

Mobile phone adoption: Optimising value for older adults in a developing country

Judy van Biljon

School of Computing,
UNISA PO Box 392
Pretoria, 0003

vbiljja@unisa.ac.za

Tobie van Dyk

School of Computing,
UNISA PO Box 392
Pretoria, 0003

vdyktj@unisa.ac.za

Helene Gelderblom

School of Computing,
UNISA PO Box 392
Pretoria, 0003

geldejh@unisa.ac.za

Abstract

Mobile phones in South Africa have enjoyed an unprecedented technology adoption rate due to their accessibility and usefulness. This prolific adoption of mobile phones diverts attention from their limitations which include small displays, restricted input and output facilities, and poor sound quality. The effects of aging, such as failing vision, impaired hearing, loss of memory and manual dexterity intensify mobile phone restrictions leading to further marginalisation of the elderly. The purpose of this paper is to investigate the suitability of the mobile phones available for older adult users in the South African context with special attention to the issues of developing communities. The findings indicate that most of the mobile phones available do not address the limitations of aging, even phones designed for the elderly do not meet many of the needs and expectations of older adult users. The situation is exacerbated by the finding that many older people do not choose their own mobile phone while salespeople and the relatives who select the phones for them are not knowledgeable about their needs. In response we propose a mobile technology adoption checklist that could inform the design and selection of mobile phones for the elderly. Given the socio-economic context of South Africa as a developing country, many older people do not have the luxury of selecting a new phone. They use a phone passed on from younger relatives and there the issue of training becomes relevant. This paper makes a theoretical contribution in verifying our findings against the literature on technology adoption for the elderly and highlighting the case for developing countries. From a practical perspective, researchers as well as organizations that design and market mobile phones for the elderly stand to benefit from the checklist for mobile phone selection.

1. Introduction

Mobile phones have immense potential as knowledge exchange devices in the developing world due to their accessibility (Botha & Ford, 2008) and familiarity. In the developed world the personal computer and Internet-connectivity is almost ubiquitous. In the developing world features such as limited dependence on permanent electricity supply, easy maintenance, easy to use audio and text interfaces, and affordability has made the mobile phone the most important networked knowledge exchange technology

(Van den Berg et al., 2008). The level of technology penetration in Africa is low compared to developing countries (Beute, 2004). However, mobile and wireless technology adoption in South Africa is challenging this trend (Botha & Ford, 2008) and mobile phones have been hailed as the saviour technology for addressing digital differences between developed and developing communities (van Biljon & Renaud, 2009).

The purpose of this paper is to investigate the suitability of the available mobile phones for the older adult users in the context of South Africa as a developing country. We use the terms elderly and older adult to refer to people over the age of 60. The prolific adoption of mobile phones diverts attention from their limitations. The physical constraints include small displays, restricted input and output facilities (Brewster, 2002) and poor sound quality (Dunlop & Brewster, 2002). The effects of aging, such as failing vision, impaired hearing, loss of memory and manual dexterity make these limitations more pronounced for elderly users (Lee, 2007). This detracts from the total mobile phone worth which has been expressed as a function of usefulness and ease of use (van Biljon & Renaud, 2008). In the context of the developing world, mobile phone value is still influenced by ease of use and usefulness but usefulness takes on a new meaning where the mobile phone is more than an additional communication device, it is the only communicating device (Van den Berg et al., 2008).

The importance of the mobile phone to elderly people in a developing country such as South Africa and the specific constraints brought about by aging provide the rationale for this study. If the design of mobile phones, service delivery and support in using mobile phone technology address the needs of the elderly, this technology has immense potential to add value to their lives. However, if their needs and limitations are not addressed, mobile phone exclusion can further disadvantage this already marginalised group. According to Weber (2009) much of Information and Communication Technology for development (ICT4D) research focuses on improving the human condition, but he warns that relevance should not be pursued at the expense of formulating rigorous models of reality. Providing older adults with usable phones through more appropriate selection of mobile phones for the elderly, or at least providing them with the knowledge required to use the phone they already have, is inherent in our practical contribution. Verifying our findings with technology adoption models and specifically the user context is the theoretical contribution towards the existing body of knowledge on the mobile phone usage of the older adult. The mobile phone checklist on mobile phone selection for the older adult is a practical contribution that will improve mobile phone usefulness and ease of use.

2. Mobile phones and the older adult

To study mobile phone adoption of the elderly in a developing world context we needed to consider existing mobile phone adoption models as overviewed in section 2.1. We then examined the needs, limitations and expectations of the older adults in relation to mobile phone usage in section 2.2.

Mobile phone adoption

There are various approaches towards describing and modelling the extent and level on which a specific user group embraces a specific technology. An in-depth study of technology adoption and acceptance is beyond the scope of this paper but in explaining the context we will briefly refer to an adoption model, an acceptance model and finally a model that combines acceptance and adoption in describing technology adoption of the older adult user.

Technology acceptance models aim to identify the factors that could influence the decision to accept the technology. The seminal *Technology Acceptance Model* (TAM) was proposed by Davis (1989). TAM defines the following six distinct factors essential in determining user attitude towards a new technology:

- *External variables* (EV), such as demographic variables, influence perceived usefulness (PU) and perceived ease of use (PEU).
- *Perceived usefulness* (PU) is defined as ‘the extent to which a person believes that using the system will enhance his or her job performance’ (Venkatesh et al., 2003).
- *Perceived ease of use* (PEU) is ‘the extent to which a person believes that using the system will be free of effort’ (Venkatesh et al., 2003).
- *Attitudes towards use* (A) is defined as ‘the user’s desirability of his or her using the system’ (Malhotra & Galletta, 1999). Perceived usefulness (PU) and perceived ease of use (PEU) are the sole determinants of attitude towards the technology system.
- *Behavioural intention* (BI) is predicted by attitude towards use (A) combined with perceived usefulness (PU).
- *Actual use* (AU) is predicted by behavioural intention (BI).

