

OLDER ADULTS' USER EXPERIENCES WITH MOBILE PHONES: USER CLUSTER IDENTIFICATION

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Abstract. A self-report questionnaire study was conducted with 154 older adults in the U.S.A. to capture older adult's experience with mobile phones and to identify representative users. Based on mobile phone usage behavior, three distinct user segments were identified: explorers, basicians, and minimalists. Characteristics of each cluster were described in terms of demographic information, subjective usability evaluation, and desired feature in the future. This study indicates older adults are not homogeneous in their mobile usage and provides information for strategic segmentation for mobile phone development.

1. Introduction

Mobile phone use by older adults in the U.S.A. is radically increasing. It was estimated that about 50% of older Americans ages 65 to 74 were mobile subscribers, and 30% of those ages 75 to 94 had mobile phones in 2005 (Brown, 2005). In spite of increasing adoption rates among older adults, there is little research on their user experiences with mobile phones. Although two previous studies revealed that older adults tend to use mobile phones for very limited purposes, such as calling or texting in an emergency situation (Kurniawan, Mahmud, & Nugroho, 2006; Mann et al., 2004), these results may not be generalizable to the overall older adult population due to their limited focus on a certain user characteristics such as female users or individuals with disabilities.

Older adults, however, are a diverse group (Abascal and Civit, 2001). The diversity within older adults increases in physical, sensory, and cognitive areas, combined with a wide variability in other areas such as education and computer skill level (Fisk et al., 2004; Syme & Eisma, 2001; Zajicek & Brewster, 2004). Nevertheless, few studies investigated the heterogeneity of this population regarding mobile phone use and its relationship with

demographic characteristics, whereas numerous studies were keen on comparisons between older people and young people (Marguie, Jourdan-Boddaert and Huet, 2002; Ziefle and Bay, 2005).

The lack of understanding of the heterogeneity within this population creates a major challenge for mobile phone developers when defining a representative older adult user in the User Centered Design (UCD) process (Syme and Eisma, 2001). Unless these older adult groups can be reliably defined, needs analysis and user requirements developments will yield misleading information about users in the design process (Gregor, Newell and Zajicek, 2002). Despite the critical nature of the issue, few studies have addressed the identification of representative user group(s) in the older adult population for mobile phone design. For this reason, a self-report questionnaire was conducted to capture older adult's experience with mobile phones and to identify representative users.

2. Method

2.1. PARTICIPANTS

A total of 154 older adults who owned a mobile phone participated in this study. Participants were selected in the 20 states of the U.S.A. using a convenience sampling method. 118 participants (76.6%) were from Virginia, and 36 people (23.4%) from 19 other states. The large number of Virginian participants resulted from the sampling method in which numerous senior centers in Virginia collaborated in recruiting participants.

The mean age was 70.8 years ($SD=7.0$; $Min=56$; $Max=90$), and the length of their mobile phone ownership was 6.8 years ($SD=4.5$). Of these respondents, there were 99 young-old adults (64%) aged 55 to 74 years old and 55 old-old adults (36%) aged 75 years or older. There were 53 males and 101 females, yielding a relatively low male-female ratio of 52.4, compared to 70 from the U.S. Census 2000 summary (US Census Bureau, 2001).

Participants were selected from a wide range of residence areas (28% from urban, 44% from suburban, 28% from rural areas) and household annual income (from less than \$10,000 to more than \$100,000). 145 people (94.2%) reported that they were healthy, and nine people reported various minor disabilities such as hearing disabilities and visual disabilities.

2.2. MATERIALS

Data were collected using both a mail-in survey and an online survey that were included within a larger multi-item instrument. Questions in the survey,

which are reported here, included mobile phone feature usage, perceived usability with their own mobile phones, desired features in the future, and demographic characteristics: age, gender, education, length of phone ownership, and computer use, internet use, and email use.

The mobile phone feature usage was measured by asking frequency of use for 20 specific functions: make a call, receive a call, phonebook, speed dial, call history, voice message checking, text messaging, voice memo, change ringer tone, calculator, calendar, alarm, multimedia messaging service, camera, game, internet, voice activation, clock, listening to music, and speaker phone. Those 20 functions were selected since they were relatively common across differing phone manufacturers. A four-point scale was used: 1- never to 4- frequently.

The perceived usability was measured using the mobile phone usability instrument that includes 12 items: simplicity, learnability, text reading on screen, text reading on buttons, menu navigation, understanding error messages, error recovery, ease of pressing buttons, ease of inputting text, reference material, ease of battery replacement, and ease of battery charge (Lee, 2007). All items were measured using a 5-point Likert scale, anchored at the end points with strongly disagree (1) and strongly agree (5). Desired features were examined by asking participants to mark all features they wished to have in a future phone among 23 features (email, emergency call button, and audio display in addition to 20 features that were listed in the current mobile phone usage).

