# Moses – Method for Selecting Senior Mobile Phones: Supporting Design & Choice for the Elderly

Tobie van Dyk
School of Computing, UNISA
PO Box 392
Pretoria, 0003
+27 (0) 12 4296676
vdyktj@unisa.ac.za

Karen Renaud
School of Computing Science
University of Glasgow
18 Lilybank Gardens, Glasgow, UK
+44 (0) 141 3302052
Karen.Renaud@glasgow.ac.uk

Judy van Biljon
School of Computing, UNISA
PO Box 392
Pretoria, 0003
+27 (0) 12 4296873
vbiljja@unisa.ac.za

## ABSTRACT

The current focus on the development of mobile and ubiquitous computing technologies presents new and exciting challenges for the evaluation of interactive products. Despite a vast and growing literature on mobile phone requirements for the elderly there are no customisable design guidelines to support and inform designers and especially, the people who buy and sell mobile phones for the elderly.

This paper presents a method for using a customisable, prioritised checklist to guide phone and feature selection, specifically for older adults. To identify and isolate the items for this list, we collected data relating to the needs of elderly mobile phone users by interviewing 147 elderly mobile phone users. The data was analysed and the findings used to construct the checklist. Building on and extending previous research involving guidelines and checklists, this paper adds value by proposing a *prioritized* checklist to inform the selection and design of mobile phones. The mechanism prioritises features, attaching a weight to each, to support quantification of the suitability of a particular phone for a specific person. The same mechanism can be used by interface designers who have to select an optimal set of features. The paper should be of interest to mobile phone users, designers, practitioners and researchers in the field of mobile Human-Computer interaction.

## Categories and Subject Descriptors

H.1.2 [**User/Machine Systems**]: Human factors, Human information processing, Software psychology; J.4 [Social and Behavioural Sciences] Economics, Psychology, Sociology.

## General Terms

Human Factors, Design, Mobile Phone, Guidelines

## Keywords

Mobile phone choice, elderly, checklist, usability

## 1. INTRODUCTION

The needs, expectations and limitations of the older adult, in terms of technology, have received considerable attention. In this paper we use the terms senior, elderly and "older adult" to refer to people over the age of 60. Technology acceptance models for the elderly [9; 31; 32], as well as a range of design guidelines [12; 15], have been proposed. The variety of guidelines presents a conundrum: which set of the growing number of guidelines is the best, and how should they be applied, especially for special-needs groups?

For example, Jones and Marsden [15] and Heo and Ham [12] both propose mobile phone design guidelines. While these guidelines are undoubtedly valuable, they tend not to be specific enough to give clear directions on choosing between the ever growing numbers of features. Keeping up with the range of emerging features is challenging in itself. Another problem with existing guidelines is that all aspects are given the same importance and it is difficult for designers to prioritise when they are unable to address every single item on a particular list. Unfortunately, most people designing or purchasing phones for the elderly do not have time to study and extract the necessary information from the vast and growing literature on mobile phone design. We argue that what is lacking is a prioritised ordering of the aspects to be addressed.

Guidelines, in the form of lists, provide information in a structured way that is suitable for referencing but the one-dimensional structures are not particularly suited to supporting prioritisation. In this paper we will argue for the use of a customisable, prioritised checklist, as explained in the following subsections.

### 1.1 Checklists

The usability of products has traditionally been measured and regulated by standards and guidelines. S*tandards* are specific design rules, high in authority and limited in application, whereas *guidelines* are lower in authority and more general in application [6]. Checklists have been used in usability evaluation since 1989, for example in measuring the usability indices of websites [18]. They are different from guidelines in the sense that checklists are specific to a context, precise and often have an implied order [8]. In designing or selecting a mobile phone for an elderly person, the selection order is important since it is often necessary to restrict the number of features that can be included and afforded and prioritization supports a reasoned choice. Furthermore, age-typical afflictions affect the elderly in a non-uniform way - some may have larger cognitive challenges (Alzheimer) than others, who may have challenging dexterity (Parkinson) problems. Inclusion of features thus does not have to be exhaustive. A checklist approach, which supports such prioritisation, is more fitting than a set of equally-weighted guidelines. It would be especially helpful if the checklist could be customised or tailored to some extent, to match the needs of the person in question.


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## 1.2 Moses

This checklist, we believe, supports the choice of mobile phones in a particularly accessible way. It will also inform mobile phone designers by providing them with a way of prioritising their choice of features to implement within their financial and time constraints. We will call our approach Moses: ***M**ethod f**O**r **SE**lecting **S**enior mobile phones*, and we present this visually in Figure 4.

