THE EFFECTS OF ANTHROPOMORPHISM AND AFFECTIVE DESIGN PRINCIPLES ON THE ADOPTION OF M-HEALTH APPLICATIONS

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March 2017

DECLARATION OF INDEPENDENT WORK

DECLARATION WITH REGARD TO
INDEPENDENT WORK

I, <u>JEANNE COETZER</u>, identity number ▮▮▮▮▮▮▮▮ and student number ▮▮▮▮▮▮▮,
hereby declare that this research project submitted to the Central University of Technology,
Free State for the degree MASTERS in INFORMATION TECHNOLOGY, is my own
independent work; and complies with the Code of Academic Integrity, as well as other
relevant policies, procedures, rules and regulations of the Central University of Technology,
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other person in fulfilment (or partial fulfilment) of the requirements for the attainment of any
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_____   **29 June 2017**

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ABSTRACT

Previous research has found that M-Health initiatives have not been adopted and used effectively in many cases, especially in rural communal locations. Based on this, the researcher has surmised that factors contributing to the non-use of such initiative could be the resulted of a lack of knowledge with regard to the use of technology, literacy challenges, possible fear of technology and a lack of information regarding interventions that have the potential to improve quality of life. Consequently, an initiative that has usability as its core function may play a critical role in the use and adoption of such technologies.

The researcher wondered if and how anthropomorphic and affective design principles which aspire to extract an emotional or positively reinforced sub-conscious reaction from users may influence the adoption and use of M-Health initiatives when applied to said interventions. This study therefore set out to investigate the effects of anthropomorphism and affective design principles on the adoption of M-Health applications, with the Sethakeng rural community in the Northern Cape province of South Africa research population after consent was obtained from the relevant community leaders.

The researcher wanted first to ascertain whether anthropomorphism and affective design could influence the adoption of Mobile-Health applications, then to identify which was the more effective method to design Mobile-Health applications and finally, to provide guidelines and recommendations about the most effective design theory, as identified in the study, when designing applications.

This study predominantly employed a mixed approach research methodology which included action research cycles and quantitative data in the form of usage statistics, obtained from CloudWare, in the final report.

A case study was conducted in a rural South African setting to explore and eventually understand the relation between the case community and the intervention. A qualitative research design best allowed the researcher to get a better understanding of the research problem identified and the obstacles facing the relevant rural community and quantitative data

assisted with better understanding the relevant usage trends in terms of the M-Health intervention.

The objectives of the case study were to observe the phenomenon and describe it with regards to the case community, document the reactions of the case community to different instances and variations of the phenomenon and, lastly, to report on the design principle that yielded the most positive reaction from the community from a usage perspective; thereby indicating the adoption of the design methodology employed.

The research contributed towards the successful development, placement and scrutiny of two emotion-driven interfaces for the same M-Health intervention. A distinctive perspective was provided with regard to affective and anthropomorphic design to identify the better design model for improved application acceptance in a rural community context. At the conclusion of the study, evidence suggested that community members found the anthropomorphic interface design superior.

The researcher was thus able to explore, identify, develop and list a set of guidelines that can be used in the area of emotional design. Each guideline was based on what worked in practice and was applied successfully throughout this study.

The researcher would like these guidelines be implemented and utilised by other designers in the field of interaction design for future designers.

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LIST OF ABBREVIATIONS

Afctv Dsgn	Affective Design
Anthro Dsgn	Anthropomorphic Design
ATM	Automated Teller Machine
AG	Age Group
HCI	Human-Computer Interaction
CLI	Command Line Interfaces
CM	Community Members
GUI	Graphical User Interface Design
HF	High-Fidelity Prototype
ISO	International Standards Organization
LF	Low-Fidelity Prototype
M-Health	Mobile Health
NGO	Non-Government Organisation
PC	Personal Computer
PVR	Programmable Video Recorder
PDA	Personal Digital Assistant
RD	Research Design
UCD	User-Centered Design
UX	User Experience
VR	Virtual Reality

CHAPTER 1

Introduction

1.1   Background Information

A number of different methods outlining design techniques, guidelines and principles for human-computer interaction design have emerged since the rise of the field in the 1980s. Experiences have evolved from Command Line Interfaces (CLI) to Graphical User Interfaces (GUI) (Microsoft, 2008). Computers were initially used mostly by programmers and scientists, came to assist ordinary people in their everyday lives, at home and at work, as their use became more readily available. As a result, computers have become smaller, cheaper and more people have started using them – including non-experts. Today, people from all demographics are using computers, smart phones, tablets and the applications available for these technologies. According to Garret (2011), a modern mobile phone has many more features than a desk phone of the 1990s and as a result, the process of creating a successful product has to be quite different.

Although knowledge of the internal workings of a computer is not a prerequisite of proper usage thereof, knowing how to use the computer and its software is a necessity in modern society. Therefore, product design has to be supported by user experience Users have to understand and use an application so that the desired results are achieved. Consequently, manufacturers of computers and software have identified the benefits of creating products that are "user-friendly" and argue that the easier a product is to use, the more people will purchase and use it. This has resulted in interface design having a huge impact on the usability and effective use of applications. Usability is defined by The International Standards Organization (ISO) as the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments.

Learning to use a system or application can be quite daunting for users with different levels of experience, therefore a user interface that is designed effectively will have a positive effect on

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how much effort the user puts in for an effective, efficient and satisfying experience. Interface Design involves arranging interface elements so that they enable users to interact with the functionality of the system (Garret, 2011) as providing input and interpreting the output from the system takes a certain amount of effort from the user. The human psychology and physiology of the users also play a role in this respect and, therefore, must be taken into account when the usability of an application is determined.

User-centred design (UCD) is a modern, widely practiced design philosophy rooted in the idea that users must take centre-stage in the design of any computer system. Users, designers and technical practitioners work together to articulate the wants, needs and limitations of the user and to create a system that addresses these elements (McCracken & Wolfe, 2004). From multimedia workstations to hand-held PDAs, Virtual Reality (VR) headsets, and network PCs - the modern computer is predominantly interactive. Thus, today's designers and software engineers need to adopt a user-centred approach to system design (Newman & Lamming, 1995), , since the functionality of a product and the design process thereof are associated with the usability of the user interface of the relevant product. A usable product describes how well and whether a product can be used for the purpose for which it is intended. It is, therefore, of the utmost importance that designers should take into account the efficiency, effectiveness and satisfaction the users will experience when engaging with the product. Besides cultural and national differences, users form different conceptions or mental models of their interactions, and have different ways of learning and keeping knowledge and skills (different "cognitive styles" as in, for example, "left-brained" and "right-brained" people).

As users gradually master new interfaces, their preferences also change (Rouse, 2005). Since user interface technology changes rapidly and offers new interaction possibilities to which previous research findings may not apply, the different principles and layers of designing an effective interface become important. One of the areas of interest, when it comes to the effective and comprehensive design of user interfaces, is the role of user emotions when interacting with a product. An important question to ask, in this regard, is whether an interface can manipulate the user's emotions in such a way that the interaction is efficient, effective and satisfactory.

The area that allows users to experience different feelings and emotions when using applications, since it aims to create and deliver affective interfaces is called ***affective design*** (Reynolds and Picard, 2001). This is because the application may solicit some emotions from the user, giving him or her an enjoyable experience whilst interacting with it. In turn, this may lead to the user achieving his or her intended goals as well as those for which the application was designed.

The research area of usability, ***anthropomorphism***, is closely related and linked to affective design. Anthropomorphism is when designers attribute human-like qualities to non-living objects, for example Sonic the Hedgehog, a game released in 1991 that features a blue hedgehog as the hero or main character (Kennedy, 1992). This series' characters are almost all anthropomorphic animals such as foxes, cats, and hedgehogs that are able to speak and walk on their hind legs like humans. Another example is the paperclip MS Office used at one stage that has a little face and appears when one asks for Help. To assess the effects of the above mentioned design issues, principles need to be applied to a domain, discipline or area of study.

The focus of this study, therefore, was on the effects of these design principles on software applications, a domain that has received a lot of world-wide attention the last 5 years. The primary method of data accumulation, dissemination and information reception of this domain (Mobile-Health, or M-Health) is based on mobile technology and applications and provides many opportunities for Mobile-Health application development (Coleman, 2009). Mobile-Health is when mobile devices are used to support the practice of medicine and public health by integrating mobile telecommunication and multimedia technologies to produce mobile and wireless citizen-centred healthcare delivery systems. It is an advancement in technology and forms part of *Electronic-Health* or *E-Health*, which has a number of initiatives currently active throughout South Africa. There is evidence to suggest that only a small number of these initiatives has been successfully adopted by the intended audience. Over the past decade, much research has been done with regard to the usability of M-Health or Mobile-Health applications, which can be divided into many different areas and is explored further in later sections of this document.

1.2   Problem Statement

In many cases, Mobile-Health initiatives in rural communal settings have not been adopted as expected. Contributing factors may include not knowing how to use the technology employed as the delivery mechanism, literacy challenges, and the fear of technology. Other contributing factors could be usability and design. If applied to interventions, anthropomorphic and affective usability design could be the answer since they aim to solicit an emotional or positively reinforced subconscious response from users. This, in turn, could lead to the adoption of Mobile-Health initiatives.

1.3   Purpose of the Study

The purpose of the research was to prove that anthropomorphism and affective design influenced the adoption of Mobile-Health applications, to identify which between the two was the more effective method to design Mobile-Health applications and to provide guidelines and recommendations about the most effective design theory for applications as identified in the study.

1.4   Hypothesis and Research Question

Anthropomorphism and affective design principles have an effect on the adoption and use of Mobile-Health applications and it is possible to identify which method is better for designing said applications.

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1.5   Methodology

In achieving the objectives set out in Section 1.3, qualitative research design was employed. A qualitative research design allowed the researcher to gain a deeper understanding of the research problem identified and helped identify possible obstacles in a rural South African setting.

The researcher employed a case study to explore and ultimately understand the relation between the case community and the phenomenon.   The objective of the case study was to:

- observe the phenomenon and describe it with regards to the case community;
- document the reactions of the case community to different instances and variations of the phenomenon;
- report on the most effective design principle based on the case reaction.

To collect the data, the researcher employed the following data collection techniques proposed by Coombes (2006):

- **Observation:**   The systematic recording of the case group's interaction with the phenomenon;
- **Questionnaires:** Open ended questionnaires to allow respondents to elaborate on their experience with the phenomenon;
- **Group Discussions:**   Informal and voluntary gathering of individuals with the researcher to exchange ideas, information, suggestions and needs with regard to the phenomenon.

Unpublished data collected directly from people as a primary source of data, together with existing literature, was vital to the success of this study. All ethical permissions were obtained from relevant ethical committees before the research commenced since ethical issues should be taken into consideration when human participants are involved in research, especially in the South African context.

The research strategy and design took on the form represented in Figure 1.1.
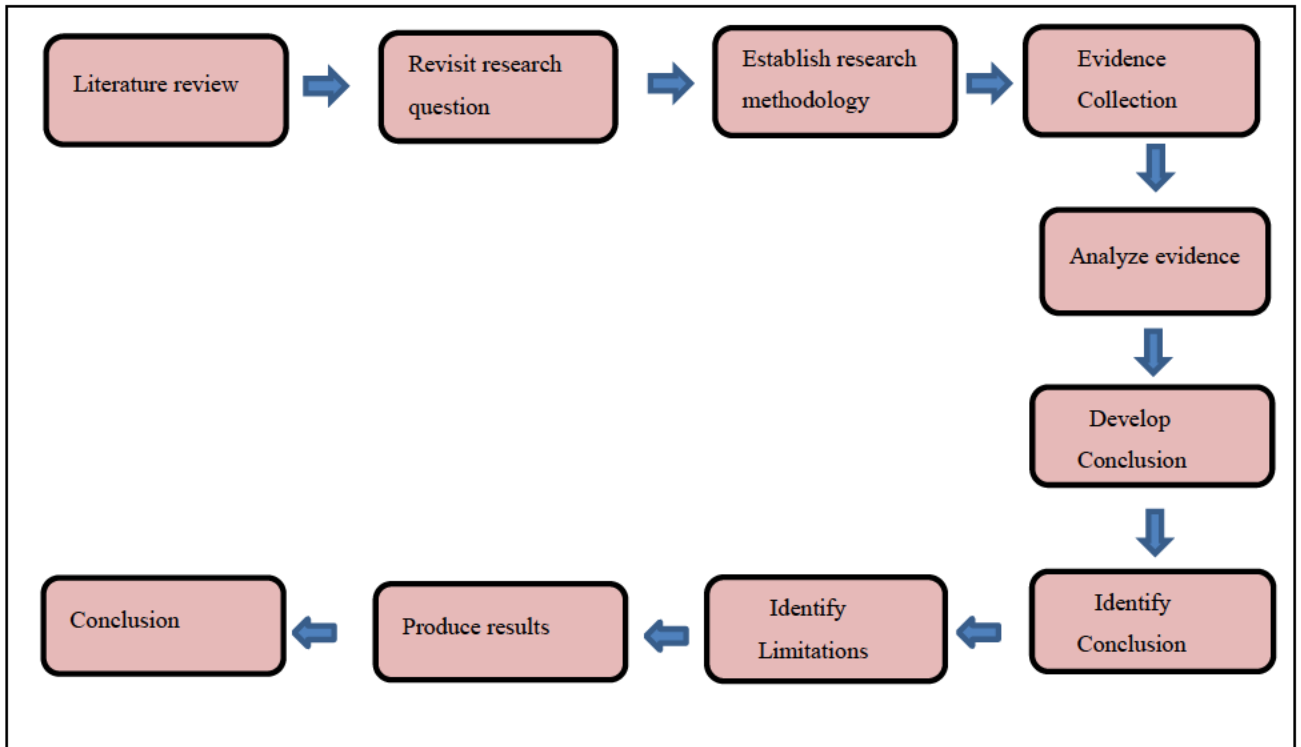
Figure 1.1 Research and Design Methodology

The researcher also employed principles of action research where different iterations of the phenomenon was presented to the case community, using the empirical data collection techniques discussed earlier in this section.

1.6   Contributions

The encompassing aim of this study was to investigate the effects that a mobile interface which was re-designed using two emotionally driven design methodologies, namely affective design and anthropomorphic design would have on the adoption and use of named application within a rural community context. The underlying design principles on which these two design approaches are founded were applied in the re-design effort of an existing interface of an M-Health application for evaluation purposes.

A rural community in the Northern Cape province of South Africa was identified as a suitable case community in which to conduct the research related to this project. The sampling was

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convenient in nature as a healthcare professional known to the researcher was already working within the community. The re-designed interface versions of the application were introduced to the community in different phases during plotted action research cycles.

The contributions emanating from this study were identified as being able to track and ascertain which of the applied design methodologies, i.e. which interface, had the most positive effect on the adoption and use of the application, albeit contextually. Albeit contextually limited, the results of the study also provided insights into the role emotional connections and interface design had in terms of the adoption and use of an application as well.

Another contribution that resulted from the study was that the researcher was able to identify and list a set of design guidelines with the aim to aid designers of applications that will be used in a rural community setting. The guidelines were successfully applied throughout different phases of the study and proved effective in practice.

A unique set of data collection tools were also developed and applied by the researcher. These tools took the form of emotional response recording tools as well as an observation checklist (See Appendix A) that was used to collect other data that would otherwise not have been collected. These tools proved especially useful when interviewees and group members were engaged when collecting data. This was also true in cases where different levels of literacy were encountered amongst the community members. Valuable data were obtained through the application of these data collection tools.

1.7   Overview of the Chapters

Chapter 1 serves an introductory purpose, provides background information, introduces the study, and expounds the intended contributions and merit of the study. Moreover, the research questions are specified. In addition, relevant literature is scrutinized to aid the direction of the study as well as to familiarize the researcher with current and former research relevant to the objectives of this study. The most relevant contributions of the content reviewed are discussed in Chapter 2, through a review of literature pertaining to the study.

Chapter 3 focuses on detailing the selected research approach, discussing biases relevant to the study, introducing the case community and discussing the relevant research designs. This chapter also includes thoughts on the unique data collection tools developed for this study as well as the data collection methods, which includes interviews, focus groups, observation, and cloud analytics. The discourse associated with the three action research cycles and the related data collection done in each cycle are also included in the latter part of the chapter.

Thereafter, chapter 4 provides an overview of the M-Health application related to this study, the functionality thereof as well as a review of the initial design in terms of emotional design methodologies. Also covered in this chapter is how and why community members were divided into different age groupings. The interpretation of the analyzed data in the context of each action research cycle and the reviewed designs are also presented in Chapter 4. The design guidelines developed during the course of this study are then explained.

1.8   Chapter Conclusion

Chapter 1 introduced the study and also gave the problem statement, purpose, hypothesis, expected outcomes and contributions. As mentioned in the preceding section, Chapter two presents the literature reviewed in relation to this study.

CHAPTER 2
Emotion and Usability Design

2.1   Introduction

Technology has become increasingly integrated in many aspects of daily life. Every day and every moment, people all over the world send emails, use mobile phones, text one another, listen to music on iPods or MP3 players, record shows on PVR and digital recorders, or use some form of technological product or service. According to Saffer (2010), good engineering makes all these things possible but making them usable, useful and fun to use, is the work of proper **interaction design**. De Souza and Bevan (1990) maintain that the main goal of usability is to make products and systems easier to use and to match them more closely to user needs and requirements. The theoretical lens through which the study was approached or viewed, was out of usability delineated to emotional responses through Human-Computer Interaction (HCI). Thus, the concept of **usability** in designing new systems and applications has become increasingly important in product design and **is defined** as the extent to which a product can be used in a specified context of use by specified users to achieve specified goals with effectiveness, efficiency and satisfaction (De Souza & Bevan, 1990).

Usability is about the e**ffectiveness**, which refers to whether the user can complete tasks and achieve their goals when using the product, i.e. do what they want to do; it is about e**fficiency** which refers to the amount of effort required from the user to complete a task (Often measured in time) and finally usability is about s**atisfaction** that refers to the user's impression concerning ease of use of the product.

The above mentioned is affected by **the users** using the product – are they highly trained and experienced users or novices? Usability is also affected by the **user's goals** - what are the users trying to do with the product and does the product support what they want to do with it?   The context of use' or the **usage situation** also plays a critical role in usability which poses the question of where and how the product is being used (De Souza and Bevan, 1990).

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Mobile devices have become the most wanted device that everyone wants as a means to communicate, for entertainment and managing one's live. According to eMarketer (2015), smartphone users worldwide would have totalled 2.16 billion in 2016, having increased from 1.9 billion in 2014. This influx of mobile technology means that millions of people can be reached through social media, information management, financial applications and mobile health applications that may improve the lives of many people.

2.2   Design in general

Users of software applications and products prefer them to be simple to use - spontaneous whilst not hindering their normal thinking processes. According to Van Gorp and Adams (2012), users want applications that are friendly, focused, useful, enjoyable and fast to use. They assert that users like applications which do not make them feel incompetent, but ones that allow them to make connections with ideas and people and products or systems which they understand when they are engaging them (Van Gorp, 2012). Most of these objectives and others central to usability can be achieved through good design.

2.3   Good and Bad Design

The design, development and use, represented by interaction on either the digital or physical level of interactive products, arguably considers *usability* a central concern. The term usability typically refers to concepts like learnability, effectiveness and overall user enjoyment when engaged with a product (Sharp, Rogers & Preece, 2007). To design an envisioned product with the aim to address the afore mentioned conceptual issues, one can start by assessing and comparing examples of similar products in terms of good and poor design. When considering the evolution or redesign of an interface or product one can assess and compare the design issues of the existing design. In short, the designer should aim to identify possible strengths and weaknesses of the existing design as well as those of the envisioned design. Different interactive systems may have several strengths and/or weaknesses and by identifying and comparing these, one can begin to understand what it means when something is considered

usable or not (Gandhi-Shepard, 2013). Although some people may find it easy to identify or tell the difference between good and bad design, that is not the case for everyone.

There are some obvious visual and emotional indicators that can easily tell a user if a design is good or bad. Visually, a bad design is when users cannot identify what they are looking at and cannot fathom where to go or what to do with the product. When a website, for example, is bursting with loads of information, colours, images, icons and animations, the user might not be able to understand them and feel overwhelmed or bombarded with information and visual stimulants. As a result, the user might be totally confused and lose interest or focus and leave the website without achieving what was intended. Neumeier (2014) states that a wealth of information leads to a poverty of attention.

