

Older people and mobile phones: A multi-method investigation

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Abstract

This paper investigates issues related to the use of mobile phones by people aged 60 years and over and characteristics of an ageing-friendly mobile phone. This study combines qualitative and quantitative analysis methods of Delphi interviews, focus group discussions, and online survey. The expert interviews and the focus group discussions covered usage patterns, problems, benefits, and desired and unwanted features. The issues raised in the discussions were translated into an online survey of 100 people. This study revealed that older people are passive users of mobile phones, that they experience fear of consequences of using unfamiliar technology, and that most preferred design features are aids for declining functional abilities. Gender differences in preferred design features were observed, with women focusing on haptic aids and men on perceptual aids.

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1. Introduction

Mobile phones are rapidly becoming a feature of today's society. According to the Office for National Statistics, nearly 90% of people living in the United Kingdom aged 15–34 owned or used a mobile phone in February 2003. The ownership drops slightly for older people, with only 60% people aged 65–74 years and 36% people aged 75 years and over owning mobile phones (National Statistics, 2003). People over the age of 60 use mobile phones for very limited purposes, such as for calling or texting in emergencies (Coates, 2001), on average making five calls and sending two text messages weekly (Ofcom, 2006). Users of this age group were reported to experience problems related to displays that are too small and difficult to see, buttons and characters that are too small causing them to push wrong numbers frequently, too many functions, non-user-friendly menu arrangement, unclear instruction on how to find and use a certain function and services that are too expensive (NTT DoCoMo, 2001). One possible cause of this problem is the lack of understanding

among mobile phone designers about the complex nature of functional impairment experienced by older mobile phone users. This is evident, for example, in a published study on mobile phone design for older persons that accommodates physical disabilities (mainly visual) rather well but does not refer to problems older persons might have with reduced cognition (Irie et al., 2005).

One approach that can alleviate the problems older mobile phone users experience is through involving them when developing mobile phones, at least at the requirement stage, and ideally throughout the development phase. Past studies showed that when enquired, older people were quite vocal in specifying the functions they would like to have in their mobile phones, e.g., health monitoring (BBC News, 2004), or a simple, easy to use phone with speech-control (NTT DoCoMo, 2001). It is unfortunate that not many projects that actively involved older persons (an exception is the universal design activities reported by Fujitsu—although the oldest participant was 'only' 60 years old of age (Irie et al., 2005)), or that investigated issues of mobile phone use with older persons in structured and systematic ways. However, there are some exceptions to that, as the following three studies show.

Using a method called 'Own suggestions, Pairs' suggestions, Explanation, Ranking and Arranging' (OPERA) Mikkonen et al. (2002) brainstormed ideas regarding the

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needs of older persons that can be potentially fulfilled through mobile technology. Older persons were able to come up with innovative ideas on the use of mobile technology such as one-stop help centre or security bracelet that can send calls for help. They suggested that the main functions of mobile technology were for maintaining and developing social relationships and providing health and security services.

Melenhorst et al. (2001) used focus group discussions to investigate perceived context-related benefits of mobile phones for older persons. The group stated that the main benefits of mobile phones are to keep in touch with someone emotionally close who lives more than half an hour apart, to set time for a leisure activity with a friend, and to immediately share exciting good news.

Finally, a comparative study on older and younger mobile phone users' mental models shows that older adults' mental model of mobile phone menus were mostly hierarchical (Ziefle and Bay, 2004). When asked to organize existing functions, older users tended to create shallower menus and allocated fewer functions to the appropriate superordinate functions than younger users did.

2. The study

While all of the studies cited above had contributed to the understanding of the use of mobile phone by older persons, many of these studies adopted a single data gathering method, e.g., focus group, questionnaire, etc. In addition, many followed solely the empirical strand (the understanding of issues) or built strand (the design of ageing-friendly phones) with few studies linking these two strands. The reported study aims at bridging these two strands by actively involving older persons to understand the issues related to their mobile phone use, with the view of translating the findings into a set of requirements for the design of an ageing-friendly mobile phone. Specifically, this study seeks to answer the following two research questions:

1. What are the issues that older persons face when using mobile phones?
2. What are the characteristics of an ageing-friendly mobile phone?

This study combines quantitative and qualitative methods. Qualitatively, Delphi interviews and focus group discussions were analysed. Quantitatively, findings from the online questionnaire designed in collaboration with the focus group were statistically analysed. By combining the analysis of these various methods, the study aims to arrive at a more nuanced understanding of the nature of the use of mobile phone among older people to meet their needs.

Delphi interviews were deployed to gather experts' opinion and judgement about the focus of the study. This technique was originally established as a method for structuring a communication process among a number of

experts (Linstone and Turoff, 1975). It involves an iterative process used to collect and distil the judgments of anonymous experts using a series of questions interspersed with feedback. The questions are designed to focus on problems, opportunities, solutions, or forecasts. There are four requirements for expertise: (i) knowledge and experience with the issues under investigation; (ii) capacity and willingness to participate; (iii) sufficient time to participate in the Delphi; and (iv) effective communication skills (Adler and Ziglio, 1996). Since expert opinion is sought, a purposive sample is necessary where people are selected not to represent the general population, rather their expert ability to answer the research questions (Fink and Kosecoff, 1985). In this study, Delphi interviews were conducted with two experts (one to answer more technically oriented questions, and the other to answer questions related to his experience as an older competent mobile phone user) to understand the nature of mobile communication design and how it affects different users and uses. No published application of the Delphi method in the area of design and evaluation of a technological artefact or the area of ageing can be found. This attempt can thus be seen as a test bed for using Delphi method in studies involving older persons and technology. The findings of the interviews feed into the topics that were used as guidance for the focus group discussions.