## 1.3 Conducting Mobile Phone Research

There documented problems with the way mobile HCI research has been conducted, Kjeldskov and Graham [19] identified the following methodological problems with mobile HCI research:

- Little research on the question of what is useful and what is perceived problematic from a user-perspective.
- Limited focus on real-world settings.
- The practice of evaluating systems by trial and error rather than grounding engineering, evaluation and theory in methodological foundations.

Hagen, Robertson, Kan, and Sadler [11] disagree by stating that the possibilities for research to understand mobile technology use in real settings are richer than those discussed in Kjeldskov *et al*.'s [19] study. Given the prolific research interest in the field of mobile HCI some of the challenges listed by Kjeldskov *et al*. [19] may well have been addressed but these challenges remain useful criteria for estimating the value of each study in mobile HCI. Furthermore the development phase of mobile phones is relatively short compared with consumer appliances; this is due to the rapid change in mobile technology, the limited life cycle of mobile devices and increasing market competition [17]. According to Ji, Park, Lee and Yun [14] this need for faster, more efficient usability evaluation methods supports the idea of considering a checklist for mobile phone evaluation. In a comparative experiment they found the checklist evaluation of a mobile phone interface was able to identify the majority of the problems identified during usability testing. Furthermore, it was more efficient than traditional approaches [14].

## 1.4 Summary

Our study addresses the following question: *How should an approach for choosing or designing a mobile phone for the elderly user be constructed, and what should it focus on?* It is possible to address choice and design together since guidelines for designing mobile phones often align with the guidelines for selecting a phone from the vast and confusing array of available phones.

Our research design is qualitative and involves a study with 147 participants aged 60 to 87. Using a combination of a questionnaire, an interview and direct observation, we gathered information regarding each participant's experience with, and attitude towards, his or her mobile phone. Participants were taught to use an unfamiliar function on their mobile phone. Their problems, learning behaviour and their success or failure was noted.

Due to the nature of our data gathering procedure, which was user-centric rather than designer-centric, we believe that our approach will lead to an improved match between the stated needs of the elderly and a particular mobile phone's characteristics.

Our findings confirm those of previous studies with respect to the essential features and limitations to be considered in mobile phone design for the elderly. The novelty of our proposal lies in the fact that we address the limitations of earlier research by proposing a way of prioritising the issues and also indicate how this can be customised to match individual needs. This checklist for phone and feature selection can be used by designers, buyers and sellers of mobile phones for the elderly. This bridges the gap between the researchers and practitioners by creating a shared awareness of the fundamental issues involved in designing for the elderly and how mobile phones can be selected to overcome those.

The paper is organized as follows: In section 2 we provide the background for the study by discussing mobile phone design, designing for the elderly and the intersection of those fields. In section 3 we describe the research methodology and in section 4 we discuss the results of the research. Our findings are summarized in section 5 and we conclude the paper in section 6.

# 2. BACKGROUND

In this section we examine general guidelines for mobile phone design, and we continue with a review of studies on designing for the elderly. We conclude by examining guidelines specific to mobile phone design for the elderly.

## 2.1 Mobile phone design

Jones *et al*. [15] provide mobile device design tips arranged into one of three categories namely physical characteristics, complexity and features (abbreviated as PCF). Many of the guidelines identified have attributes that could belong to more than one of these three categories. For example, display size is a physical characteristic but also has a significant potential complexity implication. Both Ji *et al*. [14] and Van Biljon *et al*. [32] presented the guidelines as a checklist but not prioritized which makes it more difficult to apply them.

Jones *et al*. [15] make specific recommendations for mobile applications designed for use in the developing world. They specifically recommended using the visual language of cellular handsets as a starting point and found evidence for the effectiveness of iconic interfaces. Furthermore they warn against the use of hierarchical menus stating that: "For Africa at least, be wary of interfaces that rely on users' understanding hierarchically classified data (such as hierarchical menus) – we have found that hierarchies are not a common way of thinking across all cultures." [15]:334.

More recently Hoober and Berkman [13] published a comprehensive and detailed guideline to mobile interface design. Their work is useful when detailed choices have to be made between interface (soft and hard) objects, as they provide advantages (patterns) and disadvantages (anti-patterns) for virtually every interface element on mobile devices. They do not, however, specifically draw attention to the needs of the elderly.

Ji *et al*. [14] propose a mobile phone user interface usability checklist, but that, too, does not address the needs of specific user groups such as the elderly. Furthermore, the term *checklist* refers to the application of a set of precise instructions in a context, often containing an implied order [8]. The use of the term *checklist* to refer to a list containing many pages of items to be evaluated on a 7 point Likert scale (as is the case in Ji *et al*. [14]), deviates from the common meaning of a checklist as the former seems closer to the format generally associated with questionnaires.