If required to look at much contradictory content at once, for example numerous different colours, several animated things, too many advertisements or a confusing navigation structure, as shown in Figure 2.1 that could lead to a bad emotional response from the user. When a user is confronted with this type of visual overload, it may lead to a very frustrated and confused user. Emotions of frustration and confusion are generated and the source of these emotions may be the poorly designed interface of the interactive object. The object in itself may be valuable in terms of solving a particular problem or aiding in accomplishing a certain task, but the unfriendly/poorly designed interface may lead the user to cognitively classify the object as being a hassle to use.
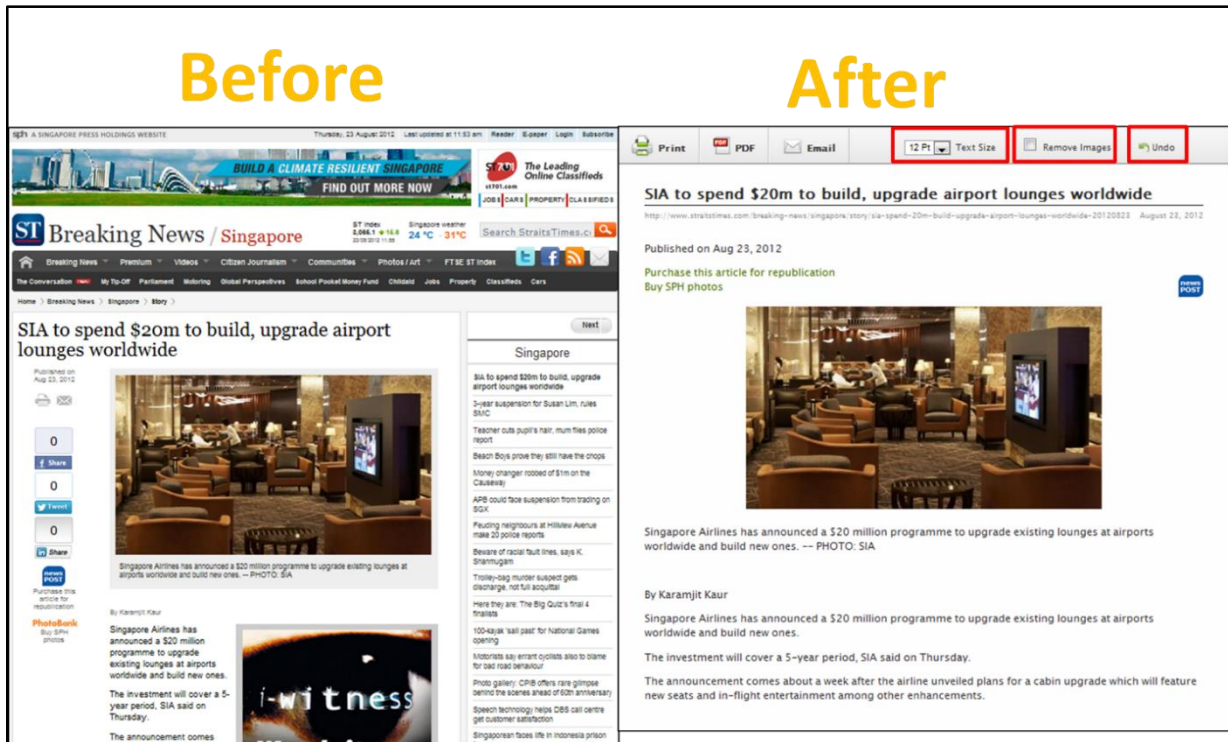
Figure 2.1 Example of a bad interface design that was amended to a good interface design.

Visually a good design often looks eye-catching and professional. The information is structured logically and every element has its own space and time for attention (Gandhi-Shepard, 2013). A user of the product or system will be able to follow the design graciously and move from one point to the next without difficulty. The emotional reaction that may be invoked by good design is that of understanding, respect and trust in the product or system. The banking industry, for example, understands this and that is why banks are organized, branded and professional with staff dressing appropriately for business - they aim to invoke trust in customers. Almost the same applies to the design of a good interface - just as we look for a respectable place to bank our money, we want the information on websites, applications and products to be evident, reliable and structured (Neumeier, 2014).

While good design is not achieved without effort, experience, research and countless iterations of design efforts ultimately lead to good and appropriate designs that realize users' needs.

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2.4   The User Experience and User Engagement

Users of systems and products want to have positive and great experiences when using them to achieve their goals. They want to be engaged in the experience. A challenge that designers of interactive systems face is that they should go beyond just designing usable systems, but should aim to design systems and products that provide people with great experiences (Benyon, 2014). User experience is not about the internal workings of a product, but about how it works on the outside where the user comes into contact with it. When a user is asked about his or her experience in interacting with a product or service, the question is about the user experience and not the product as such (Garret, 2011). Such questions could include how easy it was to figure out how to operate or navigate the interactive object; whether performing simple tasks proved challenging; how it felt to interact with the product; whether the product was aesthetically pleasing; and whether the user felt engaged in the experience.

Several factors, such as designing for emotions, designing for the user experience and realizing the importance of aesthetics in design, contribute to the creation of high-quality experiences for people using interactive systems and products. It is the user or groups of users who actually have the experience with the interaction. Experience design is about knowing that interactive products and services not only exist in our daily lives, but also have an emotional impact on who we are. Experience influences our culture and who we are as individuals (Benyon, 2014). People act, think, feel and make meaning of everything around them, including their perception and sensations, while interacting with a product or engaging in activities. In truth, experiences cannot be designed, but designers can design *for* experience, just as a system or product can be designed *for* emotion.

Emotion is a very significant part of user experience as experience is about performing an action and being constantly aware of the emotions and sensations that we feel, for example watching a suspense movie, reading a gripping novel, experiencing a challenge in an online game, working on an important document or watching a sports game (Benyon, 2014).   The quality of the activity that is undertaken by the user, draws the user in and makes it unforgettable, satisfying and fulfilling - which are all feelings or emotions being experienced.

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Desmet (2003) identifies a number of product emotions such as boredom, inspiration, amusement, surprise, fascination, dissatisfaction, etc. All these human emotions should, therefore, be kept in mind when designing systems or products (Desmet, Hekkert & Hillen, 2003). Designing an interface with the aim to solicit certain emotions from the interaction experience can be categorized as emotional design. We expand on this topic later in this dissertation.

According to O'Brien & Toms (2008), engagement is a quality of user experience characterized by attributes of challenge, positive affect, endurability, aesthetic and sensory appeal, attention, feedback, variety/novelty, interactivity, and perceived user control. It is about ensuring that the interaction with a product or system continues while the user performs an action or engages with the product or system. On the other hand, a product or activity is engaging if it draws the user or person in, appears to surround the action, holds our attention, and interests us unceasingly during the interaction (Benyon, 2014). Interactive technologies are the medium that the designer of the system or product shapes to involve the user to ultimately lead to an engaging experience.

Closely related to the user experience, is aesthetics in the user experience. Aesthetics is a large area of study that is concerned with human appreciation of beauty and how things are recognised, sensed, and judged (Desmet, 2003; Benyon, 2014). Aesthetics will not be discussed in this dissertation, although the importance of making things beautiful plays a major and critical part in interaction design to invoke positive emotions from the user.

2.5   Interaction Design

Interaction design is the practice of designing interactive digital products, environments, systems and services (Cooper, Reinmann & Cronin, 2007). It mainly focuses on the behaviour elicited from users during interaction with the product or system which aims to satisfy the requirements and needs of the people who will be using it (Cooper, 2007).

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The benefits of good interaction design, is clear every time you use Facebook to update your status; withdraw money from the ATM; use your coffee machine for making an espresso; use a software application to write a letter or create a presentation or to use the web to purchase a product online, book airline tickets, search for information, and so forth.

The opposite is also true if poor interaction design is evident. Examples of poor interaction design include, but are not limited to struggling to figure out how to connect your mobile device to your computer to synchronize files; having difficulty to purchase a ticket online because of poor design; having difficulty to set your PVR to record programs; trying to set the clock on your new oven or struggling to figure out how to use the new photocopier/scanner, printer at the office (Saffer, 2006).

There are many products and systems that have been developed without taking the users' needs into consideration. For these types of designers, it is all about technology and the functions that the products and systems perform. Bringing usability into the design process is the aim of interaction design. As mentioned earlier in the discourse, the main principle with regard to interaction design is about designing products that are easy, enjoyable and effective to use from the user's perspective (Sharp, Rogers & Preece, 2007). It also aims to increase positive user experiences and lessen negative user experiences (Nanlee, 2013). Other concerns of interaction design include the possible behaviour of the user and how the system will accommodate and react to the behaviour of the user (Garret, 2011).

The process of interaction design requires four basic activities which are fairly universal and can also be found in other disciplines, for example architectural design (Cooper, Reinmann & Cronin, 2007). These activities include: identifying needs and establishing requirements; developing alternative designs that meet those requirements; building interactive versions of the designs so that they can be communicated and assessed and evaluating what is being built, throughout the process.

Having **users involved** throughout the development process is an important consideration of interaction design and is referred to as user-centred design. Other considerations are

identifying specific **usability** and **user experience goals.** These should be identified, documented and agreed upon at the beginning of the development process (Rogers, 2011).

Interaction design methodologies include several usability and user experience goals to be achieved in the design of a product. A usability goal is understood in terms of specific questions relevant to the study and the epistemological goals of the study. In turn, these questions can produce usability criteria. According McCracken and Wolfe (2004), **usability goals** entail:

Effectiveness: the user's ability to accomplish a desired goal or carry out tasks.

Efficiency: how quickly users can accomplish goals or finish their work using the system.

Safety: can mean the safety of users or the safety of data and protecting them from hazardous situations.

Utility: has to do with the services and functionality that the system provides.

Learnability: how easy it is to learn to use the system.

Memorability: once a system is learned, how easy it is to remember how to use it.

(McCracken & Wolfe, 2004)

2.5.1 User experience goals

User experience goals are a set of particular qualities that reveal what the interaction with the system or product *feels* like to the users, i.e. whether the system is satisfying, enjoyable, fun, entertaining, helpful, motivating, aesthetically pleasing, rewarding emotionally fulfilling and supports creativity (Sharp, 2007). After all, when designing and developing a product, the goal is to reduce feelings of negativity and to boost positive feelings toward the product (Nanlee, 2013).
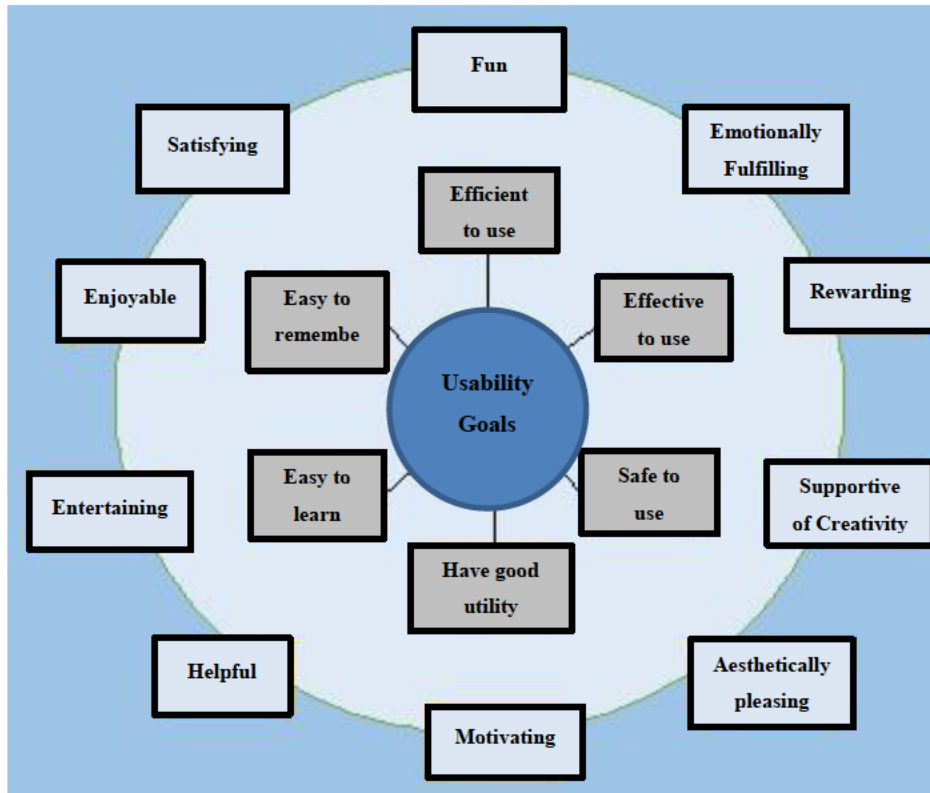
Figure 2.2 Usability goals (center ring) of interaction design and user experience goals (outer ring) of interaction design.

User experience goals are represented in the outer ring of Figure 2.2 and the usability goals discussed earlier in this section in the inner ring. The question that now arises is what the influence of the user experience goals are on the usability goals of interaction design.

Not all usability and user experience goals are applicable to the design and evaluation of an interactive product being developed (Rogers, 2007). Some combinations may not work well together, for example designing a system to control a certain process may be impossible to design to be fun and safe at the same time. Central to interaction design is understanding and identifying the nature of the relationship between usability and user experience goals (Cyr, 2015). Being aware of this enables designers to investigate different combinations when designing products and systems.

2.6   Understanding the Problem Space

It is human nature to make assumptions or claims about why we think something might be a good idea or not. By explaining the assumptions or the claims of the users, the design team are positioned to view multiple interpretations of the problem space (Sharp, 2007). This divulges conflicting and problematic views which, in turn, allow the designer to answer several questions about the existing product or system.

Before the physical design of a system or product is initiated, it is of vital importance that the designer understands the problem space. This means that there should be an initial understanding and hypothesising of what the user experience of the product or system is at that moment and how this can ultimately be enhanced or improved (Cyr, 2015). To successfully improve existing systems or products, designers are obligated to think through how their ideas will support or extend the way people interact and communicate in their everyday lives. For example, the designer should determine what is wrong with or lacking in the current activities, tasks or applications and find ways to improve and enhance them to ultimately lead to the success thereof.

Understanding the problem space leads to the consideration of what information and functions are needed for and from the system to achieve its purpose and fulfil the needs of the users (Benyon, 2014). A prerequisite to understanding the problem space, is to identify the usability and user experience goals discussed in Section 2.5.1.

2.6.1   Interaction types

Another way of understanding the design space is in terms of the users' interactions with a system or product. Understanding this may help designers to formulate a theoretical model by determining what kinds of interaction to use, as well as the reason thereof, for the envisioned product or system before committing to a certain interface type. The consideration of the interaction type that will best support the users' experience can highlight the compromises,

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problems, benefits and drawbacks of using a certain interface type (Johnson & Henderson, 2002).

There are many other methods of defining the specific area and context-based activities that users participate in, such as learning, working, socializing, browsing, problem-solving, decision-making and information searching. For the purpose of this study, the most important activities that were considered were instructing, conversing and manipulating.

2.7   Emotion and Design

Emotion, the driving force behind motivation, is a positive or negative experience that is associated with a particular pattern of physiological activity (Cherry, 2011).

According to Chakrabarti & Gupta (2007), emotions are the felt tendencies or reactions toward anything like people, objects, ideas, events, etc. Emotions practically enhance all our experiences, pleasant or unpleasant, awake or asleep. Studies have shown that a person's general experience of well-being is strongly influenced by day-to-day felt emotions. Emotion directs attention and affects memory. There is a very good reason why emotion is so closely linked to memory – it keeps us alive. If we had no memory of negative or positive experiences, we would not be able to prevent ourselves from repeating negative experiences or knowingly repeat positive experiences (Walter, 2011).

We receive information about the world through our senses (Van Gorp & Adams, 2012). Our senses feed our perception of the world. Much of the information that we obtain each day, is simply thrown away or screened out from our memory because we do not have the attention capacity to process, interpret and remember all the information we come upon. We are not even aware of most of the information that we throw away. Focusing our attention determines the experiences that enter memory and the ones that do not. The information that has made it from our short-term to long-term memory is processed and interpreted by our brains and compared to the information we already know (Davenport & Beck, 2001).

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By using all sensory information, we form mental models or a "map" of the world and reality. The understanding of information that we hold of something is often referred to as a 'mental model' (Benyon, 2014). As mentioned earlier, mental models are used to make predictions about an external event before actually carrying out actions (McCracken and Wolfe, 2004). Nobody has the same mental model for the simple reason that we are not exposed to things around us in the same way. We use these mental models to help us make decisions and to guide us through our daily lives. But what causes some of the information that we receive via our senses to be ignored and others to be processed?

Attention selects relevant information by focusing on it and deleting information that is considered irrelevant by simply ignoring it. **Emotion** is the energy that drives and directs attention (Van Gorp & Adams, 2012). Emotion and other affective states like moods, sentiments and personality traits influence every aspect of our interactions with brands, products and basically everything that we use or are exposed to (Forlizzi & Battarbee, 2004). According to Demirbilek (2001), emotions are not triggered by situations or events, but by our thoughts, beliefs, values and attitudes about the situations or events. Having an emotional response to an object or a situation is not an automatic response. The automatic response is deep inside our brains to the thoughts that we have associated with the situation or the object. We use the mental models that are formed in our brains to assist in decision-making (Demirbilek & Sener, 2001).

Donald Norman, a pioneer in usability and human-computer interaction, points out that beautiful design creates a positive emotional response in the brain, which actually improves our cognitive abilities.

> *"Attractive things make people feel good, which in turn makes them think more creatively. How does that make something easier to use? Simple, by making it easier for people to find solutions to the problems they encounter".*   (Norman, 1988)

Emotion is an essential part of who we are as human beings and it can play a pivotal role in the effective design of products (Van Gorp & Adams, 2012).

2.8   Relating emotions to product design

The field of usability design takes root in the cognitive sciences in the form of a combination of psychology, computer science, human factors and engineering (Norman, 1988). Design professionals are starting to realize that there are tangible benefits in exploiting emotional design with regard to all types of consumer products including software, websites, communications as well as marketing. According to Van Gorp & Adams (2012), there is an urgency in products to stir up emotions, communicate personality, and capture the attention of viewers and to create satisfying user experiences.

Designers are challenged with the task to design products that will stimulate predetermined desired emotions in the users. Consequently, whereas emotion and design were previously ignored by designers, causing frustration, they have now become important factors in product design. Picard (2003) maintains the reason affective design has not been properly incorporated in the design process is, in part, because affect has been misunderstood and is hard to measure (Picard, 2003).

Emotion is central to the human experience and influences perception, cognition, rational decision-making, communication, and learning every-day tasks. An emotional response is triggered by everything that we see, hear, and feel and we react to that in different ways. As such, it is no longer enough that a product functions properly, is usable and efficient or has aesthetic appeal, it also needs to address our emotions in multiple ways (Desmet, Hekkert, & Hillen, 2003). Thus, user expectations of products are changing and they have a need for ease-of-use, attractiveness, functionality, safety and reliability in products. Users expect more from everyday products and recent design trends show an inclination towards objects that inspire users, enhance their lives and help trigger emotions (Demirbilek & Sener, 2001).

This section of the chapter will focus on defining and exploring emotion and emotional design and look at the incorporation of emotion in product design.

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2.8.1   *Emotions in product design*

With continuing advances made in technology and the ever increasing understanding of physiology relating to affective states, interest in emotion with regard to design is growing because, according to some business studies, it makes good business sense. Effective and efficient design provides an implicit motivation within people to purchase well-designed products. Different research studies were conducted by the Design Council [1] and it was found that $1/3^{rd}$ of fast growing businesses implemented proper design (Aurove Design, 2013). Emotional design is all around us. If a product invokes a positive emotion from a user the possibility, according to research, is that the product will be more successful in terms of usability.

Invoking emotion from a user when using a product can be challenging. Available technology, for example mobile phones, that a large portion of a given population may have access to, can address this dilemma by employing such technologies' features. The use of emoticons has become a common method of expressing feelings or mood when using text messaging to communicate.

An **emoticon** is a metacommunicative pictorial representation of a facial expression which, in the absence of body language and prosody, serves to draw a receiver's attention to the attitude or mood of a sender's nominal verbal communication, changing and improving its interpretation.

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[1] The **Design Council**, formerly the **Council of Industrial Design**, is a United Kingdom charity incorporated by Royal Charter. Its stated mission is "to champion great design that improves lives and makes things better".

Figure 2.3   Emoticons conveying emotion.

Electronic greeting cards or Ecards are another way to convey emotion as shown in Figure 2.3. Ecards are electronic greeting cards sent over the internet via your email account. This is a fun, cheap and easy method of sending greetings to businesses, friends, relatives and the like. These cards are available in many different formats, colours, graphics and themes. Features of Ecards include the possibility of entering personal messages, adding or removing music, changing of colours, themes, and formats. This allows the user to send a message conveying certain emotions, evoking emotions in the receiver of the Ecard as well.

2.9   Exploitation of emotion in interface design

The form of a product, visual or the shape and feel, conveys plenty of elusive information to the consumer, regardless of the intent. Consumers make sense of things through various sensory stimuli. This information does not only provide the pre-mentioned highly nuanced information, but also conveys meaning and induces emotion. In reality, all design is emotional whether it is intended to be or not (Capper, Mark, 2013). The trick is shaping the emotion by exploiting the human senses and invoking an emotional response to the benefit of your product.

There are several ways in which to utilize emotion in the design process with the aim to stimulate and increase use of a product. A design can affect a user on a more personal level by using several elements that can be seen as "emotion carriers", for example obvious carriers like

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colour, images, shapes, textures, sounds, and so forth. Other methods of soliciting an emotional response from a user, like humour, can be classified as a less obvious carrier.

