyzing the dynamics of social factors in technological substitutions, argued that innovators and early adopters "are always on top of their field's literature and with many connections and are therefore best reached by more direct communication media. According to Rogers (1995), early adopters were younger and more educated.

H4a: Education level affects attitudes toward the acceptance of mobile phone use in public places.

Individuals with higher education are more likely to agree to the acceptance of mobile phone use in public places.

H4b: Education level affects the frequency of mobile phone use. Individuals with higher education have higher mobile phone usage frequency.

### 3.5 Effect of Work Status on Attitudes of Acceptance and Usage of Mobile Phones

Katz and Aspden (1998) found that the ownership of mobile communication devices was determined by social location effects, such as the need to be in touch or being highly mobile, suggesting that working people might have a higher need for mobile phone use. In addition, Rice and Katz (2003) found that there was a significant correlation between work status and the use of mobile phones, and mobile phone users were more likely to work full-time. Busselle, Reagan, Pinkleton, Jackson (1999) looked at the factors that affect the usage of an innovation among faculty and staff at Washington State University, and found that those owning more technology were heavier users of the Internet. We can argue that individuals who are working will have more access to technology, they will tend to use the mobile phone technology more, making and receiving calls more frequently, and they will also be more accepting of the use of mobile phones in public places.

We hypothesize the following:

H5a: Work status affects attitudes toward the acceptance of mobile phone use in public places.

Individuals who are working are more likely to accept the use of mobile phones in public places.

H5b: Work status affects the frequency of mobile phone use. Individuals who are working have higher mobile phone usage frequency.

### 3.6 The Effect of Age and Gender on Attitudes of Acceptance and Usage of Mobile Phones

Busselle, Busselle, Reagan, Pinkleton, Jackson (1999) found that age and gender affects Internet usage, with younger males being heavier users of the Internet. Rice and Katz (2003) found that mobile phone users were younger than non-users. Turner, Love and Howell (2008) found that younger respondents used their mobile phones more often, and older participants were less accepting toward the public use of mobile phones by others. Rogers (1995) also theorized that early adopters were younger and more educated.

H6a: Age affects attitudes toward the acceptance of mobile phone use in public places. Younger individuals are more likely to agree to the acceptance of mobile phone use in public places.

H6b: Age affects the frequency of mobile phone use. Younger individuals have higher mobile phone usage frequency.

From their research on the gendered nature of mobile phone culture in Israel, Lemish and Cohen (2005) concluded that men and women might have different attitudes toward mobile phones. Rakow and Navarro (1993) noted male and female users used the mobile phone differently. The mobile phone “seems to be an extension of the public world when used by men, an extension of the private world when used by women”. Nysveen, Pedersen, and Thorbjørnsen (2005) found that social norms and intrinsic motives such as enjoyment were important determinants of intention to use among female users of mobile chat, whereas extrinsic motives such as usefulness and – somewhat surprisingly – expressiveness were key drivers among men.

Turner, Love, and Howell (2008) found that female respondents were more accepting toward mobile phone use in public places, while male participants expressed greater annoyance with the public use of mobile phones. They also found that female respondents used their mobile phones more often than male respondents. DeBaillon and Rockwell (2005), however, did not find significant difference in the use of mobile phones between men and women among college and high school students.

According to Tannen (1990), women and men communicated for different purposes. Women seek human connection such as friendships, intimacy, true solidarity, and communion whereas men are concerned with accomplishment and achievement. Women talk more in private for connection and to disclose life details, while men talk more in public to convey information. Thus we postulate that women may have a tendency to have more frequency and longer duration of the mobile phone. In addition, Tannen (1990) also suggests that females are more emotional and tend to avoid conflict while males are more rational and are comfortable with conflict.

We therefore hypothesize that

H7a: Gender affects attitudes toward the acceptance of mobile phone use in public places. Males are less likely than females to agree to the acceptance of mobile phone use in public places.