Focus group discussions were used in this study because they have a long history in market and medical research and had been shown to be very effective in drawing upon respondents' attitudes, feelings, beliefs, experiences, and reaction in a way that would not have been feasible using other methods (Goss and Leinbach, 1996). This is especially important when attempting to get in-depth information from older persons, who might be more hesitant to state their opinions regarding technology in individual interviews. Two focus groups were recruited through flyers placed in supermarkets, bridge clubs and organizations for older persons such as the College of Third Age and Age Concern. In addition to their age (60 years old or over, the retiring age of women in the UK), the inclusion criteria require the participants to have some experience with mobile phone operation. Unfortunately, the restriction of the focus group technique that requires a commitment from the whole group to attend the sessions multiple times in the same place has led to one focus group of women only (recruited at the College of Third Age; they are also friends outside the class and therefore were able to commit to meet multiple times for the focus group discussions) and another of men only (recruited at Manchester Bridge Club), although upon reflection, these gender-biased groups had contributed to gender-specific design ideas that would not otherwise be picked up.

An online questionnaire was then devised based on the issues raised by the focus groups and Delphi interviews. Online survey is a very effective method for getting a large number of data from respondents with varying characteristics in a short period of time; albeit the online nature of

the survey limits its coverage to people with Internet access (however, there was evidence of a highly positive correlation between Internet and mobile phone users and therefore, arguably the online survey could reach older mobile phone users (Rice and Katz, 2003)).

3. Delphi interviews

Existing studies on the use of mobile phones by older persons (e.g., Ling, 2004) were extracted to form the basis of the list of topics used as interview guide. Two experts were interviewed individually. The aspects investigated were:

- patterns of use;
- problems older mobile phone users experience;
- benefits of mobile phones for older persons;
- roles of mobile phones in the wider picture of older persons' lives.

3.1. Profile of experts

The first expert is a young mobile phone technical expert (28-year-old male) who had worked with mobile technology for several years, since the technology was still analogue and had been observing his grandparents using their mobile phones. The second expert is an older expert mobile phone user, a retired computer science faculty member (78-year-old male), and who own the newest Motorola RAZR phone. The experts were recruited from personal referrals and none is related to the author. In addition to the four requirements of expertise for participating in the Delphi interview (Adler and Ziglio, 1996), a minimum exposure to mobile technology of at least 3 years with frequency of use of at least five times of voice calls a day and the use of advanced functions such as text messaging.

Both experts were expected to provide an in-depth understanding of the limitations of the current mobile technology in facilitating an effective interaction for older users from a technological perspective. In addition, they were also asked to speculate on how a future ageing-friendly mobile phone would be. It should be noted that the Delphi method requires 'pooled' reporting, where the information reported should not reveal which expert stated a certain assertion.

3.2. Patterns of use

Combining the experts' opinions and observations (of friends and family members in the case of the older expert and of grandparents and their friends in the case of the younger expert), the following are the patterns of use of mobile phones by older persons:

- *Older persons are passive users:* Older people tend to use the technology only when there is no alternative

communication method. Most consider mobile phones as a modern version of landline phones. Therefore, they would rarely, if ever, use functions beyond making and receiving voice calls. They mostly use the phones to be contacted (either via voice calls or texts) rather than to make calls or send texts.

- *Hesitation to adopt and use:* The technology used by many mobile phone devices/services can be intimidating and overwhelming due to its complexity, leading to hesitation to adopt mobile phones as the main communication device. However, once the current cohort of young generation who grows up with mobile phones becomes older, the usage of mobile phones by older persons will most likely increase.

3.3. Problems experienced

Combining experts' observations, opinions and experiences, the problems older persons might experience when using mobile phones are:

- *The size and location of the buttons:* Small buttons crammed together hamper many operations, even as simple as answering a call. Small and crammed buttons defeat the main aim of providing mobile phones to older persons (i.e., for emergency). It would be difficult for older persons to dial an emergency number with those buttons, especially when they are in stressful situations.
- *T9 predictive texting is more distracting than helping:* T9 predictive texting is more distracting than helping, especially because wrong predictions require users to delete the wrong characters—and this operation requires multiple key presses, which might be difficult for older persons with joint problems.
- *Texting is a problem:* Texting is a problem because it is difficult for some older persons to correlate a button and the three letters associated with it (e.g., the letter 'b' is activated by pressing the number '2' twice). Some older persons also tend to panic when they received a text message as retrieving a message can be intimidating for them. Some also think that it would be impolite not to reply immediately—something that would be impossible without knowing how to retrieve a message.
- *Remembering own number:* Some older persons carry a card with their own number printed on the card. If there is a way to easily retrieve own number, this would have been a great help for older persons.
- *Cost:* Both the device and the services are prohibitively expensive for most pensioners. Monthly plan is too expensive as older persons do not use much airtime. Most older users would be on a pre-pay plan, and this usually does not give them good deal on various calling features.
- *Coverage:* Until recently the coverage of some services was poor in smaller towns and rural areas, which disadvantage older persons who retire in those places.

- *Customization*: Older persons still need to rely on other (often younger) persons to perform customization operations such as how much to top up or filling in address book. This defeats the purpose of providing mobile phones for older persons, which is to maintain their independence.
- *Battery life*: It is getting more and more difficult to buy basic mobile phones, and modern phones have short battery life because the devices have to power various functions that most older persons do not use, such as colour screen and musical ring tone. This is problematic for older persons who tend to forget to recharge their phones.