The use of humour can be applied to make a user feel comfortable by soliciting a smile or a good laugh. By nature, we constantly seek emotional connections with others and things. That is why we like to see images of faces on websites, and why we appreciate somehow recognizing ourselves (Idler, 2012). If we recognize something, it immediately makes us feel connected or understood. According to Walter (2011), we know ourselves so well that we try to relate everything we see to ourselves. This allows us to feel comfortable and connected to a physical or intangible object and makes the object relatable and more fun to use.

2.10   Why design for emotion?

The designer faces many challenges and considerations when designing interactive products and services. Sanders (1992) describes three main categories of product requirements that cover all the aspects of users' emotional experiences with products:

- **Useful**: perform the tasks it was designed for;
- **Usable**: easy to use and interact with;
- **Desirable**: provide pleasure and create attention;

The emotional needs of users are very complex and multidimensional when it comes to products, websites and applications. We want the product to be easy to use, but it must also work in the way the user expects. To fulfil the goals and needs of the users, the design must therefore be **useful**. In principle it means that the product must be able to perform the task it was designed for. It must be **usable** in the sense that the interaction of the product should be reliable, predictable and easy to understand.

The final category of the user's emotional experience with a product is **desirability**. The pleasure that is suggested by an attractive and beautiful product has become an essential part of the experience of purchasing the product, owning and using it. A very good example of a

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product that incorporates all three these categories is the iPod music player. The iPod was designed by Apple as a product that was so simple to use that it was almost too basic to envision as a successful product, but Apple realized that producing a product with a pleasurable and quality experience to its users was only possible with effective interaction design (Rogers, Sharp & Preece, 2011).

Many features of the iPod contribute towards its success. The device consists of a click wheel, five buttons and a very basic hierarchical menu system to navigate the music library (LePage, 2006). The device is designed to be elegant, simple, and easy to operate when navigating to a song, artist, playlist or album. The plain white colour and likeable name of the iPod directed it into the course of becoming one of the most successful music players available. All these factors, including its appealing name and content (iTunes, iPod) led to the iPod becoming one of the greatest of its kind and a need-to-have fashion item for teenagers, students and the like.

The fundamental objective of the iPod is all about the music and making it simple and effective to use. The reason the iPod is so successful is that Apple thought about the way we listen to music and broke down the process to its core, not adding unnecessary features or buttons. The emotional experience of the user using the iPod is that of satisfaction and desire – we feel we need that product. With reference to emotional design in product design and the three Sanders categories, the enjoyment provided by beauty has become and additional part of the emotional experience for the user during purchase, ownership and use of many types of products and applications (Van Gorp & Adams, 2012).

It may be that a new product or discovery can be very useful, but because it is a new discovery, it is not as usable or aesthetically pleasing as initially anticipated. The first computers introduced to the market place, for example, were quite large and made use of command line interfaces as compared to the beautiful graphical user interfaces we find in products and applications in today's environment. As products become more common and functionality the standard, more competitors who produce products incorporating the same functions start entering the market place (Sanders, 2002). With that being said, the usability and desirability

aspects of a product become more important with increased functionality and designers need to focus on these aspects as part of emotional design.

In the current competitive market, products that do not pay attention to usability and aesthetics with relation to physical products and software applications, fail to attract the attention of customers and thus may fail as products in the market place (Van Gorp & Adams, 2012). Thus, to generate better value for customers and clients, as well as increasing the perceived value of the product, the user's emotional responses whilst using the product should be considered as part of the design process. On both conscious and subconscious levels, emotions affect our key reasoning functions.

2.11 Affective design

Affective design is the design of a product to encourage certain emotional experiences and responses from users, like happiness, pleasure, confidence and trust. The aim of affective design is to identify the emotional relationship between users and products so as to create products that, in some way, elicit pleasure from the user (Cyr, 2015). This interaction may, in turn, lead to the user achieving his or her intended goals with regard to the use of the product for its intended purpose. When the user is satisfied with the use of the product, the requirements of the product have been met from a design perspective, i.e. the product is useful, usable and desirable as described by the three categories put forward by Sanders. An example of an affectively designed product is Affectiva's Q Sensor that is worn on a wristband or bracelet. The Q Sensor saves or conveys a wearer's stress levels throughout the day, giving doctors, caregivers, and patients themselves a new tool for observing the reactions of the person wearing the bracelet. The device detects and records physiological signs of stress and excitement by measuring slight electrical changes in the skin, allowing people to keep track of stress during everyday activities. The design is aesthetically pleasing as shown in Figure 2.4 and has the appearance of any type of bracelet used to monitor, for example, heartbeat, distance and calories burnt.

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Applying affective design concepts to, for example an interface or any physical product, can be achieved by implementing techniques like making use of a visually attractive interface full of eye-catching colours, fonts, images and paying attention to the intuitive layout or design of objects.

Figure 2.4   The Q Sensor measures skin conductance, temperature and motion to record a wearer's reactions to events.

2.12   Affective interaction design

An important factor in interaction design is the emotional response of users. Designers must be aware of key aspects in their designs that can influence emotional responses (Sharp, Rogers & Preece, 2007). Critical to the success of products, is the need for products to deliver positive emotions and avoid negative responses. Making use of expressive interfaces, anthropomorphic design and applying affective design principles, can achieve this. Studies have shown that affective aspects can affect a user's perception of usability for a specific product or system (Rogers, 2011; Cyr, 2015).

2.13   How do we design for affective aspects?

Good product design that incorporates affective and emotional design, may lead to very successful products. Efficiency, effectiveness and satisfaction are the three main goals of affective design (Ibid.). Reaching these goals may lead to certain outcome variables that elicit enjoyment, involvement, trust and satisfaction (Cyr, 2015).

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Several factors that influence affective design include the use of colour, visual layout, language used, and images or pictures that allow the user to make a connection with the product. Making important items prominent and clear, and placing items where the user's eye catches them are very effective and powerful methods of directing the user's attention to where it should go (Serengul, 2006).

According to Carrol (2003), a user's perception of how a system works is informed by colour usage, Gestalt laws (e.g. proximity, continuity, similarity), pre-attentive processing theory that is used to distinguish an element of a display from other components with the use of colour, shape, motion, or depth; and affordances that suggest a possible action. Designers having a basic understanding of these theories, and principles associated to perception should anticipate these guidelines when a user interface is designed.

An example of a software product that benefitted from affective design is the online application Mint.com®. The application requires users to share their critical bank routing numbers and other financial details. An application like this is often regarded with distrust and fear because of the request for personal and sensitive information from the user. Mint® was launched in 2006 and faced severe trust issues from potential clients (Walter, 2011). Walter (2011) quotes Jason Putorti, the then Head Designer of Mint®, as saying that he designed Mint® according to human emotions and succeeded in overcoming the trust issues of the users. For Putorti, trust is more of an emotional reaction than a lucid decision, thus he used the power of visual and affective design to encourage this emotional reaction in a positive way (FusionCharts, 2013) and states that:

> *"Flat, function-driven design is boring. It works well in a product such as Flickr, where the content itself is the meaning and delivers the emotional feel. In this case, the job of the UI (User Interface) designer is to get out of the way. A financial management app is a different challenge, the information has to be presented in a useful way that also delights and excites the user"*

Since using and looking at a banking website can be very practical and uninteresting, Putorti chose green as Mint's colour and incorporated more 3D designs to separate important sections from less important sections. The result of this design decreased the probability that users would make invalid clicks. The design was based on minimalism and responsiveness as part of the organizing principles behind the design (FusionCharts, 2013).
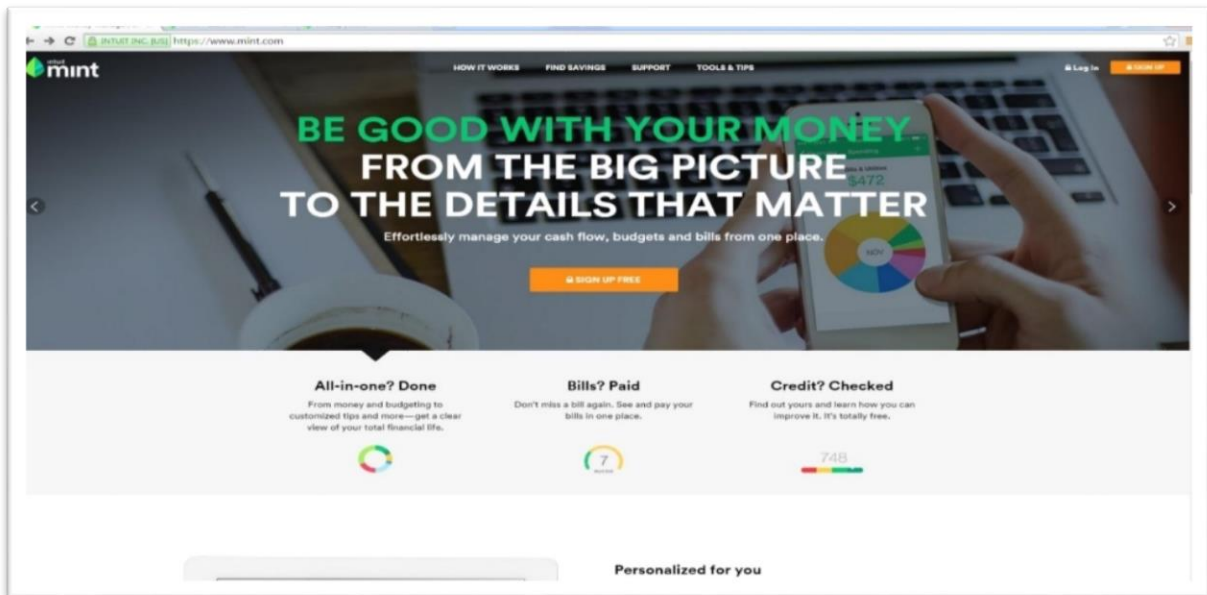
Figure 2.5   Homepage for Mint.com.

The emotional experience of the design is essential for both the designer and the user. Spending time to choose the right colour scheme and design elements for the application was crucial to the design team in order to get the feel exactly right. To further ensure user trust, the icons for the login screen accentuated the secure nature of the page, helping persuade users who might otherwise have been uncertain to give away their bank information. In September 2009, precisely two years after launching the app, Mint® was acquired by Intuit for an enormous $170 million. As of November 2013, Mint.com had more than 10 million users who trusted this product (FusionCharts, 2013). This example indicates that exploiting affective and emotional design in products may lead to very successful products and examples of the screen design can be seen in Figure 2.5 and Figure 2.6.

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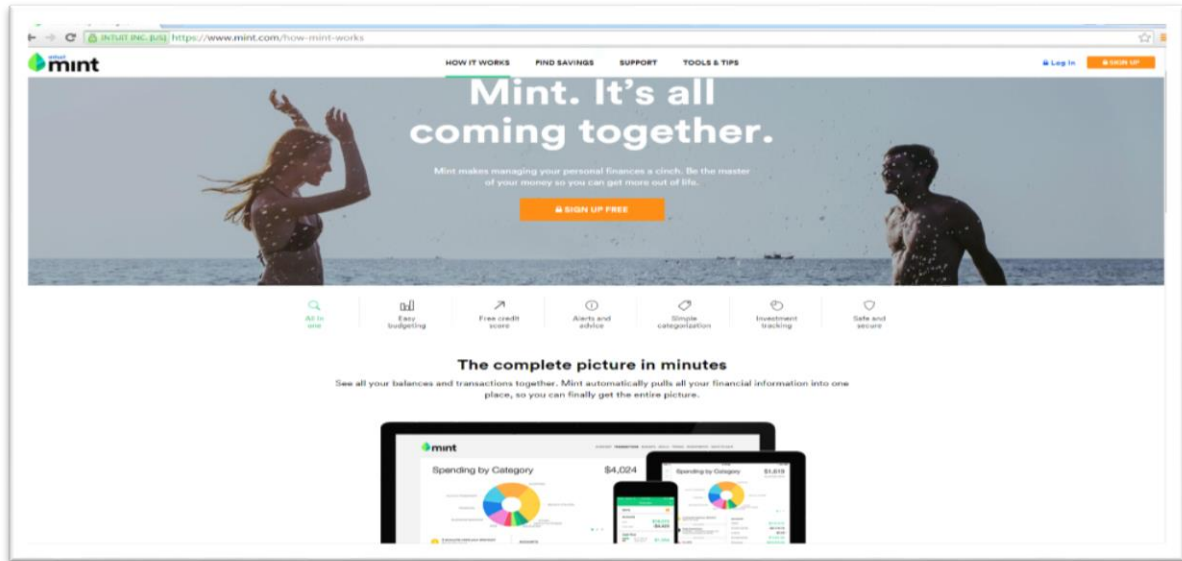
Figure 2.6 An example of a well-designed page of Mint.com.

Incorporating visual and design patterns in a user interface promotes consistency. Gube (2015) believes that it is essential for providing a predictable user experience that reduces cognitive load and facilitates a user's interpretation of how a system works.

2.14   Anthropomorphism and Emotion

Anthropomorphism is the term used when designers of new products assign human-like qualities, emotions or thought patterns to non-human or inanimate objects (Rogers, Sharp & Preece, 2011). Thus, anthropomorphism is a type of personification which is the action of giving human characteristics to animals or objects with the goal of creating imagery. The aim thereof is mostly to make an object or animal perform and look like a human being (Literary Devices, 2013). An example of anthropomorphism is the creation of human-like animals in movies like *The Lion King* and *Shark Tale*. Another example is Pinocchio, the famous wooden doll that was anthropomorphized when he was given abilities of a real human boy. Adding life-like qualities to non-human objects can make a user feel more at ease and reduce anxiety when interacting with or viewing a product, for example LeapPad, which is one of the products of the company LeapFrog.

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The founder of LeapFrog, Mike Wood, searched for a method to help his child learn to read. Many children feel anxious about learning to read and Wood wanted his child, and others, to feel self-assured and eager about learning. With this in mind, LeapFrog was designed as an enjoyable, interactive reading system that brings books and reading skills to life. The next exciting product developed by LeapFrog was LeapPad. LeapPad is an interactive learning system similar to an iPad or tablet that was designed with children in mind. Children tend to learn better when they are having fun. This educational product is a useful, usable and desirable method of learning. Anthropomorphism has been incorporated to a high degree in the interface of the LeapPad as can be seen in Figure 2.7. Friendly faces of animals and objects, like a talking pencil, is part of the interface with which the child interacts.

Figure 2.7 The LeapPad with an anthropomorphic interface.

According to research done by the National Assessment of Reading Progress, LeapFrog products are currently used in more than 120 000 classrooms across the United States (Tag Kindergarten, 2009). LeapFrog can supply more than 40 efficiency studies, case studies and white papers documenting children's, teachers' and parents' use of LeapFrog school programs that indicate the successes achieved by the LeapPad Learning System[2]. For example, at the Unified School District in Los Angeles, USA, the LeapPad system was used as part of their Literacy Centres where pre-school children took part in a year-long study whose dominant tool was the LeapPad. It was found that these children achieved a 74% gain in early reading skills, exceeding those children who received only the standard district literacy program materials.

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[2] LeapFrog Enterprises, Inc. Copyright©

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Overall, the LeapFrog System ensures an enjoyable, exciting, learnable and satisfying experience to its users.

Anthropomorphism is, thus, a commonly used occurrence in adverts, for example, dancing non-human characters in certain children's serials, walking and talking animals and toys, and cartoon characters. A good example of anthropomorphism for adults is the Michelin Man. The Michelin Man is used in the Michelin Tyres Company's advertising campaigns to promote the purchase of their tyres. The ultimate goal of advertising is first, to create brand recognition and, subsequently, a fondness and loyalty towards the product (FastCoDesign, n.d.). The Michelin Man is a chubby character built from tires and is used in various situations to invite the purchasing of the Michelin brand of tyres for the viewers' cars. The message that the Michelin Man sends to the viewers is that the right tyre changes everything. Michelin tyres stick to the road and save fuel. Figure 2.8 shows some images of the Michelin Man as portrayed in advertisements.

In the words of Alison Heiser, Michelin's vice president for marketing: *"His mission is to show that the tire maker, Michelin, does not only keep safety in mind, but is also a "little bit on the edge" in terms of quality and innovation".* According to Tire Business, an industry journal, it was estimated that in 2002 the sales, after enhancing the role of the Michelin Man in adverts, increased to 10% in the North American passenger tire-replacement market from the previous year's 9%. Consumers felt that they could trust the brand and therefore purchased the tyres (Tire Business, 2009).

Figure 2.8 Depictions of the Michelin Man.

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These characters mentioned above, all attract the consumer to buy the products. A familiar example of anthropomorphism in a software application is the Office Assistant in Microsoft's earlier packages. The Office Assistant was an intelligent user interface, or agent, for Microsoft Office that assisted users by way of interactive animated objects, like a paperclip, which interfaced with the Office Help content (Freeman, 2007). However, "Clippy", the animated paperclip, interrupted users when it recognized an activity and offered "help", but never remembered what the users' responses were.   This demonstrated how difficult it was to make an anthropomorphic agent work in the real world (Zimmerman, Ayoob, Forlizzi, & McQuaid, 2005). An example of Clippy is shown in Figure 2.9.
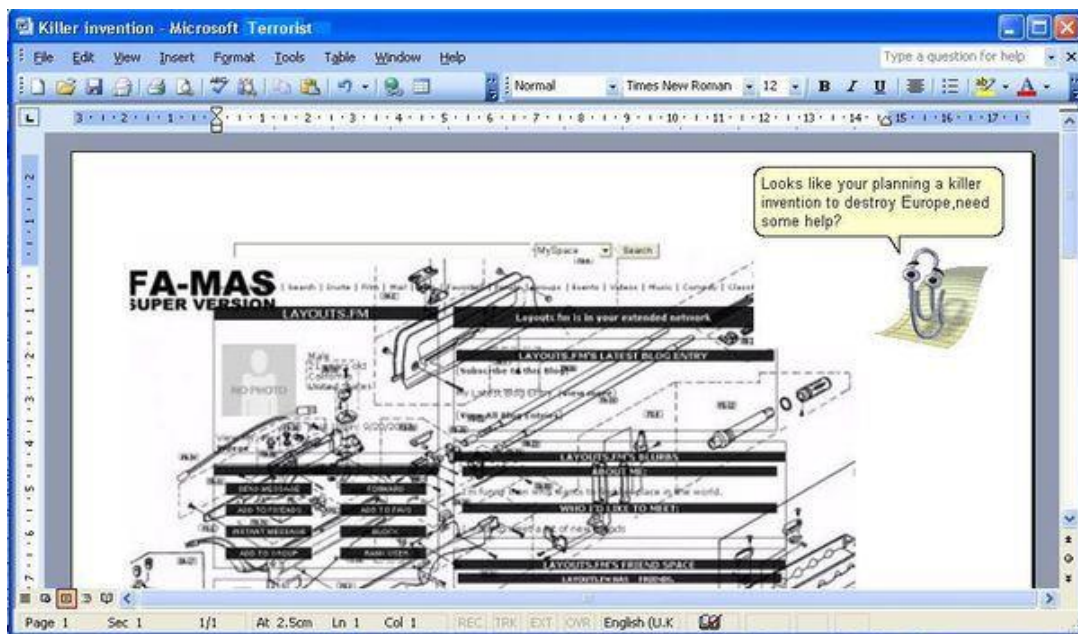
Figure 2.9 An example in MS Word where Clippy popped up unexpectedly.

The main reason for using anthropomorphism is to evoke an emotional response from the user who forms a relationship with the product (Morgan, 2012) and make the overall interactive experience a pleasurable one. As soon as users enter into a relationship with a product, the emotional value of their experience with the product may be like the emotional value of their experience with other people. Interacting socially is mostly a pleasurable experience and infusing a product with anthropomorphic design methodology may lead users to experience a more positive emotional effect when interacting with it (Chandler, 2010).

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2.14.1   *Using Agents in Anthropomorphic Design*

An increasingly prevalent form of anthropomorphism is to create **agents** and other virtual characters as part of an interface (Rogers, Sharp & Preece, 2011). A virtual agent is a computer generated, animated, artificial intelligence virtual character, which usually has an anthropomorphic appearance that can help the user search the web and give assistance or information on products. They can be created to assist as companions or instructors in educational products, assistants for shopping online, and many more.   Agents can be created to be animals, for example, plants or people who interact with the user during the interaction process.

An experiment was done with consumers using an online shopping website that either consisted of a text only interface or one that had a virtual tour guide that interacted with the consumer. The results of the experiment indicated that a more positive effect was solicited from the consumer, a better sense of flow experienced, and more intentions of purchasing products induced where the shopping website with the virtual tour guide was used (Wang, Baker, Wagner & Wakefield, 2007).

Another example of an agent used to assist the user while purchasing products, is **Anna**. She is a virtual agent who helps and supports customers who want to purchase products on the IKEA (a furniture company that has branches worldwide but is based in Sweden) website (De Wolf, Morton & Van Lun, 2016). Figure 2.10 shows an image of Anna as she is portrayed in Sweden. Anna answers questions about IKEA's products, prices, sizes, delivery, opening hours etc. When customers ask her questions, she opens related pages in a browser window. She is also able to express emotions, for example if she could not find the information that was requested. She is a familiar face to millions of customers visiting the IKEA website and is able

to speak diverse languages from around the world about all the different products available (De Wolf, Morton & Van Lun, 2016).