## 2.2 Designing for the older adult

Siek [30] reviewed a number of studies that examine the ability of the elderly to use computer input devices. These studies found that they tended to be slower in completing motor-muscle-based tasks (compared to younger age groups) and that

when comparing control keys, mouse, and light-pen input devices, the elderly preferred the (light) pen. She also found that older people made more mistakes compared to younger users, and they had difficulty with fine motor control tasks such as double clicking. Older people performed *point and click* and *click and drag* manipulations slower than younger people, but completed them with the same accuracy. The likely reason for this is that the elderly may exhibit reduced fine motor control, muscle strength, and pincher strength, all of which are typically associated with old age. We should, however, bear in mind that they have also probably had less experience in using these input devices than younger users [21]. Therefore some of the cognition problems currently experienced by the elderly may diminish as more experienced users age but the physical constraints will remain.

O'Connell [23] emphasises that although the elderly technology user has many characteristics in common with users with disabilities, they also have a unique set of characteristics that should be catered for during the design of interactive products. She reasons that the single most important usability aspect when designing for the elderly is related to reliability and the reliable delivery of functionality – and this may be achieved through robustness, reducing, facilitating recovery from, and offering explanations for errors, consistency, operability. Other important factors are personalisation (making them feel as if the product had been designed for them, and also to accommodate their unique needs), helpfulness, trustworthiness and confidence building, reducing their cognitive load, and letting them feel in control.

## 2.3 Mobile phone design for the elderly

In designing mobile phones for the elderly, it is important to know exactly what they use mobile phones for. The literature provides clear indications of older people's motivations for using mobile phones as discussed in section 2.3.1. Section 2.3.2 explores the literature for specific characteristics suggested for mobile phones for the elderly and in section 2.3.3 we discuss issues related to mobile phone adoption by the elderly.

### 2.3.1 Older people's motivations for using mobile phones

Some years ago, Maguire and Osman [22] found that older people primarily considered mobile phones a way to obtain assistance in emergencies, whereas younger people used mobile phones mostly to interact socially. Older people's needs were generally related to maintaining independence. For example, older women were interested in finding the nearest retail shop that met their needs with location aware systems, whereas older men wanted to know how to travel using various forms of transportation. Abascal and Civit [1] as confirmed by Kurniawan and Zaphiris [21] found that older adults valued the safety and increased autonomy mobile phones gave them.

Ten years on, the landscape has changed. Many older people now also use mobile phones as a social interaction tool ([9]; [4]), but its safety value remains an important motivation for using it (especially for females) [20]. Staying in touch with children and grandchildren is cited as a primary advantage of having a cell phone, but, apart from communication, they also use the phone for organisational tasks [31]. In developing world contexts the usual aspects of communication and organisation remain, but the importance of the device for communication is more pronounced for rural users who often do not have access to landline telephones [33].

### 2.3.2 Preferred mobile phone characteristics

When considering preferred mobile phone features for the older adult one has to be aware of the physical, cognitive, social and infrastructural contexts of use [26]. The *physical* context relates to constraints such as vision, hearing and dexterity [15]. The *cognitive* context relates to the fact that many older people are not familiar with the mental model underlying mobile phone menus and they make take longer to learn new skills [31]. The *social* context relates to their often diminishing contact with the outer world and the fact that their main contacts are family and friends [24]. The *technological* context refers to the mobile infrastructure, including the available networks, provided services and features. The mobile context poses unique challenges and opportunities in terms of mobility, portability and personalisation [35].

Reported findings about the requirements of older mobile phone users often relate to size – e.g., screen size, font size and icon size. Maguire *et al*. [22] found that older people want small phones with large buttons – which inevitably means fewer buttons, and location aware systems. They typically prefer larger fonts (e.g., 12-point font) [5]; [20]) and bigger icons (e.g., 25mm) [30]), even if they are able to read smaller fonts and icons. Kurniawan [20] found that, unlike their younger counterparts, older women wanted brightly coloured, bulkier phones that they could easily locate in a cluttered handbag.

In Van Biljon *et al*.'s study [32] involving 46 respondents over the age of 60, the following features were the most prominent requirements mentioned: bigger buttons, bigger text on the buttons, easier to remember menu paths, bigger text on screen, audio facilities including voice input/output and text-to-speech functionality, better colour contrast, fewer functions, larger screen size, and buttons that are further apart. Van Biljon *et al*. [31] describe older people's mobile phone requirements noting their need for autonomy, relatedness and competence as basis for their needs. Their results confirm many of the requirements already mentioned, such as bigger buttons, bigger font size on the buttons, good spacing between the buttons, and simple, and consistent menu structures. In addition, they found that older users did not want any buttons on the side of the phone that could be activated accidentally, and that the number of buttons should, in general, be minimised. According to their study older users disliked slide-out keyboards.

