

## A Test of the Technology Acceptance Model The Case of Cellular Telephone Adoption

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### Abstract

*This study examines patterns of cellular phone adoption and usage in an urban setting. One hundred and seventy-six cellular telephone users were surveyed about their patterns of usage, demographic and socio-economic characteristics, perceptions about the technology, and their motivations to use cellular services. The results of this study confirm that users' perceptions are significantly associated with their motivation to use cellular phones. Specifically, perceived ease of use was found to have significant effects on users' extrinsic and intrinsic motivations; apprehensiveness about cellular technology had a negative effect on intrinsic motivations. Implications of these findings for practice and research are examined.*

### INTRODUCTION

Since the launch of commercial cellular phone service in the United States in 1983, the adoption and use of the technology has increased exponentially; similar patterns of use can be seen worldwide (Carlson, Kahn and Rowe, 1999). However, despite the proliferation of cellular telephones, few academic studies have examined why and how cellular telephones are adopted and used. Hence, this study—with the help of the Technology Acceptance Model (TAM)—attempted to examine the motivations and perceptions of people using cellular phone services in a large metropolitan setting.

### THEORETICAL BACKGROUND

Motivation Theory as articulated by Deci (1975; 1972; 1971) argues that behavior is determined by intrinsic as well as extrinsic motivation. While extrinsic motivation precipitates actions because of external rewards such as improved job performance or advancement (Vroom, 1964), intrinsic motivation refers to the performance of an activity for no other reason other than the satisfaction

derived from the activity itself (Davis, Bagozzi, and Warshaw, 1992). Davis et al. elaborate further that perceived usefulness is an extrinsic motivator, while enjoyment is an intrinsic motivator. Thus, the decision to adopt a new technology—such as cellular phones—will depend on people's motivation, both intrinsic (level of enjoyment) and extrinsic (expectation of external rewards).

In contrast, the Theory of Reasoned Action (TRA) articulated by Fishbein and Ajzen (1975) explains people's actions by identifying the causal connections between various components: beliefs, attitudes, intentions, and behavior. The theory is concerned with the determinants of actual and intended behavior: It reasons that behavior is determined by intention which in turn is determined by a person's attitude toward behavior and the subjective norm concerning that behavior. According to TRA, the attitude toward a behavior is determined by the person's beliefs that the behavior will lead to certain outcomes and the evaluations of these outcomes. Subjective norms refer to the social pressure exerted on the person to perform (or not perform) the behavior.

Davis (1989) adapted the TRA model to develop the Technology Acceptance Model (TAM), which is specifically meant to explain computer usage behavior. The TAM replaces the attitudinal determinants of TRA with two distinct variables—perceived ease of use and perceived usefulness. Like TRA, TAM theorizes that actual computer usage is determined by behavioral intention, but differs in that the intention is jointly determined by the person's attitude toward using the system and perceived usefulness. The attitude toward computers is also jointly determined by perceived usefulness and perceived ease of use.

Igbaria's (1993) study of microcomputer technology acceptance was primarily based on the TAM. This study extended previous research by investigating the network

of multivariate relationships among various external factors, the perceived complexity of the system, different motivational factors and system usage. Specifically, three main motivations affecting technology acceptance were examined: (a) intrinsic motivations (such as enjoyment and fun); (b) extrinsic motivations (such as usefulness); and (c) social pressure. Our study adapts Igarria's motivational model of computer use to cellular telephone technology.

Most studies of cellular telephone use focus on the needs of business users (e.g., Carlson et al., 1999). These studies suggest that most mobile communicators have to deal with business on the road, changing time schedules, making appointments, or serving the urgent needs of clients. Given the focus on business use, a number of studies of cellular telephone use have examined the question of utility and the impact of task-related attributes (e.g., Hsu, 1992). Less attention has been paid to other factors such as individuals' perceptions of and intrinsic motivations to use cellular phone technology. A growing number of studies suggest that people are likely to adopt cellular telephones not just as a business tool, but also as a result of social pressure, as a perceived security device or even as a source of enjoyment (Kwon, 1994; Davis, 1993).

Davis' study (1993) about the social impact of cellular telephones reports that cellular telephones are useful for maintaining interpersonal relationships, i.e., binding family ties and providing frequent connections, and are a powerful medium for decision making. The Davis study also identified the motivations for early adoption of cellular telephones as being internal (such as gaining social status or exploring new "toys") and external (such as job requirements or potential for career advancement).

