

Socio-cultural factors and capacity building in Interaction Design: results of a video diary study in Botswana

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Abstract

This paper presents the results of a video diary study that was conducted with ten novice interaction designers in Botswana, to investigate socio-cultural factors (SCFs) in interaction design. The overall aim of this research is to gain new insights into design behaviour in different cultures in order to inform international interaction design capacity building. To this end, this research investigates what SCFs are considered during the design process, which are accounted for in prototype designs and which interaction design concepts participants use to implement SCFs in their designs. The results reveal 13 categories of SCFs considered during the design process, 10 of which were implemented in prototypes. Participants used five main interaction design concepts to implement SCFs: simplicity, wearable devices, accessibility, universal design, and conversational interaction. In addition, they tended to rely on adaptations to existing products rather than creating new designs. Recommendations for capacity building include the need to identify concrete examples and alternative interaction design concepts that focus on a wider set of SCFs; and to draw upon the synergy between local product design practices and interaction design practices in order to learn how to transition SCFs into interactive products.

1 Introduction

Socio-cultural factors are customs, traditions, perceptions and beliefs that characterise a cultural group and influence the thoughts, feelings, actions and behaviours of individuals in that group, including designing and using interactive products. Examples include structures of family and communities, kinship, power, religion and rituals; these are often ingrained from birth, and are reinforced by lived experience.

Socio-cultural factors are “essential to identify genuine problems that designed products need to address” (Aranda-Jan et al, 2016). Accounting for socio-cultural factors in the design of an interactive product increases its likely usefulness (Abdelnour-Nocera et al, 2007) and facilitates its acceptance in the target user community (Chavan and Gorney, 2008). Identifying and implementing relevant socio-

cultural factors is therefore key to acceptance and use, but can be challenging. Socio-cultural factors are specific to the context (deBoer and Chevrollier, 2010), can vary greatly from region to region and project to project, and may change considerably over time (e.g. Braa et al 2004).

Although a body of well-established concepts (such as processes, methods, and techniques) for interaction design exist, their heritage lies in largely Western contexts (Winschiers-Theophilus and Bidwell, 2013). Their applicability in other contexts, such as emerging markets, has been questioned and has led to a desire to reframe interaction design and human–computer interaction (HCI¹) through local and indigenous perspectives (Abdelnour-Nocera et al, 2013). In addition there have been calls for more critical research into the tensions between local cultures and HCI principles (Winschiers-Theophilus and Bidwell, 2013).

While understanding the target users’ characteristics and the need for co-creation with users are well-accepted within interaction design, (e.g. Rogers and Marsden 2013, Soro et al, 2016), few studies focus on understanding how SCFs are identified and implemented by designers, and how, or whether, existing interaction design concepts support the implementation of SCFs in designs. This paper presents a study that investigates these issues through a video diary study of design behaviour with novice interaction designers in Botswana. Specifically, the paper addresses the following three research questions:

- **What SCFs do novice interaction designers in Botswana consider during design?**
- **Which of those considered are implemented in prototype designs? and**
- **Which existing interaction design concepts are used to implement them?**

Building capacity in interaction design was identified as a big challenge by Ho et al (2009), and capacity building in Africa remains an issue nearly ten years later (Lazem and Dray, 2018). Answering these questions will inform international interaction design capacity building, and support the evolution of interaction design practice.

The rest of this paper is structured as follows. Section 2 provides background on SCFs in (interaction) design and capacity building in HCI, Section 3 explains the methodology and context, Section 4 presents the findings, Section 5 answers the research questions posed above and highlights suggestions arising from the findings, and Section 6 concludes the paper with empirically-grounded recommendations for capacity building in interaction design.

2 Background

2.1 Socio-cultural factors and design

Carlson (1992, p175) states that successful products “are not just bundles of technical solutions; they are also bundles of social solutions. Inventors succeed in a particular culture because they understand the values, institutional arrangements and economic notions of that culture”. It is surprising then that although research trying to understand designers’ behaviour and design processes has been on the rise since the 1960s (e.g. McDonnell and Lloyd, 2009; Cross, 2017), the role of the socio-cultural

¹ HCI (human-computer-interaction) and Interaction Design are used throughout this document, according to the original source. For the purposes of this paper the terms are interchangeable.

context has only recently received more attention (Christensen et al, 2017). For example Clemmensen et al (2017) analyzed aspects of the design thinking process, and found indications that culture impacts on design processes, and Dhadphale (2017) recently reported that especially in the early phases of the design process, the investigation of cultural factors that may influence design decisions is becoming more common place in global corporations. Based on ethnographic research in Ghana and China, Avle and Lindtner (2016) suggest the need to expand our understanding of ‘design’ to include a range of diverse design practices and cultures, and shows how designing is entangled in local and global socio-cultural contexts.

The influence of SCFs on the designed artefact has been researched for longer, although the literature is still limited. Below, we consider studies of SCFs in product design and in interaction design.

2.1.1 Socio-cultural factors in product² design

Christiaans and Diehl (2007) argue that not all products have to be localised in their physical appearance to be successful. For example, consider the iPod and ballpoint pens. What users do with these products, such as what they listen to or what they write, defines the cultural identity, not the product itself. However, they also identified products that are highly localised, such as kitchen and bathroom appliances (something echoed in Chavan (2005)). Their observations seem to agree with Mooji’s (2004) proposal that the older the product category, e.g. washing machines, showers etc, the more cultural manifestations it has. In a related study, Kim et al (2006) asked Dutch and Korean users to design the interface for a microwave and a washing machine. They found that these designs were influenced by local culture, and each cultural group had their own preferences for the interfaces and functions.

In a comparative content analysis of design concepts by Iranian and Australian industrial design students (based on a 30 min sketching task) Razzaghi, et al (2009) showed that participants in Iran embedded different socio-cultural realities in their designs compared to Australian participants. For example, designs for a personal communication device included mechanisms to hang it around the user’s neck, but the rationales given in each group were very different. They also found that the two cohorts highlighted different features.

The relationship between socio-cultural factors and designed artefacts is complex. Two models are useful for this discussion (see Fig 1).

Rosenman and Gero (1998) conceptualised the relationship between SCFs and designed artefacts by introducing the notion of a techno-physical (artificial) environment that interacts with the socio-cultural (natural) environment. For example, people are distributed across the world, and want to communicate with one another over distances. This need is influenced by socio-cultural factors such as family and community relationships, or work and trading practices. Humans create artefacts and systems to address this need, such as letters and postal services or mobile phone and network services. The purpose of an artefact emerges from and lives within a socio-cultural environment, but in order to design anything a human must interpret this purpose and develop the structure, the behaviour and function of the artefact. These

² We use the terms “product design” and “product” to refer to the design of a non-interactive product, or non-interactive elements of a product. Where we refer to an interactive product, we use the adjective “interactive”

three aspects of the designed artefact live in the techno-physical environment but are interpreted (through use) in the socio-cultural environment.

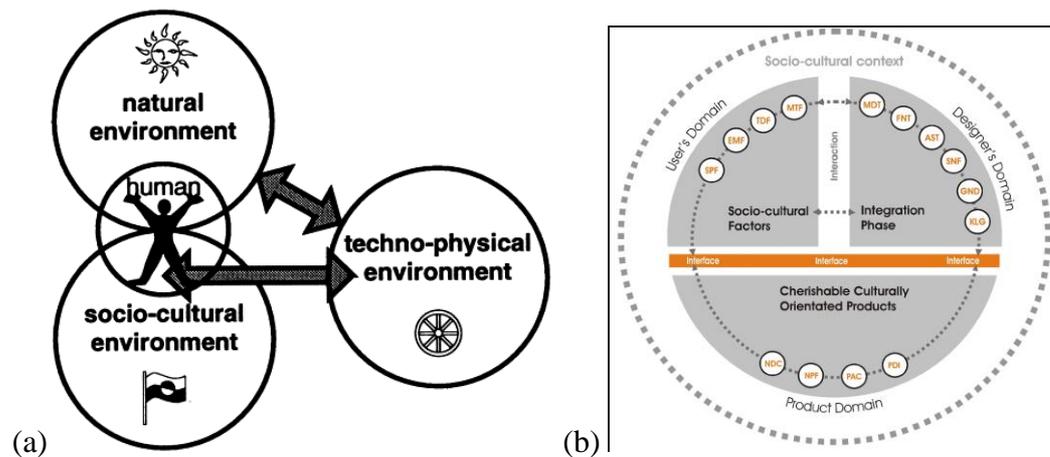


Figure 1. Two models relating socio-cultural factors and the designed artefact: (a) Rosenman and Gero (1998), (b) Maolosi et al (2010)

Maolosi et al (2010) also conceptualised the relationship between SCFs and products through a culture-oriented design model based on studies of product designers in Botswana. This model describes the relationship between the user's domain, the designer's domain and the product domain, and shows that socio-cultural factors from the user's domain are integrated into design to form cherishable culturally-oriented products; factors embedded in the product facilitate the product's use within the socio-cultural environment. This model was developed through two related studies.