Studies reporting on the needs, requirements and characteristics of older mobile phone users use different groupings. For example, the study by Ji *et al*. [14], on a checklist for usability evaluation of the mobile user interface, proposed five main grouping principles which represent support for cognition, information, interaction, performance and the user. Van Biljon *et al*. [32] used physical, complexity and features as categories to classify mobile phone adoption characteristics.

Considering the importance of physical characteristics it seems more appropriate to differentiate on the physical level and group user needs according to the visual, auditory, dexterity and cognitive aspects with some additional needs that did not fit under the main categories grouped under other as depicted in Figure 1.

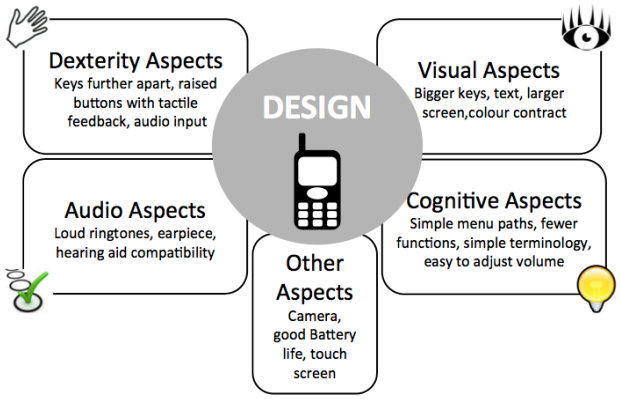


**Figure 1. Checklist groupings**

## 2.4 The Senior Mobile Phone Adoption List

The senior mobile phone adoption checklist presented an extensive requirements list for predicting the adoption of senior mobile phones. The list is the synthesis of the reviewed characteristics of commercially available phones, phone features that were not deemed desirable and the additional characteristics as empirically identified from interviews and a survey. Three essential categories of characteristics emerged from this list:

(1) Physical characteristics: It must have large, easy to understand keypad buttons that give good tactile feedback when pressed. It must have a large, high contrast screen with options for increasing the font size. It must have an extra loud loudspeaker.

(2) Complexity characteristics: It must be easy to add talk-time to the phone. The menu structures must be flattened and simplified using self-explanatory terminology. Each keypad button should, at most, control one extra function.

(3) Features: The phone must have the two essential functions (making and receiving phone calls). Non-essential, but desirable, functions include (in order of priority): Emergency (speed dial) function, alarm and scheduling functions, emergency button, voice input and output, and text messaging (SMS).

Previous findings by Renaud *et. al* [31], Gelderblom *et al*. [9] and Van Biljon *et. al* [32] indicate that most current mobile phones do not address these limitations nor do they meet the needs and expectations of older adult users. The situation is exacerbated by the fact that few older people choose their own mobile phones. Because of cost implications, the tradition of passing phones to older relatives when a new mobile phone is purchased or a phone is upgraded, will probably continue. It would be ideal for these relatives, friends and salespeople to be made aware of what older users need and what support and training is required to successfully assist them to adapt to a new, or first, phone.

While the senior mobile phone adoption checklist [32] provided a good starting point, there is a need to validate the findings with a larger group to inform the creation of our proposed checklist. Furthermore there are continuous development in the field of mobile phone design for the elderly [7], and since the target group is getting more exposed to technology their cognitive characteristics may also change. Therefore it is necessary to evaluate existing checklists against new data on user requirements as described in the next section.

# 3. RESEARCH METHODOLOGY

The research philosophy is interpretive, the research approach inductive. The research strategies include a literature investigation, surveys and interviews, with a structured questionnaire as data capturing tool.

We divided our research procedure into two parts that can be described as follows:

- A literature study on the design of mobile phones and the design of technology for the elderly. These two fields were then narrowed to the design of mobile phones for the elderly. In addition we reviewed mobile phone adoption to critique existing models and frameworks on their suitability for the elderly.
- The expansion and verification of the senior mobile phone adoption checklist [32] based on the data captured for this study. The data was collected over a period of 12 months in (mostly) South Africa and Scotland.

In Section 3.1 we explain the data collection procedure and in Section 3.2 we discuss the data analysis.

## 3.1 Data collection

The data was collected by three classes of post-graduate students in human-computer interaction and information technology, who served as field workers to collect data on older people's use of mobile phones. Using a questionnaire as starting point, they interviewed respondents and then studied the respondents' interaction with their cellular phones. Students had to identify a function on the cell phone that the elderly participant has never used, and then teach him or her how to use that function. Together with the completed questionnaire and notes from the interviews, the students submitted a detailed report on their observations of each participant while using the cell phone. The responses included interviews with 147 mobile phone users (60 male, 87 female) between the ages of 60 and 89. 123 respondents resided in South Africa, while 24 lived in Scotland.