Furthermore, a survey of cellular subscribers in the U.S. (Telecommunications Reports, 1995) found that nearly two-thirds of the respondents subscribed to cellular services for personal uses rather than business. Another study (James, 1992) also reported that while cellular telephones were an important business tool, "personal use" was the fastest growing sector of the market. Reasons cited for the growth in use ranged from better safety to reduced stress to increased productivity. The study also suggested that in areas where long commutes were common, a cellular telephone made it possible to use the time for business or other needs. Articles in the popular press also report that many people use cellular telephones for a variety of reasons including security, safety, and convenience (e.g., *The Honolulu Advertiser*, June 4, 1995).

## RESEARCH MODEL

This study presents and tests a model (see Figure 1) of cellular telephone usage in a large metropolitan area in Hawaii. Our research model suggests that user acceptance of new technology is affected directly and/or indirectly by: (1) individual characteristics; (2) perceived ease of use; (3) perceived usefulness (i.e., extrinsic motivations); (4) enjoyment/fun (i.e., intrinsic motivations); and (5) social pressure. In addition, since apprehensiveness about technology was found to be an important factor in moderating usage in other contexts (Davis, 1994), it was included in this model as well. Each of these factors is explained below.

**Individual Differences:** Studies have shown that individual differences (e.g. gender, age, education, and professional orientation) play an important role in the how information technology is used (Zmud, 1979). Studies in the area of marketing have also confirmed the importance of demographic variables in studying adoption (Assael, 1981). In an analysis of diffusion research, Rogers (1995) found that early adopters of an innovation had higher socioeconomic status than later adopters. Status was typically indicated by such variables as income, education and occupational prestige.

**Perceived Ease of Use:** is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). A construct that is the opposite of perceived ease of use is perceived complexity which is defined by Rogers (1995) as "the degree to which an innovation is perceived as difficult to understand and use." Rogers suggests that his research and experiences lead to the conclusion that the more complex a technology is perceived as being, the slower will be its rate of adoption.

**Apprehensiveness:** in the context of this study refers to anxiety about using a new medium or technology (Dordick and LaRose, 1992). The concept of apprehensiveness is similar to "computer avoidance" (Moore, 1989) which results in individuals avoiding the use of computers due to their innate fear of the technology. Even telephones in the early days of their adoption aroused apprehension. McLuhan (1964) explained such apprehension by labeling the telephone an "irresistible intruder in time and space." Similarly, Mitchell (1984) noted, "a ringing telephone is an intrusion into personal privacy and individual predictability." Pool (1983), while partly agreeing with

previous assertions, indicated that the telephone can increase apprehension in some ways while it can decrease apprehension in other ways.

**Extrinsic Motivation:** refers to the source of behavior prompted by a person's need for external rewards, such as how useful the technology would be (Igarria, 1993). According to Rogers (1986), relative advantage and compatibility are two important attributes of innovations that affect adoption. He suggested a number of sub-dimensions of relative advantage such as the degree of economic profitability, a decrease in discomfort, and savings in time. A study by Tannenbaum (1991) found that people perceived cellular phones as advantageous when they wanted to exert more control over their work environment or to manage their family responsibilities. In a related finding, cellular adopters indicated they had more opportunities to "deal with others" than did non-adopters (Hsu, 1992).

**Intrinsic Motivation:** induces activities where "there is no apparent reward except the activity itself" (Deci, 1975). Intrinsically motivated behavior arises from people's need to feel competent and self-determining in dealing with their environment (Deci, 1975). Previous research on traditional phone use suggests that telephones can reduce loneliness and anxiety, promote a sense of security and well being, increase social interactions, and maintain cohesion within family and friendship groups (Dordick and LaRose, 1992; Williamson, 1993). Other studies (e.g., Pool, 1977) also confirm that intrinsic motivations such as increased freedom and a reinforced sense of existence are instrumental in people choosing to use telephones.

**Social Pressure:** includes the motivations of individuals who believe they should use cellular telephones for obtaining a higher social status or a more important position in their society. The study of microcomputer usage by Igarria (1993) reports that social norms have significant effects on system usage. Rogers (1995; 1986) also indicates the importance of social norms on the rate of the diffusion of innovations. He defines a norm as "the most frequently occurring pattern of overt behavior for the members of a particular social system." Thus, an important motivation for individuals to adopt an innovation is the desire to gain social status. For certain innovations, the social prestige that the product conveys to its user may be the sole benefit that the adopter receives (Rogers, 1995).