2.3. DATA ANALYSIS

Two-step cluster analysis was performed to segment participants according to their mobile phone feature usage. The two-step clustering component was used because it provides the capabilities to determine the optimal number of clusters based on the Bayesian Information Criterion method (Weakliem, 1999), whereas other traditional clustering methods, such as hierarchical clustering, require analyzers to determine the number of clusters, which can be an arbitrary decision (Everitt et al., 2001). One-way ANOVAs were also used to test differences among the three clusters in other questionnaire responses. Pair-wise comparisons using the Tukey HSD ($\alpha = .05$) were performed in post-hoc tests. All data analyses were performed using SPSS (version 15.0).

3. Results

3.1. CLUSTER ANALYSIS AND PHONE USAGE PROFILING

The Two-step cluster analysis identified three user clusters. The resulting clusters were: 46 participants (29.9%) in Cluster 1, 63 (40.9%) in Cluster 2, and 45 (29.2%) in Cluster 3, respectively. Figure 1 shows the mean frequency of 20 feature use across clusters. Users in Cluster 1, referred to as “explorers” hereafter, appeared to be active mobile phone users who used various communication features frequently such as make/receive a call, phone book, speed dial, call history, and voice message checking, while using other features such as ringer change, calculator and calendar rarely. Users in Cluster 2, termed as “basicians” hereafter, were characterized by less frequent use of basic communication features, compared to explorers, and little use various additional features. Cluster 3, referred to as “minimalists” hereafter, included low-end users who utilized a mobile phone very rarely. Minimalists placed and received calls rarely, and they did not use any other features at all. The differences in the phone usage among clusters were tested using a one-way ANOVA. A significant difference was found from the use of all 20 features among three clusters at $p < .05$.

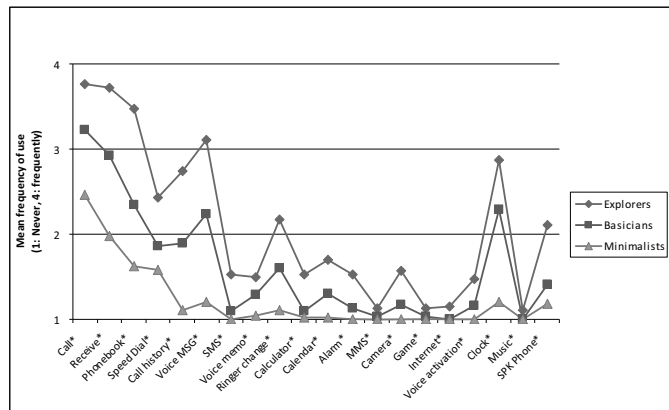


Figure 1. Mobile phone usage by user clusters (*: $p < .05$).

3.2. DEMOGRAPHIC CHARACTERISTICS

To determine if a combination of demographic variables can predict user classification, a multinomial logistic regression was performed using the stepwise procedure. The resulting model indicated that age, length of phone ownership, and internet use were significant variables in predicting the cluster classification (Table 1). The model was a good fit (-2log-likelihood = 118.71, $\chi^2 = 203.53$, $df = 134$, $p < .01$) in that it could predict the classification at 79.9% accuracy. The Nagelkerke's pseudo- R^2 was .84. This indicated that those who were relatively younger, adopted the mobile phone earlier, and used the internet frequently, tended to be high-end mobile phone users who utilized more features and frequently.

TABLE 1. Resulting model of the multinomial logistic regression.

Variables	-2 Log Likelihood of Reduced Model	Chi-Square	df	p
Intercept	118.71			.
Age	221.96	103.25	56	.01
Phone ownership	187.44	68.73	40	.01
Internet Use	136.47	17.76	10	.05

3.3. SUBJECTIVE USABILITY EVALUATION

The mean ratings of 12 usability items were examined to compare detailed usability problems among clusters (Figure 2). One-way ANOVA revealed a significant difference for simplicity [$F(2,148)=4.67$, $p < .05$], menu navigation [$F(2,148)=7.03$, $p < .01$], recovery from mistake [$F(2,147)=8.98$, $p < .01$], and battery replacement [$F(2,148)=6.41$, $p < .01$]. The Post-hoc Tukey HSD ($\alpha = .05$) indicated that explorers perceived their phones significantly easier on the four items than basicians and minimalists. Basicians and minimalists, specifically, reported serious problems with four items: 'menu navigation', 'understanding error message', 'text input', and 'user manual' commonly.

3.4. FEATURES DESIRED BY CLUSTERS

Figure 3 shows features that participants desired to have on their phone in the future. One-way ANOVA showed a significant difference in the number of desired features among the three clusters, $F(2,146)=25.06$, $p < .01$. Explorers wanted to have about 12 features while basicians and minimalists wanted to have about nine and six features, respectively. Explorers expressed their

interest about additional features beyond communication, such as a camera feature. Meanwhile, minimalist users desired to have only basic communication features that included make/receive calls, clock, phonebook, speed dial, and voice message. Chi-square test found a significant difference from phonebook, speed dial, call history, voice message checking, text messaging, voice memo, ringer change, calendar, camera, internet, email, voice activation, clock, and speaker phone at $p < .01$.