Using data gathered by student field workers in the way described above is open to rater bias and unmeasured rating differences, but it has a number of significant advantages, namely:

- Each field worker only had to interview one respondent, thus there was no restriction on how long they could spend with the subject.
- Most of the students elected to interview a senior family member (e.g. mother, father, mother-in-law, grandmother), which suggests a trusting relationship between respondent and interviewer.
- Doing the study with only one participant made it possible for the field workers to report in great detail on their findings, providing us with a rich set of data to analyse.

## 3.2 Data analysis

The data extracted from the student assignments were organised into a spreadsheet under the following headings: Age, Gender, Occupation/previous occupation, Highest qualification/school grade, Place of residence, How long owned phone, How was phone acquired, How often used, Which functions used, Make/model of phone, Do you like the phone?, What would you change?, Mobile phone makes life easier/difficult?, Task learnt, and Additional information. The interview and observation reports were combined in a separate document in

such a way that each discussion could be linked to the corresponding row in the spreadsheet.

As part of the data analysis a list of features was compiled that were specifically mentioned by the participants as things they would like to have on their phones. We recorded the number of times each of these features were mentioned across all participants. The features were then organised according to the categories

Complete anonymity has been ensured: neither respondents nor student researchers have been identified in any of our reports.

## 4. RESULTS

Building on the senior mobile phone adoption checklist [32] , the data collected for this study were combined with the data in the [32] 2010 study, which led to a total of 147 respondents. Whereas the 2010 study involved only South African respondents, this study included 24 respondents resident in Scotland.

Table 1 shows a wish list of changes proposed by the respondents in column 1. The second column gives the number of times the feature involved was mentioned in the data. For example, the item 'fewer functions' mentioned by 16 of the respondents is related to cognitive challenges, as is menu complexity, and the preference for a set of reduced (yet balanced) features.

The third column labelled "Weight" is calculated by expressing the count as a percentage of the total for that category. For example the total of the count numbers for the visual category is 107, and the item "Bigger text on screen" then has a weight (i.e. importance factor) of 29/107 = 27% We consider it justified that all of the first 4 categories (visual, cognitive, dexterity and audio) should be represented as equals during the phone selection because the challenges to the elderly associated with each of these four categories could be considered equal in importance.

**Table 1 What elderly participants would like to change about their phones**

| Grouping | Times mentioned | Weight (% of group) |
|---|---|---|
| **Visual** | | |
| Bigger text on screen | 29 | 27 |
| Larger screen size | 29 | 27 |
| Bigger text on the keys/buttons | 26 | 24 |
| More colour contrast | 9 | 8 |
| Audio-input/output, voice-prompts, text-to-speech, speech to text | 8 | 7 |
| Bigger phone | 4 | 5 |
| Lighting on screen shouldn't fade too quickly | 2 | 2 |
| **Cognitive** | | |
| Easier to remember menu paths | 20 | 39 |
| Fewer functions | 16 | 31 |
| Easier way to adjust speaker's volume/ring | 6 | 12 |
| Easier to understand terminology | 5 | 10 |
| Easier to load air time | 2 | 4 |
| Support different languages | 2 | 4 |
| **Dexterity** | | |
| Bigger keys/buttons | 53 | 65 |
| Buttons further apart | 12 | 14 |
| Bigger phone | 4 | 5 |
| Raised buttons | 3 | 4 |
| Keypad tones/tactile click | 3 | 4 |
| Touch screen | 3 | 4 |
| Separate keyboards for text and numbers | 2 | 2 |
| Joystick/Keys less sensitive | 2 | 2 |
| **Audio** | | |
| Loud ringtones | 5 | 72 |
| Earpiece/hearing aid compatibility, | 2 | 28 |
| **Other** | | |
| Add camera | 4 | |
| Better battery life | 3 | |
| Add GPS functionality, Clearer battery status indicator, Clearer indication of new message/missed call, Web access, Top/bottom distinction, More memory, No battery operation, , Log onto Internet by itself, Torch, Better quality photos, Switch on faster, More robust (drop proof), Automatic key locking function, Make it easy to set to Silent, Stylus to press buttons, Buttons must be soft, Better grip, Loudspeaker setting | All of these were mentioned once | |

Our questionnaire reflects the interpretivist nature of the research since it asked participants about their needs, giving them the flexibility to respond and contribute rather than providing a fixed set of needs to choose from. The disadvantage of this approach is that it is more complex to gauge the importance of a need or feature. The fact that a participant did not mention a particular feature does not mean that they did not consider it important; they may not have thought about it at the time or other, more important features, were uppermost in their minds. It was therefore important to triangulate our data with mobile phone design guidelines from the literature.

Figure 2 is a fishbone representation of the categories of challenges as presented in Table 1, where the top layer represents physical (sensory) problems (Visual, Tactile and Auditory) and the bottom layer cognitive challenges due to complexity characteristics.