The primary dependent variable in this study was the extent of cellular telephone usage. The two indicators of usage are the number of calls with various calling

partners (personal: spouse, family members, and friends; work-related: colleagues, customers and others related to business or profession).

## METHODOLOGY

This study gathered information through a mail survey of cellular phone subscribers in a large metropolitan area in Hawaii. The sample (N=500) was drawn from the subscriber list of a large cellular service provider in the state. One hundred and eighty-five questionnaires were returned, giving a thirty-seven percent response rate. Among them one hundred and seventy-six completed questionnaires were utilized in this study.

The four-page survey consisted of 33 questions, each representing a component of the research model; the questions were selected for their theoretical importance as well as their potential relevance to practice. The variables were measured with a variety of check-off, fill-in, and scaled-response items. Virtually all the constructs in the research model (except use) were operationalized using standard scales from the literature.

Prior to the distribution of the actual survey, a pilot study involving a sample of 27 people was conducted to validate the content of the questionnaire in terms of relevance, accuracy and wording. The lessons learned from the pilot suggested some changes with respect to the instrument. The appropriate changes were made to the final questionnaire.

Individuals were asked to indicate the extent of agreement or disagreement with various statements concerning cellular telephones on a seven-point Likert-type scale ranging from (1) strongly disagree to (7) strongly agree for perceived ease of use, apprehensiveness, extrinsic motivations, intrinsic motivations, and social pressure. The respondents' scores for each construct were obtained by summing across all the item scores of the individual variables. The hypothesized relationships among the study variables depicted in the model were tested using multiple regressions and path analyses.

## RESULTS

Contrary to expectations, individual characteristics of the cellular telephone users (gender, age, income and occupation) had no significant impact on users' perceptions about cellular telephones (see Table 1).

Users' perceptions, however, had a significant relationship with their motivations. This result is consistent with the results of previous research (e.g., Igarria, 1993) which found that users' perceptions had a strong direct effect on the perceived usefulness of computer technology. Specifically, as shown in Table 1, perceived ease of use had a significant and strong association ( $\beta=.44$ ,  $p<.001$ ) with respondents' extrinsic motivation (usefulness of cellular telephones). Unexpectedly, however, there was no significant relationship between the respondents' apprehensiveness about cellular telephones and their extrinsic motivation to use them ( $\beta=.03$ ,  $p<.72$ ). This finding suggests that respondents' extrinsic motivations are strongly mediated by the perceived ease of cellular telephone use.

As expected, perceived ease of use was found to have a significant and positive relationship with intrinsic motivations ( $\beta=.40$ ,  $p<.001$ ). This result implies that individuals who thought that cellular telephones are easy to use, also thought that using them would lead to increased enjoyment, freedom or security. Also in accordance with expectations, apprehensiveness about telephones was found to have a negative and significant association with intrinsic motivations to use them ( $\beta=-.14$ ,  $p<.05$ ). In other words, higher levels of the respondents' apprehensiveness about cellular phones were associated with lower levels of intrinsic motivations to use them.

In general, users' perceptions about cellular phones were strongly related to their motivations to use them. Perceived ease of cellular telephone use and apprehensiveness about telephones combined, explains twenty percent of the variance in extrinsic motivations and eighteen percent of the variance in intrinsic motivations. These values suggest the importance of the links between perceptions and motivations towards cellular phones.

Contrary to expectations, individual characteristics, except age, were found to bear no significant relationship to the social pressure variables. Age was found to have significant and positive associations with social pressure to use cellular telephones ( $\beta=.29$ ,  $p<.001$ ) as shown in Table 3. This result supports the notion that there is more social pressure on older people to use cellular telephones than on younger people.

Also contrary to expectations, there was no significant relationship between the respondents' motivations to use cellular telephones and their level of personal calls. The respondents' extrinsic motivation and social pressure to

use cellular telephones also did not have significant associations with work-related cellular phone use.

However, interestingly, and as expected, the respondents' intrinsic motivation to use cellular telephones had a significant and negative association with work-related cellular telephone use ( $\beta=-.28$ ,  $p<.01$ ). This finding suggests that cellular telephone users are likely to perceive stress and feel constrained in their work-related cellular telephone use.