Figure 2.10 Anna, the generic IKEA virtual agent as she appears in Sweden.

The IKEA website is seen in many countries across the world and although most of the websites have Anna as their virtual agent, according to previous research done, there are some countries who prefer not to have the agent. Countries like Spain, Greece, Turkey, Israel, Saudi Arabia, Hong Kong, Taiwan, Kuwait and Romania have the IKEA website without the Anna agent (Data from IKEA websites, 2008, 2009). It was found that a possible reason for not having Anna on the IKEA websites may be contributed to the questions whether it was culturally acceptable or good to have an agent at all, especially because of Anna being a woman. Most European countries, Japan and Australia have the standard Anna figure on their websites as shown in Figure 2.11, but in Dubai, for example, Anna is used but she has much darker hair as shown in Figure 2.12 below.

A question that arises is what an artificial communicator should look like as seen in different cultural contexts. Kipp et al. (2009) note that there are three different female Anna agents found on IKEA's websites, namely the generic Swedish red-haired Anna, a blonde

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stereotypical Swedish-looking Anna who appears on German and British web pages and the dark haired Anna on the web pages of IKEA in Dubai.

Figure 2.11 Generic Anna in Sweden and the Anna portrayed in Germany.

Figure 2.12 Anna as she appears in Dubai in the Middle-East.

The blond and red-haired Swedish agents look like a typical woman working in the sales department of the IKEA Company, while the agent in Dubai represents an image of what a business woman possibly would look like in Dubai. The conclusion is thus that culture plays a role in the presentation of virtual agents in different countries and should be taken into account when designing virtual agents.

Several studies have demonstrated that visual judgments made by the user of a product influence perceived usability (Mbipom & Harper, 2009). These studies have demonstrated that users perceived usability as "what is beautiful and useful" (Tracktinsky, Katz & Ikar, 2000). If the user sees a beautiful product, it is assumed that it will be easy and enjoyable to

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use and this can assist in the learning process as well as the success of the product in a usability context.

2.15   Mobile phone usage

The Internet accessed via a desktop computer or laptop was widely accepted as a communication tool from its early stages in first-world countries. However, in developing countries like South Africa it was the mobile phone that became the dominant communication tool. Since the start of mobile phone connectivity, the infrastructure has grown exponentially and the number of mobile phone users in South Africa currently stands at 42 300 000, which is 92% of the population in South Africa (Vodacom, 2014). Usability theories had a definitive influence on the design of mobile phones as well as on its software.

It is a well-known fact that South Africa has one of the largest telecommunications markets on the African continent (Smith, 2015). In many sectors of the South African population, mobile phones have become a standard and dominant form of voice and data communications. Mobile phones are taking the place of computer internet access and, as recent reports show, more than 60% of South Africans use mobile phones on a regular basis to access the Internet (Smith, 2015).

Even though half the South African population of 51 million people live below the poverty line, more than 75% of those in low-income groups who are 15 years or older, own a mobile phone (Finweek.com, 2013). The research also indicates that mobile ownership at the base of the employment pyramid - households with an income of less than R432 per month per household member - is comparatively higher than other African countries (See statistics in Figure 2.13 below).

South African population	51.8 million
Total mobile connections (active sim cards)	66.1 million
Total unique subscribers (people)	40.7 million
Mobile penetration (active connections to population)	128%
Estimated active smartphones in South Africa	11 million
Estimated mobile data penetration (connections)	39%
Prepaid subscriber base	83%
Post-paid (contract) subscriber base	17%

Figure 2.13 Statistics on mobile phones in South Africa.

Mobile devices are here to stay. According to an eMarketer report, mobile phone penetration would have risen from 61.1% to 69.4% of the global population between 2013 and 2017 (eMarketer, 2014).

With low-cost handsets and the infiltration of mobile networks worldwide, millions of people who never had regular access to a fixed-line telephone or computer now use mobile devices for communication and data transfer (Vital Wave Consulting, 2009). It is not just the devices themselves that make them more universal – it is what they can do for us. Users expect to interact with technology, to touch the screen and expect a response. Our mobile devices are with us all day every day, giving us recommendations, information, directions, and more (The Nielsen Company, 2015). We can make use of mobile devices to enhance our lives by allowing access to applications like mobile health services, among others.

Figure 2.14 The Future of Mobile Device Usage (Tapia, 2014).

Reports of increasing mobile usage, as can be seen in Figure 2.14, have led companies like Deloitte to state that smartphone adoption is likely to increase, and with it, data consumption. South Africa's biggest mobile phone operator, Vodacom, noted a huge growth in new subscribers on their network in SA from 2.1 million to 34.2 million over the last ten years. These figures were published in their year results ending March 2016 (Staff Writer & BusinessTech, 2016). According to the report, the average data consumption of the 14.2 million smart devices on their network, 572 MB per month was used by subscribers (Staff Writer & BusinessTech, 2016).

By taking advantage of the increase in mobile phone usage, available applications may have a better chance or a larger impact in helping improve the quality of live for many people who previously did not have free access to services like health care. By exploiting mobile technology and the related functionality, access to health care, emergency assistance, and other valuable services can be promoted and improved around the world. Moreover, applying

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interaction design principles, like affective design and anthropomorphism to the applications being developed, for instance mobile health applications, may lead to increased adoption and usage of these applications in communities across the globe.

2.16   Mobile Health (M-Health) and technology

Interest in the field of M-Health is on the rise across the world and can be traced to the progress of many interconnected trends (Vital Wave Consulting, 2009). M-Health is an abbreviation for Mobile Health, a term used for the practice of medicine and public health supported by mobile devices. Epidemics and a shortage of healthcare workers are continuously presenting challenges to governments and healthcare providers across the world. Fortunately, the enormous growth of mobile communications and the related technologies like smart applications over the last decade offers new hope for the advancement of quality healthcare (Vital Wave Consulting, 2009). Billions of people now have access to dependable technology, including those who had previously been left behind by the 'digital divide'. The M-Health field has emerged in recent years, mainly as an application for use in developing countries as a means of accessing medical services as shown in Figure 2.15 below.

Figure 2.15 M-Health impact in Healthcare (Tapia, 2014).

Access to healthcare, affordability and quality are problems all around the world (West, 2013). Mobile technology opens ways to address these problems and improve health care delivery to individuals world-wide. Although M-Health applications are mostly disseminated on mobile devices like mobile phones, tablets, and PDAs to provide access to health services and information, they also attempt to affect emotional states (Cipresso, Serino & Villani, 2011). These applications include mobile devices for the collection of clinical health data in communities, delivery of healthcare information to health practitioners, researchers, and patients. They can monitor patient vital signs and provide care directly to patients.

According to the United Nations Foundation in partnership with the Vodafone Foundation (Vital Wave Consulting, 2009), the M-Health field has already begun to change health delivery world-wide with several projects that are on-going. Tangible benefits can be seen through current projects in the developing world, including the following:

- increased access to healthcare and health-related information, especially hard-to-reach populations;
- improved ability to diagnose and track diseases;
- timelier, more actionable public health information;
- expanded access to on-going medical education and training for health workers.

(Vital Wave Consulting, 2009)

In many cases of rural communal settings, Mobile-Health initiatives have not been adopted as expected. Attributing factors may include a lack of knowledge with regard to the use of the technology employed as the delivery mechanism, literacy challenges, fear of technology, affordability, and so forth. The "digital divide" is also a factor to consider with regard to M-Health initiatives not being adopted. The "digital divide" refers to the gap between the more fortunate who have access to information and communication technology and the less fortunate who do not have sufficient access (Huang & Chen, 2010). Fortunately, the use of mobile devices has seen an enormous growth over the past decade, as discussed previously and, as such, mobile devices are reaching further into developing countries than any other technology and health infrastructures (Vital Wave Consulting, 2009).

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The usability and design of these M-Health initiatives may play a pivotal role in the adoption and use of such initiatives. Anthropomorphic and affective usability design principles aim to solicit an emotional or positively reinforced sub-conscious response from users and may influence the adoption of Mobile-Health initiatives if applied to such interventions.

2.17   Chapter Conclusion

This chapter described what user interaction design entails and highlighted the importance of usability in product design. Usability is a central concern in the design, development and use of interactive products and outlines concepts like effectiveness, efficiency, satisfaction, enjoyment and learnability associated with the use of products or systems. A discussion of the user experience and the issue of user engagement related to product use, was included in this chapter. Interaction design was defined and placed in context in terms of usability design, understanding the problem space, the goals of interaction design, and different interaction types were explained.

Related to the experience of the user when interacting with a product, is the issue of the emotions of the user while interaction takes place. The extent to which a user will learn, use or promote a product depends on how convincing the user interface is, what feelings the user experience when using the product, and how trustworthy the user finds the product. Good interaction and interface design are central to achieving this goal and the difference between good and bad design was explored.

Principles that can be applied to products and systems to contribute to a more enjoyable user experience are affective and anthropomorphic design principles. These principles were defined and discussed in this chapter and some practical examples were given in order to contribute to a better understanding of the principles.

Furthermore, as previously mentioned, these principles were applied to an M-Health initiative to determine the effects thereof on user experience, adoption and use. Mobile phone usage

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was discussed and information provided on the tremendous growth of the mobile phone market in today's environment. Mobile Health initiatives were implemented worldwide and the positive contribution M-Health has made toward improving countless lives was identified. In rural communities the adoption of such initiatives has not been embraced as expected and with this study the researcher aimed to apply the above mentioned principles to positively contribute to the use of such an intervention. As the objective was to design an interface so as to bring about an emotional experience from the users, the contextual and cultural aspects had to be taken into account.

When it comes to conducting research, biases toward a specific result or idea is a concern that must be kept in mind by the researcher. However, the purpose of the study was to investigate which of the two aforementioned design principles applied to the interface design of a mobile application were preferred based on the emotional responses elicited by the particular design. From a contextual point of view, the researcher had a limited preference toward the two affective design philosophies under scrutiny when this study was initiated.

The next chapter discusses the research methodology applied to the study, it justifies the data collection method used and refers to the possibility of bias and how the researcher overcame this obstacle. Ethics in the particular study and how the researcher approached it, is discussed briefly. The case community is described and the process of collecting the data from the community by employing action research is elaborated upon.

CHAPTER 3
Research Methodology

3.1 Introduction

This chapter focuses on the data collection selected and employed by the researcher, whilst also providing a justification for the selection for this particular study. Furthermore, the ensuing sections also provide an overview of the research design (RD) and how the selected empirical data collection methods were utilized whilst conducting the research. The scope and boundaries of the study are also presented in this chapter and the case study relevant to the research is introduced.

3.1.1 Planning phase

The planning phase saw the researcher plan for what needed to happen in each of the action research steps relevant to each cycle. The key aspects for the planning phase were:

- *Identify the problem and suggest possible solutions:* Investigating the two design methodologies employed to re-design a current version of an existing M-Health intervention. The ultimate aim was to determine which design methodology would contribute to the adoption and usage of the intervention.
- *Establish a timeline for community visits:* Being mindful to allow ample time for community members to use the versions of the differently designed interventions before scheduling a case community visit and data collection endeavour. Also taking note of the protocol involved in scheduling community visits as explained by the chief of the community. This meant that a request for a meeting with the community had to be lobbied at least two weeks before an intended case visit.
- *Consider the cultural context of the community:* Investigating and determining emotional connections in terms of community-wide relations, perceptions, subjective

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effects, traditional values, and inanimate objects with which they identified emotionally as a traditional community.

- *Decide on approaches to gauge emotion:* Implementing interviews, group discussions, and observation as data collecting tools. Using low-fidelity (LF) prototyping tools to allow for fast development and scrutiny of designs.
- *Implement changes in a revised version of the intervention:* Applying what was learned from the case community visits, the data collected and the scrutiny of the low-fidelity prototypes. Using what was learned to formulate possible improvements and implement these to an improved version of the interventions' interfaces in a high-fidelity (HF) format for the succeeding cycle. Lastly, recording all the steps followed so that evidence was available for scrutiny at any stage of the project's lifecycle.

3.2   Vindicating the Selected Research Approach

The researcher anticipated that a large portion of the results relevant to this study would be expressed or reported in non-numeric terms. This is partly because many of the research questions were open-ended. Furthermore, this study investigated the emotional responses of people when engaging a particular interface design, which is considered hard to quantify, but can be successfully reported on in non-numeric terms. A qualitative research approach seemed appropriate when taking these factors into account.

This study also aimed to understand, or to offer a view on how the emotional responses of the users who interacted with the interface related to the actual usage of the intervention. That being said, the actual use of the intervention did not depend exclusively on the interface and how it was designed, but also on the medical needs of the community members, amongst other factors, as the intervention is for M-Health. What the proper scrutiny, comparison and interpretation of different sets of collected and historical data revealed was that the redesigned interfaces influenced trust in the intervention in some way. Although the chapter focuses primarily on qualitative data, some of the findings are in terms of numbers, usage statistics and the like and therefore quantitative in nature.

In the preceding two paragraphs, the different aims of this study and the types of data required to answer the research questions were considered and explained. Since both qualitative and quantitative techniques were used, it is safe to state that a mixed method approach was ultimately used in this study.

A qualitative approach was used to gather, scrutinize and interpret the data related to the emotional aspects and responses of the two design paradigms investigated in this study. On the other hand, a quantitative approach was employed to assess and quantify usage data and a subset of the interview data related to the two differently designed interfaces (the two design paradigms under investigation) of the intervention (Kothari, 2009).

Before the research design is presented and discussed, the issue of bias is discussed in the next section, as it relates to the overall research design used.

3.3   Bias

The existence of biases is a concern when it comes to conducting research, especially when a mixed method methodology is considered (Gerring, 2004). Biases may exist in both the researcher and respondents in a case study context and can occur in different phases of the research, including the planning, data collection and analysis phase, for example, when an action research RD is considered.

The researcher had no predisposition toward any of the two affective design philosophies when this study was initiated or throughout. As far as the case community is concerned, the ideas formed by the researcher at the beginning of the work was purely based on reviewed literature and only after the subsequent first visit to the case community, did the researcher note any additional ideas formed.

In this study, it was important to consider that some users of the M-Health intervention were illiterate, thus the researcher had to make provision for these instances. As a possible way to counteract the obstacle of illiteracy, the researcher used pictures in the design of the interface.

The data collection methods were adapted to the aforementioned assumption and discussed in every cycle of the research study.

3.4   The Research Design

According to De Vaus (2001), the term research design can be used to describe the overall strategy that the researcher chooses to integrate the different components of a study in a coherent and logical manner: a type of blueprint for the study. A proper RD ensures that the researcher will be able to address the research problem or answer the research questions effectively and includes the details related to the collection, assessment and analysis of the data. The RD, therefore, encompasses the research methodology employed, the data collection tools utilized as well as the method(s) of analysis.

In their work, Vogt et al. (2012) list various RDs as well as which RD to use when and how. The RDs discussed in the aforementioned discourse include action research design, case study design, casual design, cohort design and cross-sectional design, to name a few. Very clear from the literature was that the research problem/questions, particular to a study, determine(s) which research design to follow, and not the other way around. This study used a combination of two RDs, namely a case study and an action research design. The following section gives a short overview of what action research is as well as case study design.

3.5   Action Research

3.5.1   Definition

Action research is described as "learning by doing". A problem is identified by a group of people who then perform some action(s) to resolve it, see how successful their efforts were, and if not satisfied, try again (Ghazala, 2008). Action research is a spiral process that consists of investigating a problem, taking action and finding facts about the result of the action. This

kind of research is about both 'action' and 'research' and the relationship between the two (Power & Naysmith, 2005).

The following is an apt description of action research:

> "*A participatory, democratic process concerned with developing practical knowing in pursuit of worthwhile human purposes… It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people and more generally the flourishing of individual persons and their communities*".   (Reason & Bradbury, 2001)

Action Research has not emerged from a single academic discipline but has developed over time within a wide range of disciplines and professions, including education, psychology, social policy, community development and international development (Brydon-Miller, Greenwood & Maguire, 2003). The action research design employed as well as the execution said action research design is elaborated upon in dedicated sections of this discourse, namely Section 3.9 and Section 3.11.

3.5.2   *The Action Research Process*

Kemmis and McTaggart (2002) developed a simple model of the cyclical nature of the typical action research process (Figure 3.1). Each cycle has four steps: plan, act, observe, and reflect. The diagram shows the four steps in action; the movement from one critical phase to another; and the way in which progress may be made through the system (Kemmis & McTaggart, 2002). At first, a problem is identified which is followed by a combined hypothesis of several possible solutions. After identifying possible solutions, a single plan of action materialises and is implemented (O'Brien, 2001). The next step involves collecting data on the results of the intervention which is then analysed, and the findings are interpreted in terms of how successful the action was.
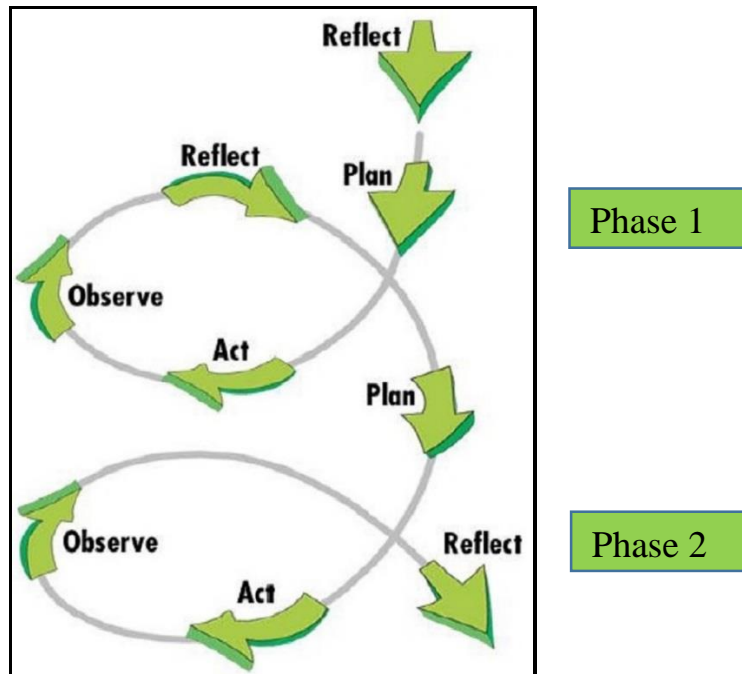
Figure 3.1 A Simple Action Research Cycle developed by Kemmis and McTaggart.

The problem is re-assessed and the process begins another cycle of planning, acting, observing and reflection until the problem is resolved satisfactorily (Dick, 2000, O'Brien, 2001). A crucial step in each cycle is critical reflection. The researcher recollects what has already happened and then critiques the findings (Dick, 2000). The increased understanding which arises from the critical reflection is then put to good use in the designing of the steps that follow.

3.5.3   When is action research used?

Action research approaches have a number of possible and existing applications in international development, including organisational learning and evaluation. Action research is used in real situations rather than in forced, unnatural experimental studies. The reason for this is the focus of action research on solving real problems. However, it can be used by social scientists for pilot studies or initial research in cases where a precise research question cannot be formulated because the problem is vague or confusing (O'Brien, 2001).

Action research is chosen mostly when circumstances require flexibility, where people are involved in the research; or when change must take place quickly in a particular environment (O'Brien, 2001; Popplewell & Hayman, 2012). Those who employ action research are generally researchers who aim to improve understanding of their domain, or academics who are invited into an organisation by decision-makers aware of a problem needing action research but lacking the necessary methodological knowledge to handle the problem.

3.5.4   Action Research Tools

Action research is more of an all-inclusive approach to problem-solving, instead of a single method for collecting and analysing data. This method allows for different research tools to be used as the research is conducted (O'Brien, 2001). The methods include the keeping of a research journal, observations, recordings, questionnaires, structured and unstructured interviews, and case studies. All these methods are common to the qualitative research model.

3.5.5   Role of the Action Researcher

The action researcher's role is to implement action research in such a way that the outcome for all participants is acceptable and agreed upon. The process should also be maintained by the action researcher after the study is completed. According to O'Brien (2001), there are a variety of roles that the action researcher must take on at various stages of the research process. These may include the following: planner, leader, catalyst, facilitator, teacher, designer, listener, observer, synthesizer, and reporter.

Action research is unique in the sense that the researcher has a dual role as both researcher and implementer of the program being studied (Trondsen & Sandaunet, 2009).

3.6   Case Study Design

Yin (2009) defines a case study as the study and analysis of actions, decisions, events, individual(s), organizations, projects or other systems that are studied holistically through

different research methods. In a case study design, data collection occurs over a sustained period of time usually predetermined by the researcher.

This study investigated a phenomenon within a real-life context and a singular case design was employed.

A case study RD was also employed for the following reasons:

- To aid in gaining an understanding of a phenomenon through detailed contextual data collection and analysis and the relationships between events and conditions.
- The application of a set of different methodologies with various sources from which to investigate the research problem.
- Examination of real-life situations relevant to the phenomenon or vice versa and provision of a basis for the application of concepts, theories and the like or the exploration and assessment of a hypothesis.
- The introduction of an intervention with the aim to investigate a phenomenon within a certain context. (Gerring, 2004)

The use of a case study RD was decided upon as the literature suggests case studies especially useful when testing different contextual hypotheses and theories (Stake, 1995). Since this study considered a particular phenomenon within a traditional rural community context, an RD was fitting.