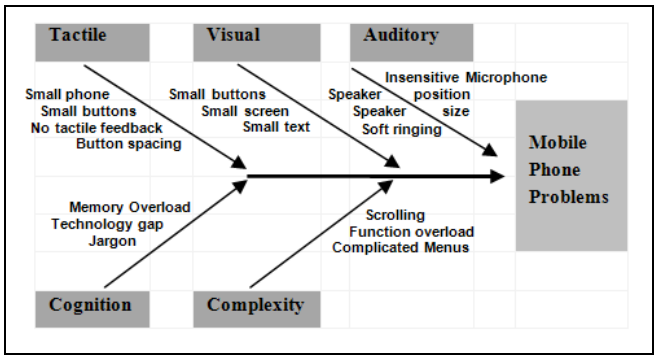


**Figure 2. Mobile Phone Cause and Effect Diagram**

## 5. FINDINGS

In this section we explain the use of two approaches as an aid in selecting mobile phones for the elderly. The first is through the use of our weighted checklist, and the second through the application of our usability metric called the Moses approach. (Moses refers to a ***M**ethod f**O**r **SE**lecting **S**enior mobile phones*, as presented in Figure 4.)

We present a specific example which shows how to decide between two phones based on the Moses approach. The section concludes with an explanation of the application of Moses for

mobile phone design, where we attempt to reconcile the different requirements and expectations of our two main interest groups firstly the decision makers that select and purchase/donate a mobile phone for use by the elderly, and secondly the designers of these phones.

## 5.1 Moses

We consider the findings presented here, and as in Table 1, to be important, because previous findings indicate that almost all of the current range of mobile phones (whether basic or smart) do not address the limitations or do not meet the needs and expectations of older adult users [9; 26]. The situation is exacerbated by the trend of passing older phones up the generation tree when a when a new mobile phone is purchased or contract renewed.

Caretakers, relatives and friends of the elderly should be educated about the needs of older mobile phone users so that they understand that these users need support and training to successfully manage and use a newly acquired mobile phone. A phone which is perfectly suited to a younger user is not necessarily suitable for an older person. The weighted checklist combined with the review-based usability quantification is a very simple way to highlight potential problems as explained in Section 5.2.

## 5.2 Applying the Moses Approach

As an example of the practical application of the results presented in Table 1 we present the following mobile phone suitability checklist. The number of times that each phone feature is mentioned (column 2 in Table 1) provides a reasonable and convenient way to rank the importance of different features. The rightmost column offers a weighting for each feature.

This makes it easy to apply the findings of this study. Each elderly phone user will not necessarily be subject to the same challenges to the same extent as others (some may, for example, have a need for greater visual compensation than another, who may need cognitive assistance). The person assisting with the selection of the mobile phone for the older person should:

1. identify the most pressing lifestyle challenge or characteristic;
2. focus on that particular group in Table 1;
3. for each feature mentioned in that group:

   if the feature is present, add the weighting to your total
4. The larger the total value, the more suitable the phone.

There are two ways to use the checklist in Table 1 to test the suitability of a phone. The first is a quick and relatively easy determination based on a choice of a single characteristic group from Table 1 which will reflect the most important elderly challenge, and this approach is discussed below. The second is a more comprehensive evaluation which includes a review of the user ratings as presented in Table 2.

For example, say an elderly person is mostly tactile or dexterity challenged. Assume we are considering two phones:

- Phone A has big buttons which are far apart, but does not display any of the other features in that group.
- Phone B has loud ringtones and a touch screen

The total (79) for Phone A will be calculated as follows:

| | |
|---|---|
| Big buttons: | 65 |
| Large button spacing | 14 |

The total (4) for Phone B will be calculated as follows:

| | |
|---|---|
| Loud ringtones | 0 (not in group) |
| Touch screen | 4 |

Hence Phone A is a better match for that particular person's needs. If he or she suffers from both auditory and dexterity problems then the final total would be calculated by summing the weights for features in both the dexterity and auditory groups. Note that the summation is merely an estimation of the suitability of the phone for the person based on the understanding that a higher value is better.

## 5.3 Usability Metric

Checklists will help us to judge mobile phone features, but usability can only be judged based on actual usage of the phone. This is problematical in terms of choosing a phone, since one would prefer to be able to make a judgement *before* purchasing a phone. Discovering difficulties after the fact is an unsatisfactory way of uncovering usability flaws.

Thanks to the explosion of social media and the practice of listing reviews on large e-commerce sites we propose a quick and easy solution to assessing usability. It is well known that people will consult their peers for recommendations before purchasing important products [10; 25]. Previous research confirmed this tendency in older users of mobile phones [26].