In contrast, the technology adoption process (Haddon, 2003) describes users’ acceptance or rejection, as well as their use of technology and thus takes a longer term view. The domestication of technology model consists of the following four phases (Silverstone & Haddon, 1996):

- *Appropriation*: Process of possession or ownership of the artefact.
- *Objectification*: Process of determining roles product will play.
- *Incorporation*: Process of interacting with a product.
- *Conversion*: Process of converting technology to intended future use or interaction

There have been many revised models and also applications of these models for specific user groups. One example is the senior technology acceptance model (STAM) (Renaud & van Biljon, 2008). The model draws on technology acceptance and adoption models to integrate the acceptance factors with the adoption process and apply that to the older users' context. The study was done in South Africa with English speaking, city dwellers as respondents. The STAM is depicted in Figure 1.

Drawing on the model of Silverstone and Haddon (1996), STAM models the adoption process in three phases, namely objectification, incorporation and conversion/non-conversion. STAM removed the appropriation phase during which the user contemplates buying a phone and gathers information about available products, since elderly users typically receive a mobile phone as a gift. The intention to use is determined by perceived usefulness as well as by social influence (i.e. children urging parents to use the phone). The model also emphasises the role of facilitating conditions (e.g. financial constraints) and allows for direct acceptance if they are not derailed by any facilitating conditions. Ease of learning is regarded as a key determinant of actual use that can directly cause acceptance or rejection (i.e. without the user having to go through an actual use phase). A poor experimentation and exploration experience may lead to the perception that the technology is difficult to use and this may result in rejection. STAM provides a useful point of departure as long as we recognise that the respondents were too homogenous in terms of experience, social status, and educational background to be representative of the South African population.

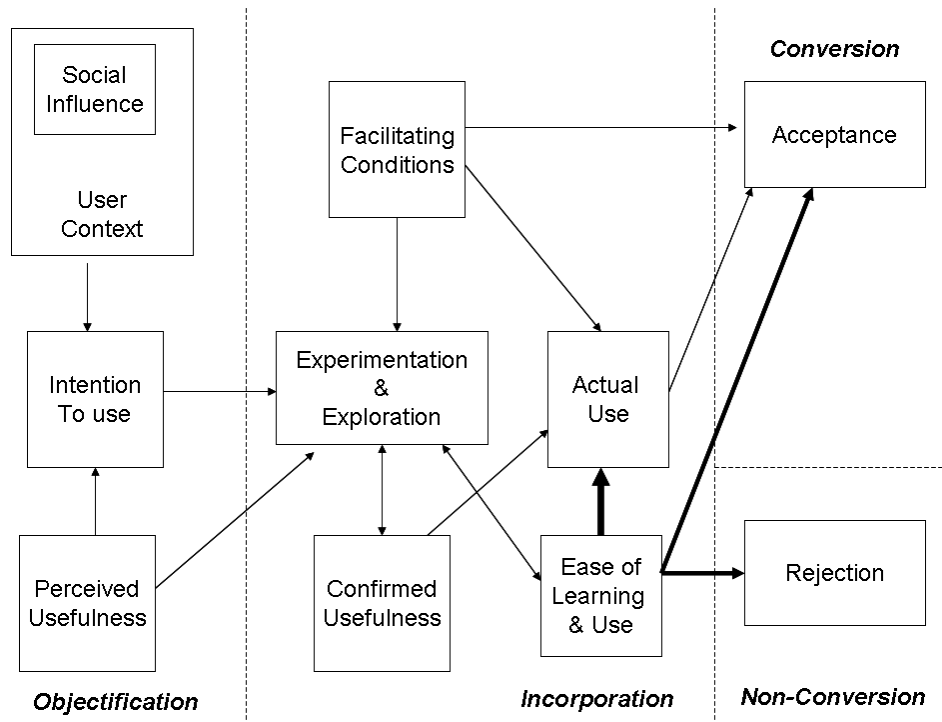


Figure : **Senior Technology Acceptance & Adoption Model (STAM)** (Renaud & van Biljon, 2008)

2.2 Mobile phone needs of the elderly

According to Brown and Venkatesh (2005) life cycle stages and income are potentially relevant in understanding household technology adoption decisions. The mobile phone usage of older adults share communalities with other household technologies since they use the phone for personal rather than business communication. Apart from communication they also use the phone for organisational tasks (van Biljon & Renaud, 2008). In developing world contexts the aspects of communication and organisation remain, but the importance of the device is increased where the mobile phone becomes the only communication device (Van den Berg et al., 2008). In the mobile context, the user and the equipment can be mobile and the surroundings may therefore change constantly. This is fundamentally different from traditional computing environments and information appliances such as landline phones. It is therefore necessary to discuss the needs and limitations of the elderly in terms of four different contexts (physical, social, mental and technological) as defined by Kiljander (2004) and Jones and Marsden (2005). The physical context is discussed in section 2.1.1, the social context in section 2.1.2, the mental context in section 2.1.3 and the technological in 2.1.4.

Physical Context

The physical context denotes the physical constraints of the usage environment (Jones & Marsden, 2005; Kiljander, 2004). Here we need to consider both the physical limitations of the device as well as the limitations of the surrounding physical context. Screen size,

memory, storage space, input and output facilities are more limited in mobile phones (Brewster, 2002; Young, 2003), while sound output quality is often poor (Dunlop & Brewster, 2002). The physical limitations of mobile phones are exacerbated by the physical and cognitive effects of aging. Impaired hearing, vision and loss of manual dexterity impact negatively on the ease of use of mobile phones (Renaud & van Biljon, 2008). For example, a person with impaired vision will find it more difficult to see on a small screen, loss of manual dexterity makes navigation on the keypad more challenging and voice communication against background noise becomes near impossible. The implications are that the design of phones for the elderly should provide for bigger buttons with larger text on the buttons and on the screen to improve ease of use (Lee, 2007).