3.7   Ethical Considerations in Research

Research is vital to successfully advance the health and well-being of individuals. In the pursuit of any research, the dignity, rights, safety and well-being of participants must be the primary consideration (Dept of Health Research Governance framework, 2009). This forms part of research ethics which deals mostly with the interaction between the researcher and the people he or she is studying. Section 3.7.1 provides details about the procedure followed to identify and recruit the members of the case community.

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3.7.1 Details about the procedures and criteria that was used to identify/recruit research participants

Poverty, limited health-care services, multi-level illiteracy, cultural and language differences, and a limited understanding of the environment pertaining to the research project may contribute to the possibility of the exploitation of the participants in the sense that the research agenda may be thrusted upon them unwillingly. The researcher kept this in mind, whilst aiming to adhere to the guidelines for ethical research put forward by Emanuel et al. (Emanuel, Wendler, Killen & Grady, 2004). This was done with the objective to minimize the risk of exploitation under the above mentioned circumstances.

As the Tswana community identified for- and involved in this project falls under the ethnic community category and with certain of the identifiers mentioned in the previous paragraph present, the researcher had to keep the conduct of ethical research in the forefront throughout the research process. The Declaration on the Rights of Indigenous Peoples requires researchers to consult and cooperate in good faith with the ethnic people concerned through their own representative institutions. This is important in order to obtain their free, prior and informed consent before adopting and implementing statutory or administrative measures that may affect them[3]. Before taking any actions, the researcher should aim to obtain consent through consultation.

The researcher followed ethical conduct and principles for recruiting the participants. A collaborative partnership between researchers and sponsors in developed countries, and researchers, policy makers and communities in developing countries helps to minimize the possibility of exploitation by ensuring that a developing country determines for itself whether the research is acceptable and responsive to the community's health problems (Emanuel, Wendler, Killen & Grady, 2004).

One of the key issues in recruitment is that the researcher and the communities have a joint partnership and should share responsibility for assessing the importance of research problems,

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[3] Free, Prior and Informed Consent of Indigenous Peoples. Office of the High Commissioner of Human Rights, September 2013.

the value of the research to the community, planning and conducting the study, and distributing and ensuring that results are used for improvements.

3.7.2   *Community Involvement to Facilitate Participation*

Involving the community of a targeted population in the research is a common method to establish trust and ease up barriers that may exist in relation to the community. Outreach workers from the targeted community are identified and employed to establish a working relationship and connection with the community. The inclusion of these "cultural insiders" as investigators is a popular community engagement strategy (Yancy, Ortega & Kumanyika, 2006).

An additional community involvement strategy was employed by engaging and working with organisations that perform social work within the community, specifically churches and other NGO's. According to Yancy et al., community involvement and relationship building are essential when aiming to establish trust and are central components when community-based participatory research is considered. Without the aforementioned, experimental tests, the execution of assessments and so forth are doubtful to be successful in the community on socio-political, logistical or ethnical levels (Yancy, Ortega & Kumanyika, 2006).

3.7.3   *Identification of Targeted Participants*

Cultural arrangements, identification of community members as participants within the context of the research being executed and the strategies employed to recruit such individuals   may influence the participation positively or negatively and could ultimately lead to recruitment success or failure.

The role of the participants in the research were identified and discussions undertaken with the community in question to help recognise desired cultural practices. Visual presentations about the research content, PowerPoint presentations and revealing the impact of the proposed project are all things that could be used to form part of content-related cultural adapting (Yancy, Ortega & Kumanyika, 2006).

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The identification and recruitment of participants in the current research project was done in a joint partnership between the researcher and the community involved. The researcher used a research recruiter who had experience with the community to assist with recruiting the research participants.

Procedures and criteria for recruiting the participants:

a) **A counselling session with the community:** community leaders and cultural representatives were given clear information about the research project in a counselling session before the research commenced.

b) **Sharing information about the purpose of the research:** enough information was given to the community leaders and cultural representatives about the research project in order for them to choose participants from the community in a way that would not cause stigma or damage within the community.

c) **Criteria for including a community member in the research**: verification that a proposed participant was able to give informed consent and had abilities, such as language and communication skills, to take part in the research. A participant could not be a minor.

Procedures and criteria for the recruitment of the research participants:

a) Obtained ethics clearance for the research project, in principle, from the local university.

b) Conducted sensitization sessions to train and counsel participants prior to the design sessions.

c) Obtained community leaders and local cultural representatives' involvement and agreed on terms of reference for participation.

d) Prepared local and culturally relevant information consent forms (pre-study enrolment).

e) Obtained ethics clearance and approval for data collection for the local design sessions from the local university.

f) Conducted information consent sessions with the potential participants to introduce them to the research project.

g) Conducted co-design sessions with participants (plan - prepare materials and agenda; design, reflect - analyse, revise, adapt).

h) Post-study data administration and dissemination.

3.7.4   Informed Consent

As discussed in the previous sections, it is clear that the participants have rights to protection of their privacy. An important document that forms part of any research project where people are involved, is the informed consent form. An informed consent form was drawn up and presented to the community leader. The informed consent form explained the purpose of the study and promised participants that their personal details and performance will not be made public and will be used only for the purposes stated. By signing the informed consent, an agreement was reached between the researcher and the participants to validate the professional relationship that existed between them.

All the relevant information concerning the study were provided at an educational level and in a language that the participants could understand. The researcher had the responsibility to ensure that the study was ethical and that participants were treated with respect.

3.8   Research method employed for the relevant study

Although the research methodology employed in this study was predominately qualitative in nature with action research cycles, quantitative data in the form of usage statistics was included in the final report. Therefore, this study ultimately utilized a **mixed approach** with regard to research methodology.

A qualitative research design allowed the researcher insight into the research problem identified and the obstacles encountered in a rural South African setting. On the other hand,

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action research cycles allowed the researcher to reflect on and refine the relevant interface designs applied to the intervention. Then again, quantitative data assisted with better understanding the relevant usage trends.

The researcher employed a case study to explore and ultimately understand the relation between the case community and the phenomenon. The objective of the case study was to:

1. Observe the phenomenon and describe it with regards to the case community.
2. Document the reactions of the case community to different instances and variations of the phenomenon.
3. Report on the design principle that yielded the most positive reaction from the community from a usage perspective, ultimately indicating the adoption of the design methodology employed.

Principles of action research were also evident where different iterations, after reflection of the intervention interface design, were presented to the case community. Empirical instruments used to gauge community views and opinions included observation, questionnaires and focus groups or group discussions as discussed in earlier sections of this chapter.

The following data collection techniques were used:

- **Observation:** The systematic recording of the case groups' interaction with the phenomenon.
- **Questionnaires:** Open ended questionnaires to allow respondents to elaborate on their experience with the phenomenon.
- **Focus Groups/Group Discussions:** Informal and voluntary meetings between individuals and the researcher to exchange ideas, information, suggestions and needs with regard to the phenomenon.

Unpublished data collected, directly from people, is known as primary data. This data was recorded in a research diary and was as vital as existing literature to the success of this study.

When human participants are involved in research, ethical issues should be taken into consideration as mentioned in the previous section. In the South African context, this fact is especially true and all ethical permissions were solicited from relevant ethical committees before the research commenced. Statistics, generated by an online cloud-based service provider to which the intervention was connected, were used to help the researcher gain insights into the usage of the intervention with regard to each of the interaction designs applied.

3.8.1   *More about the Case: Location and Cultural Background*

This sub-section provides an overview of the case community involved in this study. The information shared here is based on reviewed literature and what was gathered through observations, inquiries and interviews amongst the community members during scheduled community visits.

The Sethakeng rural community was selected as the case sample for this study. The sample was one of convenience in nature, chosen for the purpose of intervention diffusion and empirical data collection. A convenience sample was chosen since the researcher worked with a healthcare professional who was already known to both the community and the PhD student who developed the original M-Health intervention and, in turn, knew the researcher. This eased the process of gaining the community's acceptance and the subsequent permission to work within it.

Sethakeng is located near Kuruman and Dithakong in the Northern Cape Province of South Africa. This area of South Africa is also known as the Kalahari (Figure 3.2).

Figure 3.2 Google Maps representation of the location of the Sethakeng Case Community.

Culturally, the case community was a Niger-Congo or Bantu-speaking one, very traditionally Tswana community, which includes all the Sotho/Tswana clans living either in Botswana, Lesotho or South-Africa.

The community hierarchy consists of a chief (what may also be referred to as a king) as the head of the community. The chief is followed by a community captain, who fulfils the role as the voice of the chief as well as that of the community i.e. the official voice of both the chief and the community members. Community members follow the community captain in the hierarchy, then revered members who also act as a subset of community leaders and are usually older males. The eldest males of each household fulfil the role of the leaders of the households within the community. In cases where there is an absence of a male in a household, the males of the larger, or extended family, act as the leader of that particular household. In extreme cases where there are no males within a particular family, the eldest female may approach the community captain and gain a voice through him to request the role as the head of the household or request for someone else to act in that position. Figure 3.3 depicts the hierarchy of the Sethakeng case community.
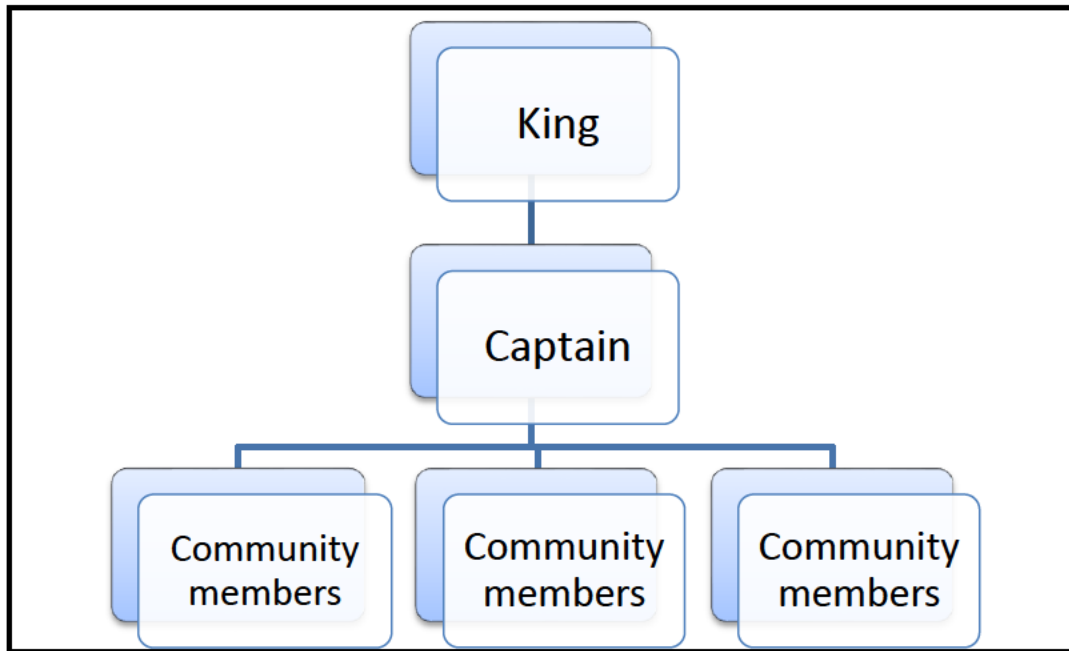
Figure 3.3 The Hierarchy of the Sethakeng Community.

Middle-aged and young men between the ages of eighteen and fifty typically work in the surrounding mines within a 200km radius of the community. Older then act as the surrogate leaders of the households when the middle-aged and young men work at the mines. Older women look after the households and gardens where younger women cannot fulfil these duties because they work in nearby towns. Lastly, younger males tend to care for the livestock, while women younger than 18 assist with various household chores.

Interestingly, it was discovered that the community was also involved in sand mining to generate income for the community. Sand mining is a practice of extracting sand from a type of open pit with excavating equipment. The sand, in the case of the community related to this study, is sold to a concrete manufacturer located in the region. The course, abrasive, sandy composition of the ground of the surrounding Kalahari is almost perfect for the aforementioned application.

The children in the community have access to education through a community-based school with qualified teaching personnel from the community corps itself. Community meetings are

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held either at the school or at the community kraal, or community centre, with various facilities, including the official office of the chief.

Although the general level of literacy within the community was higher than expected, the community struggled with "information literacy". Mobile devices, varying in specification level, were owned by approximately 90% of the community, including adolescents. A number of the older community members from both sexes as well as a sub-set of middle-aged community members where not fully literate.

The researcher observed that the infrastructure of the community was also in a relatively poor condition, with a few homes that had access to electricity, running water and other basic services. Homes were constructed from various materials, ranging from traditional brick and cement to zinc, mud, grass and wood construction. A specific group of community members were responsible for the collection of household waste, which was then burned in a designated area.

Roads leading to the community and connecting to other settlements were made of gravel, rendering the terrain that had to be traversed, challenging. Transport is limited to mainly donkey-carts, bar the few community members who own motorized vehicles. Refer to Figure 3.4 for a limited overview of the community setting.

Figure 3.4 Limited graphical overview of the community setting.

Although the community still believes in consulting a traditional healer, or a Ngak, who is supposed to have powers to intercede on its behalf with the ancestors, many members largely seek medical help from a number of other, less traditional resources, which include "Western" clinics, hospitals and other healthcare providers and services that can be classified under

"Western" medicine (buzzsouthafrica, 2014). However, there are no fulltime healthcare practitioners or services directly available in this community.

A medical clinic used to operate in the nearby settlement of Dithakong, but the particular clinic was not operational at the time this study was executed. The closest point of healthcare access was the town of Kuruman, some 90 km from the community setting. The community members were therefore facing serious challenges, like poor road conditions, access to reliable transportation, etc., that directly impeded regular access to healthcare services. This resulted in a separate investigation into whether an M-Health intervention would be suitable to address some of the healthcare access and provision needs expressed by the community. Subsequently, an M-Health application was developed and introduced into the community and the re-design of the interface of this intervention is what has formed the basis of this study.

A medical doctor, located in the nearby town of Kuruman, provides healthcare services to the community on certain Sundays of a given month by traveling to the community setting with what can be best defined as a mobile clinic. As mentioned earlier, transport was an inhibiting factor with regard to access to healthcare. The community at large therefore welcomed the introduction of an intervention that could perceivably assist the community members with access to the services of the named healthcare practitioner.

3.8.2 *Establishing a relationship with the case community*

When considering a case study RD, it is imperative that the inquisitor forms a relationship with the object (Thomas, 2011), in this case, the community itself. A connection with the object can increase the honesty with which the respondents report accurate information to the researcher. This, in turn, can benefit both the study and the respondents. The commitment and trust of the respondents may also increase and they may more readily accept changes that emerge from the research (Thomas, 2011).

There were certain protocols that had to be followed to engage the community in the research because of the traditional nature of the Sethakeng case community. One protocol involved the researcher personally meeting with the chief of the community, as this was part of the

community values. At this meeting, the researcher explained the reasons for approaching the specific community, what the study involved, and why it was relevant to the community and vice versa.

As previously mentioned, the case study was a convenience sample since the researcher worked with a healthcare professional who was already known to the community and with who a relationship of mutual trust had already been established. Another reason why the study is deemed a convenience sample, as mentioned, is because a PhD study was also already being conducted in the community that used the M-Health intervention albeit to different ends. After personally meeting with the chief, a meeting was held with the community and all the relevant leaders to get their support and permission to allow the community members to take part in the study.

After two weeks, the researcher received permission to engage the community and conduct the research. During a special meeting, the research objective was explained clearly to the community members and consent was given that allowed the researcher to use all data, photographs and other material collected from or related to the community in the dissertation.

As the researcher aimed to investigate the effects of an affectively and anthropomorphically designed M-Health interface with regard to the adoption/use thereof, different looking versions of the existing M-Health intervention were introduced within the community at different stages. Another RD had to be considered not only to conduct the research in a scientifically sound manner, but also to allow enough time to examine the phenomenon properly within the community context.

3.9   Action Research Design for This Study

Conducting research for differently designed interfaces meant that the interface design had to be amended a number of times and that these designs had to be re-evaluated. Moreover, it made sense to investigate the effects of the differently designed interfaces in independent cycles. The term "independent" does not indicate that the completion of one cycle naturally flowed into the next cycle of the succeeding design paradigm under investigation, but rather that each design paradigm was treated independently from another.

Action research was therefore also utilized during the course of this project. Figure 3.5 is a high-level depiction of the intended, inclusive course of action.
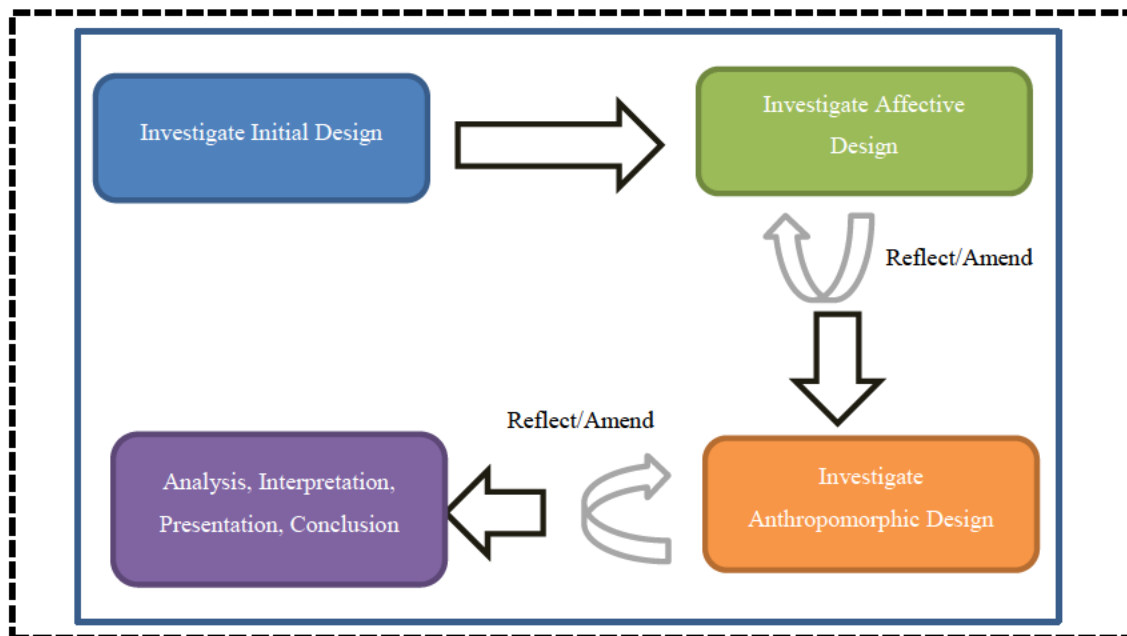
Figure 3.5 A high-level depiction of the intended action research cycles.

It was envisaged that two action research cycles would be executed with regard to each of the re-designed interfaces according to the different design methodologies under investigation. The problem-solving process would therefore be cyclic-progressive in nature. The action research RD provided the researcher with the necessary platform to determine the situation of interest and introduce an intervention in the form of the re-designed user interfaces. Subsequent sections of this chapter are dedicated to discussions of each performed cycle.

The reasons for including an action research design for this study was because the researcher was the entity who introduced an intervention within a certain case context and thus also the phenomenon under investigation, lead the inquiry as well as undertook the necessary action(s), analyzed and interpreted the resulting data, from an introspective point of view, performed the role of an agent conducting the particular study with the aim to change that which was being researched and acted as the primary facilitator and inquisitor.

The aim of the research was interactive inquiry to better grasp the phenomenon within a particular community context and a series of reflection, re-design and application cycles were followed (MacIsaac, 1998). The actions taken, were based on some form of response, i.e. the actions were response driven and ultimately the aim was to improve interaction design practices relevant to the two investigated design paradigms by suggesting a set of guidelines in the context of interaction design, the investigated design paradigms and the case environment from the research conducted.

During each of the action research cycles, the researcher aimed to make use of both qualitative and quantitative techniques and related tools to gather data, with members of the case community playing an active role in the process.

Many scholars agree on the basic components of the action research process. Davison, Martinsons and Kock (2004) sum the action research components up in an ascending list of steps to follow when engaging in action research. These four steps are as follows for each action research cycle:

a) *Planning:* Identify the problem area/research questions and suggest possible solutions.
b) *Taking action:* Identify what data is needed to answer the posed research questions. How will the data be obtained? Introduce the intervention.
c) *Data collection/Observation:* Collect data by using existing empirical methods or newly designed methods. Observe the effects of the action(s) taken. Analyse the data.
d) *Reflect:* Evaluate and describe both the actions taken and the effects of the actions.

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The action research steps presented here, also referred to as phases, offer an encompassing view of action research steps put forward by different scholars. Some scholars like Mertler (2012), for example, outline seven steps related to each action research cycle. However, the researcher found the preceding four steps the most inclusive of those investigated and is of the opinion that they were sufficient for this study.