Maolosi et al (2007) identified socio-cultural factors of Botswana culture in two ways: performing a content analysis of folktales and contemporary policy documents; and analysing traditional Botswana objects (such as a porridge stirring device, wooden spoons, a thumb piano, necklaces, and baskets) for embedded socio-cultural factors. Results showed socio-cultural factors at different granularities. Factors were sorted into three categories: social practices; emotional factors; and material possessions. Subsequently, students were given a design brief and explicitly asked to design culturally sensitive products integrating the identified socio-cultural factors. Designs were then analyzed together with retrospective interviews with the designers about their designs and the culture-oriented design model evolved from this (Maolosi et al, 2010).

2.1.2 Socio-cultural factors and interaction design

Accounting for socio-cultural factors of the users and their context is integral to the field of interaction design (Preece et al, 2015), but socio-cultural factors are deeply embedded and can be easily mis-interpreted. For example, Perrier et al (2015) implemented an SMS system and service design to improve the communication between nurses and pregnant women in Kenya. Although the system was successful overall, some features did not work as expected, and this seemed to be due to a lack of understanding of the nuanced impacts of socio-cultural factors that contributed to the final design, e.g. where the sharing of phones led to missed messages.

In the late 1990s and early 2000s the global reach of companies and their websites led to guidelines for localisation of products, culturally-sensitive design, and the HCI for

development (HCI4D) research field. HCI4D primarily focused on user-centred design principles to develop and evaluate products for low-income countries (Wyche, 2011), and on studying challenges to technology adoption and access to information (Roy et al, 2018). Challenges identified for designers and researchers in developing countries include environmental harshness and technology access; socio-cultural factors such as corruption, affordability, (ICT) illiteracy and language diversity (Brewer et al, 2006, deBoer and Chevrollier, 2010) have also been identified.

But this approach proved to be problematic (Chavan, 2005) and the HCI4D community has evolved and broadened their scope to consider technology development and use in under-served, under-represented, and under-resourced regions wherever they are located (<http://www.hcixb.org>; Taylor, 2011).

An alternative approach to accounting for SCFs in interaction design is to reframe HCI using indigenous perspectives (Abdelnour-Nocera et al, 2013). This requires a focus on developing the capacity of local designers, and empowering them to design interactive products for local situations, because “Genuine localization, . . . , requires locating accountability in the production of technologies; for Africa, this means design by Africans in Africa for African situations” (Bidwell and Winschiers-Theophilus, 2010, p32).

2.2 Capacity Building in HCI and Interaction Design

Capacity building (also called capacity development) aims to improve the skills, instincts, abilities, processes and resources that organizations and communities have to achieve their own objectives (adapted from UNDP (2019)). Capacity building in interaction design was identified as an issue for Africa at the first AfriCHI conference (<http://www.africhi.net/>) in November 2016 (Lazem and Dray, 2018), but had been recognised as a challenge for many years. Smith et al (2007) suggest that capacity building programmes for interaction designers will need to differ in different cultures. In addition, they point out that principles underlying the user-centred approach are derived from USA and Northern Europe. They propose a framework that challenges the notion of “universally transferable” education and takes account of specific contexts. Their work emphasises the way forward as being to examine a range of existing methods and knowledge to assess their applicability in developing nations, by identifying similarities, differences and local influential factors rather than to tailor established approaches.

The need to take account of specific contexts has been addressed in different ways. Bidwell and Winschiers-Theophilus (2010) identify the potential of training overseas graduates studying in Africa to embed African scenarios and views into global HCI. Abdelnour-Nocera et al. (2017) studied the cultural dimensions and performance of HCI undergraduate students in 5 different countries (China, UK, Mexico, Namibia and India), and related the students’ performance to their cognitive styles. They found that students with a higher analytical cognitive profile are more likely to provide a richer analysis in a heuristic evaluation (analytical) task, but no significant correlation was found in a persona creation (creative) task. They also suggest that understanding the cultural dimensions present in a group of students provides educators with an initial reflection on the implications of “the values, relations and interactions scripted in the content and delivery of HCI concepts and methods”.

As one output from the AfriCHI workshop, Lazem and Dray (2018) propose the development of a localised living curriculum for Africa, i.e. one that is regularly

refreshed and is flexible and diverse. They also identify roles for HCI educators, including to understand how established Western techniques work in local cultures. The work reported below contributes to understanding how established techniques work in local cultures and informs the development of a localised living curriculum. It accomplishes this by investigating how SCFs are identified and implemented by novice designers in Botswana, and relating this behaviour to established interaction design concepts and techniques.

3 Methodology

A one-month video diary study was designed to address the research questions posed above. Such studies ask participants to capture activity in certain situations (Katzeff and Ware, 2006) and often include prompts sent out through email or text messages (e.g. Palen and Salzman 2002). A video diary was chosen for three main reasons.

Firstly, so that participants would design in as natural a setting as possible, able to conduct activities such as visiting sites, talking to other people, studying other sources of inspiration, without limits on time or setting. Secondly, to capture the designers' 'voices' in the data, rather than rely on researcher interpretation. Although the researcher is present in the designer's mind, it is the participant who chooses what to record and which entries to select, with the assumption that there is some importance attached to the content. The video diary method has ecological validity, because diaries capture in situ data and the researcher has limited influence (Carter and Mankoff 2005). Thirdly, diaries are familiar to researchers and participants and they are used frequently in HCI research (Iivari et al, 2014).

3.1 Study setting

The study reported here was one phase of a wider investigation into the design behaviour of students in Botswana (Sharp et al, 2013). The Open University, UK (OU) partnered Botho University, Botswana to deliver a top-up degree programme of Computing and its Practice, and this programme included a level three module 'Fundamentals of Interaction Design'. This module used material co-created with the local tutors in Botswana, and a DVD of videos and online activities, which reinforces and complements a core textbook. The module took a process-oriented approach to interaction design, with a strong emphasis on producing and evaluating prototypes. During the 6-year partnership, over 4000 students in Botswana studied the module and over 30 local tutors were trained to advise and guide students and grade their work.

Two of the researchers in Botswana (Rajah and Turugare) were also tutors for the Interaction Design module; they co-designed the study, ran it locally, interacted with the participants on a regular basis, and participated in analysis. Mbayi-Kwelagobe was primarily responsible for data analysis (see below). Sharp, Lotz and Woodroffe (plus Blyth, see acknowledgements) co-designed the study, oversaw the study's execution in Botswana and contributed to the analysis; Sharp and Woodroffe developed and taught the Interaction Design module and Blyth was a tutor on the module in the UK.

3.2 Participant selection and briefing

Students who had studied ‘Fundamentals of Interaction Design’ at Botho University and who had participated in previous related research (Sharp et al, 2013) were contacted via telephone. Respondents were interviewed by the local researchers to determine their motivation and to explain the commitment required, and ten were chosen as participants. Several selection criteria were considered including: gender balance, marks gained in the module’s design assignments, ability to read and write in the English language, level of enthusiasm and motivation to take part, level of participation in the previous study, and availability at time of study.

All participants had attended Government Community Schools for their education prior to Botho University. Participants’ ages ranged from 21 to 30+ years; 7 of the 10 participants were female. Participants had varying language backgrounds, and the majority spoke Setswana, but English, Sesubiya, Kalanga and Zulu were also spoken. Six out of the ten participants had previously been exposed to design mainly as school subjects of Art, Design and Technology, Fashion and Fabrics. The module was therefore not the only formal design education they had received.

The participants were briefed together in a group by the research team. One pocket-sized, easy to use re-chargeable video-camera was handed out to each participant. The camera was demonstrated, the design problem, diary participant booklet, study timescale and potential activities were introduced and discussed. Participants were encouraged to ask questions. During the briefing, participants also tested several types of recording techniques using the cameras, e.g. self-recording, interviews and recordings of the environment.