Social context

The social context refers to the social interaction that stems from mobile device usage (Jones & Marsden, 2005; Kiljander, 2004). With increasing age comes reduced involvement with other people (Abascal & Civit, 2001; Phillips & Sternthal, 1977). The reasons differ but the net effect is reduced access to information that is readily available to younger people and the risk of marginalisation. Social contact is primarily limited to friends and their extended family and this group provides them with the advice and support they need. Friends and relatives, especially the opinion of children and grandchildren influence the behaviour of the elderly mobile phone user (Lee, 2007; Mallenius *et al.*, 2010). The adoption implications are that the role of friends and family in obtaining and using a mobile phone has to be acknowledged.

Mental Context

The mental context relates to aspects of the user's understanding of the mobile handset usage model (Kiljander, 2004). Ziefle and Bay (2004) suggest that elderly mobile phone users do not have a mental model of the ubiquitous hierarchical menu system used by mobile phones. Therefore they struggle to find the features they want to use and often give up on using them (Osman *et al.*, 2003). People perform more slowly and with less precision as they age. The ability to learn is not impaired but the rate of learning is reduced (Baldi, 1997; Salthouse, 1985). Burke and Mackay (1997) found that the formation of new memory connections is impaired with age. They also struggle to filter out irrelevant stimuli so it takes longer to process the relevant information in learning to use the device (Phillips & Sternthal, 1977). This explains why elderly users appear to have difficulty learning how to use a new mobile phone (Lee, 2007), and use fewer of the available features than younger people (Van Biljon, 2007).

Mobile phones are acquired by a widespread population of users who will probably not receive any formal training in operating them (Dunlop & Brewster, 2002). Furthermore,

device vendors consolidate multiple functions into a single device and the mobile user has to handle interleaving of multiple activities previously unknown when only a landline or a stationary computer was used (Preece et al., 2002). Social isolation and diminished access to productive (predominantly younger) mobile phone users together with the mental effects of aging discussed here justify the need to support older adults in mobile phone adoption.

Technological Context

The technological context refers to the mobile infrastructure including the available networks, services provided and the features of the mobile device (Jones & Marsden, 2005). The division of responsibilities among vendors and service providers can be confusing with the result that users do not know who to contact to resolve a mobile phone problem. The cost of mobile phone use is an important issue to older people in developing countries where mobile phone services are expensive compared to those in the developed world. Cost also impacts on the range and type of services used, due to the cost advantage of text messages over voice, text messages appear to be more popular in South Africa than in developed countries.

3. Research design

Our investigation into the suitability of mobile phones available for the older adult user in the South African context is guided by the following two questions:

- Which mobile phones are available for the elderly?
- Do the available mobile phones meet the requirements of the elderly in South Africa as a developing country?

To answer the first question a literature study was done to find specific characteristics of mobile phones designed for the elderly. To answer the second question we gathered data through interviews with 46 mobile phone users between the ages of 60 and 87. The data captured in the literature study was analysed to extract a list of criteria for evaluating mobile phones for the elderly. This checklist was then compared with the findings from the interviews to ascertain the task-technology-fit between the requirements of elderly mobile phone users and mobile phone characteristics. In the sections that follow we discuss the sampling, data collection and data analysis respectively.

Sampling

For this research we needed a diverse sample of at least 40 respondents over the age of 60. Two of the authors teach a postgraduate course on Universal Accessibility for which more than a hundred students were enrolled in 2009. One of the topics in this course is designing for the elderly. We addressed the sampling problems by using students as 'field workers' and assigning each of them the task to identify between one and three suitable

respondents. They then had to teach the respondents a new function on their cell phone, complete a questionnaire with them, and write up their observations and conclusions. This assignment formed part of the students' formative assessment. Forty seven students completed the task. Of the 52 subjects that were interviewed, 46 (16 male and 30 female) were identified as suitable for the study reported here. Most of the respondents were under 70, with 15 between 70 and 89 as depicted in Table 1.

Table Respondents' age distribution

Age	Number of respondents	
60-64	12	26%
65-69	19	41%
70-74	8	17%
75-79	3	7%
80-84	2	4%
85-89	1	2%
Unknown	1	2%
Total	46	

More than half of the respondents are city dwellers, with the rest living in smaller towns and rural areas as depicted by the pie chart in Figure 2.

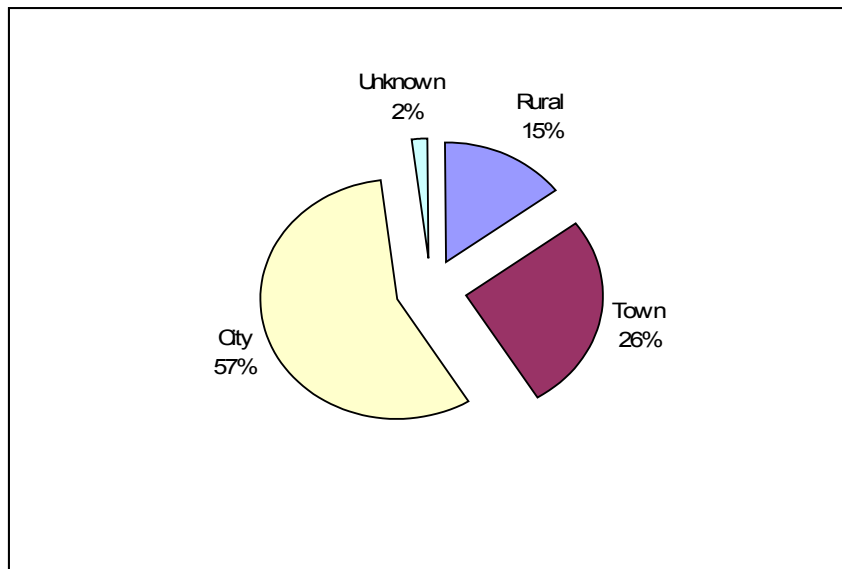


Figure : Respondents' living area distribution

Data collection

Data was collected by postgraduate students who acted as field workers. Their task was to use a questionnaire (see Appendix A) as a starting point to conduct a study on the