According to Martinsons et al. (2004), each of the action research steps includes a series of guidelines. Guidelines, additional comments and amendments relevant to this study are summarized in the sections that follow.

3.9.1 Taking action

A plan had to be formulated, after which action was taken to implement said plan. Following is a summary of the key aspects considered:

- *Implement LF prototyping tools:* LF prototyping allows for fast prototyping and scrutiny, affording rapid amendment to the utilized prototype for further usability testing. As LF prototyping usually does not incorporate any, or very little functionality, the researcher developed an LF prototyping method based on the underpinnings of storyboarding and named it interactive storyboarding to simulate interactivity. This method allowed for rapid amendment, community member scrutiny, and also for data collection through observation.
- *Use approved methods for data collection:* Observations, group discussions, interviews, research diary and video recordings were used.
- *Develop tools for data collection purposes:* As mentioned earlier, the researcher developed interactive storyboarding method also served as a conduit for collecting data. Furthermore, a novel paper-based recording instrument was developed based on the principles of interviews, checklists and pre-determined anticipated reactions. A succeeding section of the discourse is dedicated to discussing these two tools.
- *Create groups for participation in action sessions:* Community members were divided into different age groups to allow candid responses during the data collection process. As the case community was a very traditional African community, women

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and younger members were not allowed to speak their mind to the extent that usable data could be collected when in the same company as the men and other leaders of the community.

- *Perform data collection:* Data collection methods and tools, developed particularly for this study, were used.

- *Keep clear and consistent records of what has been found:* Notes of observations, comments and discussions were made for future exploration in a replicable, consistent manner.

3.9.2   Observe

Observation used various methods to record the reactions, feelings, comments and emotions of the users while interacting with the intervention.

- *Record observations:* Focused on the actions and emotions of the users and all findings were recorded as far as possible. Video recordings were made of relevant interactions for later scrutiny.

- *Be aware of non-verbal indicators:* The facial expressions and body language of participants were very important. Valuable information may be collected by what is left unsaid. This was accomplished by reviewing video material.

3.9.3   Reflect

The reflection step entailed the following:

- *Critically reflect on the action that was taken during the action research cycles:* Recall what had already happened and critique findings.

- *Identify what the outcomes were of the planning phase:* Think of the issues and objectives identified in the planning step and reflect whether they were addressed and/or achieved.

- *Delve into what was discovered about what worked and what did not:* Consider that the findings may not be what was expected, uncover what the actual findings meant and how they influenced the project, and what the way forward should be.

With the aim on consistency, the researcher decided to follow the afore mentioned framework during each action research cycle involved, whilst utilizing the data collection instruments as discussed in the section that follow.

3.10   Data Collection Instruments Utilized

This section looks at how the selected data collection instruments (Chapter 3) were utilized and to what ends. Four instruments for collecting data were employed, namely observation, interviews, focus groups and the proprietary statistical analysis functionality of the cloud storage service used by the intervention. Each instrument produced different sets of data that will be discussed in the next chapter of this discourse.

3.10.1   Observation

Preece et al. (2015) note that observation, as a data collecting instrument, can help researchers understand the context, tasks and goals of participants relevant to a particular research problem. Direct and indirect observations are both acceptable forms of data collection where, for example, individuals are observed engaging in a given task in a natural setting or in a controlled environment.

Taking the experience as well as the comments made by Robson (2011) into account, the researcher formed a very basic framework to structure and focus the observation data collection process.

The framework identified items to look for, namely:
2. The person or people who were interacting with the intervention.
3. The place where the intervention was being used.
4. The activities and goals engaged in.
5. What the actions performed were.
6. What the feelings and/or mood of the group were.

This framework proved very effective in helping to keep the research aims in sight during the observation process. Observation, however, goes further than looking at what people do with what, where and how. Ting-Toomey and Chung (2005) argue that non-verbal communication like facial expressions, hand gestures and other nuances of human behaviour can actually tell a lot about what a person is feeling, experiencing or not communicating verbally. Furthermore, inanimate objects have also been found to have significance where emotions are concerned; for example, the Swastika emblem invokes different emotions in different people. These arguments resulted in the researcher also making use of video records to record the participants when engaged in a particular task, for later analysis.

The researcher, using the framework mentioned earlier in this section, assumed the role of participant observer, meaning that the researcher actively engaged the community members whilst observing their actions. The environment where the community is geographically located, including the natural settings, the houses, traditional artwork, and so forth, were observed and notarized.

To help the researcher gauge the immediate feelings related to a task or a question that was raised, the researcher developed a graphical emotions display tool. This was done to help the researcher record the emotions experienced at a particular juncture of the observation process. As humans can experience a multitude of emotions, some which may be harder to observe, the graphical emotions display tool was limited to six emotional responses. Figure 3.6 illustrates the aforementioned tool.

Figure 3.6 The graphical emotions display tool.

Sets of these images were created and handed out to the community members. They received training on how to use these images and what emotion each image represented, although the represented "emotion" was also visible in text on each image. The images were also connected to an observation checklist (figure 3.7 and Appendix A), which was developed to help record the emotional responses of the community members to compare with the video material at a later stage. When tasked to give an emotional response about a specific task to be completed using the intervention, or presented with a layout of a re-designed version of the intervention's interface, the community members were requested to hold up the image which best described the emotion they were experiencing at that stage. They were also requested to use the think-aloud method (Erikson and Simon, 1985) to verbally confirm what the images they were holding up, were expressing.

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Observation Checklist for accessing and using the M-Health Application – Version 1 (current version)						
Emotions displayed	**Didn't know what to do**	**Bored/ Unsatisfied**	**Surprised**	**Uncertain / Do not trust this**	**Satisfied**	**Very satisfied**
Task						
Accessing the application from the smart device						
Log in screen: Logging in to the application by selecting correct group						
User Menu: Does the user understand the meaning of the icons?						
User Menu: Comments on the use of colour and icons – how does user feel about the elements?						
User Menu: Ability of user to click on the correct and desired action – message, map or info						
Communication Menu: Does the user understand the meaning of the icons?						

Figure 3.7 A snippet of the observation checklist related to the graphical emotions response tool.

The think-aloud method was also employed during other observation endeavors, with the aim to better gauge what the community members were thinking or feeling, when, for example, they were confronted with a particular interface design. This method was employed in one-on-one observation sessions that were set up in the community kraal (centre), where the researcher had more control over the environment, etc. In addition, observation notes were recorded by the researcher in a research diary for later reflection.

3.10.2 Interviews and Focus Groups

Fontana and Frey (2005) define interviews as conversations with purpose. Four main types are commonly used: **open-ended**, also known as **unstructured interviews, structured interviews**, **semi-structured** and **group interviews**.

Group interviews were decided upon as the researcher enforced a fair amount of control on the conversation and developed a pre-determined set of interview questions. The researcher also performed the duties of facilitator to guide the group interviews. What is more, the interviews ranged from informal to formal, with the aim to collect data related to first impressions and reactions to new designs as well as to record feedback about particular design features respectively.

The community members were divided into groups of no more than ten people representative of gender, age and social standing within the case community. These focus groups formed the basis of the group interviews. Closed and open-ended questions were asked with regard to the different interface designs of the developed intervention as well as questions relating to the community's background, beliefs, etc. The focus groups were composed and designed to encourage candid responses, as was the setting of the interviews, the community kraal (centre): neutral, yet familiar. The open-ended questions allowed detailed answers to collect a richer set of data from each group, whilst the closed questions allowed the researcher to collect opinions with regard to the interface designs that could be analysed, scrutinized and presented quantitatively. All focus groups were subjected to the same questions within the same setting, albeit at different times.

A framework from the work of Robson (2011) was used to develop the interview questions. The framework outlines the following:

- Do not make use of compound sentences when posing questions.
- Keep all questions as short as possible, addressing one issue at a time.
- Do not use design language when referring to design aspects in a question.

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- All questions should be as neutral as possible without inferring any preconceptions or aiding the answer in any way.

The responses to the closed questions were recorded on a list that included the possible answers to the posed questions next to check boxes that were simply checked throughout the group interview process. Responses to the open-ended questions were recorded with an electronic recording device.

3.10.3   Cloud Analytics: Using Proprietary Cloudware

Cloudware is software running on a remote server that is connected to the internet. The software can provide a wide range of functionality and services, from database storage facilities to data back-up services, to name a few (Petcu et al., 2011). The intervention introduced to the community used a cloud service for storing a rich array of user-related data. The service permitted the requisition of data, within defined parameters, analysis of data as well as the reporting of subsets of data through a virtual analytics dashboard. The service also allowed the analysed data to be downloaded and stored on a local machine.

This functionality proved especially valuable as far as usage data was concerned. It allowed the researcher to query, for example, usage data between certain dates, related to certain users. If one considers that the different interface designs were introduced at different times during the study, one can appreciate the functionality of the relevant cloudware and its usefulness to the data collection process.

The data collected by the cloudware and the relevance thereof is presented and deliberated upon in the following chapter.

3.11   The Action Research Cycles: Executed

The action research steps introduced in Section 3.3.2 were followed and applied to each action research cycle engaged in, as mentioned earlier. The succeeding sections focus on the

objectives of each action research cycle. Three action research cycles in total were executed and in each cycle, a different interface design was investigated. The community was exposed to three differently designed interfaces, the first design was the one with which they were familiar and had been using from the intervention's introduction. The second was based on affective design principles, and finally, the third design was developed by employing anthropomorphic principles.

3.11.1 Action Research Cycle One: Investigating the Initial Interface Design

The first action research cycle was dedicated to exploring the feelings the community members associated with the use of the initial version of the interface design. This research cycle also explored the subjective emotional relationships that might have existed within the community and aimed to identify them. The relationships between the community and colour, patterns observed in traditional art, animals, people, faith and beliefs as well as inanimate objects were explored with the aim to develop an interface that could solicit emotions from the users. The affective designed interface was introduced in the second research cycle.

The investigation related to the initial design of the intervention lead the researcher to consider the effects that participant biases may have had on the data collection process when the investigation into this particular design commenced. After all, the users of the intervention were used to it. They were already familiar with the buttons and menu design, the layout and general design as well as the colours used and the associated functionality of the interactive sections of the design.

After the reflection step of this first cycle was completed, it was decided not to engage in a second round of investigation within this cycle. A rich set of data already existed and was accessible via the cloud service mentioned earlier and the data deemed relevant was collected during the first, and only, iteration within this cycle. Moreover, it was never the objective to amend the design of the initial interface within the context it was created and presented. This version of the design did not consider the emotional aspects of design as is the case with the affective and anthropomorphism design approaches, but focused rather on addressing functionality as a primary design objective.

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The data related to the subjective emotional connections that exist within the community and amongst its members was used to develop an interface based on the principles of the affective design approach. This design was transferred to the second action research cycle.

3.11.2   Action Research Cycle Two: Investigating the Affective Design

The objectives of the second research cycle were to investigate the effects of an affective designed interface in terms of intervention adoption and usage as well as to refine the interface design. Furthermore, the second round of this action research cycle was utilized to explore issues that could be useful when considering anthropomorphic interface design within the community.

It has already been mentioned that the data collected in action research cycle one was used to aid the development of an affectively designed interface. Not mentioned, though, was that the first iteration of the interface design was not based on the data collected during the first action research cycle, but on affective design principles based on theory, i.e. what was learned from the reviewed literature. The literature that was investigated covered the affective design approach and principles related to varying contexts as well as general background studies and reports with regard to the Tswana people.

The information emanating from the literature and the analysed data from research cycle one enabled the researcher to design an interface for the intervention that aimed to solicit emotional responses from the users. This meant that the design also aimed to accommodate the emotional needs of the users and address issues like trust, for example. Jarvenpaa and Tractinsky (1999) state that cultural factors shape people's trust, attitudes and related behaviours. As the goal was to design an interface so as to elicit an emotional experience from the users, the contextual and cultural aspects had to be taken into account.

During the first round of the second action research cycle the investigation focused on exploring the emotional reactions of the community toward the affective designed interface, whilst carefully noting relevant comments from the focus groups especially. After the reflection stage, nominal changes were made to the design and the process of collecting data,

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relevant to the refined design, was engaged by using the same methods as with the first round of this cycle.

The researcher also used the second round of this action research cycle to explore contextual factors that could be utilized in an anthropomorphically designed interface attempt. During a second reflection stage, all data and thoughts were recorded and the affectively designed interface was reviewed for the last time. By combining information that emanated from relevant theory and on what was learned from the second round of this action research cycle regarding anthropomorphic issues, the researcher designed an anthropomorphically designed version of the interface before moving to the third action research cycle.

3.11.3   Action Research Cycle Three: Investigating Anthropomorphic Design

When an interface designer assigns human traits to non-human or inanimate objects, it is classified as anthropomorphism or anthropomorphic design (Preece et al., 2015). Anthropomorphism can be found in many forms of literature, especially in fairy tales. In recent years, it has also been applied to create software agents or avatars and has even been used to create the very popular emojis used in mobile communications to express emotion.

The third research cycle introduced an interface design based on the principles of anthropomorphism and presented four software agents, based on the inquisition regarding this topic during round two of action research cycle two. The objective of the particular design was to enhance the user experience, whilst aiming to elicit or invoke emotional responses from the participants.

The data collected from the first round of this action research cycle was analyzed and subsequently reflected upon. Changes were made to the anthropomorphic design and introduced during the second round of action research cycle three. The reflection stage of the second round of this action research cycle saw the researcher recording related final thoughts, findings and what was learned with regard to this action research cycle.

After the conclusion of action research cycle three, the researcher moved to final data analysis, interpretation and presentation with the objective of examining the information against what was hypothesized.

3.12   Chapter Conclusion

This chapter was discussed the research approach selected for this study and the research design, which consisted of a case study design as well as an action research design. Also, included in this chapter was an overview of adapted action research steps, an introduction and discussion of the case community and how the researcher established a relationship with the community.

A detailed discussion followed regarding the data collection tools employed as identified in this chapter, whilst novel data collection tools developed for this study and how they were employed were also reviewed. Finally, insights were given into the action research cycles, what each cycles aims were, and how the cycles were executed.

The following chapter will introduce the different designs as referred to in the action research cycle discussions. It was decided to introduce and discuss the different designs in the following chapter as the designs resulted from the data collection process and information gathered from literary sources. The next chapter will also include the presentation and the discussion of relevant analyzed data.

CHAPTER 4
Data Collection and Analysis

4.1   Introduction

This chapter focuses on different topics arising from the data collected and analyzed. The discussion commences with a summarized view of the original design of the M-Health application as well as a high-level description of the application's functionality. The researcher decided to review the latter because of the belief that functionality drives design in many instances (Plutchhik, 2001).

Following sections of the chapter are dedicated to reviewing the analyzed data as collected in each action research cycle as well as elaborating on the insights gained from the analyzed data.

4.2   Background: The M-Health Application

M-Health applications have been developed with varying aims in mind, ranging from a simple "remember to take that pill" application to more sophisticated interactive applications that allow doctors to provide on-site medical advice without the limitation of distance.

The M-Health application related to this study was developed to assist a rural community in gaining meaningful and regular access to health services and information. These aims were based on the needs of the community as identified by them, as well as those of the healthcare provider mentioned elsewhere in this study.

The developer of the application related the needs into the features of the application and to accomplish the encompassing aims, the application included the following functionalities:

1. GPS patient-location sharing ability to allow emergency response time;

2. Instant messaging (IM) with voice and "chatroom" between connected patients as well as the healthcare professional;

3. Image sharing between patient and healthcare professional;

4. Remote diagnosis abilities via video-sharing and live video functionality;

5. Virtual healthcare notice board to share information with patients and community members in general;

6. A scheduler to indicate the personal visits of the healthcare professional to the community. Here, the application used visual and audible alerts for easy information dissemination.

Community members where trained to use the application over the course of three community case visits.

4.2.1   *The Interface of the Application*

Figure 4.1 graphically depicts a collection of screenshots of the user interface of the first iteration of the M-Health application. As the user interface is the section of the application that interlinks the user, the device and the application, one can consider the user interface as the representation of the interaction design portion of the M-Health intervention.

The interface was designed with simplicity of use in mind, not taking any emotional aspects of the user experience into account at all - not directly that is. The assumption was that a level of satisfaction would be experienced when a user was able to complete an intended task successfully, as will be discussed later in this section.

Using research from a separate study, the developer considered the basic and technological literacy of the community members at inception and development of the interface, and therefore limited text-based input. This does not mean that the developer did not cater for those community members who were literate and would be able to engage the healthcare professional via text. Certain sections of the intervention do allow for text-based communication amongst community members themselves and with the healthcare provider.

4.1 a. Login Screen

4.1 b. User Menu

4.1 c. Communication Menu

4.1 d. Health Info
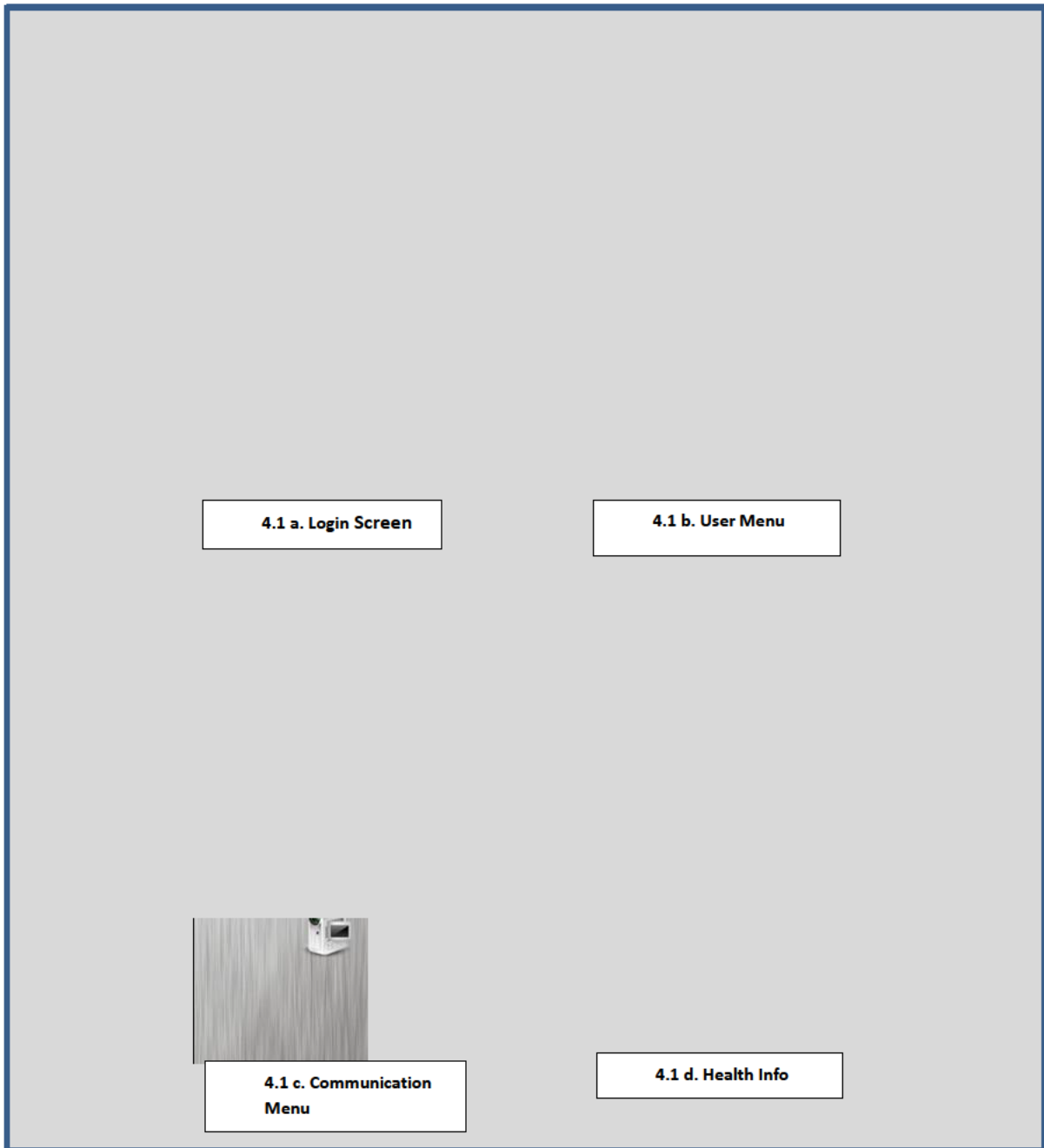
Figure 4.1 Graphical depiction of the user interface of the first iteration of the M-Health application.

The most fundamental functionality of the application was driven by image-based interaction. This means that an illiterate member of the community or one with limited literacy and technical ability was given access to sections of the application to engage functions that could potentially save his or her live or provide him or her with a sense of comfort, for instance the

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assurance that when the GPS locater was activated, it worked properly and someone would respond to the emergency.

In Figure 4.1, the first screen (4.1 a) is the opening screen the user was exposed to when the application was activated. The numbers signify a specific group of users, the number 1 was assigned to senior male members of the community, ranging from age 55 and up. The number 2 was assigned to senior female users from the same age grouping as the senior males. Numbers 3 and 4 were assigned to middle aged males and females, respectively, ranging from the age of 40 to 55. Number 5 was assigned to the younger male grouping ranging from age 16 to 40 and number 6 to the female counterparts of this age group.