The diary participant booklet included suggestions for suitable kinds of recordings, language use and translation need, technical parameters and data storage, points of contact with the local researchers and a request that the participants state the date and time in each of their recordings. The design problem given to participants was to design an interactive product to improve patient care at home for seriously ill patients; the problem description is at a high level of abstraction to allow wide-ranging design considerations. Drawing on Chavan’s (2005) Bollywood method, the task was framed as a realistic and compelling story:

“The Minister of Health has promised to improve patient care at home for the seriously or terminally ill, and has asked you to look at what is going on and design something that will make a real difference. This initiative is called the “Home Based Care Medical Programme” and is a major objective of the government. If you can pull this off your career will take a huge leap forward as the Minister has promised to give you public recognition for your efforts.”

This domain was chosen in consultation with authors Rajah and Turugare, who suggested that the participant group would have widespread experience and understanding of it, and so would not need lengthy explanation.

3.3 Data collection procedure

Participants were asked to make regular diary entries over a period of a month. The lengths of recordings were not prescribed, but working on the problem for an hour per day was suggested. These entries could take a variety of forms including: pieces ‘to camera’, i.e. self-recording; interviews with friends, carers and medical staff; and discussions of paper-based designs. The output from the design exercise was not

prescribed either, but students studying the module had been taught to produce different types of paper-based prototype for an interactive device. One of the local researchers met each of the participants at least once a week, and more often in some cases. At these meetings he downloaded the video diary entries and answered participants' questions. Any other written or sketched outputs such as prototypes were photographed and collected. At the end of the study all participants joined in a focus group to present their designs, and this was video-recorded.

Each day, participants were sent one or two text messages via their mobile phones. These messages prompted them to think about the design problem, reminded them to make a diary entry or asked questions related to the design process taught in the interaction design module they had studied. Table 1 shows some of the messages sent during week 2 of the diary study. Participants were not prompted to use any particular interaction design concepts.

Table 1 Example of prompts sent to participants in week 2

| | | |
|------------|---------|---|
| 14/05/2012 | 1000hrs | <ul style="list-style-type: none"> You could have a look at the news or other media to get some ideas. Have you made a diary entry today? |
| 15/05/2012 | 1000hrs | <ul style="list-style-type: none"> What challenges are faced by care givers? What challenges are faced by doctors? |
| 16/05/2012 | 1000hrs | <ul style="list-style-type: none"> Who are the stakeholders for your product? Have you made a diary entry today? |

3.4 Data analysis

A thematic approach to video diary analysis (Roberts, 2011) was used to identify socio-cultural factors that were considered during the design process. This was primarily conducted by Mbayi-Kwelagobe. She was native to Botswana, spoke Setswana, the local language used by participants when English was not used, and held a PhD from the UK in International Development which focused on Botswana's diamond trade. The analysis was inductive, based on the diaries and background demographic data. Socio-cultural factors were identified based on the researcher's extensive academic and personal knowledge of the socio-cultural context of Botswana. No direction or preconceived list of SCF categories was used. To identify SCFs, the following steps were taken. Throughout analysis the first four authors met on a regular basis to discuss the findings:

1. all the videos were watched and listened to by the first four authors in order to gain a deep overall understanding of the data. Demographic and other background data of the participants was used as context;
2. an initial analysis was conducted for each participant. This identified potential themes in each participant's data, which were discussed between the first four authors. Each potential theme was justified as an SCF by evidence regarding the socio-cultural situation within Botswana, for example the theme *Views on the elderly* in Participant 1's data is justified as follows: "It is widespread in Botswana that when people who have moved

from the rural to urban settings and they fall ill they return back to the villages to be taken care by the grandparents or older family members. The rural-urban migration has also left a lot elderly people with the sole responsibilities of tending to the land and taking care of the home.”; the theme *Poverty among the sick and caregivers* is evidenced by the suite of Poverty Eradication programmes in operation;

3. a more detailed analysis was then conducted for each participant that expanded on the SCF themes, including quotes and diary entry timings. This analysis looked at each diary and explained how the SCF impacted on what the participant did in their design activity;
4. the SCFs identified from individual participants were collated and refined into overall themes to produce 13 SCFs considered during the design process.

The prototypes themselves were then considered to determine whether an SCF was implemented in a design or not. The detailed diary analysis produced in step 3 above was first reviewed to extract information about how the SCF impacted on what the participant did. Then the drawn prototypes were examined to determine whether and how the SCF impacted on the final design. The diary entries were used to ensure that the participant explicitly linked the design to the SCF rather than relying on the researchers’ interpretation. In addition, the focus group recording was studied to see whether participants referred to socio-cultural factors when presenting their designs.

A similar procedure was used to determine which interaction design concepts were used to implement SCFs in the designs. The detailed analysis from step 3 above was reviewed to extract any references to interaction design concepts that impacted on the designs. Both diary entries and the focus group recording were studied for evidence that the participant was explicitly using these concepts to implement SCFs in their designs.

4 Findings

The first sub-section characterises the video diary data (4.1), looking at the format of diary entries and outputs. The second sub-section (4.2) describes the socio-cultural factors considered during design, the third sub-section (4.3) considers which of the SCFs were implemented in the prototype designs, and the fourth (4.4) identifies which interaction design concepts were used to implement them.

4.1 Diary entries

Ten participants took part in the study, generating 219 diary entries. Table 2 characterises these entries. The number of entries per participant varied between 10 and 46, with a median of 21. The length of recordings varied between a few seconds and up to 18 minutes, with the majority of entries being 2-4 minutes.

Participants talking directly to camera was the dominant diary style followed by interviews predominantly with friends and family but occasionally with strangers. Participants had difficulty engaging with the interview technique. Four diarists in particular (P1, P44, P63, P66) were shy or not confident enough to engage with people and/or record people on camera. Participants stated they could not persuade interviewees to take part without paying them or because they were fearful about the consequences of speaking out on camera. Some interviewees were shy and refused to be recorded, in which case the participants either summarised the interview or didn’t reveal the interviewee’s identity.

At times, participants staged interviews, e.g. giving scripts to friends or family to read out or preparing the interviewee about what to say (indicated by all interviewees giving the exact same replies or mentioning on camera that they forgot the ‘answer’), such as P2 and P22. Recordings of participant or interviewee were close up shots or bust shots, or extreme close up of feet or hands. The majority of recordings were made in English but interviews were often in Setswana. Sometimes a participant would make comments in Setswana to friends off-camera who were helping them, such as holding the camera or giving prompts to remind them of what they had planned to say.

Participants also showed environments in their entries, but often these were just side effects of people not wanting to be shown directly on camera. Some environmental scenes were recorded purposefully to show where problems in home-based care were encountered. Overall, there was a mixture of recordings made indoors and outdoors, but most were made outdoors. The light and sound conditions were mostly good, except recording of notes and prototypes which were often out of focus and too dark.

Eight participants included paper prototypes in their recordings, and these were also photographed separately. One participant’s attempt to draw while recording exemplified the challenging conditions of recording the production of paper prototypes.

Table 2 Diary entries the participants made

| Partici pant | No of entries | Length (mins:secs) | Type | Scene description | Material shown or produced |
|-------------------------|--------------------------|-------------------------------|---|---|---|
| P1 | 27 | 0:05-9:20 | 4 off camera showing environment, 4 off camera showing prototype, 3 to camera, 3 on and off camera showing artefact, 1 off camera drawing prototype, 1 interview showing prototype, 1 interview showing environment | Extreme close up to wide shots, mixed light and sound quality, outdoors and indoors, paper prototypes and artefacts partially blurred, local dialect and English, with help from friend | Artefacts, paper prototype |
| P2 | 17 | 0:45-4:00 | 10 talking to camera, 5 interviews, 1 showing notes, 1 showing environment | Bust shot to wide shot, good light and sound, outdoors and indoors, local dialect and English | Notes |
| P14 | 23 | 0:30-18:00 | 11 talking to camera, 6 interviews, 3 to and off camera showing prototypes, 2 to and off camera showing environment, 1 to and off camera showing artefact | Extreme close up to long shot, mixed light quality, good sound quality, outdoors and indoors, paper prototype and artefacts partially blurred, local dialect and English | Artefacts, physical and paper prototype |
| P15 | 14 | 1:20-8:30 | 8 interviews, 6 talking to camera | Close up to bust shot, good sound and light, outdoors and indoors, English | Notes |