respondents' interaction with their cellular phones. In addition to completing the questionnaire, they could add questions they thought might contribute to the study. Students also had to identify a function on the elderly person's cell phone that the person has never used on the phone, and then teach him or her them to use the function. Using data gathered by students in the way described above may be open to rater bias and unmeasured rating differences, but it has the following advantages.

- Most students interviewed only one respondent and there was no restriction on how long they could spend with the subject.
- The University of South Africa follows a distance teaching model, which means our students are spread widely throughout South Africa. Consequently our sample represented urban, rural and small to medium town respondents.
- The students are diverse in terms of nationality and home language and the respondents reflected this.
- Most of the students selected a family member (e.g. mother, father, mother-in-law, grandmother) which means the respondent trusted, and was comfortable with the interviewer.
- Doing the study with only one or two participants made it possible for the students to report in rich detail on their findings, providing us with a set of extensive data to work with.

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 have you owned the phone, How was the phone acquired, How often do you use the phone, Which functions are used, Make/model of phone, Do you like the phone?, What would you change?, Does it makes life easier/difficult?, Description of the task learnt, and Additional information.

The students' discussions of their findings were combined in a separate document in such a way that each discussion could be linked to the corresponding row in the spreadsheet. Complete anonymity has been ensured, neither the respondents nor the students can be identified from any of our reports.

4. Results and findings

We present an overview of the mobile phones available for the elderly in section 4.1. We summarise the features and functions to be considered when designing or buying a phone for them in the form of a checklist in 4.2. In section 4.3 we present the results from our study.

An overview of current mobile phones aimed at the elderly

There is a noticeable and growing trend to custom design mobile phones for the elderly Mulberry (2010), Rehabilitation Engineering Research Centre on Mobile Wireless

Technologies for Persons with Disabilities (RERC, 2010) and Senior Mobile (2010). We observed two main design approaches, that we chose to describe as the *Basic Phone Approach* and the *Adapted Phone Approach*.

The *Basic Phone Approach* entails designing a very basic large-button and large-screen-font, extra-loud loudspeaker phone with a only a few essential functions such as receiving and making calls, text messaging (SMS), pre-programmed emergency speed dialling and a panic button. This is in essence a 'back-to-the-past' approach, and has been criticised by Hassan and Nasir (2008) argue that mobile phone design and usage for older persons should not be limited to 'old style, out-of-date models, that supports only very basic calling functions'.

The second design approach is the *Adapted Phone Approach* which entails redesigning a modern full-function mobile phone so that it caters for the specific needs of the elderly. Adaptations include remote monitoring (i.e. persistent one-way communication), voice recognition and speech output, managing the phonebook remotely (such as via SMS), zoom options for enlarging the screen characters, simplified and flattened menu structures, readable button inscriptions, and in some cases even GPS (global positioning system) location tracking functions.

Commercially available examples of the first design approach are the Emporia Talk, the Samsung C3060R, the LG NS1000 and the ZTE S302, as discussed below. Pictures of two of these phones are shown in Figure 3, see (a) and (c).

- Austria-based Emporia-Telecom (Emporia, 2010) attempts to reduce the inherent complexity of mobile phone use for seniors with its Emporia-Life product line through using big buttons, a large screen with large font size and simplified (i.e. flattened) menu structures. These phones are also hearing-aid compatible - a physical and acoustic design characteristic. Distinct Emporia-Life features are the ability to manage the device's phonebook via SMS text messaging and an optional automatic switch to voice command mode once a phone connection is made (Emporia, 2010).
- The Chinese designed and manufactured ZTE S302 has large and widely spaced buttons, but unfortunately this leaves insufficient room for the display. The resulting screen font size is small and it is not possible to display the commonly used *select*, *menu* or *back options*, which make the phone unfamiliar and unintuitive to use. The phone has some advanced features such as an FM radio, a torch light, a birthday reminder, various speed dial options and keys, and a convenient keypad lock switch on the side of the phone. It also features a prominent large red SOS emergency button at the back, that can be used to send an SMS text message such as 'Emergency please call', to a set of pre-programmed emergency numbers (ITNewsAfrica, 2009).

- Samsung also followed the first design approach. The Samsung C3060R looks like most other standard candy bar phones but the phone interface has more contrast, and vital information is presented in bigger and more readable text. The buttons on the keypad are slightly larger than normal with bigger numeric text.

(a)Emporia Talk

(b)Samsung Jitterbug

(c)Vodafone ZTE S302

(e) Owasys 22C

(d)Clarity Life C900





Figure : Examples of mobile phones designed for the elderly

Examples of the 'adapted phone' approach are the Samsung Jitterbug (Jitterbug, 2010), the German-Austrian designed Clarity Life C900, and the display-less Owasys 22C (refer to Figure 3 (b), (d) and (e) for pictures of these phones. The Clarity Life phone uses a sliding design which may be confusing for the elderly, but it has very large and comfortable keypad buttons, and offers the option of easily magnified text (Mulberry, 2010).

As an example of a completely redesigned mobile phone, the Owasys 22C is aimed at the elderly user with very poor vision or blind users. This mobile phone does not have a display, but has all the basic features needed to make and receive telephone calls and its easily learned speaking interface replaces the absent screen. Other characteristics of this phone are hemispherical-shaped keys that protrude from the panel and are spaced sufficiently apart from each other so that it is easy for the user with poor vision to distinguish one key from another.