We can therefore safely use the published reviews of these products to determine whether there are reported usability problems. This could be tackled rigorously by conducting a sentiment analysis of all reviews and coming up with a quantification mechanism. Certainly this is a good topic for future research. In the short term, to simplify the process, we propose using only the ratings given by the reviewers on a popular website selling the phones. Since averages are fundamentally flawed [29] we propose a different scheme, as follows:

Complexity Rating = percentage of 5 star ratings – percentage of 1 star ratings

While this scheme only takes the extremes into account, in doing this it reflects a tally that counts triumphant and disastrous usability, and ignores neutral reviews.

We plan on verifying this measure in future work. This method offers a quantification of usability, using data that is available to any mobile phone user. The method is also simple enough to be applied by anyone with internet access.

## 5.4 Detailed Example of Choosing a Phone

Consider a choice between the TTfone TT002 - Big Button Easy to use Senior Mobile Phone[1] (left), and the Binatone-Big Button Speakeasy-200 Mobile[2] (right) as in Figure 3.

[1] http://ttsims.co.uk/index.php?route=product/product&manufacturer_id=38&product_id=262

[2] http://www.cordless-phones.uk.com/mobile-phones/sim-free-mobiles/binatone-speakeasy-200-mobile?gclid=CIWnr6ec-68CFY8PfAodQ1_uFQ

**Figure 3. TTfone and Binatone**

**Table 2. Application of the selection weighting scheme**

| | TTFone Score | Binatone Score |
|---|---|---|
| **Vision** | | |
| Big text on screen | 27 | 27 |
| *Larger* Screen size | 0 | 27 (a) |
| Big text on buttons | 24 | 24 |
| Colour Contrast | 0 | 0 |
| Audio Input/Output | 3.5 (b) | 0 |
| *Bigger* Phone | 0 | 5 (a) |
| Lighting shouldn't fade | 0 | 0 |
| **Vision Total** | 54.5 | 83 |
| **Auditory** | | |
| Loud ringtones | 72 | 72 |
| Earpiece/hearing aid compatibility | 28 | 0 |
| **Auditory Total** | 100.0 | 72 |
| **Cognition (Usability Metric)** Complexity Rating (c) (Amazon 12/5/12) | 33 (39/119) – 18 (21/119)= 15 | 44 (41/94)- 15 (14/94)= 29 |
| **Cognitive Total** | 15.0 | 29 |
| Total Score | 169.5 | 184 |

It is not clear, at the outset, which the best option would be for a vision, auditorally and cognitively challenged person. In Table 2 we compare the two phones according to our weighting scheme presented in table 1:

(a) Larger screen and biggest phone gets the score, others get zero – this applies to all subjective measures.

(b) Only achieves ½ score of 7 because it matches it only partly.

(c) Complexity rating for each of the two phones based on phone user ratings from Amazon.com as on 12 May 2012. For example for the TTFone: We looked up the number of 5 star (39) and 1 star (21) ratings. Then we looked how many ratings there were altogether (119). We then worked out percentages and subtracted one from the other.

The final result from table 2 indicates that, since the Binatone score is higher, it should be the user's preferred choice.

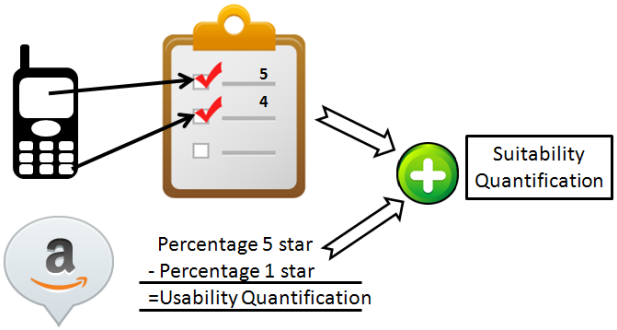


**Figure 4. The Moses Approach**

## 5.5 Designing a Phone

Designers have many conflicting pressures when they design mobile phones. They are constrained by increasingly short time-to-market schedules, cost and other resource constraints. They clearly cannot satisfy all possible users, with all possible needs. We suggest they adopt one of two strategies in using the Moses approach:

1. Abandon the practice of designing a generic mobile phone for what is an extremely diverse and heterogeneous user group. This is the current approach and it is clearly failing. In a world of increasingly personalised products it seems short-sighted to adopt this 20th century approach to selling mobile phones. It would be better to market phones to the visually challenged, the forgetful, or those with dexterity difficulties. Then the designer, in choosing particular features, could use the check list and focus on those particular features that will be of most use to the market segment.
2. If they do not wish to specialise, but still want to offer a phone that meets at least minimum standards of usability for the elderly, they can use the checklist to choose those features that are most heavily weighted.

   Whereas, in choosing a phone, we use user reviews to quantify usability, the designer can use the specific items in the cognitive group when designing the software for their phones. It will help them to understand the issues elderly users have with traditional software, and probably prevent them from falling into common usability traps.