| | | | | | |
|------------|----|------------|--|---|----------------------------|
| P19 | 17 | 1:15-13:15 | 7 interviews, 5 off camera showing environment, 2 off camera showing prototype, 1 to camera, 1 showing prototype, 1 showing environment | Close up to long shot, good sound and light, outdoors and indoors, paper prototypes blurred, local dialect and English | Paper prototypes |
| P22 | 46 | 0:02-8:40 | 24 interviews, 6 mistakes, 6 off camera showing notes, 4 off camera showing environment, 2 off camera back screen, 2 off camera showing notes and prototype, 2 to camera | Extreme close up to bust shot, outdoors, good light and sound, false or by mistake recording attempts, notes and paper prototypes blurred, local dialect and English, with help from friend | Notes and paper prototypes |
| P34 | 23 | 0:45-7:00 | 12 talking to camera, 5 off camera and show prototype, 5 interviews, 1 off camera and show environment | Extreme close up to bust shot, outdoors and indoors, good light and sound, paper prototypes blurred, English | Paper prototypes |
| P44 | 10 | 1:00-3:30 | 6 talking to camera, 2 talking off camera show paper prototype, 1 show environment, 1 off camera | Close up to bust shot, outdoors and indoors, good light and sound, paper prototypes blurred, English | Paper prototypes |
| P63 | 20 | 0:55-5:00 | 19 talking to camera, 2 off camera and show paper prototype | Extreme close up shot, outdoors, good light and sound quality, paper prototypes blurred, English | Paper prototypes |
| P66 | 22 | 1:30-10:30 | 19 talking to camera, 2 to and off camera and show paper prototype, 1 to and off camera drawing prototype | Extreme close up shot, indoors, good light and sound quality, paper prototypes blurred, English | Paper prototypes |

4.2 What Socio-cultural factors were considered during design?

Thirteen socio-cultural factors were identified in the design process reported in the video diary data. Not all of them were discussed equally by all designers. These SCFs are described below, and examples of their implementation in designs are given in Section 4.4.

4.2.1 Lack of loving or supportive care from the caregivers

A theme that emerges strongly is the lack of loving or supportive care from the caregivers.

“People who are under medical homecare they face many challenges some of them they can lead to their condition to continue deteriorating and not to improve as expected. First of all the problem that we have is that people who are the caregivers they lack that love and kindness. When you are sick and people are not kind to you it can go into your mind and you won’t improve your health but what will happen is your health will continue to deteriorate why

because you need that love and kindness. This is psychological now. Even if the medical is okay and is coming in time but if the caregiver lacks that love and kindness you might not heal but you might continue in that situation”
(P15 Diary 1, 00:28)

This is either because the sick are seen as a burden due to the caregivers’ other responsibilities or because the patient is seen as being too ill and therefore requiring too much care. Another reason that at times comes up explicitly and other times comes up more subtly is that patients may not be given adequate care because of the stigma attached to the illness that the patient is suffering from. The reasons for this stigma will be discussed further under the Stigma theme.

4.2.2 Differing levels of comfort with technology

The interaction with technology emerges on two levels: (1) amongst the participants and interviews, (2) and also amongst their identified user groups. Some of the participants and interviewees appear to be more comfortable than others with using the camera to record their diaries. Uncomfortable participants often do not appear in their diary entries and they also tend to have fewer people who are willing to be interviewed on camera. In terms of the user group, simpler and more familiar technologies seem to be generally preferred by the participants. This theme is strongly related to the elderly caregivers theme and literacy theme.

“I assume that these people they do not have information on using the interactive product. So the medical home product should be easy to operate”
(P66, Diary 11, 00:37)

4.2.3 Caregivers being illiterate or semi-literate

Illiteracy is also a key theme that emerges with caregivers being seen as mainly illiterate or semi-literate. This is seen as making the caregivers less able to administer medication correctly and take care of the patients appropriately. The solutions are often multilingual to allow less or uneducated carers to use the solution using Setswana instead of English.

“The other thing is of the caregiver being illiterate. Some medication they require you to be precise. Like they say you take two pills in the morning, in the afternoon and in the evening. So if the caregiver is illiterate they might end up doing what he or she thinks is right. (P15, Diary 1, 02:02)

4.2.4 The advanced age of caregivers

A theme that comes out strongly in many of the participants’ diaries is that caregivers are mainly older members of society. However, it is not clear what is the exact age group that the participants are referring to when they say ‘elderly’ or ‘older people’. These users are generally seen as being less educated and less able to learn how to use new technologies. Simplicity and ease of use were therefore seen as important features of most solutions.

“As most caregivers are old people or women and most of the time they are behind [with] technology. For example, they do not have clocks, watches, even cell phone and this may lead to patients to take medication earlier or even later than is prescribed by the doctor.” (P63 Dairy 1, 1:49)

Socially, the migration to urban areas by younger people, in the pursuit of better economic prospects, has left the older generation alone in rural areas. They are faced with the task of tending the land, a task that would usually be done by the younger generation. They are also tasked with taking care of the sick when they return home. The participants generally see old people as forgetful because they have so many other duties to take care of around the home, such as cooking and cleaning for the patient. Most of the ideas that the participants come up with are mobile in order to allow the caregivers to get on with their other tasks as they take care of the patient.

“... Caregivers often forget to give medication to the patient and on the other hand it is because they are workaholics, they work very hard and as you know old people they like working. So they end up forgetting their duty, the responsibility they have with the patients.” (P1 Diary 5, 01:12)

4.2.5 Poverty among the sick and caregivers

A high occurrence of poverty amongst families in the home-based care system emerges as a very strong theme in the diaries. The families are seen as being financially constrained and this affects their ability to provide adequate care. For example, families are seen as not always being able to afford nutritious food, specialised care and the transportation of patients to the health care facilities.

“Yes, we do not always have the food we have been told to eat by doctors. Sometimes when you wake up there is no food in house. You have to go your relatives home to ask them to make you some tea so you can take your pills. During that time you might miss the time you need to take your medication. So say you are supposed to drink them at 7am you end up drinking them at 9am to 10am. So these are the challenges that we facing.” (P22, Diary 3, 00:37, translated from Setswana)

Government is seen as needing to play an important role in reducing impact of this constraint by for example providing food baskets, transport to health facilities, as well as providing the solution free-of-charge to poorer families. Due the high incidence of poverty the solution is often seen as going to be available at no cost to the patients.

4.2.6 Women being seen as primary caregivers

The role of women as caregivers emerges as a theme in some of the participants' diaries. This is either because women are seen as better carers or because carers are seen mainly as being women. These carers are seen as being busy with other tasks around the home and therefore a mobile device is seen as being appropriate to enable them to get on with their other tasks as they take care of the patient.

“In our culture it is mostly believed that females know more how to take care of the sick because they know more about nutrition and healthy living. This should be kept. It is good. They [females] will take care of their patients seriously.” (P15, Diary 10, 01:09)

4.2.7 Government budgetary limitations

The same factor of poverty as above is addressed in this theme, but from a different stakeholder perspective. The government is often identified as one of the stakeholders in the participant diaries because public health facilities will be responsible for dispensing the solution. Government is also seen as being responsible for financing the solution to make sure that poorer families are able to access the solution. The government's budget is seen as being limited because of the different sectorial

demands and the recession, so the solution is envisaged to be cost-effective throughout the process by several participants.

“The government will look at the money that our country is having, our country is a developing country, which means that it does not have enough wealth because it has to distribute its money according to all the sectors in the country. Also the government will be paying for the product. They will buy it to improve the health care of the patients. The government has an impact on the product because if they do not pay for it the patients will not get proper care. On the other hand the government makes decision on behalf of the society like whether they should buy this product for the patients or not.” (P1, Diary 14, 05:50)

4.2.8 Caregivers having inadequate medical knowledge

Carers are often seen as lacking knowledge on how to take care of the patients properly because their skills differ from those of workers in the health care facilities (doctors and nurses). Although not many of the participants that identify this challenge attempt to address it with their solutions, most feel very strongly that this is something government or NGOs should address by providing carers with training.

“It is the fact that care takers are not educated and they are not trained to do the job of taking care of patients at home. So the first thing I would try and do is train the caretakers...” (P34, Diary 15, 00:26)

4.2.9 Stigma towards the sick particularly those with HIV/AIDS

Stigma comes up explicitly and implicitly in the diaries. When stigma is discussed directly it is seen as a result of the HIV/AIDS epidemic (Botswana’s infection rate is third highest in the world) that causes family members to reject those affected by the disease. The stigma could also be a result of people being seen as failures when they return to the villages with “the tails between their legs” after leaving with big dreams of making it in the city and returning home sick and weak from a disease that you mainly contract from sexual intercourse. This is exacerbated by the fact that often the patient was the only breadwinner in the family and therefore his illness has affected all his dependants significantly.