The Samsung Jitterbug (Jitterbug, 2010) listed on the New York Times Top 10 Brilliant Ideas of 2006 compiled by Pogue (2006) was one of the first mobile phones specifically designed for the elderly. It features big buttons and a loud loudspeaker. The Jitterbug is a full-function phone that employs a set of software features that simplifies the use of the phone by the elderly, such as audible menus and easily configured and trained voice recognition. It can be configured for dialling operator assistance, such as pressing a '0' can connect the user to a human operator who can then dial a number for the user. The phone contact list can be edited and submitted via the Jitterbug website, which then transmits changes to the phone, thus enabling remote contact list management (Jitterbug, 2010).

A checklist based on reviews of existing phones

Based on the literature overview of the needs and limitations of the elderly as discussed in 2.1 and the reviews of a selection of existing specialist mobile phones for the elderly as discussed in 4.1, we present a preliminary checklist in Table 2 that can be used when selecting a mobile phone for the elderly.

Table : Checklist 1 - Recommendations based on existing phones and previous research

1. Physical characteristics

a.

Large size keys with a clear spacing between the keys.

b.

Key buttons should provide for clear tactile feedback when pressed. (Audible key pressed feedback should also be adjustable via the phone settings).

c.

Keypad inscriptions should use a suitable large font with high contrast colours. A backlit keypad is preferred especially for use in low-light conditions.

d.

A big programmable, emergency button in a prominent place is desirable.

e.

The phone should have a big *Answer* button and a big *End Call* button.

f.

A keypad lock/unlock switch on the side of the phone is preferable to the normal two key press function.

g.

The phone surface should be easy to grip and the overall size of the phone should not be too small, nor should the phone be too heavy. Rubberized corners may protect the phone during falls.

h.

The case design of the phone should be hearing aid compatible, and it should have phone neck-loop compatibility.

i.

It should have an obvious top and bottom, and easily visible and identifiable speaker and microphone positions.

j.

The display should be larger than normal and the screen font should be large and high-contrast. There should be magnification and zoom options for enlarging the screen characters. The display should have adjustable brightness and contrast, as well as different colour schemes.

k.

The phone volume should have additional amplification with an extra-loud loudspeaker, a speakerphone facility, and a headphone jack.

l.

The ring tone volume control should ideally be a rotating knob with a click for all the way off.

m.

It should be easy to recharge via a cradle rather than a plug.

n

It should have a flashlight LED external on the phone body that is easily controlled via a single button.

o.

There should be an option to make the (power saving) display backlight timeout function extra long before it dims or switches the backlight off.

2. Complexity

a.

Each key should preferably control only one function, but at the same time, the number of key buttons should be minimized.

b.

Recognisable function names on buttons to facilitate recognition rather than recall.

c.

Simplified menu structures to minimize nesting of functionality.

3. Features

a.

Essential functions such as receiving and making a call, text messaging (SMS).

b.

Alarm and reminder functions (such as for wake-up and medication).

c.

Flashing and vibrating alert for incoming calls.

d.

Pre-programmed emergency speed dialling.

e.

Remote monitoring (i.e. constant one-way communication).

f.

Voice output of displayed information, as is voice input (easily trained and effective voice recognition), used for example in voice dialling.

g.

Remote management of the phonebook (such as via SMS).

h.

GPS (global positioning system) location tracking functions.

Analysis of the information contained in Table 3, indicate clusters around the following criteria:

- Vision support entailing simple labelling, larger displays and larger fonts.
- Auditory support requires hearing aid compatible design, speaker phones, easy volume control.
- Tactile support means not using touch screens.

- Mental support necessitates recognisable function names on buttons and simplified menu structures.

Results from our study

In the group of 46 respondents, 24 (52%) received it as a gift, 18 (39%) bought it themselves and 4 (9 %) received it as part of a work contract. Thus more than 50% of respondents in our study did not make the purchasing decision or selection of the phone. Table 3 shows the makes and models of the respondents' phones. Excluding the unknown models (8 of 46), not a single one of these respondents own a mobile phone that was specifically designed for the elderly. When asked whether they like the phone, 34 of the 46 answered affirmatively, 5 were unsure and the remaining 6 indicated dislike.

Table : Makes and models of respondents' phones

Make	Model (if more than one, the number is given in brackets)	Number
Nokia	N73 (4), N70 (2), 1100 (3), 1200, 6670, 6500, 6110 (2), 6300, 6310i, 3310 (2), 3600 slide, 2680s, 2610, 2630, 5110, 7100, Unknown (8)	32
Sony Ericson	w950i, W890I, K800, Unknown (2)	5
Samsung	L760, D900, D600, E360, E350, Unknown (1)	6
Motorola	Unknown (2)	2
HTC	S710 Windows Mobile 6.1 OS	1

Table 4 gives an indication of the limited way in which the respondents are using their phones. Almost half of the respondents use it only to make and receive calls, while a further fourteen uses text messaging as well. Only eight use five or more functions. This raises the question whether all the additional functionality listed in the checklist is necessary or indeed desirable for the South African elderly user.

Table : Functions used

Functions used	Number of respondents
Only receive calls	2
Make and receive calls	21
Make and receive calls and receive sms	3
Make and receive calls and receive and send sms	11
Make and receive calls and 1 or two other functions	3
Make, receive calls and send, receive sms and 1 or 2 other functions	5
Undefined response	1
TOTAL	46

Table 5 shows a 'wish list' of changes proposed by the respondents. The second column gives the number of times this was mentioned, and the last column indicates whether this characteristic or feature appears in checklist 1. The item 'fewer functions' mentioned by 7 of the respondents relates to menu complexity. Some of the respondents were afraid to

experiment with the phone in case they ‘break’ something. Others did not try the different functions offered by the menus due to concerns such as becoming lost and being unable to return to the starting point. The improvements proposed in Table 6 are related to the keypad, and button concerns are mentioned by the majority of the respondents (43), followed by screen and display improvements (33). Reduced complexity through a better menu structure and/or fewer functions (24), is the third most popular improvement suggestion.