3.4. *Benefits of mobile phones for older persons*

The two experts agreed, however, that there are some useful features that mobile phones can provide for older persons. These are:

- *Address book*: This feature can replace heavy paper-based address book that older persons tend to carry around when they found themselves unable to remember many phone numbers.
- *Alarm and reminders*: Alarm and reminders can be very helpful to remind older persons to take their medication and not to miss their appointments with their doctors.

The two experts also suggested some future functions that can potentially benefit older persons. These are:

- A dedicated help/panic button that would not require older persons to remember a series of numbers to dial when emergency situations arise. However, it was remarked that there are cheaper and easier to use devices for safety purposes such as personal alarms and fall detectors.
- A series of control buttons for important functions rather than software-based menus which are often more difficult to see, especially in smaller-sized phones.
- A hard sleeve to protect buttons from accidental pressing rather than keypad lock, as older persons tend to forget the combination to lock/unlock the keypads. Additionally, the locking feature often requires a fast succession of key presses, which is difficult for some older persons with joint or vision problem.
- A dedicated button to activate a stronger and longer lasting backlight for older persons with reduced vision and slower operation.
- A voice recorder and replay, which will be useful as a reminder. One example of its use is to record a shopping list at home, which the user can then play back in the shop.
- Environmentally aware setting that would set the ring tone in silent in quiet places and set it back to loud when the ambient noise is higher.

- A caller ID complemented with the caller's picture. This helps remembering who the caller is, which is useful for older persons with memory problems.

They also suggested that future ageing-friendly mobile phones would not be very different from old-styled ones, in that the device should still be heavy and bulky, the buttons should remain large, monochrome screen (to prolong battery life), and reduced menus to cover only basic calling features.

3.5. *Roles of mobile phones in the wider picture of older persons' lives*

Finally, the two experts were asked to comment on the roles of the mobile phones in the wider picture of older persons' lives. This was a difficult topic for the experts as they did not see mobile phones as having important roles in older persons' lives. However, some of the issues that came up in regard to this topic are:

- Mobile phones enable older persons to be contacted anywhere and anytime and mean that they do not need to stay at home for waiting for news (especially for those with frail, hospitalized, or institutionalized family members) or for communicating with friends and family. This might lead to a more active social life as they can potentially go out at will.
- Mobile phones can provide a sense of safety and security when staying home or going out alone, especially for older women and frail older persons.

4. *The focus group discussions*

4.1. *Method and participants*

The study follows the recommendation that the number of people per group should be between 6 and 10 (MacIntosh, 1981) and that the researchers met the same group several times (Goss and Leinbach, 1996). We also arranged that each session lasted around 2 hours in 'neutral' location, which was believed to be helpful for avoiding either negative or positive associations with a particular site or building (Powell and Single, 1996). The first group decided to use the meeting room of the College of Third Age while the second group decided to hold the discussions at Manchester Bridge Club in the Greater Manchester area. Three sessions per group were conducted on weekly basis.

The moderators were carefully chosen to involve researchers from various backgrounds, i.e., two HCI researchers, one retired mobile phone company employee, and one social scientist (two doubled as note takers). These moderators extracted the information from the Delphi interviews, a book on ethnographic study of mobile phone use in Norway (Ling, 2004) and other studies on the use of mobile phones by older persons (e.g., Mikkonen et al.,

2002) into four topics for the first focus group discussion session. These are: (1) usage pattern, (2) problems, (3) desired features, and (4) concerns. The term ‘problems’ in this study refers to the problems that the participants experienced or perceived when they are using mobile phones, while the term ‘concerns’ refers to the discomfort that the participants experienced or perceived when other people are using mobile phones. A list of the sub-topics that need to be covered in the discussions was drawn.

The second session was dedicated to brainstorming design features of the ‘closest to ideal’ commercially available mobile phone. To provide context for discussion, 25 brochures of models that were carried by at least two mobile phone shops and were priced at £150 or less were handed out to the groups. The moderators then went to several mobile phone shops to find a commercial model that most closely matches the criteria stated by the focus groups. The last session aimed at trying the chosen phone to verify that the model was indeed acceptable and usable by the focus group participants. The whole sessions were voice-recorded and videotaped using Sony digital camcorder for later review and analysis.

The first focus group consists of seven older women (median age = 67.5 years) and all are students at the College of Third Age, Manchester. Six had been using mobile phones for several years, and one had less than 1 year experience. Six used their mobile phones very occasionally and therefore chose the pre-pay scheme with an average top-up (credit adding) frequency of once or twice a month—they topped up in mobile phone shops or at supermarket tills. Half of them said that their phones were gifts from their children or grandchildren. The discussions of this focus group had been reported in great detail in Kurniawan (2006).

The second focus group consists of seven older men (median age = 65 years old) and all are members of Manchester Bridge Club. They all had only used mobile phones in the past year, all on pre-pay scheme with an average top-up frequency of once or twice a month. They topped up in mobile phone shops either in person or by phone.

Because the results of the discussions of the first group had been reported in great detail in Kurniawan (2006), this paper will summarize briefly the merged results from both groups and highlight gender-specific issues raised by the focus groups.

4.2. Usage patterns

Confirming the opinions of the experts gathered during the Delphi interviews, both groups stated that many older mobile phone users would only use their phones in unexpected situations rather than for casual conversations. The exception is when they need to call a mobile phone number. In the UK, calling a mobile phone number from a landline phone is expensive, especially at daytime.

Family and friends were the most called parties. Again, confirming the experts’ opinions, the groups also suggested that many older persons would use only basic calling functions and rarely use extra services such as text messaging.