“You find that it is common in this world that we live in that when someone is affected with a particular disease he or she is treated as if he has done something that is, sort of, that is not normal. It is a problem for them because you do not feel welcome to the society or community. They feel as if they are not as important to the community. So that is the main problem that they are facing.” (P22, Diary 6, 02:07)

4.2.10 The sick stop taking their medication

One of the participants identified the lack of adherence to medication being a problem that is general to Botswana. This could be because of the low cost of basic healthcare that is greatly subsidised by the government or due to the human psyche where patients stop taking medication when they start feeling better. This participant designs a solution that is to be given to not just very ill patients but all patients that receive medication from government healthcare facilities.

“The kids, as you know nowadays the HIV pandemic is very high. You know that they are even kids in Standard 4 or Standard 3 who are affected by the virus. Maybe, they are schooling and when they are at school their parents will provide them with that

bracelet, a bottle filled with water and medication in bags so that when it beeps they will take their medication.... (P22, Diary 26, 02:35)

4.2.11 The influence of traditional healing methods

This theme does not come through very strongly but in a few of the diaries traditional beliefs are seen as a challenge to home-based care when patients or carers chose to use traditional healing methods over Western medicine.

“They are working too hard to get the patients well and end up mixing the doctors medication with some other homemade solutions like traditional medications” (P44, Diary 5, 0:41)

4.2.12 The influence of alcohol and drug abuse

Alcohol and drug abuse come through mildly as a theme because it is seen as a challenge to patients taking their medication on time. This is a problem very general to Botswana and is shown by the President making it a priority through increased tax on alcohol and heightened awareness campaigns. Alcoholism is therefore common and one could argue that Botswana has a strong culture of drinking that goes back many decades.

“We always fight but at the end of the day he always takes his medication even if he can take it with alcohol but at the end of the day he will take it” (P34, Diary 11, 03:37)

4.2.13 The rural vs urban divide

Some participants argue that patients should stay in urban areas because of limited services in rural areas. Urban areas are generally more developed and have more health care facilities.

“These people who are sick they should not be kept in villages because in villages they do not have services and it is so difficult for them to reach the services then in urban areas. In most cases you find that things reach urban areas and it difficult to get them in rural areas. And you find that in urban areas like towns, cities, you find that people who have volunteered to grow vegetables so they should be eat by sick people or NGOs that do those things. In rural areas it is so difficult to find these organisations. “(P15, Diary 10, 03:28)

4.3 Which Socio-cultural factors were implemented in prototype designs?

Ten of the SCFs observed during design were reflected in the drawn prototype designs. Three SCFs considered during the design process were not represented in any of the prototypes, and no mention was made regarding how they might be implemented. Table 3 summarises the factors, their consideration and their implementation in the design prototypes, together with descriptions of illustrative examples of how the SCF was implemented. Section 4.4 includes five designs which show in more detail how the SCFs were implemented in designs.

This is quite a complex picture as several SCFs are implemented together in one design. For example, P66 designed a mobile device that is programmed to ring when medication should be taken. She accounted for: WOMEN being primary caregivers by choosing a mobile and wearable interface so that they can move around and complete

their household duties; AGE by emphasising the importance of simplicity for elderly caregivers; COMFORT by building on low technical requirements; and LITERACY through the use of simple language in English and Setswana.

Table 3 SCFs considered in the design process and implemented in designs

| Socio-Cultural Factor | Participants considering SCF in process | How implemented in prototype (example Figs) | Participants implementing SCF in design |
|--|--|--|--|
| Lack of loving or supportive care from the caregivers (LOVE) | P1, P14, P15, P19, P22, P34, P63, P66 | Encouraging message on opening screen (Fig 6) | P34 |
| Differing levels of comfort with technology (COMFORT) | P1, P2, P14, P22, P34, P44, P63, P66 | Simple and easy to use, familiar and similar to known devices (Figs 2-4) | P1, P2, P14, P34, P63, P66 |
| Caregivers being illiterate or semi-literate (LITERACY) | P1, P14, P15, P19, P22, P34, P63, P66 | Pre-set by literate user, multilingual function or use of icons instead of language (Figs 2-4) | P1, P14, P15, P34, P66 |
| The advanced age of caregivers (AGE) | P1, P19, P22, P34, P44, P63, P66 | Simple and easy to use (few buttons or steps), and mobile/wearable devices (Figs 2, 3) | P1, P34, P44, P66 |
| Poverty among the sick and caregivers (POVERTY) | P1, P14, P15, P22, P66 | Device at no cost to user, energy efficient, battery free/rechargeable (Figs 3, 4) | P1, P14 |
| Women being seen as primary caregivers (WOMEN) | P14, P15, P63, P66 | Mobile and wearable devices (Fig 3) | P1, P15, P66 |
| Caregivers having inadequate medical knowledge (MEDICAL) | P1, P2, P15, P34, P63 | Education through use of device (Fig 6) | P34 |
| Government budgetary limitations (BUDGET) | P1, P14, P15, P22 | Cost effective to produce and distribute (Fig 4) | P14 |
| Stigma towards the sick particularly those with | P2, P15, P22, P34 | Non-descript or unisex appearance (Fig 5) | P22 |

| HIV/AIDS (STIGMA) | | | |
|---|--------------------|--|----------|
| The sick stopping taking their medication (TAKE) | P14, P19, P22, P44 | Device given to all sick, not just the seriously ill (Figs 4, 5) | P14, P22 |
| The influence of alcohol and drug abuse (DRUG) | P22, P34, P66 | Not implemented | 0 |
| The influence of traditional healing methods (TRAD) | P15, P44 | Not implemented | 0 |
| The rural vs. urban divide (DIVIDE) | P15 | Not implemented | 0 |

4.4 Which existing interaction design concepts were used?

When producing prototypes, participants referred to interaction design concepts, such as design principles and interaction types, as well as concepts from other devices they are familiar with. For example, the principle of simplicity was applied by P1 and P66 to address issues related to AGE while accessibility was applied by P14 and P15 to address LITERACY. Other concepts evident in the prototypes include wearable and mobile interface types, conversational interaction, and universal design. Participants applied these appropriately, and even extend them. For example universal design aims to produce designs that are accessible to all, irrespective of disability, age, or cultural background. In this study, P22 for example, extended universality to mean that anyone might wear the device whether or not they need medication, in order to address STIGMA and TAKE.

Our analysis showed that participants used five main interaction design concepts to implement SCFs: simplicity; wearable; accessibility; universal design and conversational interaction. See Table 4.

Table 4 Interaction design concepts used to implement SCFs

| ID concept | SCF |
|------------------------------------|---------------------------|
| Simplicity (Figs 2, 3) | AGE, COMFORT |
| Wearable devices (Figs 2, 3) | AGE, WOMEN |
| Accessibility (Fig 4) | POVERTY, LITERACY, BUDGET |
| Universal design (Fig 5) | STIGMA, TAKE |
| Conversational interaction (Fig 6) | LOVE, MEDICAL |

4.4.1 Simplicity

Prototypes that were simple and easy to use were developed to address AGE and COMFORT. For example, P34 explicitly describes his design (shown in Fig 2) as

simple in response to a range of user characteristics encompassed by AGE, e.g. the simplicity of having only one button: “Only one button is simple to use.” ...