Table : What respondents would change about their phones

Proposed changes	Times mentioned	In checklist 1?
Bigger phone	2	1g
Bigger keys/buttons	18	1a
Bigger text on the keys/buttons	15	1c
Bigger text on screen	11	1j
More colour contrast	5	1j
Lighting on screen fades too quickly	2	1o
Fewer functions	7	-
Better grip	1	1g
Separate keyboards for text and numbers	2	2a
Easier to load air time	2	-
Larger screen size	10	1j
Better battery life	2	-
Louder ring tone	3	1k
Add GPS functionality	1	3h
Clearer battery status indicator	1	-
Joystick less sensitive	1	-
Buttons further apart	5	1a
Add camera	3	-
Clearer indication of new message/missed call	1	-
Keypad tones/tactile click	2	1b
Keys too sensitive	1	-
Support different languages	2	-
Web access	1	-
Easier to remember menu paths	13	2a, 2b, 2c
Touch screen	3	-
Audio input/output/voice prompts/text-to-speech/speech to text	8	3f
Easier to understand terminology	2	-
Loudspeaker setting	1	1k
Digital filter to block ambient noise	1	-
Flip-phone that answers call automatically when opened	1	-
Hearing aid function (output for earpiece)	1	1k

Note : An output for an earpiece is not the same as a hearing-aid compatible phone. The first is just a headphone output that is present in most music-enabled mobile phones, whilst the latter is a specific case-acoustic design so that the phone can be used with hearing-aids.

The checklist items not requested by participants or features mentioned in checklist 1 that were never used by the participants, are presented as checklist 2 in Table 6. The numbering of the individual items is taken from checklist 1.

Table : Checklist 2: Recommendations in checklist 1, not confirmed from the research findings

Physical characteristics

d.

A big programmable, emergency button in a prominent place.

e.

A big 'Answer' button and a big 'End Call' button.

f.

A keypad lock/unlock switch on the side of the phone.

h.

Neck-loop computability of the phone case design.

j.

The display font should be large and high-contrast with magnification and zoom options for enlarging the screen characters, and adjustable screen brightness and contrast, and different colour schemes.

k.

Additional amplification with an extra-loud loudspeaker and a speakerphone facility and a headphone jack.

Features

c.

Flashing and vibrating alert for incoming calls.

e.

Remote monitoring (i.e. persistent one-way communication).

g.

Remote management of the phonebook (such as via SMS).

5. Discussion

The findings concerning the limited function use (Table 4), and the many desired changes listed contradicts the observation that 74% of the participants expressed satisfaction with their phone. This should be seen in the context of the developing world where the mobile phone can be the only communication device (Botha et al., 2008) and therefore usefulness mitigates usability. Almost all of the current standard mobile phones, and most of the current specialist phones aimed at the elderly do not address all the noted limitations, nor do they meet the essential special needs and expectations of older adult users. The situation is exacerbated by the fact that many older people do not get the chance to choose their own mobile phones (38% selected their own phone in our study). This challenges the findings of Hassan and Nasir's (2008) Malaysian study that older mobile phone users are capable of making meaningful decisions when choosing a phone and that they use some of the more advanced phone features. It has to be noted that 56% of their respondents were aged 60 or younger (Hassan & Nasir, 2008).

Table 7 contains the senior mobile phone adoption checklist (SMAC) which is the synthesis of the characteristics of commercially available phones (checklist 1), requirements listed in checklist 1 but not confirmed by our findings (checklist 2), and other notable characteristics captured from the data. Phone characteristics unsupported by the research findings, or considered not important in the selection of a mobile phone for the elderly, have been omitted. For example, a touch-screen feature has been removed from checklist 4 because although it offers the facility for (virtual) larger keypad button it does not offer tactile feedback (which we consider to be essential for the elderly). Similarly a GPS function, although convenient, may be too costly.

Table 6 : Senior mobile phone adoption checklist (SMAC)

1. Physical characteristics

a.

Large size keys with a clear spacing between the keys.

b.

Key buttons should provide for clear tactile feedback when pressed. (Audible key pressed feedback should also be adjustable via the phone settings).

c.

Keypad inscriptions should use a suitable large font with high contrast colours. A backlit keypad is preferred especially for use in low-light conditions.

d.

A big programmable, emergency button in a prominent place is desirable, but commonsense dictates that the back of the phone (not easily visible) may not be the best place for this.

e.

The phone should have a big "Answer" button and a big "End Call" button.

f.

A keypad lock/unlock switch on the side of the phone is preferable to the normal two key press function.

g.

The phone surface should be easy to grip and the overall size of the phone should not be too small, nor should the phone be too heavy. Rubberized corners may protect the phone during a fall.

h.

The case design of the phone should be hearing aid compatible, and it should have phone neck-loop compatibility.

i.

It should also have an obvious top and bottom, and easily visible and identifiable speaker and microphone positions.

j.

The display should be larger than normal and the screen font should be large and high-contrast. There should be magnification and zoom options for enlarging the screen characters. The display should have adjustable brightness and contrast, as well as different colour schemes.

k.

The phone volume should have additional amplification with an extra-loud loudspeaker. It should have a speakerphone facility, and a headphone jack.

l.

It should be easy to recharge via a cradle rather than a plug.

m

It should have a flashlight LED external on the phone body that is easily controlled via a single button.

n.