4.3. Problems

Many older persons would experience problems with:

- *Buttons*: Some are too small, rubbery, do not click when pressed and therefore provide no feedback whether the associated number had been dialled.
- *Menus*: Too many, most of them unnecessary, difficult to understand and recall.
- *Devices*: Too small to hold comfortably.
- *Text size*: Too small to read even with corrective lenses.

Essentially most problems are related to the various components of mobile phones that are too small to be comfortable for older persons.

4.4. Desired features

Each focus group came up with suggestions on the functions an ageing-friendly phone should have (the proposing group is printed after the suggested function). Most of the desired features seem to relate to those that can support ageing-related functional impairments. Specifically, the suggested functions are those aimed at mediating:

4.4.1. Cognitive functioning and memory

- Caller identification complemented with a picture of the caller to remind users who the caller is (both groups). This has also been suggested by the experts during the Delphi interviews.
- Home screen with only four menus: voice call, text, alarm, and calendar (women).
- A reminder of important events and easily arranged phonebook (both).
- A loud audio reminder when the battery is 75% empty (men).
- Displaying own phone number in the main screen, together with date and time (men).

4.4.2. Vision

- Visual indication of whether a call has gone through (men).
- Differently shaped, coloured or located keys [to the numeric keys] for important functions (the men suggested differently shaped or coloured keys; the women suggested differently located keys).
- Brightly illuminated screen (both groups). Also suggested by the experts.
- Illuminated keypads (men).

- Voice output for available menus for those with reduced vision (men).

4.4.3. Auditory

- A speakerphone (men).
- Ability to adjust volume easily through a dedicated volume button (men).
- Audible beeping sounds when buttons are pressed (men).

4.4.4. Haptic

- One button locking function to prevent accidental dialling (women). This feature was also suggested by the experts during the Delphi interviews, albeit with different suggestions (the experts suggested a hard sleeve).
- Easily accessible ‘panic button’ for emergencies (women). This has also been suggested by the experts.
- A button to place a caller/number into a blacklist (women).
- Rubber grip on the body of the phone (men).

Observing the suggested functions, there were some gender differences in both the types of functions and the functional impairments that the functions aim to mediate. The women focused their suggestions on functions that aim at facilitating the feelings of safety and security (e.g., easily accessible ‘panic button’ for emergencies) and those that minimized the effect of unintended actions (e.g., one button locking function to prevent accidental dialling). They also focused on functions that made haptic operation easier. The men came up with more suggestions and seemed to focus on functions that help their perceptual (auditory and visual) functioning.

4.5. Concerns and annoyances

The participants stated the following topics as the main sources of concerns/worries and annoyances in regard to the use of mobile phones by other people:

- ‘Ridiculous’ choice and volume of ring tones.
- People talking loudly and ‘telling-it-all’. Ling (2004) reported that this was the number one source of annoyance of everyone, not specifically of older persons.
- More and more people use mobiles in prohibited places such as in restaurants, quiet coaches in trains, and cinemas.
- Long-term and frequent use, as in the case with of the younger generation, as they heard that this might lead to brain cancer or health problem.
- It can reduce face-to-face interaction, which they had witnessed in the younger generation—an issue that was also raised in Abascal and Civit (2001).

- It is addictive to younger generation and it impairs their ability to plan.
- It persuades excessive use especially by the younger generation, even when the parents are the ones paying the costs.
- Text messaging destroys the younger generation’s literacy skill.

4.6. Design choices

In the second session, the participants reviewed a series of brochures of commercial mobile phones. They were then presented with a printout with snapshots of various models that differ in one dimension to help them focus (see Fig. 1 for an example). They were asked to comment on those options and to suggest other preferred options if necessary.

Again there were some gender differences in the design choices. The preferred design elements were:

- *Shape*: The women preferred a flip phone with an antenna as the antenna eases picking up the phone from a crowded handbag and the flip eases the operation of answering a phone call and ending it. The men did not have any strong preference as to the shape of the phone.
- *Display*: Large screen, but more importantly, large text (both groups).
- *Colour*: Bold or silver, as these colours are easier to spot in a crowded handbag (women); the men did not have any strong preference in regard to the colour of the phone.
- *Size*: This particular design element is interesting as there the preferences stated by the women and the men groups were contradictory. The women preferred a bulky phone as it is easier to grab (from a crowded handbag) and hold comfortably, while the men preferred a light and small phone that can fit in the pocket without bulging it.
- *Buttons*: Metallic/silver buttons arranged similar to landline buttons’ arrangement (both groups). A similar finding was reported in a study on mobile phone design for older persons performed by Fujitsu (Irie et al., 2005). The women added that they preferred square and raised buttons.

Using these criteria, a mobile phone which best fulfilled the requirements was purchased (see Fig. 2). It is a flip phone, in silver and bold blue colour, with metallic square raised buttons.

4.7. Design verification

The last session was dedicated to verifying users’ expectation on the ‘closest to ideal’ model. All women participants agreed that this model fulfilled most of their physical design requirements and they were happy to know that this particular design was available in the market. Five of the six men participants expressed satisfaction with the phone.

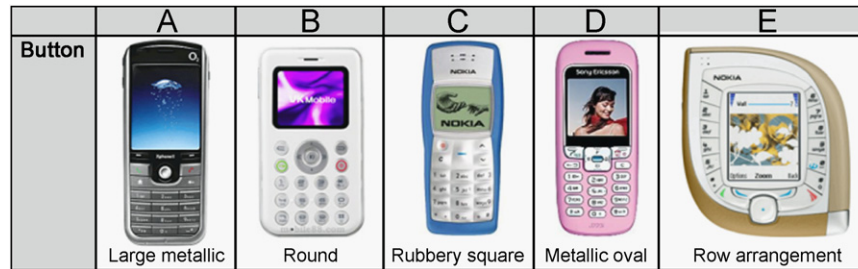


Fig. 1. An example of the snapshots of various buttons.