H7b: Gender affects the frequency of mobile phone use. Females have higher mobile phone usage frequency than males.

## 4. Methodology and Sample Characteristics

### 4.1 Survey Development

By reviewing literature and through discussion with practitioners, an initial set of survey questions was developed. Consultation was then conducted and the questionnaire was subsequently refined based on the feedback provided by experts in the field. The survey instrument was developed in English. The questionnaire was translated by colleagues in France, Italy, Turkey, and Finland into their respective languages.

The survey used a Likert scale of 7 points, with 1 indicating strongly disagree, 7 indicating strongly agree, to measure the attitudes of respondents. The attitudes on acceptance were measured in two aspects: (i) The attitudes on mobile phone voice messaging in public places (ii) the attitudes on mobile phone text messaging in public places. Each respondent was asked to indicate his or her attitude toward the acceptance of mobile phone voice use and text messaging in certain public places, specifically on public transportation, while walking on the street, in a public restroom, and in a restaurant. These locations were chosen because they represent a range of places where people are noted to use mobile phones. The items in the questionnaire are given in Table 1. Usage frequency of mobile phones was measured by the frequency with which the respondent used the phone. Each respondent was to select if he or she used a mobile phone once a month or less, several times a month, once a week, several times a week, or daily.

Insert Table 1 here

To determine the public places used in defining the construct of attitudes, in this study we focus on places where mobile phone use is legally allowed or otherwise permitted. In order to reduce the incidence of automobile accidents, many countries prohibit the use of mobile phones

while driving. Examples of these countries include France, Finland, Turkey, Italy, Greece, Germany, United Kingdom, Australia, China, Spain, and Sweden (Cellular News, 2007). In addition, to help students concentrate, many instructors stated in their course syllabus that mobile phones should be turned off in class. Further, in theatres, concerts, and performances, audience are requested to turn off their mobile phones during the movie or performance. Libraries also limit the use of mobile phones in certain areas (Lever and Katz, 2007). In this study we focus our attention on public places where the use of mobile phones is legal and permitted. Thus we do not consider the use of mobile phones during driving, in concerts, performance, classes, or libraries. Instead we consider the attitudes toward the acceptance of mobile phone use while walking on public sidewalks, in restaurants, in public restroom, and on public transportation.

#### 4.2 Sample

We conducted a survey among students in five countries: the United States, France, Italy, Turkey, and Finland. The European countries were selected because they represent a cross-section of Europe politically, economically, and geographically, from Finland in the far North to Turkey in the South, with France and Italy in between. Comparisons among these countries and with the U.S. were thought likely to be interesting. The survey was distributed to business students at universities in these countries. The survey included a statement that all respondents must either own or have full time use of a mobile phone, and so potential respondents who did not meet this criterion did not respond.

Table 2 shows the questions used to collect the demographic variables of the respondents. These variables include country, work status, gender, age, and education. In addition, for the country factor, the people administering the questionnaires noted the country in which the survey

was conducted. The country factor was coded as 1 for United States, 2 for France, 3 for Italy, 4 for Turkey, and 5 for Finland.

A total of 1079 questionnaires were collected, and on removing cases with incomplete data, 989 valid questionnaires were used in the analysis. There were 283 cases from USA (28.6%), 240 cases from France (24.3%), 194 cases from Italy (19.6%), 200 cases from Turkey (20.2%), 72 cases from Finland (7.3%). The characteristics of the sample revealed that more than half of the respondents were female (54.1%). Most of the respondents were between the ages of 20 to 25 (72.4%), with 7.9% under 20, 40.2% between 20 to 22, 32.2% between 23 to 25, 11.4% between 26 to 30, and 8.3% above 30. About 30% of the respondents were graduate students, while 70.3% were undergraduate students. About 45% of the respondents were working. About 34% had owned the mobile phone for more than 5 years, 39% had owned it for 3 to 5 years, 15% had owned it for 2 to 3 years, and 13% had owned it for less than 2 years. Table 2 also summarizes the demographic characteristics of the respondents in percentages.