There should be an option to make the (power saving) display backlight timeout function extra long before it dims or switches the backlight off.

o.

Longer battery life

p.

Keypad buttons are not too sensitive (too easily accidentally pressed).

2. Complexity

a.

Each key should preferably control only one function (not always possible on a limited size device), but at the same time, the number of key buttons should be minimized. Avoid button overload (dedicated function buttons).

b.

Recognisable function names on buttons to facilitate recognition rather than recall.

c.

Simplified menu structures to minimize nesting of functionality.

d.

An easy way to load talk (air) time.

e.

A clear indication of battery charge remaining.

f.

A clear(er) indication of a missed call and message received

g.

Easy to understand terminology and markings.

3. Features

a.

Essential functions such as receiving and making a call, text messaging (SMS).

b.

Alarm and reminder functions (such as for wake-up and medication).

c.

Flashing and vibrating alert for incoming calls.

d.

Pre-programmed emergency speed dialling.

e.

Remote monitoring (i.e. constant one-way communication).

f.

Voice output of displayed information could also be useful, as is voice input (easily trained and effective voice recognition), used for example in voice dialling.

g.

Remote management of the phonebook (such as via SMS).

h.

Reduce the number of non-essential phone functions.

i.

Add a camera

j.

Add internet access

k.

Support additional languages in addition to English.

Two essential sets of characteristics that impact mobile phone usage of the elderly emerge from SMAC. These are the need for physical and mental support in mobile phone design that map to the physical and mental user contexts as discussed in sections 2.1.1 and 2.1.3.

The physical context of the elderly requires large, easy to understand keypad buttons with tactile feedback when pressed; a high contrast screen with options for increasing the font size and an extra loud loudspeaker. These three essential characteristics are supported by the findings as presented in Table 5 where suggested improvements related to the keypad and buttons, are mentioned by the majority of the respondents (43), followed by screen and display improvements (33).

The mental context of the elderly necessitates reduced complexity. Simplified menu-structures and menu functions are mentioned by 24 of the respondents as possible improvement (Table 5). Flat menu structures, simplified terminology and the requirement that each keypad button should at most control one extra function were also mentioned. An easier way to add talk-time was also requested.

The most used functions confirm the importance of the social context (section 2.2.2). The phone should have the two essential functions of making and receiving phone calls. Non-essential but desirable functions include (in order of priority): an emergency (speed dial) function, alarm and scheduling functions, emergency button, voice input and output, and text messaging (SMS) facilities.

Notably most respondents (62%) did not select their own phones. Mobile phones were bought for them by younger people (children or grandchildren) who have completely different priorities when selecting a phone. This heightens the importance of the SMAC checklist in presenting informed and verified information on the needs of older adults mobile phone use.

6. Conclusion

In this paper we investigated the appropriateness of mobile phones that are available for the elderly in South Africa as a developing country. Phones designed for the elderly meet more of the needs, limitations and expectations of this user group but none of our respondents owned a phone designed for the elderly. Furthermore, less than 40% of the respondents selected their own phone. The contribution of this paper is to confirm that the physical, social, mental and technological contexts proposed in technology adoption literature also apply to the developing world. It also provides a better understanding of the user context as depicted in STAM, and highlights the fact that usefulness moderates ease of use characteristics for developing contexts.

The practical contribution is to provide a checklist (SMAC)that should be useful to designers, relatives, salespeople and the general public, who supply phones and services to the elderly without possibly understanding the physical, mental, social and technological challenges of the elderly. We also recommend that older people should receive appropriate training that focus on the most used functions first and then progress according to their specific needs. Training is particularly important in a developing country context where the mobile phone may be the only available communication device and cost constraints may prevent them from owning a phone designed for the elderly. Due to cost savings the tradition of passing phones to older relatives when a new mobile phone is obtained will probably continue. The resulting usability problems can be alleviated by providing appropriate support and training. Mobile phone training has been neglected mainly because of time and cost concerns, but also because younger generation do not fully appreciate the needs and limitations of the elderly. We acknowledge that no single phone can realistically adhere to all the requirements listed, but propose that a checklist be used as a point of departure in designing, selecting and understanding the mobile phone needs of the older adult in a developing country. The relatively small number of participants is a limitation of this study and further investigation is needed to verify the findings, refine the checklist and outline the specific training needs of older adult users in developing communities in order to promote adoption and maximise the potential of the phone they have.

References

- Abascal, J., & Civit, A. (2001). Universal access to mobile telephony as a way to enhance the autonomy of elderly people, *WUAUC 2001*. Alcacer so Sal. Portugal.
- Baldi, R. A. (1997). Training older adults to use the computer. Issues related to the workplace, attitudes and training. *Educational Gerontology*, 23, 453-465.