# 6. LIMITATIONS

The results reported here suffer from some potential flaws:

1. A large number of post-graduate students were involved in gathering this data. It has to be acknowledged that it is difficult to enforce quality control in such a situation. It is not unheard of for dishonest researchers to falsify findings (although it is very rare). It is possible that one or more students did not actually interview an elderly researcher, but merely manufactured the responses. On the other hand, this research was able to reach a much larger number and greater diversity of participants than the researchers could have reached if they had conducted the research themselves. This is directly linked to the validity of the findings, and [27] points out the difficulty of ensuring that you are reaching a representative sample when you carry out this kind of research. Furthermore, many of the students interviewed a family member, which suggests a

trusting relationship, and a greater tendency for open and frank disclosure [34]. In balance, the benefits, we feel, outweigh the negatives, and the way we used the results means that manufactured data from a minority of students should not affect the overall ratings to a great extent.

2. The other problem is related to the fact that we relied on self-report and compiled our checklist based on what the participants said they wanted. Some studies report that self-report is indeed reliable [16; 28]. Others question the validity of self-report, being concerned about bias or inaccurate reporting [2; 3]. In cases where self-report is unreliable the main reason appears to be the social acceptability bias, where people do not want to admit to socially unacceptable behaviours. Since the focus of our study was mobile phone preferences and usage it does not seem that social acceptability bias would manifest in influencing self-reporting in this context. Furthermore, the afore-mentioned trusting relationship between many of the researchers and participants probably would maximise accurate disclosure.
3. The final problem is related to the fact that we relied on our participants coming up with responses in an uncued fashion. It could be that they were unaware of particular features that could have been useful to them, and therefore these features would appear to be less important in our weighted checklist. By interviewing a large number of participants we have tried to ensure that our list is comprehensive, if not exhaustive. Furthermore, this problem is offset to a certain extent by the fact that this mode of interview mirrors the approach most people take to choosing a mobile phone. They have a set of known wanted features in mind when they embark on their quest. These might well be augmented as they encounter available phones with nice-to-have features. Since the students themselves are likely to be familiar with the latest innovations in mobile phone features it is probable that they would have introduced particular features of interest to their participants, much as a mobile phone salesman would have done.

While acknowledging the impact of these possible limitations, we argue that, in balance, our findings have value since they offer new insights into what a wide range of heterogeneous elderly mobile users want, and we also propose a simple way of supporting them in choosing their phone to meet their specific needs. The strengths of the paper lie in the relatively large data set (147 participants) and the in-depth interviews conducted with each one. With regards to methodological criteria the research design addressed the user-perspective: the data was captured in a real-world setting and the findings were analysed and interpreted against existing guidelines and checklists thereby grounding the work in existing theory. This means that the research design satisfied all the criteria, which are often lacking in mobile HCI research [19]. Furthermore, the use of a prioritised checklist seems novel in mobile human-computer device interaction research, as is the proposed usability metric.

We do acknowledge that designers and users of mobile phones have different requirements and expectations for a set of selection guidelines, but we are of the opinion that user-centred design supports our view that requirements emanating from the actual users in their natural context should be of value to these designers. In this paper we aimed to address the user needs through the checklist in Table1. Section 5.5 is aimed specifically at designers, although the checklist may also be useful to designers.

# 7. CONCLUSION

This paper reports on the selection and prioritisation of mobile phone features for the elderly user. The study critiques and extends existing research on the use of guidance lists in mobile phone evaluation for older people. The contribution of this paper is a prioritized checklist that can be customised to quantify the suitability of any specific mobile phone for the specific needs of an elderly phone user experiencing particular challenges. Previous research in this field has concentrated on guidelines for designers, as can be seen from the research of Ji et al. [14] and [7]. While mobile phone design guidelines and lists do have value for suppliers and buyers of mobile phones for the elderly it is important to consider how the latter should use the guidelines to make an appropriate selection and that is the novel practical contribution of this study.

Checklists are not new in HCI research but they have received far less attention than guidelines. Considering the characteristics of a checklist as being a concise, ordered set of instructions the value of that format in a fast paced society with rapid development expectations and short production cycles is certainly worth considering. In addition, we argue that the prioritized checklist approach to mobile phone design and selection discussed in this paper is worth considering as a possible response to the call for innovative evaluation methods in mobile HCI – and that is the theoretical contribution of the study. If all mobile phones aimed at the elderly were perfectly designed there would be little need for a selection approach such as Moses but clearly existing research suggests otherwise. Due to cost and other constraints these phones all support age-related challenges to a lesser or greater extent, and our approach helps the user make an informed choice of the available phones. Further research is recommended to refine the usability quantification metric mentioned and test the checklist items in a survey to validate the relative importance. Testing the checklist with mobile phone sellers and buyers will make the research more generaliseable and useful in industry.

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