Insert Table 2 here

#### 4.3 Instrument Validity and Reliability

The validity of a construct is established by conducting confirmatory factor analysis (Bollen, 1989). We performed content validity and convergent validity checks for all the scales. Content validity refers to whether the scale representatively measures the concept it is intended to measure. Content validity was established as most of the items in our questionnaire were derived through a comprehensive study of relevant literature and existing instruments (Ling, 2004; Ling and Haddon, 2003). Convergent validity refers to whether all the items of the observable variable represent one

single construct. Before conducting convergent validity analysis, the scales were checked for unidimensionality. We demonstrate the unidimensionality of our constructs by specifying a measurement model for each construct and by examining how well the constituting items represent the same construct. For each of the nine constructs, as shown in Table 3, all items constituting the construct have t-values greater than 2 and are significant at the 0.05 level.

In addition, we conducted factor analysis on each of the construct using SPSS. As shown in Table 3, all the items represent one factor accounting for the variance. The items for each variable were further checked for reliability using SPSS. Reliability refers to the degree of stability of the scale and is demonstrated by checking the Cronbach's alpha for the items for each construct (Bollen, 1989, p. 215). A scale is reliable if alpha is close to 0.70 or higher. Table 3 shows the items of each of the two constructs all had reasonable reliability.

Insert Table 3 here

## 5. Results and Findings

The data were analyzed using LISREL (Jöreskog and Sörbom, 1989, 1999; Long, 1983), an instrument used for the analysis of structural equation models. LISREL is a useful tool in understanding the underlying dimension of a latent variable, such as the attitudes of the user toward the acceptance of mobile phone use in public places, and gives an accurate picture of the simultaneous effect of the demographic factors on the attitudes. In the structural equation model, a set of empirically operational indicators are defined for each dimension of each construct (Jöreskog, 1993). Maximum likelihood estimation (MLE) was used to obtain the structural coefficients (Bollen and Long, 1993).

The final model is given in Figure 2. In the final model, the latent construct “Attitudes toward the Acceptance of Mobile Phone Use in Public Places” is made up of two significant indicators, “Attitudes toward the Acceptance of Mobile Phone for Voice Messaging in Public Places” and “Attitudes toward the Acceptance of Mobile Phone for Text Messaging in Public Places”.

The adequacy of the model in Figure 2 is assessed using various measures. In testing structural equation models, the null hypothesis is set up a priori not to be rejected, while the chi-square statistic tests whether the observed data fit the hypothesis of the proposed model, and a smaller chi-square value indicates a better fit. For small sample sizes that might have slightly departed from normality, instead of using the chi-squares, the chi-square per degree of freedom should be used. A ratio of approximately five shows a reasonable fit while a ratio between one and two is an excellent fit (Kaplan, 2000). The ratio of the model in Figure 2 is 1.793 (chi-square = 10.76 with 6 degrees of freedom), indicating a very good fit.

Other measures of fit include the goodness of fit index (GFI) and normed fit index (NFI). Both the GFI and NFI are always between zero and one, with one indicating a perfect fit while any value above 0.9 suggesting a good fit (Bentler and Bonett, 1990). The model has a GFI of 1.00 and a NFI of 0.99. This shows a good fit. The adjusted goodness of fit (AGFI) is 0.98. This again shows a good fit. Similarly, the non-normed fit index (NNFI) and the comparative fit index (CFI) are two additional measures ranging from 0 to 1, where values greater than 0.9 represent a good model fit. The NNFI and CFI for the model are 0.97 and 0.99 respectively. Finally, the structural equation model was assessed using the root mean error of approximation (RMSEA) and the standardized root mean square residual (SRMR). The RMSEA is a measure of the discrepancy per degree of freedom for the model. A RMSEA value of 0.05 or less indicates a good model fit

(Browne and Cudeck, 1993, p.144). The SRMR is an absolute fit index sensitive to misspecification and a value of 0.05 or below indicates a good fit (Hu and Bentler, 1999). The model has a RMSEA of 0.028 and a SRMR of 0.015, thus indicating a good model fit. Thus, the GFI, AGFI, NFI, NNFI, CFI, SRMR, and RMSEA all indicate that the model has a good fit.