- Beute, N. (2004). Bringing computers and the internet to schools in disadvantaged areas in South Africa. Retrieved 24 May 2010, from <http://www.citte.ac.za>
- Botha, A., Batchelor, J., Van der Berg, M., & Sedano, C. I. (2008). Ability through mobility. Paper presented at the Third *International conference on e-learning*, Cape Town, South Africa.
- Botha, A., & Ford, M. (2008). Digital Life Skills for the young and mobile. *Digital Citizens*. Paper presented at Mlearn: The bridge from Text to Context, Shropshire, United Kingdom.
- Brewster, S. (2002). Overcoming the lack of screen space on mobile computers. *Personal and Ubiquitous Computing*, 6(3), 188-205.
- Burke, D. M., & Mackay, D. G. (1997). Memory, language and ageing. *Philosophical Transactions of the Royal Society: Biological Sciences*, 352, 1845-1856.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- Dunlop, M., & Brewster, S. (2002). The challenge of mobile devices for human computer interaction. *Personal and Ubiquitous Computing*, 6(4), 235-236.
- Emporia. (2010). Emporia home. 20 May 2010, from <http://www2.emporia.at/en/home/>
- Haddon, L. (2003). Domestication and mobile telephony. *Machines that become us: The social context of personal communication technology*, (pp. 43-56.). New Brunswick, New Jersey: Transaction Publishers.
- Hassan, H., & Nasir, M. H. N. (2008). The use of mobile phones by older adults: A Malaysian study. *SIGACCESS Access Computing* .,(92), 11-16.
- ITNewsAfrica. (2009). Vodacom launches phone for the elderly. Retrieved 20 May 2010, from <http://www.itnewsafrika.com/?p=3212>
- Jitterbug. (2010). The cell phone for senior citizens. Retrieved 20 May 2010, from <http://www.jitterbugcellphone.org/>
- Jones, M., & Marsden, G. (2005). *Mobile interaction design*. Hoboken, NJ: John Wiley and Sons.
- Kiljander, H. (2004). Evolution and usability of mobile phone interaction styles. *Doctoral dissertation*, Helsinki University of Technology, Helsinki.
- Lee, Y. S. (2007). *Older adults' user experiences with mobile phones: Identification of user clusters and user requirements in industrial and systems engineering*. Virginia Polytechnic Institute and State University, Virginia.
- Malhotra, Y., & Galletta, D. F. (1999). Extending the technology acceptance model to account for social influence: Theoretical bases and empirical validation. In *Proceedings of the thirty-second annual hawaii international conference on system sciences* (Vol. 1, pp. 1006): IEEE.
- Mallenius, S., Rossi, M., & Tuunainen, V. K. (2010). Factors affecting the adoption and use of mobile devices and services by elderly people – results from a pilot study.
- Mulberry. (2010). Cell phones and cell phone plans for seniors. Retrieved 20 May 2010, from <http://www.squidoo.com/cell-phones-for-seniors>
- Osman, Z., Maguir, M., & Tarkiainen, M. (2003). Elderly users' requirements for location based services and mobile phones. *LNCS*, 2795, 352-357.
- Phillips, L., & Sternthal, B. (1977). Age differences in information processing: A perspective on the aged consumer. *Journal of Marketing Research*, 14(2), 444-457.
- Pogue, D. (2006). Brilliant ideas that found a welcome. 20 May 2010, from <http://www.nytimes.com/2006/12/28/technology/28pogue.html>

- Preece, J., Sharp, H., & Rogers, Y. (2002). *Interaction design - beyond human-computer interaction*. New York: John Wiley & Sons, Inc.
- Renaud, K., & van Biljon, J. (2008). *Predicting technology acceptance by the elderly: A qualitative study*. Paper presented at the SAICSIT 2008: Riding the Wave of Technology, George, South Africa.
- RERC. (2010). Your guide to choosing a cell phone. Retrieved 20 May 2010, from <http://www.wirelessrerc.org/for-consumers/your-guide-to-choosing-a-cell-phone-page-1-of-2.html>
- Salthouse, T. A. (1985). Speed of behavior and its implications for cognition. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (second ed.). New York: Van Nostrand Reinhold.
- SeniorMobile. (2010). Cell phones for seniors. 20 May 2010, from <http://cellphonesforseniorcitizens.com>
- Silverstone, R., & Haddon, L. (1996). Design and the domestication of information and communication technologies: Technical change and everyday life. *Communication by design: The politics of information and communication technologies* (pp. 44-74). Oxford: Oxford University.
- van Biljon, J., & Renaud, K. (2008). *A qualitative study of the applicability of technology acceptance models to senior mobile phone users*. Paper presented at ER2008, 27th International Conference on Conceptual Modeling, LNCS 5232: 228–237, © Springer-Verlag Berlin Heidelberg
- van Biljon, J., & Renaud, K. (2009). *Distance education as enabler in crossing the digital divide: Will the phoenix fly?* Paper presented at the IDIA2009 Development Informatics Conference, 28-30 October 2009, Berg-en-Dal, Kruger National Park, South Africa.
- Van Biljon, J. A. (2007). *A model for representing the motivational and cultural factors that influence mobile phone usage variety*. Doctoral Thesis, School of Computing, University of South Africa, Pretoria.
- Van den Berg, M., Botha, A., Krause, C., Tolmay, J. P., & van Zyl, P. (2008). *Mobiled: A step backwards to look ahead*. Paper presented at the Conference on Mobile Learning: From Text to Context, Shropshire, United Kingdom.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.
- Weber, R. (2009). *Research on ict for development: Some reflections on rhetoric, rigor, reality, and relevance*. Paper presented at the Proceedings of the 3rd International IDIA Development Informatics Conference, Berg-en-Dal, Kruger National Park, South Africa.
- Young, T. (2003, November). Software interface design for small devices. Retrieved 2006/10/12, from <http://www.cs.ubc.ca/~trevor/writings/SmallScreenDesign.pdf>
- Ziefle, M., & Bay, S. (2004). Mental models of a cellular phone menu. Comparing older and younger novice users. *Lecture Notes in Computer Science: Mobile Human-Computer Interaction – MobileHCI 2004*, LNCS 3160/2004, 25-37.

Appendix A: Questionnaire used in data capturing

- A. Demographic information.
 - a. Age?
 - b. Gender?
 - c. Occupation (or previous occupation if retired)?
 - d. Highest school grade passed or highest qualification?

e. Where do you live (city area, small town, rural area, etc.)?

B. Experience with cellular phone.

a. How long have you owned a cell phone?

b. How did you get it (Bought from shop, bought informally, gift from children, etc.)?

c. How often do you use it (5 times a day, once a day, once a week, etc.)?

d. What functions of the phone do you make use of?

e. What is the make/model of the phone?

C. General, open-ended questions.

a. Do you like the phone?

b. What would you change about it if you could?

c. Does it make your life easier or more difficult?