The path coefficients that illustrate the patterns of causation among the set of variables in the model are summarized in Table 1. They express the causal effects of each variable upon the others; thus each coefficient represents the net effect of that variable controlling for all others. The path coefficients are the standardized regression coefficients ( $\beta$  coefficients) obtained from the appropriate multiple regressions.

With the path analyses, the overall goodness of fit index (Q) based on the generalized variance indices (GVIs) for the restricted (refined) and full (prior) models was calculated as specified by Bobko (1990) for each type of cellular telephone usage, including personal use and work-related use. (Note:  $Q = GVI_{full}/GVI_{restricted}$  and the value  $W=-(n-d)/nQ$  has an asymptotic chi-square distribution with  $d$  degrees of freedom, where  $d$  is the number of path coefficients set to zero and  $n$  is the sample size).

The full model was established with every variable being linked with every other variable based on the user acceptance theories of communication technologies. The restricted model was the proposed model for this study with 14 fewer paths based on the results of the pilot study. Bobko (1990) suggests that the value of Q should be compared across studies because the significance level—as with other chi-square tests of fit—is greatly affected by sample size.

In this study, despite the weak relationships between users' motivations and cellular telephone usage, the overall model fit the data well. Personal cellular telephone use had a Q value of .97 which was significant at the  $\alpha=.001$  level while work-related cellular telephone use had a Q value of .90. The results are summarized in Table 2.

The confirmation of many of the research expectations provides general support for the proposed research model in this study. The major findings from the research model demonstrate the significant associations

between: the age of respondents and social pressure to use cellular telephones; between users' perceptions and motivations; and between motivations and cellular telephone usage. The implications of these results are discussed below.

## DISCUSSION

In general, the respondents' individual characteristics (including gender, income and occupation) had no significant effect on their perceptions of cellular telephones and the social pressure to use them. However, age of the respondents had a strong and significant association with the social pressure they faced to use cellular telephones. Older respondents felt more pressure to use cellular telephones compared to younger respondents. As Davis (1995) reported, cellular telephones were considered appropriate gifts by family members to ensure an older person's safety. Therefore, providers of cellular services can emphasize, in their marketing strategy, aspects such as family needs and security needs that cellular telephones can fulfill.

According to Rogers (1995), there is inconsistent evidence about the relationship of age and innovation adoption. He concludes that about half of the studies on this subject show no relationships. For instance, Sindi (1992) found that age had no direct effect on attitudes and intentions toward using the system. Lucas (1975) also found no relationship between age and system use. However, other studies (e.g., Brancheau and Wetherbe, 1990; Assael, 1981) have reported links between age and technology use. Results from this study suggest further research is needed to clarify this issue.

Results from this study also suggest that people's motivations to use cellular telephones are influenced more strongly by their perceptions about the ease of use of the telephones than by the degree of apprehensiveness they have about using them. In general, a majority of the respondents felt that cellular phones were easy to use. These individuals also felt that cellular telephones would enhance their personal and professional lives. A number of empirical studies in information systems (Davis, 1989; Davis et al., 1992; Moore, 1989; Sindi, 1992) have found that ease of use is an important determinant in the adoption and usage of a technology. In other words, those who perceive a system as being easy to use are more likely to be users. This was supported in this study as well. Thus, efforts to make cellular telephones even easier to use would improve people's motivations to use them and thereby increase actual use.

In this study, both perceived ease of use and apprehensiveness about cellular technology were strongly associated with users' intrinsic motivations to use cellular telephones. This finding is consistent with those of other studies (e.g., Bandura, 1982; Lepper, 1985) regarding the effects of self-efficacy on intrinsic motivation. Thus, service providers may be able to increase their subscription base by advertising factors that may reduce people's apprehensiveness to cellular telephones including the ability to turn it off when not wanted and the availability of voice mail.

Overall, the fact that perceived ease of use and apprehensiveness were significant determinants of people's motivations to use cellular telephones has important implications for managerial practice. When planning mobile communication services in a market, managers need to determine how people perceive cellular telephones and then attempt to influence people's motivations to use them. As seen in this study, making cellular telephones easier to use and less intimidating can increase people's usage of the medium.