He also addresses COMFORT “The bracelet will remind patients to take meds. It has to be effective. It has to be safe to prevent any mistakes and easy to learn. Not everyone is computer oriented.” ...

and LITERACY “I cannot use complex English for a device used by grandparents.” (P34 Diary 13, 02:09)

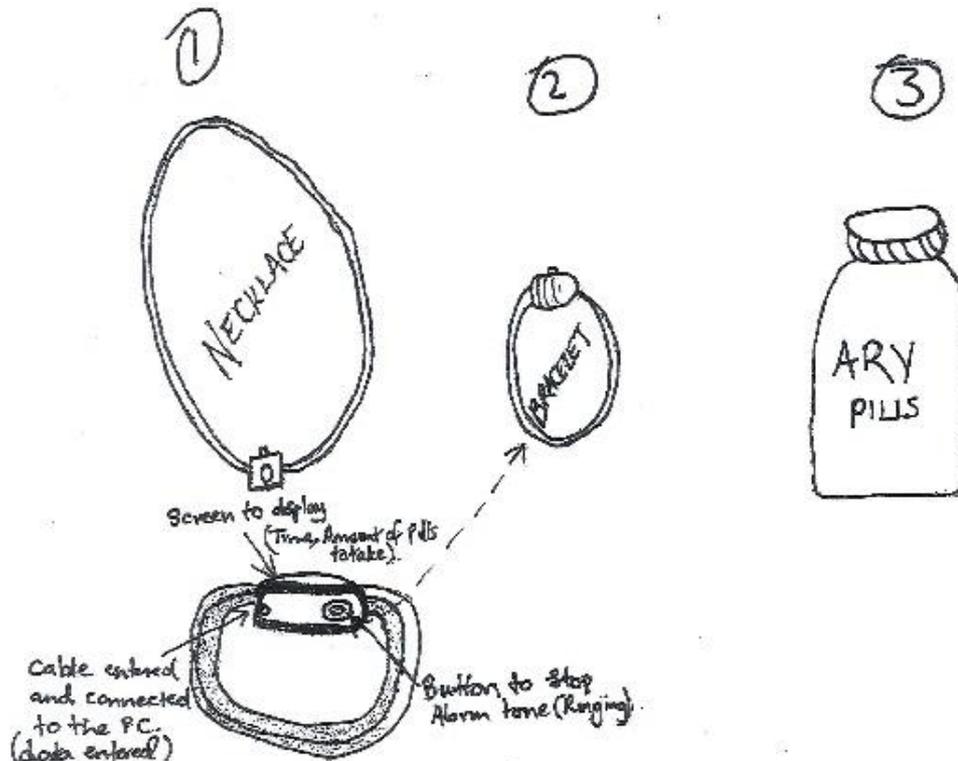


Figure 2. The design produced by P34: (1) necklace, (2) bracelet and (3) container. This design implements AGE and COMFORT using the interaction design concepts Wearable device and Simplicity. The design implements LITERACY by using simple language and allowing a doctor to pre-set alarms through the container. See Fig 6 for P34’s approach for LOVE and MEDICAL.

4.4.2 Wearable devices

Wearable and hence mobile devices were developed to account for SCFs AGE and WOMEN. For example, P1’s overall design has two bespoke wristwatch designs, one for the patient and one for the caregiver. The patient’s device sends measurements via a sensor to the caregiver’s device (in Fig 3) that gives an alarm, shows readings of temperature and some other relevant information on the screen. P1 recognises a need for mobile devices because elderly females are more likely to be caregivers:

“Compared to men females stay at home so they are in a position to take care of the sick because men go to work” (P1, Diary 10, 03:16)

“The elderly are hardworking. A mobile device would be better for the elderly because they can get on with their other work and while they are providing care. (P1, Diary 23, 05:32)

In this case, WOMEN is accounted for explicitly but it often remains only implicitly addressed with the rationale given for wearable designs being so that alerts or reminders are noticed by caregivers who have to attend to chores in the house throughout the day.

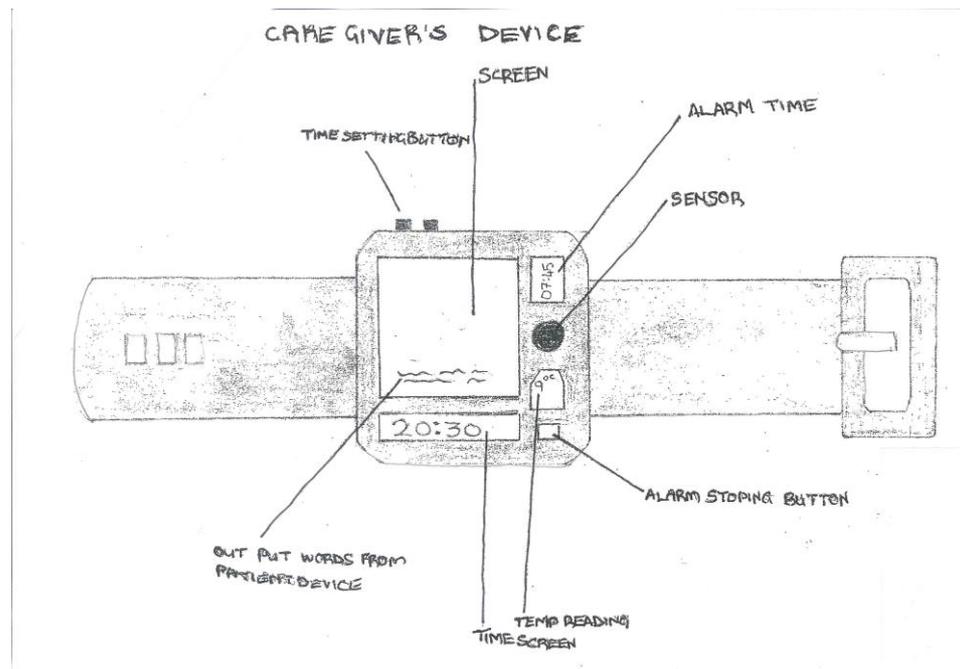


Figure 3 The design produced by P1: a simple wristwatch design for the caregiver. This design implements AGE and WOMEN using the interaction design concepts Wearable device and Simplicity. COMFORT is addressed by choosing a simpler, less technologically advanced solution; LITERACY by including audio output in different languages; and POVERTY by choosing a design for which the battery only needs changing once a month. Labels are “output words from patient device”, “time screen”, “temp reading”, “alarm stopping button”, “sensor”, “alarm time”, “screen”, “the setting button”

4.4.3 Accessibility

Accessible designs were proposed to address LITERACY, POVERTY and in some cases BUDGET. Prototypes were often seen as needing to be pre-set by the distributors to address LITERACY, e.g. P22. Multilingual or icon-based designs were also proposed to address accessibility at different levels of literacy, e.g. Figs 2, 3, 4. Cost effectiveness (BUDGET), was important so that the government could offer it at no cost to the patients due the high incidence of POVERTY. The former was addressed by the prototypes being energy efficient, while the latter was addressed by loaning the devices, and being distributed with pre-charged batteries and extra batteries being available from the hospital.

For example, the Med Alert Bottle System (MABS) design by P14 (Fig 4) is based on an interactive bottle that the pharmacist pre-sets with times medicine needs to be taken. It vibrates, issues audio sounds and lights up in different colours and icons depending on the time of the day, which facilitates its use by illiterate users. It is given to financially constrained patients when dispensing medicine. The bottle is loaned from the government and will need to be returned after the medication has finished.

“... So to save money my concept was to come up with an all-in-one product. What I mean by all-in-one is both the medication and the solution will be in one bottle...”
 (P14, Diary 21, 04:28)

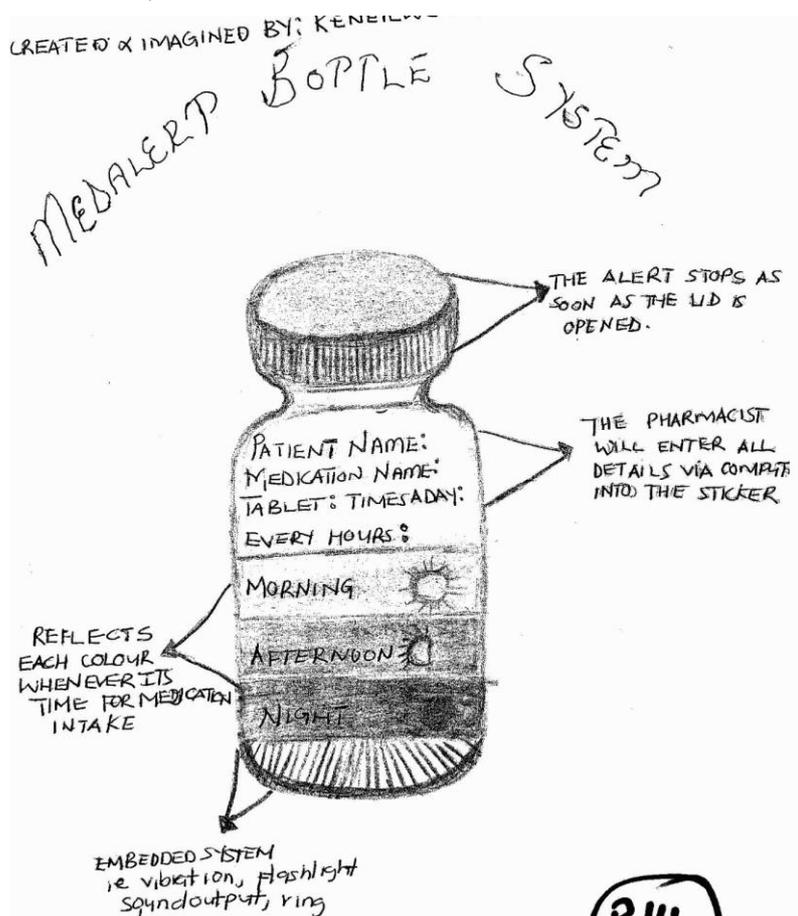


Figure 4. The design produced by P14: Med Alert Bottle System (MABS). This design implements LITERACY through pre-set alarms and high use of colours, sounds and images, POVERTY as it is loaned to patients so no cost to them, TAKE because it applies to all patients and not just the very sick, and BUDGET because both the medicines and the alert system are in one bottle that is re-set and reused after medication has finished which reduces the costs of the device. The design also accommodates COMFORT by using an ordinary medicine bottle and being “invisible to the patient”