Fig. 2. The commercial model with most of the features specified by the focus group.

When asked to specify which features of this phone they liked/disliked the most, the women participants stated that the ‘handiness’ of the phone (‘it’s the right size’ and ‘it feels good to hold’) and the flip phone with an antenna as the positive features and the stiffness to open/close the phone as the negative one. The men participants chose the time displayed when the phone was closed and the dedicated volume button at the side as the positive features and the weight and size of the phone as the negative ones (too big and too heavy). Again gender-specific opinions were observed here, although both groups placed some importance on the tangibility of the phone (size, weight, handiness).

5. Online questionnaire

Based on the issues raised in the Delphi interviews and focus group discussions, a set of questions for a larger

survey was developed. These questions were then discussed with the focus group during a meeting where a £50 participation reward was handed to each participant. This discussion highlighted several issues that would not otherwise have been captured. For example, the focus group suggested that rather than asking for exact age (which many older women would not be willing to reveal), a range of ages should be used as options (e.g., 70–75 years old—an age range of 5 years is therefore used in the online questionnaire). Similarly, asking about income was deemed offending for some pensioners who do not have any income or are on small pension.

The questionnaire was placed in a website dedicated for surveys, hosted by the University of Manchester. Invitations were mailed to organizations for older persons, mailing lists and personal email addresses (with the owners’ permission). There were two inclusion criteria for participating in the survey: the respondents must be 60 years and over and have used a mobile phone before. To encourage participation, the purchased phone was given away through a lucky draw after the survey ended.

5.1. Analysis methods

The questionnaire gathered both quantitative and qualitative data. The quantitative data were analysed using descriptive statistics as well as a multivariate data reduction technique called Exploratory Factor Analysis (EFA) using SPSS 11.0 software. EFA is a widely utilized and broadly applied multivariate data reduction technique to uncover the underlying structure of a set of variables. It is called ‘exploratory’ because there is no prior theory of how the variables would group together. Briefly, EFA condenses intercorrelated variables into fewer dimensions, called factors. EFA generates a table in which the rows are the observed variables and the columns are the factors that explain as much of the variance in these variables as possible. The correlation coefficients between the variables and factors are called ‘factor loadings’. The meaning of the factors must be induced from seeing which variables are most heavily loaded on which factors through observing factor loadings. Though not a strictly mathematical criterion, the number of factors is usually limited to those whose dimension of meaning is readily comprehensible—the Kaiser Criterion suggests dropping all factors with

eigenvalues under 1.0. Because some factors are dropped, not all of the variance is explained by the retained factors; and the percentage of the variance explained by these factors has to be reported.

A survey of a recent 2-year period in PsycINFO yielded over 1700 studies that used some form of EFA (Costello and Osborne, 2005). The most commonly used setting in this survey was used to analyse the data. Essentially, the variables were extracted using principal component analysis (PCA) with varimax orthogonal rotation and using Kaiser Criterion. To improve the reliability of the analysis, the varimax rotation was confirmed with the direct oblimin oblique rotation. The Kaiser Criterion was also confirmed by observing the scree plots. Only the results of the varimax rotation are reported in this paper. To make the presentation cleaner, the factor loadings less than 0.5 were suppressed, as studies suggested that factor loadings less than 0.5 indicate weak relationship between the observed variables and the factors they load on (Costello and Osborne, 2005). To ensure that the factor naming was sensible, two statistics researchers named each factor independently, and then agreed on one name through a discussion.

One of the most heatedly debated topics in the focus group discussions was the sources of concerns and annoyances in regard to the use of mobile phones. However, given that there are indefinite possibilities of these sources, ranging from health issues to communication problems to theft, the focus group suggested that the questions regarding older people's sources of concerns and annoyances should be asked in an open-ended fashion. Therefore, the questionnaire also asked up to three things (in the order of severity) that the respondents were worried or concerned about and were annoyed with in regards to the use of mobile phones (either by themselves or by other people). The data were analysed using simple content analysis (Nuendorf, 2001) as this technique is more subtle than assigning relevance of human judgment. More specifically, the technique used in the study is called 'audience content analysis' as the analysed data originated from 'the audience'. Essentially, content analysis is a method for summarizing any form of content by counting various aspects of the content. This enables a more objective evaluation than comparing content based on the impressions of a researcher, which serves two purposes: to minimize subjectivity and to simplify trend detection. The main purpose of the content analysis in this study is to link causes (e.g., design of mobile phones) and effects (e.g., pattern of use).

One hundred and three respondents replied to the survey but three had missing data and therefore had to be discarded in further analysis. Out of these 100 respondents, 67 were women and 37 were men. The majority were 60–65 years old (72 respondents), with 23 respondents aged 66–70 years, 4 aged 71–75 years, and 1 aged 76–80 years. Most had used mobile phones for more than 2 years (64%) and most often called their partners (41%) or children (24%).

Half of our respondents used their phones daily. They were divided almost equally on the pay scheme (pay-as-you-go vs. pay monthly) and on average monthly spending (37% paid more than £20, 27% paid £10–20 and 36% paid less than £10). The most used function other than voice call was SMS (63%) and the least used was video call (4%).