These age classifications were done, in part, to track the application's use among the varying age groups within the community as it was relevant to the original study for which the application was initially conceptualized. These groupings fall beyond the scope of this study, but had to be considered with regard to the re-design of the application. The "A" designation allowed the healthcare provider access to functionality and was therefore assigned to and relevant to that particular party.

The next screen (4.1 b) represents the first screen the users were exposed to after logging in in their particular age groups. This section of the application allowed the users access to the communication functionality of the application, the GPS locater functionality or to receive the latest medical communique from the healthcare provider. Once the communication section of the application was engaged, the third screen in Figure 4.1 (4.1 c) was activated and the user could choose to engage the healthcare professional via text, audio, image, or video. The final screenshot in Figure 4.1 (4.1 d) depicts the healthcare communique as posted by the healthcare professional. This could be audio, text, or video.

Assessing the emotional responses of the users in relation to the usage of the application posed a daunting task. The next section elaborates on the protocol followed in attempting to do just that.

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4.2.2 Assessing Interaction Design

How can one conceptualize good or poor interaction design from a user's perspective? What feelings do an interactive product invoke during or after using an interactive product? The terms "good" and "bad" are already as subjective as emotions.

Usability, represented by interaction on either the digital or physical level of interactive products, is a central concern of design, development and use. The concepts learnability, effectiveness, efficiency, utility and overall user enjoyment while engaged with the product, are all captured within the term usability as discussed in Chapter 2. Examples of good and poor design of similar products can therefore be assessed and compared by examining the constituents of usability in terms of each design, irrespective of perspective.

In the case where the re-design or re-development of an interface or product is considered, the design issues of the current design or intended design should be taken into account, assessed or compared (Garret, 2014). Garret (2014) stresses that user experience (UX), which includes the emotional aspects of the interaction design, is a close second concern to that of usability, if not equal when considering interaction design. Everything that humans engage with has a user experience, from the newspaper to the applications on a smartphone. It includes the overall impression and emotions the user is left with during or after the experience of engaging with the product. More specifically, it is about how the interaction makes users feel, from holding the product and looking at it down to the sensual effect with which the interface or product leaves the user. User experience cannot be designed, thus the aim should be to design *for* user experience since the experience of the user influences the overall perception of the product and may also influence the use thereof (Preece et al., 2007).

Based on investigated literature, the researcher holds that it is possible to link certain emotions to the usability aspects mentioned earlier in this section, e.g. learnability. Learnability refers to how easy or difficult it is to master a system, device or product. If difficult, it may lead frustration, thus linking emotions, usability and learnability. This then lead to the question: What emotions will be at play when interacting with the application?

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The researcher decided to use observation and then interviews as the data collecting tools to address this question. The aim was to identify items and activities that the community members engaged with and in on a daily basis. This was accomplished by observing and notarizing the day-to-day doings and beings of various representative community members. Two examples of items that were identified as being used extensively by the middle-aged to senior groups of male and female community members were donkey-carts and gas-stoves respectively. Many other items and activities were recorded.

The exploration of the emotions related to the identified items and the associated activities were explored by conducting semi-structured interviews after the observation process was concluded. The usability aspects associated with the items and activities were explored first by asking certain questions. The emotional connections were explored thereafter by following these questions up with a range of sub-questions. To illustrate this process, the first action research cycle and the questions that followed revealed that very few community members owned motor vehicles and therefore many used donkey-carts as a means of basic transportation. The following is an excerpt from the actual interview developed and conducted for the identified items and activities:

Question: *"I have noticed that you use your donkey-cart quite often. How many donkeys do you own?"*
Answer: "Yes, we use the donkeys to get around and run errands. I have four of them. If I use two for the cart, then the other two can stay at home and rest."
Question: *"Do they have names?"*
Answer: "Yes, of course. How else will I be able to call them? One is called 'Long Ear', the other 'Hiccup', then there is 'Jas' and also 'Pale Boy'."
Question: *"How long have you been making use of your cart for transportation?"*
Answer: "Since I was very young, maybe 8 or 9 years old. It was my father's cart first. He was the one who taught me to harness the donkeys and operate the cart."

These questions were asked to establish a relationship of interest between the interviewer and the interviewee.

Question: *"Was it easy to learn how to operate the cart and harness the donkeys?"*

Aim of the question: Establish the learnability of using the donkey-cart.

Answer: "I did struggle at first. If the donkeys are not used to you, then they can be a bit wild. If the donkeys are used to you, the process becomes a lot easier. It is easy to learn to operate the cart. Even my children of 6 and 8 years can operate it. It is very easy."

Question: *"How did it feel when you struggled to harness the donkeys?"*

Aim of question: To establish the emotional connection associated with the learnability aspect.

Answer: "It was so long ago, but I remember feeling scared at first, scared of getting hurt by the donkeys, you know? Then, when I struggled with the harness, I felt frustrated and angry too."

Note: The above transcribed conversation was translated from Afrikaans to English for the purpose of this study. The interviewee was a middle-aged member of the community and made use of his donkey-cart to travel to the nearby sand-mining operation where he was employed.

The example of the interview presented in the preceding text of this section demonstrates the types of questions that were asked and how they were approached. The aim of the questions, as stated, was to link the usability aspects of items and the associated activities to emotional responses. Emotions of anger, frustration and fear are expressed in the scenario above. The non-verbal indicators visible on the video recording are those of pride (when speaking about the donkeys and the ability to operate the cart since an early age) as well as signs of joy. This was pointed out by a certified psychological professional who assisted the researcher in identifying emotional indicators during the course of this study. Though not directly connected to a usability aspect, these emotions were connected to the object and the associated activities, in this case the donkey-cart as a means of transportation.

One of the goals of this study was to produce a set of interaction designs for emotion guidelines, albeit delineated to this community and generalized at a later stage as part of continuing studies. To accomplish this successfully, the researcher found it necessary to identify emotions relevant to interacting with objects and the associated activities. The ultimate aims of the interviews

were to construct guidelines and determine what to assess in terms of emotions. The following emotions were identified from the various interviews as relevant when interacting with interactive objects to complete certain tasks:

- Enjoyment
- Involvement
- Satisfaction
- Trust

This list of emotions or emotional indicators was used to both develop the guidelines presented later in this chapter, as well as to indicate what to look out for and assess when reviewing the emotional responses of users interacting with an interactive product.

The following sections provide an overview of each of the emotional spheres identified. Both what could be found in literature and what was observed during the data collection process are discussed in terms of what the re-design of the M-Health application's interface should aim for.

4.2.3   *Enjoyment*

Enjoyment, as a user experience goal, has been used to measure the user's affective perceptions and expectations of products, systems and designs from as early as 2003 (Sun & Zhang, 2006). As suggested by Warner (1980), enjoyment encompasses three dimensions namely engagement, positive affect and fulfilment. The idea of enjoyment is a strong predictor of the user's approach towards a product (Childers, 2007).

From the data emanating from this study, it is thought that emotions are triggered in the user based on a response to specific design elements. The user may feel a sense of satisfaction, for example, when colours used are appealing, or when a graphical design stimulates enjoyment or excitement (Cyr, 2013). With regard to the M-Health application in question, this could be achieved with an attractive layout of screen designs, e.g. colours with which community

members can associate, menus that are easy to navigate, input boxes, meaningful graphics and an overall visually appealing "look and feel".

4.2.4   Involvement

While there are many other definitions thereof, Koufaris (2002) views involvement as a person's motivational state, i.e. interest, arousal and drive towards an object where that motivational state is activated by the relevance or importance of the object in question. Thus, if the application allows user involvement, an affective response such as enjoyment that will be greater than a provoked perceptive reaction could be attained.

In terms of the current version of the application, involvement suggests a user emotional response that includes engagement and eagerness with the characteristics of the application and therefore incorporates the components of "flow" as mentioned in Chapter 2. Invoking a feeling of involvement regarding the application may result in more interaction with the application in question since interactivity allows the user to potentially have a sense of control over the application's content and actions performed. The inherent ability of the application to allow users to interact with the healthcare provider may ultimately lead to feelings of trust, loyalty and satisfaction in the user.

Previous research found that interactivity, whether in a website, mobile application or product, resulted in user perceptions of efficiency, effectiveness, enjoyment and trust (Cyr et al., 2013). As the current version of the M-Health application does allow for interactivity between the healthcare provider and community members a feeling of empowerment might be evident among the community members who engage the M-Health application.

4.2.5   Trust

Good usability can have a massive impact on trust with regard to the user of an application, website or product (Cyr, 2013). As previously mentioned in this discourse, Mobile Health is a fast growing sector where a strong relationship or connection between healthcare and the users of these applications is facilitated through ICT (Buttarelli, 2015). The healthcare market is complicated in the sense that the personal information of users may be processed and

accessed. The protection of this type of sensitive data should be respected so that users will feel that their dignity and fundamental rights are protected and not violated (Buttarelli, 2015).

In terms of the current version of the M-Health application, the trust of community members relates to their confidence in the application as well as in having a relationship with the healthcare provider who visits the community regularly. This trust may be further invoked or stimulated by designing the interface in such a way as to represent the healthcare provider in a more graphical fashion or by integrating and digitally representing objects that the community at large value and trust.

The absence of trust is one of the biggest reasons users do not rely on a website, product or application. Flaws and problems with the overall appearance and layout of an application contribute to users losing trust in it and this influences user perceptions of the product (Binshan, 2013). If careful attention is paid to the design detail of the application whilst aiming to eliminate possible design flaws, it could ultimately lead to the users having more confidence in the product, which could have a positive impact on the user and use of the product.

According to Karvonen (2000), there is a connection between the beauty of a product, website or application and trust. Images have the power to increase user trust in a vendor or, in this case, the healthcare provider. In the case of the community in this study, it was found through observation and interviews that symbols of community values were represented on places where community members would be, or at least, feel safe. Figure 4.2 below depicts animals that form part of the community's beliefs.

Figure 4.2 Invoking trust in the community through traditionally respected animals.

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These pictures were taken at the community centre, or "kraal" where they are painted against the walls of the "kraal". This is a place traditionally associated with togetherness and safety. Upon investigation, it was found that the baboon and leopard are respected by the community and act as insignia or symbols of safety and unity. The community strongly identifies with these two animals.

The initial version of the M-Health application did not have any images that could positively contribute to making a connection between the users, the healthcare provider and the application. By including images or colours with which the community could identify, may have assisted users in making a real connection with the application, thereby increasing their feeling of trust towards the intervention.

4.2.6   Satisfaction

As stated in the previous section, the trust of the user increases when the user perceives the system as usable. This relates directly to the increase in the degree of loyalty towards the system (Flavian, 2006). Closely related to trust, is the issue of satisfaction. The better the overall usability of the product, the greater the positive impact is on user satisfaction, which in turn leads to loyalty towards the product or system.

Satisfaction may, in this case, relate to the functionality of the application: Is it doing what it is supposed to do well? What does the interface look like whilst the user is using it to accomplish certain goals? To assess if a design would increase satisfaction, the researcher decided to pose a question during the interview sessions and relate the question to the previously identified items and associated activities. The items in question varied as the interviewees varied, but the question essentially remained the same. The question was as follows: "*Would you be more satisfied arriving at your place of employment with a brand-new donkey-cart with a nice seat, lights and nice wheels or not?*" The question aimed to determine if the way something looks can also add to the feeling of satisfaction rather than it just doing what it is supposed to do well. The majority of the interviewees were of the opinion that an enhanced user experience in terms of look and feel would raise their levels of satisfaction when engaging an item to complete associated activities. Only a few interviewees responded by

stating that they would be less or equally satisfied when considering an enhanced user experience in terms of interaction.

4.3   Assessing the M-Health Application: Design of the Initial Version

This section focuses on the assessment of the initial version of the M-Health application in question during action research cycle 1. As mentioned earlier in this discourse, the focus of the design of the initial version of the application was largely focused on functionality and ease of use, whilst attempting to limit user-induced errors during engagement of the application. It came to light during an interview that the developer of the application did not know about any emotional design methodology and therefore did not intentionally pay any attention to this aspect of design during the design of the initial version of the application. When the application is activated from a mobile phone, the first screen that the user sees is the *Login* screen as shown in Figure 4.1. It was mentioned earlier that the community was divided into six different age or user groups for purposes related to another study. To login, the community members selected a number associated with their particular age group. After logging in to the correct group, the *User Menu* (Figure 4.1) is displayed.

A rich set of data was collected making use of the emotional checklist (Appendix A) that was developed explicitly for the purpose of visually gauging the users' opinions and emotions. The graphical display tool developed for data collection purposes, as presented in Chapter 3, was used in conjunction with the emotional checklist tool during interviews and group discussions. The researcher was able to use the data collected from this process as well as that emanating from the video recordings of the process to gauge the emotional responses of the community members on different levels. These levels consisted of the assessment of the different usability goals as presented in Section 4.3.1 as well as the different core emotions associated with interactive products presented in the same section.

Figure 4.3 is a graph showing the data associated with learnability in terms of enjoyment.
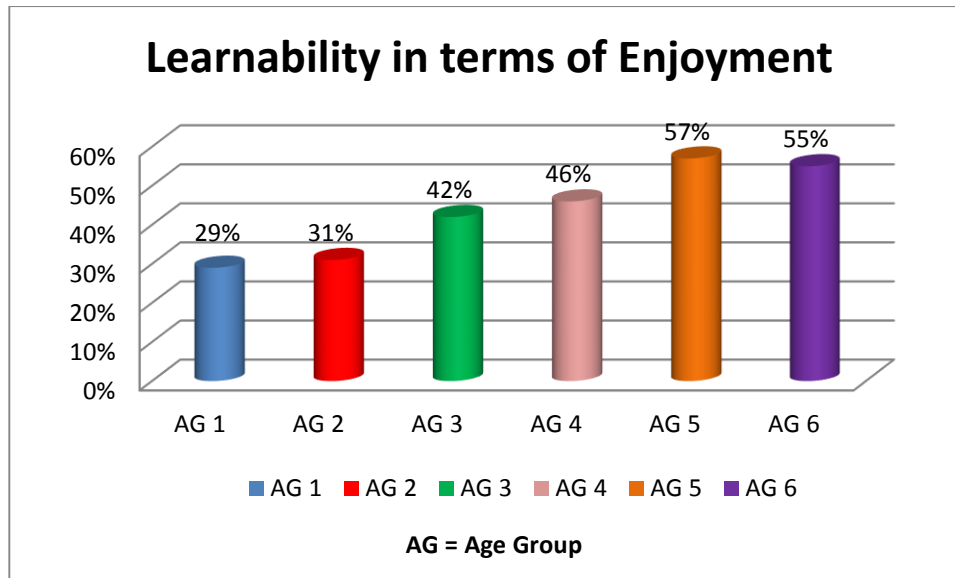
Figure 4.3 Learnability expressed in terms of the emotional response of enjoyment.

The data was combined in terms of the different usability goals to present a holistic view of the core feelings invoked by the application's design. The data presented indicates that the community members in the senior and middle-aged groupings did not particularly enjoy learning how to use the application. A distinctive feature of the data is that the female groups of the aforementioned age designations enjoyed learning how to use the application more than their male counterparts. The senior and middle-aged designations did not enjoy the learning exercise that much and therefore were less inclined to trust the application. Some of the respondents reported feeling scared of the application as they did not fully understand it. Some felt that they were being monitored and some reported that they did not like using a smart device as they felt "stupid", to paraphrase. Trust and enjoyment therefore seem to be intertwined in this particular context.

The younger age designations, on the other hand, enjoyed the learning exercise more. It was noted that, in general, the reason was a higher degree of technological literacy and know-how. Interactivity also played an important role in this age designation and related to the level of satisfaction experienced. The researcher discovered that 83% of the interviewees considered that an improved interaction "look and feel" would translate to satisfaction.

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The data revealed that approximately 47% of the total number of participants experienced satisfaction with the initial version of the application. The remaining 53% did not report feeling dissatisfied, just that excitement or anticipation did not form part of their feelings when engaging the application. These interviewees also reported that they associated excitement and anticipation with satisfaction. Furthermore, 78% of all participants reported that an improved interface may invoke satisfaction.

Figure 4.4 shares the data delineated to feelings of satisfaction when considering the interface of the initial version.
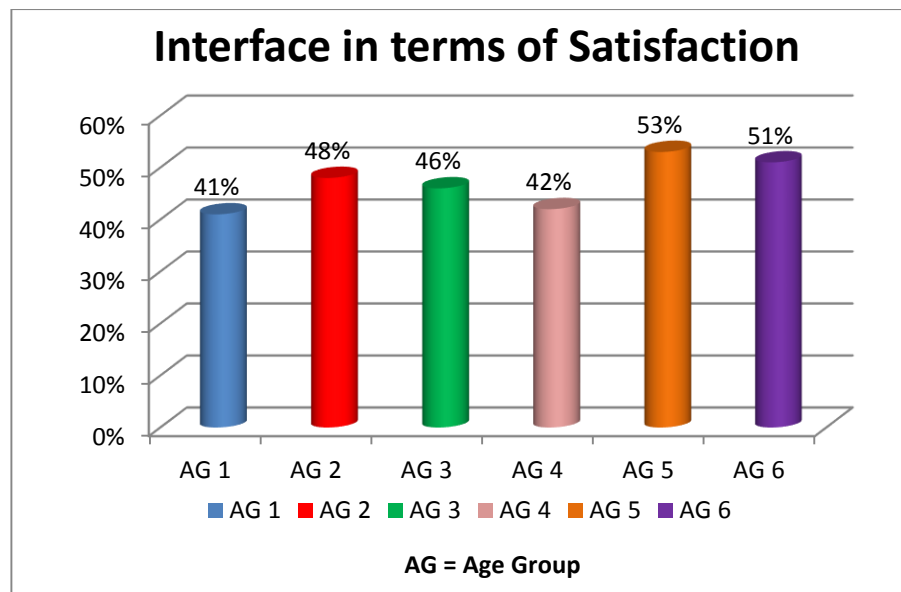
Figure 4.4 The interface in terms of the feeling of satisfaction.

Efficiency, utility, and an improved interface were also closely related to feelings of satisfaction. Community members also reported that the application did not feel like theirs, they commented that it felt generic and did not add to the feeling of satisfaction. They also based their feelings of involvement on the functionality of the application rather than that of the interface design.

The researcher attempted to capture the data related to the feeling of involvement by using a representative low fidelity prototype of the initial version of the application during interviews and group discussions. Community members were also tasked with considering only the

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interface in this regard and limiting their feelings with regard to the functionality as much as they could.

When Figure 4.5 is considered, one can deduce that community members did not feel particularly involved with regard to the experience the interface provided. This fact is especially true amongst the older user groups. The researcher cannot confirm that the participants excluded the functionality of the application in totality when they reported on the particular feeling, only that they were encouraged to do so as little as possible.
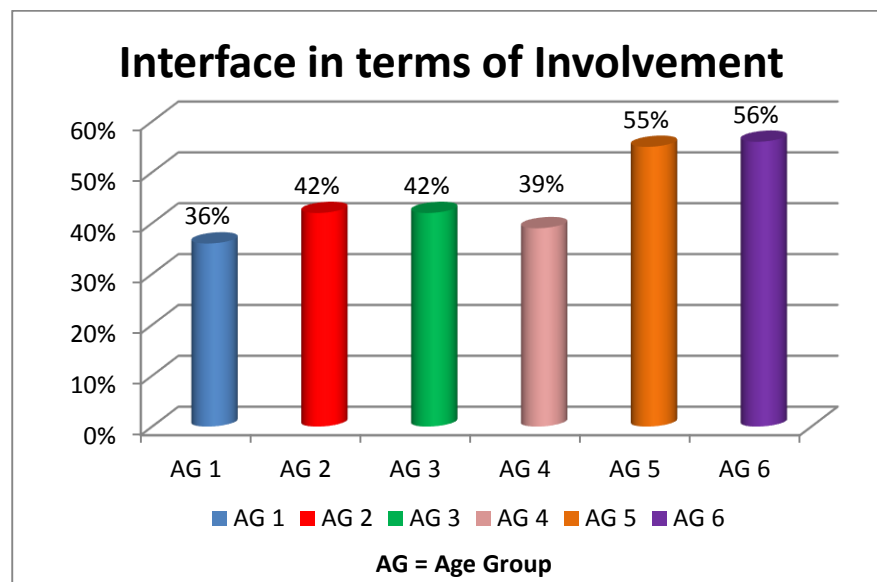
Figure 4.5 Relating the users' feeling of involvement as invoked by the interface.

Trust was particularly hard to gauge. The data related that trust was closely linked to effectiveness. Two other dimensions also played a role within the community context where trust is concerned, namely the responsiveness of the hardware platform as well as the software and the feedback/availability of the healthcare provider. The participants reported that some of the devices supplied to them were less responsive at times. This could have been a hardware or software issue and was not investigated further as it fell beyond the scope of this study. The healthcare provider also reported that he could not tend to every interaction initiated by the community and was restricted by day-to-day business in that regard. A personnel member was subsequently trained in the use of the application with the aim to improve communication.