Figure 2 summarizes the maximum likelihood parameter estimates and t-values for the model constructs shown in Figure 2. For the latent variables “Attitudes toward the Acceptance of Mobile Phone Voice Messaging in Public Places”,  $\lambda_{y_{11}}$  is set to one to define the unit of measurement for “Attitudes toward the Acceptance of Mobile Phone Use in Public Places”. As indicated,  $\lambda_{y_{21}}$  ( $t = 19.90$ ) is 0.49 and is significant at the 0.05 level. This suggests that “Attitudes toward the Acceptance of Mobile Phone Voice Messaging in Public Places”, together with “Attitudes toward the Acceptance of Mobile Phone Text Messaging in Public Places”, are observable measures of the latent variable “Attitudes toward the Acceptance of Mobile Phone Use in Public Places”. Thus H1 is accepted. Since the coefficient  $\lambda_{y_{21}}$  is positive, this shows that if a person agrees to the acceptance of mobile phone text messaging in public places, the person would also agree to the acceptance of mobile phone voice messaging in public places. As the magnitude of the coefficient  $\lambda_{y_{21}}$  is less than one, this shows that “Attitudes toward the Acceptance of Mobile Phone Text Messaging in Public Places” is a less important indicator than “Attitudes toward the Acceptance of Mobile Phone Voice Messaging in Public Places” in measuring “Attitudes toward the Acceptance of Mobile Phone Use in Public Places”.

Figure 2 also shows the factors affecting the attitudes toward the acceptance of mobile phone use in public places. As shown in figure 2,  $\beta_{12}$  is 0.03 ( $t = 2.04$ ) and is significant at the 0.05 level, showing that usage frequency is positively affected by the attitudes toward the acceptance of mobile phone use in public places. This indicates that individuals who are more likely to agree to

the acceptance of mobile phone use in public places tend to have higher mobile phones usage frequency. Thus H2 is supported.

In addition,  $\gamma_{11}$  is 0.17 ( $t = 6.35$ ) and is significant at the 0.05 level, showing that respondents in different countries differ in their attitudes toward the acceptance of mobile phone use in public places. Thus H3a is supported. In addition,  $\gamma_{14}$  is  $-0.02$  ( $t = -2.75$ ) and is significant at the 0.05 level, showing that age negatively affects the attitude toward the acceptance of mobile phone use in public places. Younger respondents were more likely to agree to the acceptance of mobile phone use in public places. Thus H6a is supported. The effects of education, work status and gender, however, on attitudes toward the acceptance of mobile phone use in public places are insignificant. Thus H4a, H5a, and H7a are not supported.

In Figure 2,  $\gamma_{23}$  is 0.10 ( $t = 3.28$ ) and is significant at the 0.05 level, showing that work status positively affects the usage frequency of mobile phones. Respondents who were working had higher usage frequency. Thus H5b is supported. Further,  $\gamma_{25}$  is  $-0.013$  ( $t = -4.81$ ) and is significant at the 0.05 level, showing that females (gender is coded as 1 for male, and 0 for females) had higher mobile phone usage frequency. Thus H7b is supported. However, the effects of country, education, and age on mobile phone usage frequency are insignificant. Thus H3b, H4b, and H6b are not supported.