4.4.4 Universal design

Universal design attributes, such as unisex design of the device and distribution of the design to all sick regardless of the level of sickness, is used to account for two SCFs: STIGMA and TAKE. For example, Participant 22 (Figure 5 below) addresses STIGMA by designing a bracelet that will be worn by all patients no matter what their illness. The bracelet addresses TAKE by allowing the teacher to support the patient and remind them to take the medication for the prescribed time. The rationale is described in her diaries:

“HIV positive kids can take it to school to remind their teachers that they need to take their medication. But it will not expose the kids to discrimination because it will be given to people with any kind of disease. It appeals to everyone because it is a bracelet.” (P22, Diary 23, 00:23)

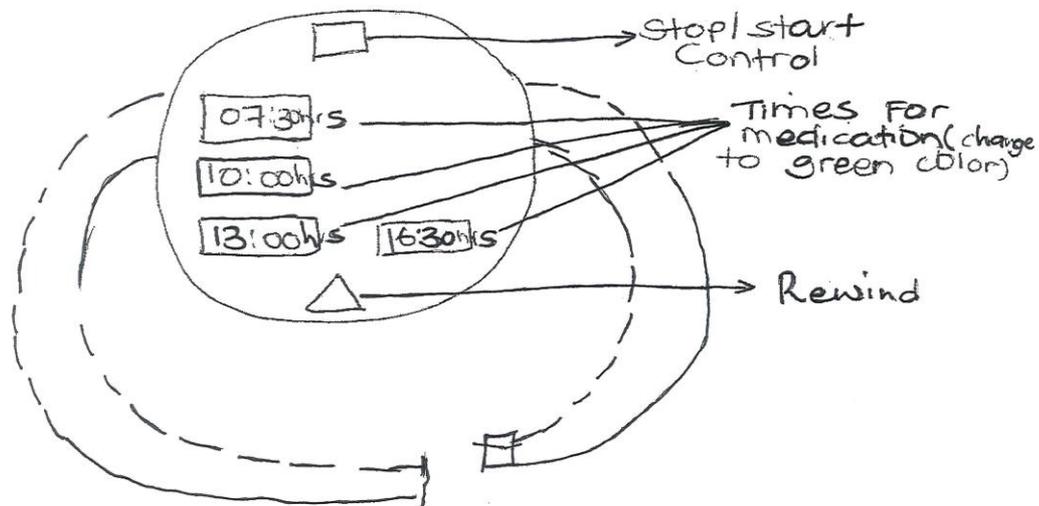


Figure 5. The design produced by P22: a bracelet for anyone to wear. This design avoids STIGMA by being given to people with any disease. This design also addresses TAKE by making it easier for “kids” to give the device to their teacher who can encourage them to take the medication for the prescribed time.

4.4.5 Conversational interaction

P34 designed a conversational interaction that addresses LOVE and MEDICAL. The device not only reminds but also motivates and educates the caregiver (Figure 6). The rationale for the decision is to build morale and keep the patients hopeful while gently reminding them about their medication.

“...This is simply to keep the patients hopeful that they will be better soon” (P34, Diary 21, 00:25).

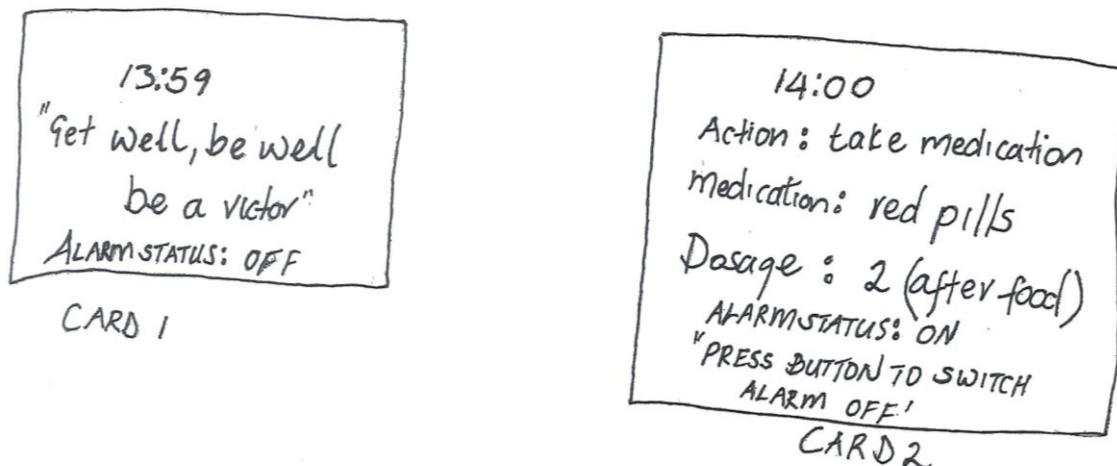


Figure 6. The interface designed by P34, using ‘cards’ of the screen content. This prototype implements LOVE through a message “to comfort the patient” on screen 1, and MEDICAL by specifying clearly what medication to take and when.

5 Discussion

This section considers the research questions posed at the start of the paper, interprets the results in the context of the two SCF models introduced in section 2, and describes limitations of the work. As each research question is discussed, implications of our findings that can inform international interaction design capacity building are extracted and highlighted in italics. These implications are particularly relevant for two threads within the capacity building literature discussed in Section 2.2: how established techniques work in local cultures (Smith et al, 2007), and building a “localised living curriculum” (Lazem and Dray, 2018). In the next section, these implications are recast as concrete recommendations that can be used to identify, devise and develop elements to include in a localised living curriculum.

5.1 What socio-cultural factors were considered during design?

Thirteen SCFs were identified from the video diaries. As part of the analysis methodology, these SCFs were justified by evidence relating to Botswana’s socio-cultural context. In addition, the research by Maolosi et al (2007, 2010) that focused on SCFs in product design (rather than interaction design) in Botswana provides a useful contrast and comparison for the SCFs identified. They identified SCFs from local folktales and traditional objects, rather than participants’ design practice. This mapping (see Table 5) shows that the two sets are complementary and comparable, and increases confidence in their validity.

Table 5 A comparison of our SCFs with Maolosi et al (2007)’s research on SCFs in product design in Botswana. Material possessions are not included in this comparison because they are products that facilitate the other SCFs.

| Maolosi theme | Maolosi SCF | SCF identified in this work |
|------------------------|------------------|--|
| Social practice | Education | Literacy issues (LITERACY) |
| | | Lack of medical knowledge (MEDICAL) |
| | Gender relations | Women being caregivers (WOMEN) |
| | Responsibility | Social stigma of illness (STIGMA) |
| | | Age of caregivers (AGE) |
| | | Traditional healing methods TRAD |
| | Authority | Lack of government funding (BUDGET) |
| Emotional | | Poverty of caregivers and the sick (POVERTY) |
| | | Rural vs. urban divide (RURAL) |
| | Frustration | The sick stopping taking medicine (TAKE) |
| | | Alcohol and drug abuse (DRUG) |
| | Love, kindness | Lack of loving or supportive care (LOVE) |

5.2 Which of these socio-cultural factors were implemented into prototype designs?

Ten of the SCFs considered during design were implemented by at least one participant and the other three were not implemented by any participant. The proportion of SCFs considered during the design process and implemented in the designs varied by participant, and no participant implemented all of the SCFs considered. For example P22 identified nine SCFs during design and implemented only one SCF in their design (STIGMA); P15 identified nine SCFs and implemented only two (LITERACY and WOMEN).