The data showed that motivation to use cellular telephones did not have a significant impact on use except for the negative impact of intrinsic motivations on work-related usage. This result suggests that the respondents did not think that cellular telephones were particularly enjoyable to use in the pursuit of their work. Viewed another way, cellular telephone users who employed the telephones for their work might have been pressured to "hurry up and get the job done"; thus, they were less likely to enjoy using the phones.

Results of this study offer three important implications for future research. *First*, even though the research model in this study explained some of the variance in cellular telephone users' perceptions, motivations and their usage, much of the variance remains unexplained. Identifying the independent variables that account for the remaining variance is an important direction for future research. Additional variables may include factors such as education, use of other communication technologies, cost of cellular telephone use, and other socio-economic constraints.

*Second*, the research model proposed in this study can be expanded to examine the adoption of other technologies and media. In order to generalize this research model to other technologies, additional factors such as individuals' socio-economic characteristics (e.g., years of formal education and occupational status), communication awareness (e.g., exposure to mass media), cost of

competing technologies and access to other media need to be considered.

*Third*, an interesting extension of this study would be to determine how the research model can be adapted to include the perceptions of non-users. A comparison of users' and non-users' perceptions about cellular telephones will provide greater insight to the application and validation of the research model.

### CONCLUSION

This paper reports on a study conducted to test a theoretical model of cellular phone adoption and use. As The technology acceptance model examined here is valuable in understanding and explaining how users' perceptions affect their motivations to use cellular telephones. As the model suggests, users' perceptions about cellular telephones—i.e., ease of use in particular—were significantly related to their motivations to use the medium.

This research also contributes to knowledge about the acceptance and adoption of communication technologies in general. It helps reveal the effects of new technologies on human behavior and vice-versa, just as communications research in the past has done. For example, in the 1930s, communication scholars conducted research into radio as a new communication technology following newspapers and film; in the 1950s, with the advent of television, studies were pioneered about its effects. In the 1980s, the social impacts of interactive communication technologies such as computers were studied by communications scientists. And now, the study of distributed communication technologies, such as cellular telephones, needs to be undertaken a systematic fashion. The research discussed here hopes to pave the way for studying emerging communication technologies such as Personal Communication Systems (PCS).

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**Table 1: Regression Tests of the Research Model**

<b>Dependent Variable</b>	<b>R - Squared</b>	<b>Independent Variables</b>	<b>Beta+</b>	<b>t - Statistic</b>	<b>Level of significance</b>
Number of Calls	.02	Extrinsic M.	-.06	-.61	.54
		Intrinsic M.	-.09	-.77	.43
		Social P.	.20	1.86	.06
Length of Calls	.02	Extrinsic M.	-.06	-.57	.57
		Intrinsic M.	.02	.15	.88
		Social P.	.16	1.48	.14
Personal Use	.02	Extrinsic M.	-.05	-.49	.63
		Intrinsic M.	.01	.05	.96
		Social P.	.14	1.30	.20
Work-related Use	.04	Extrinsic M.	.12	1.27	.21
		Intrinsic M.	-.28	-2.58	.01**
		Social P.	.14	1.40	.16
Ease of Use	.04	Gender	-.15	-1.81	.07
		Age	.10	1.15	.25
		Income	-.05	-.52	.60
		Occupation	-.06	-.61	.54
Apprehensiveness	.02	Gender	-.09	-1.12	.26
		Age	-.01	-.17	.87
		Income	.07	.71	.48
		Occupation	-.15	-1.62	.11
Extrinsic Motivation	.20***	Ease of use	.44	6.42	.00***
		Apprehensive	.03	.37	.72
Intrinsic Motivation	.18***	Ease of Use	.40	5.75	.00***
		Apprehensive	-.14	-2.01	.05*
Social Pressure	.09**	Gender	-.05	-.64	.52
		Age	.29	3.58	.00***
		Income	-.17	-1.80	.07
		Occupation	-.03	-.29	.77

+ Beta reported here is the standardized regression coefficient.

\* P<.05, \*\* P<.01, \*\*\* P<.001



**Table 2: Goodness of Fit Index (Q)**

<b>Variable</b>	<b>Q*</b>
Number of Calls	.73**
Length of Calls	.97**
Personal Use	.97**
Work-related Use	.90

\* The index ranges from 0 (no fit) to 1 (perfect fit).

\*\* Chi-square value significant at alpha=.001.

Figure 1: Research Model