5.2. Results of quantitative data analysis

The questionnaire listed five main reasons for using mobile phones as suggested by the focus groups. Those are: for emergency, to let people know you are late, to arrange to meet people, to call home when you are out and for casual conversation. The respondents were allowed to choose more than one reason. The most responded reason for using mobile phones was for emergency (84%). Upon further discussion, an emergency was defined as an unplanned voice call, usually to ask for help in various forms (e.g., to ask to be picked up).

To understand older persons' opinions on the roles of mobile phones on their lives, the respondents were asked to rate, in five-point Likert-like scales, from 'strongly disagree' to 'strongly agree', the statements that the focus group suggested. These statements, which are represented by the words between brackets in Table 1, are:

1. It is cheaper to use mobile phone than to use landline phone (cheaper).
2. I have more friends after having a mobile phone (friends).
3. I feel more confident to go out by myself after having a mobile phone (confident).
4. I am not afraid of getting lost after having a mobile phone (lost).
5. I know I can always call somebody on my mobile phone when I am in trouble (trouble).
6. I feel safer to be alone because of my mobile phone (alone).
7. It is fun to use mobile phone (fun).

The internal consistency obtained for these measures was very high with a Cronbach's alpha of 0.890. The most positively responded statement was that they could always

Table 1
Factor loadings and variables related to the roles of mobile phones in life

Variables	Factors	
	Safety	Socioeconomic
Safer	0.879	
Confident	0.835	
Trouble	0.795	
Lost	0.782	
Cheaper		0.861
Friends		0.732
Fun		0.576

call somebody on their mobile phones when in trouble (with 90% respondents agreed or strongly agreed). The most negatively respondent statement was that they had more friends after having a mobile phone (with 77% disagreed or strongly disagreed).

The EFA reveals two underlying opinions of older persons on the roles of mobile phones on their lives: safety and socioeconomic. These two factors explained 68% of the variance. Table 1 shows the factors and the variables they load on. Safety factor are issues related to the sense of safety in vulnerable situations, such as while alone, going out, lost or in trouble. Socioeconomic factors are related to the fun aspect of using the phone, social circle, and the financial implication of using mobile phones. Linking descriptive statistics of variables to EFA, it was apparent the safety issues were positively responded while the socioeconomic issues were negatively responded. In other words, the respondents thought that mobile phones had a positive role in facilitating the feelings of safety but did not see mobile phones as having a positive role in the socioeconomic aspect of their lives.

New mobile phone models usually come with various advanced functions such as video calling, Web browsing, and others. The focus groups felt that it was important to investigate whether these advanced functions appeal to older mobile phone users. It was argued that this understanding might lead to a simpler phone design, i.e., one with some of the advanced functions removed if those functions did not appeal to the majority of older users. To investigate this, the focus groups proposed seven functions, which the respondents rated with ‘must be removed’, ‘good if removed’, ‘can live without’, ‘good to have’, and ‘must have’. The data show that the respondents tended not to choose the ‘must be removed’ option. The majority checked ‘can live without’ or ‘good to have’. The top three ‘good to have’ or ‘must have’ functions were address book, SMS, and alarm clock. The internal consistency obtained was very high with a Cronbach’s alpha of 0.809.

The EFA shows that these seven functions grouped into two factors: memory aids and entertainment. These two factors accounted for 60% of the variance. Table 2 shows the factors and the variables they load on. Memory aids are functions that act as reminders, such as diary and alarm. Entertainment represents functions that are mainly for amusement, such as video and music players. Relating descriptive statistics of variables and EFA, the respondents viewed features related to memory aids as good to have and those related to entertainment as good if removed. These measures have a Cronbach’s alpha of 0.897.

Finally, the respondents were asked to rate the problems they had in their interaction with mobile phones as proposed by the focus group. The EFA reveals three underlying factors, accounting for 67% of the variance. Table 3 presents these factors, which are buttons, tangibility, and complexity. Relating descriptive statistics of variables and EFA revealed that the respondents had big

Table 2

Factor loadings and variables related to the appeal of advanced functions to older persons

Variables	Factors	
	Memory aids	Entertainment
Diary	0.810	
Alarm	0.807	
SMS	0.615	
Address	0.601	
Video		0.872
Camera		0.787
Music		0.768

Table 3

Factor loadings and variables related to problems experienced by older persons

Problems with	Factors		
	Buttons	Tangibility	Complexity
Characters on the buttons	0.839		
Button size	0.824		
Button arrangement	0.675		
Phone size		0.848	
Phone shape		0.809	
Phone weight		0.792	
The number of options available			0.878
Navigating menus			0.789
Learning how to use			0.777

problem with the complexity of the mobile phone, followed by the buttons, with the least problem reported on the tactile aspect of the mobile phone. The internal consistency obtained was very high with a Cronbach’s alpha of 0.876.

5.3. Qualitative data analysis

This study performed content analysis in three steps:

1. *Choosing units of content*: This is the number of respondents.
2. *Coding*: This study applies simple spreadsheet manipulation to extract the text part of the questionnaires into comma separated value (CSV) to separate the content and then codes the entries.
 - For ‘annoyance’ aspect, each entry was assigned to one of nine categories:
 1. COMM (the annoyance caused by distraction to face-to-face communication).
 2. COST (the annoyance caused by cost of communication).
 3. DANG (the annoyance caused by danger due to carelessness in using mobile phones).
 4. DES (the annoyance caused by design of mobile phones).
 5. RING (the annoyance caused by choice of ring tones).