A chi-square statistic test was further performed to see if the insignificant relationships should be removed to improve the existing model. On removing the insignificant relationships in the original full model, the revised model has a RMSEA of 0.03. The chi-square difference test was performed to compare the original full model with the revised model. The chi-square of the full model is 10.76 with 6 degrees of freedom while the chi-square of the revised model is 23.01 with 12 degrees of freedom. Applying the likelihood ratio test for the comparison of models as

suggested by Bollen (1989, p. 292), we found the likelihood test statistic is 12.25 ( $= 23.01 - 10.76$ ) with 6 degrees of freedom ( $= 12 - 6$ ). This chi-square estimate is statistically insignificant at the 0.05 level (the critical value of chi-square with 6 degrees of freedom at significance level of 0.05 is 12.59), indicating the revised model is not a better model than the full model shown in Figure 2.

## 6. Implications of Our Research Findings

In this study, as consistent with theories on attitudes and usage behavior (e.g., the Fishbein model (1975) and the Technology Acceptance Model (Davis et al. 1989)), we have found that usage frequency is affected positively by the attitudes toward the acceptance of mobile phone use in public places. Thus it is important for mobile phone providers to foster positive attitudes of users toward acceptance of mobile phones in public places in order to increase users' usage frequency.

In turn the attitudes toward the acceptance of mobile phone use in public places are affected by country and age. Attitudes toward acceptance differ among countries. For mobile phone providers, analysis is required to identify the culture in each country in order to develop the appropriate advertising and promotion strategies as well as mobile phone plans that are targeted to the needs of the users in that country. For example, Turkey indicated the highest attitude toward the acceptance of mobile phone use in restaurants and the lowest toward its acceptance on public transportation. That suggests that in Turkey providers might launch mobile commerce functions that advertisers might launch ads that are more affiliated with user settings in restaurants than on public transportations.

This study shows that younger respondents are more likely to agree to the acceptance of mobile phone use in public places. This implies mobile phone developers can target at young people and develop mobile phone functions that will meet the needs of this target group. Examples

include social networking functions and mashup functions (Kulathuramaiyer, 2007), or web-based application that combines content and functionality from a variety of sources using different technologies, allowing anyone to combine existing data to develop web applications to track events such as crime, earthquakes, hurricanes.

In addition to attitudes, usage frequency was found to be affected directly by gender. Females tend to use mobile phones more frequently. This might suggest that the needs of the female customers might be different from those of the male customers, and a mobile phone plan with more minutes might be developed for the female market. Usage frequency was also found to be affected by work status. Working people tend to use mobile phones more frequently. Providers may develop plans with more minutes to appeal to the working individuals.

## 7. Limitations and Future Research

One limitation of our research is that we only include variables such as demographic factors, attitudes of acceptance of mobile phone use in public places, and usage frequency. Future research might include additional variables such as perceived ease of use, perceived usefulness, as well as tendency to use mobile phones, in order to understand the model relationships among these elements for mobile phones.

A second limitation of this study is our sample consists of college students, with more than 90% between the ages of 18 to 30, 8% between the ages of 31 to 40, and 2% over 40. Future research might conduct the survey on a larger group of respondents, with a broader age range, so that the effect of age differences may be better observed. Future research might also conduct studies among working professionals with different levels of education levels, income, work position in order to better assess the effects of these variables. A third limitation is our survey is

primarily focusing on users. Future research might include non-users as well as users, to understand how both groups assess mobile phone use in public, and the factors affecting their attitudes of acceptance.

Based on our results, compared with the respondents in United States, respondents in other countries such as Turkey, Italy, and Finland were more likely to agree to the acceptance of mobile phone use in restaurants. More detailed study would need to be conducted to investigate the differences in cultures among these countries in order to understand the difference in attitudes toward mobile phone use among these countries. Future research might address the analysis of the usage behavior, such as the time of the call, and usage duration, and their relationships to the time of the call and the location of the call.