Some SCFs such as AGE, COMFORT and LITERACY were implemented by several participants, while others such as POVERTY and TAKE were only implemented by one or two participants. It is particularly noticeable that although eight of the participants considered LOVE, only one of them attempts to address LOVE in their design.

A participant may choose not to address an SCF for many reasons, and Maolosi et al (2010) also highlighted participants' difficulty in implementing cultural phenomena into product designs in Botswana, compared to physical and cognitive factors. However it is noticeable that for SCFs with a higher proportion of implementation, such as AGE and LITERACY, techniques, principles and examples of how to address them are readily available, while for others such as STIGMA and LOVE, techniques, principles and examples of how to address them are less common.

This suggests that techniques, principles and examples that focus on a wider set of SCFs may help the implementation of other SCFs in prototype designs.

5.3 Which interaction design concepts are used to implement these SCFs in prototype designs?

Our findings show that participants, unprompted, used five basic interaction design concepts to implement SCFs in prototypes: simplicity, wearable devices, universal design, accessibility and conversational interaction. Evidence of their use was sought in the drawn prototypes, the video diary entries and the focus group presentations. Where used, these concepts were applied appropriately and, in the case of P22, universal design was understood well enough to extend it to address STIGMA.

Some interaction design concepts, such as metaphors and conceptual models, were not mentioned or used consistently. Wakil and Dalsgaard (2013) compared the use of participatory design techniques in Scandinavia and India, and found that manifest techniques, such as physical prototyping, led to more creative output from the Indian participants than abstract techniques, such as conceptual models. Perhaps for our participants in Botswana it was also more difficult to relate to abstract techniques than to manifest techniques.

This finding suggests that efforts to identify any new or adapted techniques, methods and examples focus on manifest rather than abstract ideas.

In addition to interaction design concepts, most of the solutions proposed by our designers are adaptations of simple, familiar and easy to use designs, such as a watch, bracelet or medicine bottle. This may be due to our participants being novice

designers, as novices have been found to transfer ideas more directly from existing designs (Ahmed-Kristensen and Christensen, 2008). However using existing designs as inspiration for new designs is common with experts too. An alternative interpretation is provided by Viswanathan and Sridharan (2012) who emphasise “the very important role of existing products already possessed and used by BoP consumers in serving as vehicles for add-on innovations” (p65) (where BoP refers to rural areas of developing countries).

One advantage of adapting existing designs is that the product is already in use by potential stakeholders and so acceptance of the product is likely to be smoother (Weibert et al, 2017). However, one of the disadvantages is that too many compromises to make the adaptation work may lead to the design being inadequate.

This suggests the need for the identification or development of a range of flexible, multi-purpose products already in use by the target population, and whose purpose can be adapted easily.

5.4 What do the models that relate SCFs and designed artefacts tell us?

Two models conceptualising the relationship between SCFs and designed artefacts were introduced in Section 2 (Fig 1).

Maolosi et al (2010)’s design model states that integrating SCFs into product designs relies on the designer interacting with the users to draw from their experiences. It seems that although our participants interacted with potential stakeholders and users of the product under development, they were not always able to draw insights that they could use. In many cases, participants appeared to be uncomfortable engaging with stakeholders using their chosen techniques (identified in the COMFORT SCF), and none of the diary entries showed participants demonstrating their prototypes to stakeholders. This supports the conclusion by Bidwell et al (2010) based on their study in rural Africa, that a different approach to stakeholder engagement is needed. Participants were free to use whatever approaches they preferred, but perhaps the techniques were not appropriate.

This suggests that use of alternative ways to engage with stakeholders, or better training in existing techniques may support the implementation of other SCFs in prototype designs.

Rosenman and Gero (1998)’s design model referred to socio-cultural factors transitioning to the techno-physical system. In terms of this model, our findings mean that the SCFs have not transitioned from the human socio-cultural environment to the artefact techno-physical system. Transitioning between these two worlds relies on the designer to bridge the gap using suitable techniques and processes. Kroes (2002) highlights several questions around this transition, including the need to understand better how designers bridge the gap between functional and physical views of a technical artefact.

This suggests the need for further in-depth studies of experienced interaction designers (from Botswana in this case) focused on transitioning SCFs into products.

5.5 Limitations

The interpretation of our findings is limited by several factors. In particular, the 13 SCFs identified in this study do not represent a comprehensive set of SCFs affecting interaction design in Botswana. The specific factors considered for any one design

task will depend on the domain and scope of that design task, which in this case is a home care medical product. It is clear therefore that some of the SCFs identified here, such as STIGMA and MEDICAL, are dependent on the domain. Further studies using different focus domains are needed to identify other SCFs. However, considering the set of SCFs that were and were not implemented, it seems that whether the SCF was implemented or not is independent from the medical domain.

Participants in the study were novice designers, and their behaviour cannot be seen as indicative of experienced interaction designers.

The study lasted for one month and involved ten participants. A longer study may have produced different insights and would have given the participants more opportunity to review and revise their prototypes and to receive feedback from stakeholders. Including further participants would have provided a wider range of different perspectives.

The participants knew that the video diaries formed part of a research project and were therefore made with a particular frame of reference, addressing the researchers and thinking about what the researcher would like to see (Iivari et al 2014). The prompts sent out to remind diarists to make an entry might have skewed participants' behaviour, but other issues in participants' situations might equally well have caused difficulties. For example, lack of electricity or internet could have led to uncharged phones (affecting prompt receipt) or uncharged cameras (affecting video recording) or restricted ability to check facts online (also affecting video entries).

6 Conclusions

The paper presents the results of an investigation into the identification and implementation of socio-cultural factors in interaction design. The study was designed to inform international interaction design capacity building and was conducted with novice interaction designers in Botswana. Our analysis revealed a number of findings about SCFs and interaction design in Botswana, which prompted a set of implications.

These empirically-grounded implications suggest a number of concrete recommendations for capacity building in interaction design. Specifically, these recommendations build on the understanding of how established techniques work in local cultures (Smith et al, 2007) gained through this study, and suggest what to include in a localised living curriculum (Lazem and Dray, 2018). Our findings are summarised below, together with their corresponding recommendations:

1. Not all of the SCFs considered during the design process were implemented in prototype designs. SCFs with a higher proportion of implementation are associated with readily-available techniques, principles and examples of how to address them, while those with a lower proportion of implementation are not.
Recommendation: identify or develop techniques, principles and examples that focus on a wide set of SCFs, particularly those that are prevalent in the local community.
2. Existing and familiar products were adapted with the new functionality rather than new products being developed.
Recommendation: identify and use a range of flexible, multi-purpose products in the local community whose purpose can be adapted easily, as the basis for design assignments.

3. Five established interaction design concepts were used to implement SCFs into prototypes, while more abstract concepts were not used. This shows that *well-established concepts are applicable and extendable to new SCF contexts*,
Recommendation: continue to teach and encourage the use of established manifest techniques and concepts, where applicable.
Recommendation: demonstrate the applicability and use of abstract ideas.

Furthermore, viewing our results through the lens of models that relate SCFs to the designed artefact suggest four other recommendations:

1. Integrating SCFs into products relies on the designer engaging with users. Our participants were uncomfortable using their chosen techniques to engage with stakeholders.
Recommendation: identify and use alternative ways (as well as established techniques) to engage with stakeholders.
Recommendation: approach training in established techniques through local and familiar contexts.
2. Transitioning SCFs from the human socio-cultural world to the designed artefact relies on the designer bridging that gap. However, product designs (not interactive products) in Botswana embed SCFs. In our study, not all SCFs transitioned into the designs.
Recommendation: learn how to transition SCFs into products from local product design practice.
Recommendation: learn from experienced interaction designers (from Botswana in this case) about how they transition SCFs into interactive products.

The findings suggest an approach to interaction design capacity building that would allow local practice to evolve, promoting a synergy between local (non-interactive) product design practices, and interaction design techniques and processes. This could be done, for example, by developing creative toolkits, or empowering local interaction designers to adapt and create new principles drawing on local design expertise. A key difference between interactive product design and non-interactive product design is the need to design behaviour. The goal would be to account for widgets, principles and examples that resonate with target user populations, while recognising and encouraging the development of new ways of designing interaction.

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