- 6. TALK (the annoyance caused by communication breakdowns when using mobile phones).
- 7. USE (the annoyance caused by inconsiderate use of mobile phones in general).
- 8. VIDE (the annoyance caused by video feature of the mobiles).
- 9. OTH (the annoyance caused by other aspect of the mobile phones).
- For ‘concern’ aspect, each entry was coded into one of seven categories:
 - 1. HEALTH (the concern about health problems caused by the use of mobile phones).
 - 2. COST (the concern related to the cost of communication).
 - 3. DANG (the concern of the danger caused by careless use of mobile phones).
 - 4. DES (the concern caused by the design of mobile phones).
 - 5. LOST (the concern caused by the possibility of losing mobile phones).
 - 6. COMM (the concern caused by the distraction to face-to-face communication).

- 7. USE (the concern caused by the inconsiderate use of mobile phones in general)
- 3. *Counting and weighting:* This study counts the occurrence (frequency of entry) in the questionnaire database and applies identical weighting (as there was no reason to believe that any of the codes carry more weight than others).

Figs. 3 and 4 depict the frequency of occurrences of the causes of annoyance and concern. Fig. 3 reveals that inconsiderate use of mobile phones in general got nominated as the most annoying use by the most number of respondents (28.3%), followed by choice of ring tones (27.20%) and the danger due to carelessness in using mobile phones (19.2%)—particularly road accident. However, looking at the total for the 1st, 2nd, and 3rd causes, choice of ring tones is the most annoying aspect of the use of mobile phones (75.8%), followed by danger caused by carelessness in using mobile phones (69.9%) and by inconsiderate use of mobile phones in general (66.4%).

Fig. 4 shows that respondents were worried the most about the health impact of using mobile phones (26.40%) and the danger due to carelessness in using mobile phones (23.20%). The rest of the causes received much less nominations—in the third place is the cost of communication (17.7%). Adding the 1st, 2nd, and 3rd causes, health problems is still by far the most concerning aspect with 89.4%, followed by danger due to carelessness in using mobile phones (74.2%), and the rest of the causes at 34% or less.

The content analysis seems to have revealed that most of the causes of concern and annoyance are related to patterns of use rather than design features of mobile phones.

6. Discussion and conclusions

This study had applied a series of structured investigations into how older people use mobile phones. It presents very rich data gathered through a combination of several

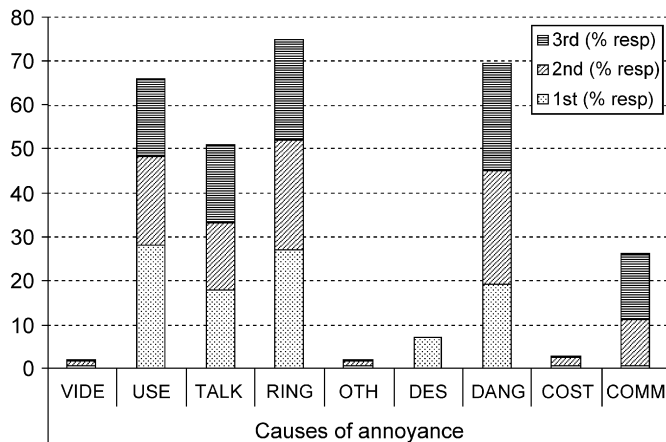


Fig. 3. Causes of annoyance: 1st, the worst; 2nd, the second worst; 3rd, the third worst causes.

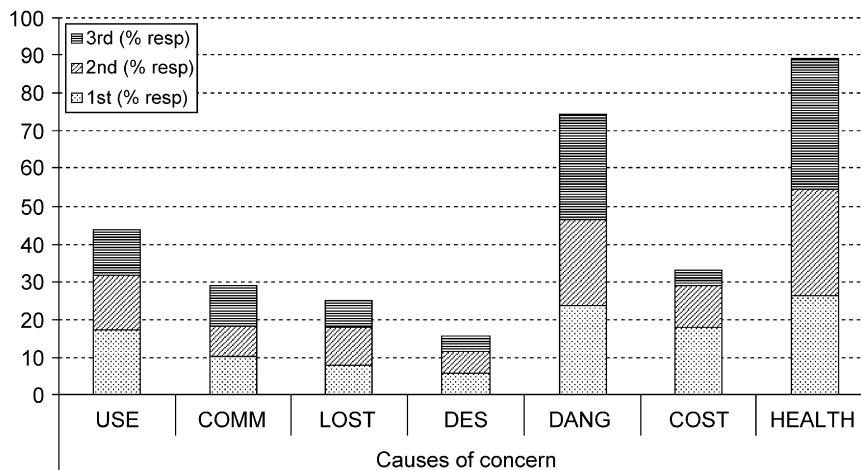


Fig. 4. Causes of concern: 1st, the worst; 2nd, the second worst; 3rd, the third worst causes.

methods. This study is one of the first studies that use Delphi interviews on the issues of ageing and technology, with a certain degree of success. These expert interviews were very informative in deriving topics for focus group discussions and highlighted issues from technological point of view that can act as assistance and hindrance to older persons. Focus group discussions have been proven in this study to be quite successful in gaining an understanding of how older people use mobile phone. Although focus group is less commonly used than other inquiry methods (e.g., interview), the focus group discussions were able to capture basic requirements of a mobile phone preferred by older people, prior to design, and highlighted gender differences in design preferences. The follow-up survey was intended to gain a balanced view of older users with different characteristics, to provide quantifiable confirmations of the opinions of the experts and focus groups, and to pick up issues that had not been stated previously, with certain degree of success. There is a downside of this survey, however, due to the online nature of this survey. The respondents were mostly women, frequent users, had used mobile phones for an extended period, and were familiar with some advanced functions, and therefore many of the findings of this survey would represent the patterns of use and opinions of older users at the high end of expertise level.