## 8. Conclusion

This paper serves as a basis for enhanced understanding of acceptance and diffusion of new technologies. Several models and theories about new technology use already exist including the Technology Acceptance Model (Davis, Bagozzi, and Warshaw, 1989) and diffusion of innovations theory (Rogers, 1995). The results of this paper indicate that other factors might be considered when examining the use of new technologies. For example, are attitudes about the use of technology in different social setting an inhibitor to the acceptance of new technology? Does the diffusion of new technology in different countries depend on the country as well as these attitudes? Exploring these and similar questions could yield interesting results in the complex problem of technology acceptance and diffusion.

In this study, we have developed a structural equation model that helps us better understand the simultaneous relationships among users' demographic factors, mobile phone usage frequency, and attitudes toward mobile phone use. Our results have shown that usage frequency depends on attitudes toward the acceptance of mobile phone use in public places, gender and work status while attitudes toward the acceptance of mobile phone use in public places differ across country and age groups. Future research might address the increasing use of mobile phones for various purposes across different countries, and how mobile phone attitudes and usage behavior might be related to others factors, such as self-esteem, culture, values. This research will help us understand how mobile phones might be better used as a means of communication and information exchange in our society.

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Table 1. Items within the Questionnaire for Attitudes toward the Acceptance of Mobile Phone Use in Public Places

Variable	Item	Question
Attitudes toward the Acceptance of Mobile Phone Voice Messaging in Public Places	Voice1	Cell phone voice calls on public transportation should not be prohibited
	Voice2	Cell phone voice calls while walking should not be prohibited.
	Voice3	Cell phone voice calls in public restrooms should not be prohibited.
	Voice4	Cell phone voice calls in restaurants should not be prohibited.
Attitudes toward the Acceptance of Mobile Phone Text Messaging in Public Places	Text1	Cell phone for text messaging on public transportation should not be prohibited
	Text2	Cell phone for text messaging while walking should not be prohibited.
	Text3	Cell phone for text messaging in public restrooms should not be prohibited.
	Text4	Cell phone for text messaging in restaurants should not be prohibited.

Table 2. Demographic Variables and Respondent Characteristics

Variable	Questions	Coding	Percentages	
Work status	Are you currently working?	1 for yes, and 0 for no	Working	45.4%
			Non-working	54.4%
			NR	0.2%
Gender	Are you male or female?	1 for male, 0 for female	Male	46.0%
			Female	53.9%
			NR	0.1%
Age	How old are you?	Age in number of years	< 20	7.7%
			20 – 22	39.6%
			23 – 25	31.2%
			26 – 30	11.7%
			> 30	9.4%
NR	0.5%			
Education	Are you a graduate or undergraduate student?	1 for graduate, 0 for undergraduate	Graduate	29.7%
			Undergraduate	70.3%
Country		1 for US, 2 for France, 3 for Italy, 4 for Turkey, 5 for Finland	USA	28.6%
			France	24.3%
			Italy	19.6%
			Turkey	20.2%
			Finland	7.3%

Table 3. Reliability, Factor Loading and Unidimensionality t-statistics of Items for the Attitudes towards the Acceptance of Mobile Phone Use in Public Places

Variable	Item	Reliability	Factor Loading	t- statistic for LISREL unidimensionality test
Attitudes toward the Acceptance of Mobile Phone Voice Messaging in Public Places	Voice1	Cronbach's alpha = 0.61	0.65	12.27
	Voice2		0.66	13.21
	Voice3		0.76	16.9
	Voice4		0.65	12.65
			1 factor 46.2% of variance	
Attitudes toward the Acceptance of Mobile Phone Text Messaging in Public Places	Text1	Cronbach's alpha = 0.77	0.76	20.85
	Text2		0.78	22.40
	Text3		0.79	23.22
	Text4		0.75	20.66
			1 factor 59.2% of variance	

Figure 1

The Hypothetical Model of Attitudes toward the Acceptance of Mobile Phone Use in Public Places