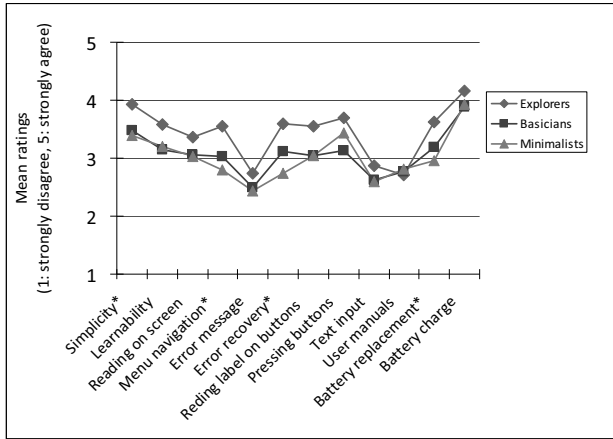


Figure 2. Usability evaluation by clusters (*: $p < .05$).

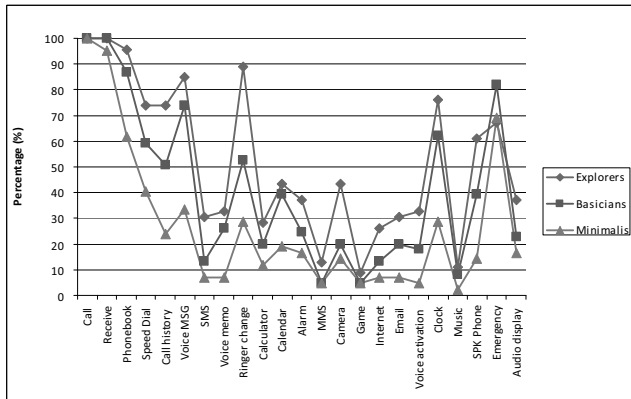


Figure 3. Phone features desired by user clusters.

3. Discussion

Despite increasing mobile phone use by older adults, there was scarce empirical knowledge about behavioral and demographic characteristics of mobile phone users in the older adult population. This study using the two-step cluster analysis suggested that older adult mobile phone users could be classified into three segments in terms of their mobile phone usage behavior as follows:

- Explorers ($N=46$, 30%): This group, composed of relatively young-old people ($M= 68.22$, $SD=6.80$), appeared to be early mobile phone adopters. They were seemed to be high-end mobile phone users as they used various features for communication purposes (e.g., phone calls, phonebook, voice message checking, speed dial, and call history) while trying out additional features like camera, ringer change, and calculator. They also appeared to have knowledge about their phone since they perceived their current mobile phone to be relatively easy to use. This group desired more features in their mobile phone including call, receive, phonebook, speed dial, ringer change, voice msg., clock, speed dial, call history, emergency, speaker phone, camera or calendar.

- Basicians ($N=63$, 41%): This group ($M=69.78$, $SD=6.65$) was characterized by the use of a few features for communication purposes (e.g., phone calls, phonebook, and voice message checking). They appeared to have limited knowledge about mobile phones as they perceived their phone difficult to use. This may explain why they do not try out additional features like the camera and calculator features. The features desired by basicians included call, receive, phonebook, emergency, voice message, clock, speed dial, ringer change, call history, speakerphone or calendar.

- Minimalists ($N=45$, 29%): This group, composed of the old-old participants ($M=74.84$, $SD=6.00$), appeared to be low-end users who use a mobile phone for emergencies only. People in this cluster used their phone very rarely and then only to place a call without using the phonebook feature. They seemed to have limited knowledge about their phone as they perceived their phone difficult to use. Features desired by this group included call, receive, emergency call, phone book, speed dial, and voice message. They could be described as late adopters.

This cluster solution is the only known research to segment older adult mobile phone users who had been reported to be homogenous in previous studies (Kurniawan et al., 2006; Mann et al., 2004). This study revealed that older adults are not homogeneous in their mobile usage while suggesting the three cluster segmentation. Mobile phone developers can refer to this cluster solution as a target user group in the development process. In addition, this study indentified features desired and common usability problems faced by

each user group. This finding should be considered by developers to balance the functionality of mobile phones with their needs (Shneiderman, 1998). However, it should be noted that this result is not necessarily complete since it was gathered based on 23 features listed in the questionnaire and other features may be desired, as they become available.

Acknowledgements

This study was conducted as part of author's dissertation research at Virginia Tech, U.S.A. The author acknowledges all participants in this research for their time, directors of local senior centers in Virginia for their support in the data collection process, and Mark Ahlenius at Motorola labs for his review.

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