The study started with two questions:

1. What are the issues that older persons face when using mobile phones?
2. What are the characteristics of an ageing-friendly mobile phone?

Collating the result of these multi-method studies had produced a rich set of knowledge related to these two issues.

6.1. Issues faced by older persons when using mobile phones

The main issues that older persons face when using mobile phones seem to relate to:

1. *Passive usage of mobile phones*: This ranges from using mobile phones only in emergency, to hesitation to use more advanced functions, to hesitation to commit to mobile phone services (i.e., by subscribing to monthly contract). This, however, could be argued as a direct consequence of older people's perception of mobile phones as a means for facilitating the sense of safety rather than as a communication device—with the perception being more pronounced with women participants than it is with men participants. This perception is further emphasized in the online survey when the EFA revealed that the safety aspects of having a mobile phone were perceived positively while the socioeconomic aspects were perceived negatively.

2. *Fear of consequence of use*: This ranges from the fear of health consequence (first mentioned by the focus group discussion, later revealed in the online survey through content analysis), to concern on the addictive effect of mobile phones on the younger generation, to its effect of reducing face-to-face interaction, to accidents caused by careless use of mobile phone such as talking while driving (revealed in the content analysis of online survey). It should be noted that fear of consequence of use in older persons was observed in other new technology, e.g., the Internet (Ellis and Allaire, 1999).
3. *Design-related*: Most of the issues under this category relate to functional ability decline experienced by older persons such as design elements that are too small (hence difficult for those with reduced vision and joint problem—stated in all studies) to menus that are too complex (for those with reduced cognition—also stated in all studies).

6.2. Characteristics of an ageing-friendly mobile phone

Although some gender differences in the desired features were observed, in general, the desired features can be categorized into:

1. *Memory aids*: These include appointment reminder, alarm, address book, diary, and caller ID complemented with the caller's picture. Linking the EFA in Table 2 and the descriptive statistics of relevant features also reveals that these features are perceived as must have or good to have features. Another set of features are not strictly memory aids but these would help older persons with reduced cognition. These include personalized interface that only displays a limited number of essential menus and design that is easy to learn and navigate (as revealed through EFA presented in Table 3).
2. *Visual aids*: These include stronger backlight, larger text, bold colour, and differently shaped, coloured or located keys for important functions.
3. *Haptic aids*: These include rubber grip, easy-to-hold phones, big buttons, and antenna (easy to pick-up).
4. *Features to minimize user error*: These features relate to fear of consequence of unintended actions flagged out in various occasions, and include features to prevent accidental dialling, noticeable reminder when the battery is almost empty, and feedback whether a call has gone through or a button is pressed.
5. *Safety features*: These include panic button and button to blacklist a caller.

Arguably, some of the patterns of use and issues the participants of this study stated are uniquely related to being old and differ considerably with patterns of use and issues faced by other user groups. For example, most likely because many of the participants of the study are retirees, business was not mentioned as the reason for carrying and owning mobile phones (while in a study of 19 new mobile

phone users in the USA, with all but one participants are of working age (Palen et al., 2000), business was cited as one of the main reasons—it should be noted, however, that just as in the case of older persons, a third of the participants in this study cited safety and security as the main reason for owning and carrying mobile phones).

Predictably, there is a marked difference between older persons' perception regarding the role of mobile phones in their life to that of teenagers'. While for older persons mobile phones are not an essential piece of communication device, for teenagers in the UK, the ubiquity of mobile phone use (especially text messaging) was, in general, commonplace; phone-mediated activities were a routine, taken-for-granted part of their daily encounters (Taylor and Harper, 2002).

Some design preferences also differ. Teenagers studied by Taylor and Harper (2002) produced a much more advanced wish list than the one produced by older persons in our study, such as memory cards to store messages that can be swapped between mobile phones.

However, there are some similarities across different age groups. For example, just like in the case of older persons, the teenagers studied by Taylor and Harper (2002) also felt obliged to immediately reply to a text message they received. Children aged 9–13 years were also found to require similar functions as those requested by older persons, namely address book, calendar, emergency services, and alarm (Cao and Kurniawan, 2007).

Using multi-method investigation had provided a more holistic view of the issues faced by older mobile phone users and the features that an ageing-friendly mobile phone should have—some are shared with other user groups while others are uniquely requested by older persons. However, several limitations of this study should be noted. First is the lack of demonstrable prototype that older persons can participatively redesign, and therefore the evaluation context was only limited to available commercial product. Second, this study focuses on existing mobile phone users, and therefore it might not be able to capture issues related to why some older persons do not become mobile phone users. There is evidence that older persons can benefit from interaction with mobile phones, and therefore, there is a need to follow this study up with non-users to understand factors that can influence changes from non-users to users. Third, the different methods used in this study carry their own biases toward the generalizability of the findings. For example, given that the first focus group's members are students at the College of Third Age, this group represents middle-class and highly educated older persons, and their views end experiences might differ from those of other socioeconomic backgrounds and education levels. However, as this study employed various information gathering techniques, it is expected that the limitation in regard to the participants' profiles of one particular study can be ameliorated by the participant profiles of other studies.

Despite these limitations, this study can function as a starting point for designers of mobile phones for older

persons as well as mobile phone service providers to implement as it provides several very concrete suggestions on design preferences, information on the sources of concerns and annoyance and the patterns of use by older persons; all of which are backed up by reasonably sized data.

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