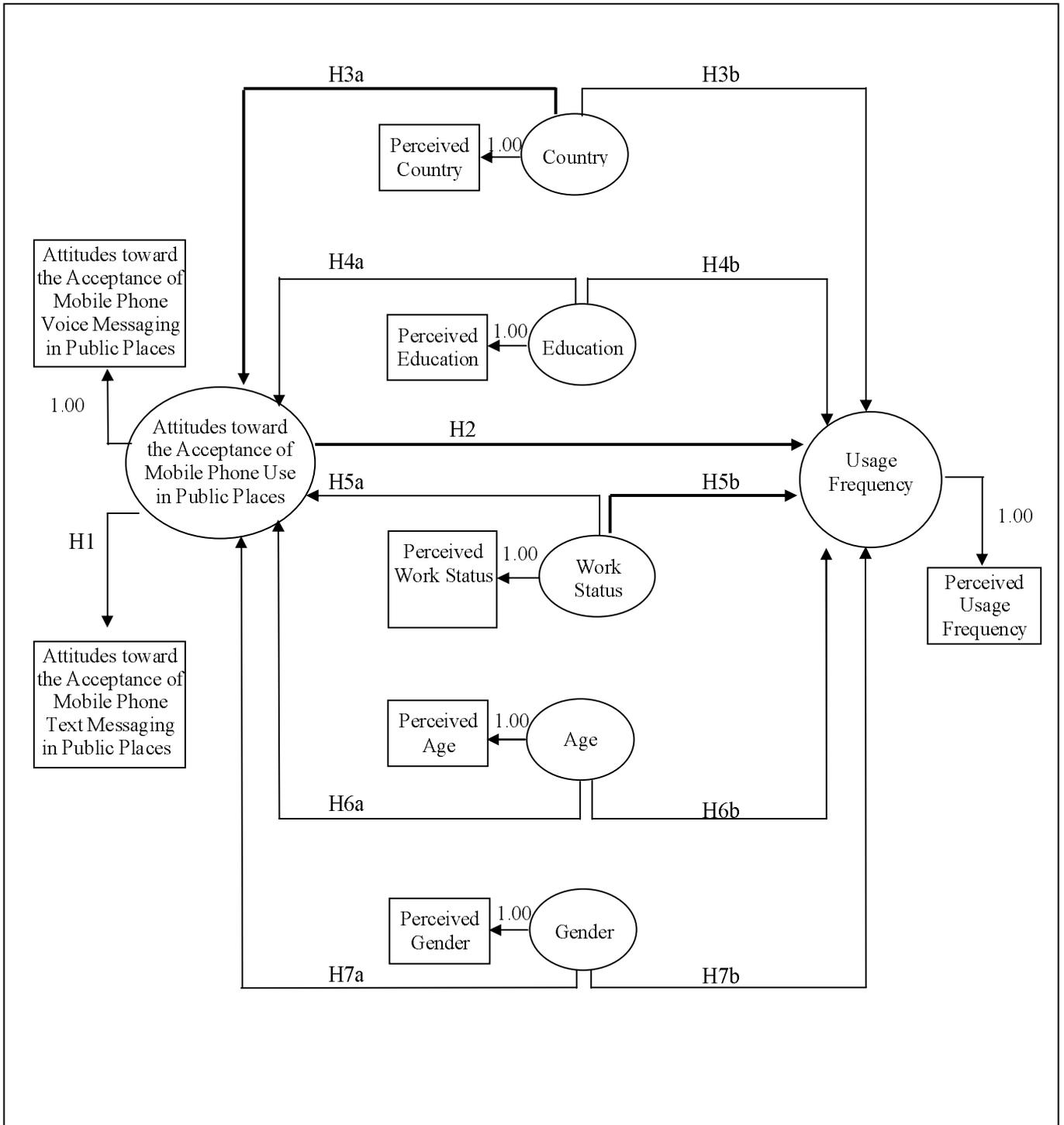


Figure 2  
 Final Estimates of the Model of Attitudes toward Mobile Phone Use in Public Places