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Did the initial version of the application inspire trust amongst the community members? As community members had been making use of the application for a period of time, a large portion reported to trust the application but was vague about the ratio between trust and interface. In an attempt to remedy this, the researcher decided to use singular images of the application in different contexts. The interviewees were then asked questions developed by the psychologist involved in this study, to draw out indicators of trust. Findings are presented in Figure 4.6.
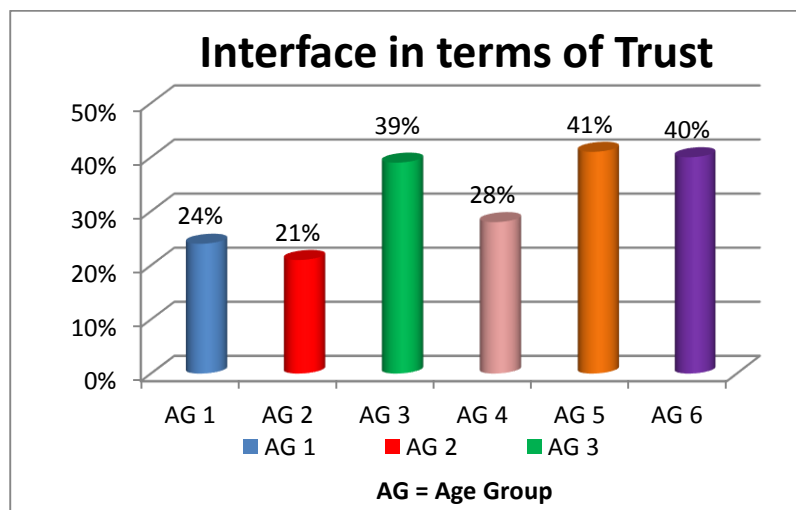
Figure 4.6 The feeling of trust amongst community members as invoked by the application interface.

The data relate that an average of 32% of the representative sample felt trust in their encounters with the application from a design perspective. Something noteworthy here is that a number of interviewees reported that their feelings, in terms of trust, were influenced negatively by them not knowing how the application interpreted it when they moved from one age group to another, nor did they know what to do when they fell in a different age group.

Enjoyment was also assessed in terms of the different usability goals as presented in Figure 4.7. The data indicated that the users experienced enjoyment when engaging the initial version of the interface and was largely influenced by effectiveness and utility as well as how the interface was designed and presented. Some of the respondents also indicated that although

they did not enjoy using the application when they started out, enjoyment came over a period of use. A question related to this fact was subsequently added to the question bank and it was found that 66% of the interviewees were of the opinion that enjoyment came as familiarity with the application and the interface grew.
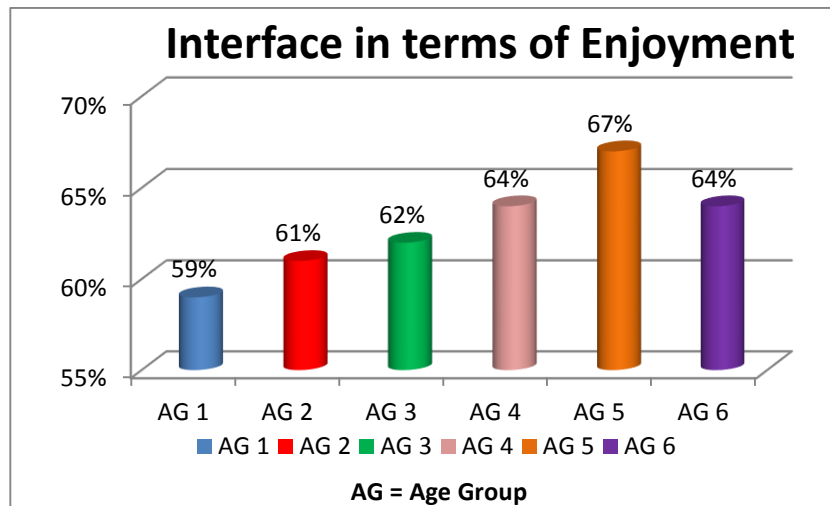
Figure 4.7 The initial user interface design in terms of the feeling of enjoyment.

The data presented in Figure 4.7 depicts a higher than expected level of enjoyment invoked by the initial design of the application.

4.4   Emotional connection in terms of affective design

When designing for positive responses, such as the user feeling at ease when interacting with an artefact, the aim should be to try and elicit certain emotional responses by motivating the user to learn, play or even exhibit trust in the artefact. Emotional interaction describes the way emotions affect one another. One emotion can have either an enhancing or waning effect on other emotions, e.g. when a person feels excitement, this could affect behavior. This phenomenon is called emotional interaction and is necessary for efficient, effective, satisfying and affective learning.

Emotions are obviously also more complex than a simple cause and effect model and can be long-lasting or short-lived. The aim of the experience should target the complexity level of the

eight basic emotions that people experience, namely anger, disgust, fear, sadness, anticipation, joy, surprise and trust (Plutchhik, 2001). The researcher found that all these emotions can be spread among the four core emotions as identified during this study.

Of great importance are the emotions the mobile application relevant to this study wanted to elicit from users engaging it and the milieu for which the application was designed, i.e. healthcare. Context can also not be ignored. On a subliminal level, the application wanted, from an emotional design perspective, to address emotions related to engaging a healthcare professional or facility positively and with dignity, hope, involvement, self-worth, trust and other relevant emotional responses within the core emotions identified.

4.5   Variables that elicit emotion

In any environment where interaction with an application or product takes place, there are affective design elements at work. These include the use of colour, images, photographs, shapes and visual cues. The purpose of this is to eventually provide the user with emotional appeal, a sense of beauty, or a positive impression derived from the total graphical look of a website (Cyr, 2013; Lavie and Tractinsky, 2004). The current version of the M-Health application aimed to achieve this goal, although after the initial investigation of the application, variables of positive emotions were not fully accomplished. The following sections discuss how these variables of enjoyment, involvement, trust and satisfaction were or were not achieved.

An exploration of how to design an interface with affective properties formed part of action research cycle 1. This included a literary review of work done in the field on which to base, for example, interview questions and topics for group discussions. A predominant topic discussed in scholarly works is that of hedonic design which, according to the Oxford dictionary (2012), means a characterization of or something pertaining to pleasure. Online shopping websites, especially, have made use of this design principle to attract customers and improve the loyalty of their customers (Magrath & McCormick, 2013).

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An environment that is based on or includes hedonic design elements frequently makes use of colour, images and shapes that relate to the user or a target audience. These aspects are employed with the expectation that they will provide the user with emotional appeal, a sense of the aesthetic, or a positive impression resulting from the overall graphical look that solicits a positive emotional response from the user (Cyr et al., 2009; Lavie & Tractinsky, 2003; Zhang, 2013).

Cyr et al. (2009) point out the importance of using colour and images to elicit emotional responses from users in an interactive environment. The researcher was of the opinion that, in the community context, empirical linkages could be established between colour and relatable imagery with specific user outcomes such as trust, satisfaction, enjoyment and involvement, among other reactions, in mind. In this light, it was decided to explore these issues to gather data that could shed light on affective design cues in the particular context.

4.6   Exploring Colour and Relatable Images as Affective Design Cues

The exploration of contextually relatable colours and images was to find a way to re-design the interface of the application affectively as to elicit emotions from specific users. With the core emotions enjoyment, involvement, satisfaction and trust were of particular interest, the researcher was able to identify relatable colours and images through the data collection processes. The outcome was an affectively re-designed interface which did not affect the functionality of the interface whatsoever although based on the input and co-design efforts of and subsequent scrutiny by the community members.

4.7   An Affectively Re-Designed Interface

As one of the objectives of action research cycle 2, the interface of the application was re-designed and assessed based on data collected from the community members in this study.

Figures 4.8 to 4.10 depict these designs and relate to the initial design of the M-Health application shared in Figure 4.1.

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Figure 4.8 The re-designed application login interface based on affective design principles and contextual user input.

Figure 4.9 The re-designed application service access interface based on affective design principles and contextual user input.

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Figure 4.10 The re-designed application information interface based on affective design principles and contextual user input.

The aim of the design was to incorporate colours, images and patterns to which the community members could relate. Figures 4.8 to 4.10 depict traditional colours like earthy browns, sunset yellows and grass-like greens. The designs also included patterns related to what was observed in traditional homesteads and images like the acacia tree and the leopard.

Figure 4.8 depicts the design of the login menu that was re-designed to allow for an eased login process; users did not have to remember what number they were anymore, but could relay their age grouping through the associated images. Also, users no longer felt like a number; this was replaced by feelings of dignity as reported by 78% of the community members interviewed. The design was further simplified by combining user and communication menus into one menu as presented in Figure 4.9.

4.8   Assessing the Affective Design

The affectively designed interface was assessed in the same manner and with the same parameters in mind as the initial design. Figures 4.11 through 4.15 relate the data visually.

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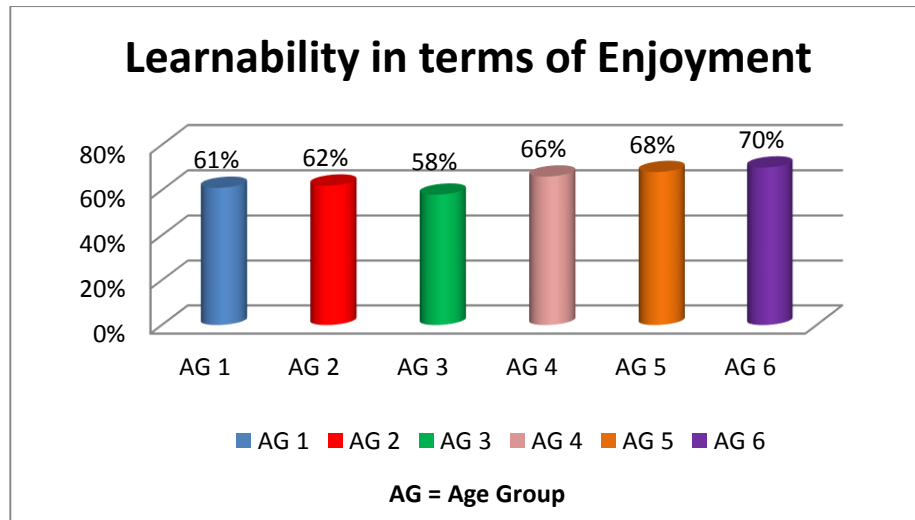
Figure 4.11 *Learnability expressed in terms of the emotional response of enjoyment*
for the re-designed interface.

When considering the core emotions in terms of usability goals identified, one sees improvement in the opinions of community members when reviewing the same usability goal and emotional outcome presented in Figure 4.3. This was especially true for the senior age grouping within the community.
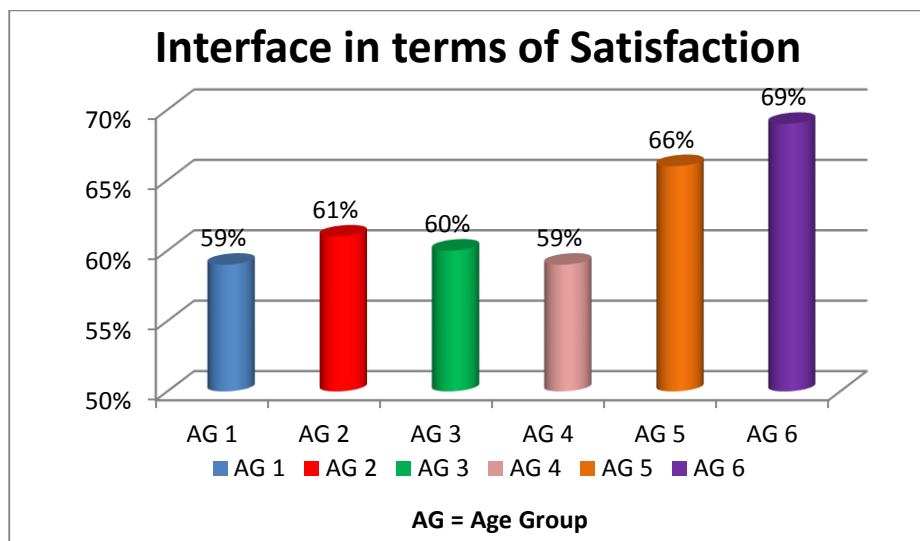
Figure 4.12   *The interface in terms of the emotional response of satisfaction with regard*
to the re-designed interface.

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In Figure 4.4, one notices an improvement with regard to what community members experienced emotionally. There was a general improvement in terms of the percentage of community members who formed part of the interviewees when the particular emotional aspect was addressed during the interviews.

Figure 4.13 represents the data collected with regard to feelings of involvement after community members were exposed to the re-designed interface. The least improvement, in the users' opinions with regard to the core emotional responses, was noted in the category of involvement.
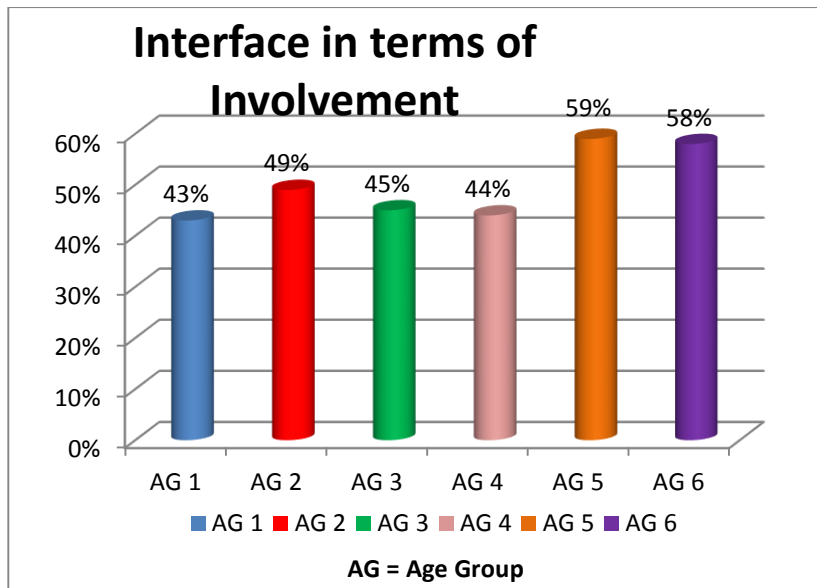
Figure 4.13 The interface in terms of the feeling of involvement experienced when interacting with the re-designed interface.

Looking at the data presented in Figure 4.14, one sees overall improvement in the emotional responses experienced by the users in terms of feeling trust (81% of respondents).

Interface in terms of Trust
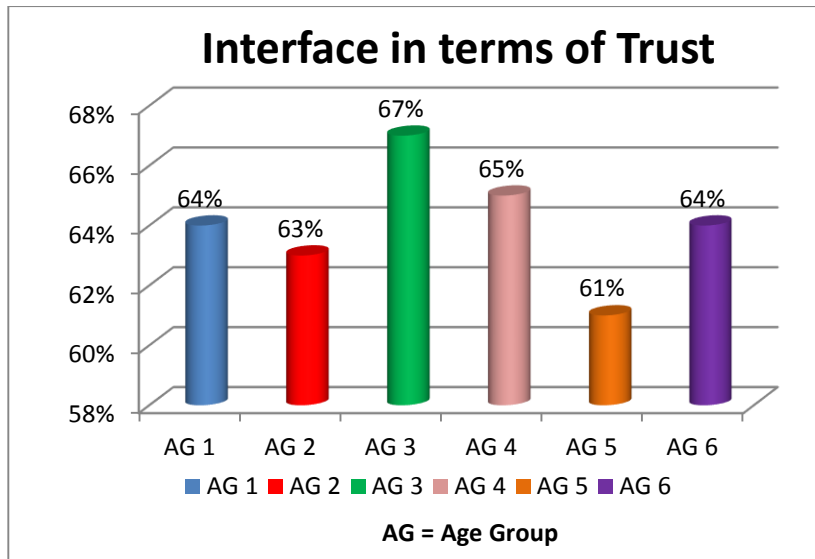
Figure 4.14 The feeling of trust invoked amongst users by the re-designed interface.

This can largely be attributed to the feeling of ownership instilled by the use of the colours, patterns and images of the community.

Finally, the feelings of enjoyment experienced by the members of the community when engaging the re-designed interface are relayed in Figure 4.15.

Interface in terms of Enjoyment
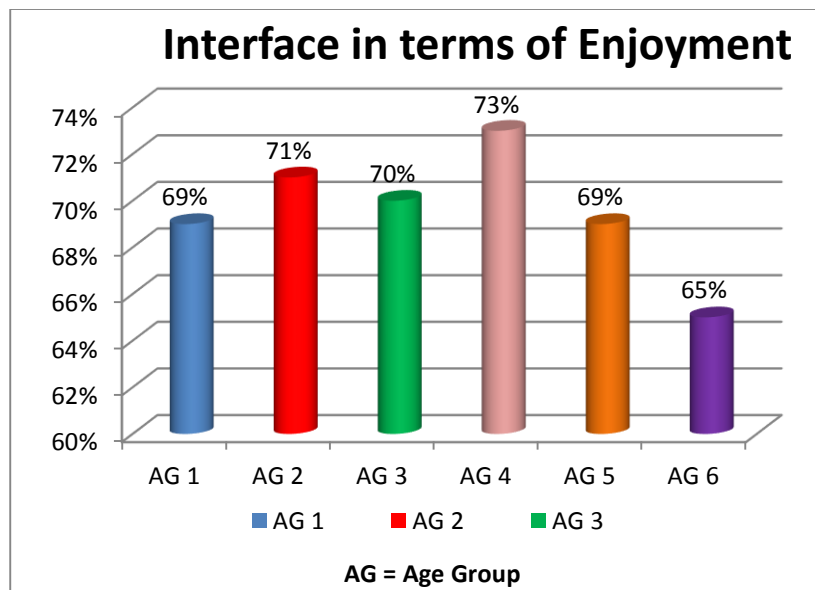
Figure 4.15 The feeling of enjoyment experienced by users when engaging the re-designed interface.

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Here too, an improvement of users' experience was noted. The data indicates that the affectively designed interface had a positive effect when the outcome was to elicit positive emotional responses from the users thereof. According to the data, this can largely be attributed to the fact that traditionally valued colours, patterns and images were incorporated into the designs. Also, the fact that the community felt involved in the process added to a feeling of ownership and pride.

The only criticism that the affectively designed interface received was that, holistically, 39% of the interviewees were of the opinion that the login screen representation of the senior and middle-aged group designations was too Western. The interviewees were of the opinion that the user experience and overall emotional responses would improve if this issue was addressed successfully.

4.9 Anthropomorphic Design

As previously stated, anthropomorphism is characterized by someone, like a graphic designer, attributing human-like characteristics to representations of inanimate or animated objects in terms of emotional design. The main objectives for the anthropomorphically designed interface in this study were to reach the same identified emotional outcomes as for an affectively designed interface and satisfy the usability goals discussed in this chapter.

The exploration of objects, historical figures within the community, legends, stories, fables and revered animals that could be used in an anthropomorphic design attempt formed part of action research cycle 2. According to the data, the core emotion of involvement was not addressed on a satisfactory level by the affectively designed interface and needed to be considered especially. The researcher was of the opinion that the development of an interactive agent could not only stimulate emotional responses from the interaction experience, but also enhance the feeling of involvement, in particular.

According to Marakas et al. (2000), the process of making inferences requires cognitive effort. This argument makes it possible to conclude that anthropomorphism is likely to be the more effective in eliciting emotional responses from users when certain contextual aspects about a

person and his or her environment are true. Waytz et al. (2007) developed a psychological three-factor theory based upon their own research related to anthropomorphism to describe and predict when a person was most likely to respond to an anthropomorphic design on an emotional level. These factors are:

- *Produced agent knowledge:* When the anthropomorphic design captures and relates a certain amount of indigenous knowledge held about an object or triggers the cognitive processes in such a way that the knowledge is called to mind.
- *Effectance*: The level of motivation to interact with or understand the immediate environment one is immersed in, irrespective of the type of environment.
- *Sociality:* what can be described as the need to establish social connections.

People were found more likely to respond emotionally to an anthropomorphic design when elicited agent knowledge was low and effectance and sociality high (Waytz et al., 2007). One cannot, however, dispute the fact that developmental and cultural variables can affect the three factors mentioned in the preceding text.

The researcher collected data with the aim to identify what or who to anthropomorphize to optimize the emotional responses from the parties engaging the application.

4.10   Action Research Cycle 3: Resulting Anthropomorphic Design

The data collection process revealed a mythical or legendary character relevant to the particular community. Of those interviewed, 52% of the interviews mentioned a fabled healer with magical healing powers through a doll-like conduit. Crude descriptions of the particular healer lead to the development of a representative software agent. With the help of software developers and translators, the software agent was programmed to exhibit interactive capabilities in terms of help functionality and responsiveness to certain actions performed by the user. Verbal responses were in the Tswana language.

The agent, for example, encouraged users to complete certain tasks once engaged, congratulating them on the successful completion of tasks, etc. This was done to establish the emotional responses of involvement and trust, in particular, within users.

Figure 4.16 depicts the representation of the agent and the conduit doll developed as part of the anthropomorphic exercise.

Figure 4.16 Interactive agents developed from community legend.

Unfortunately, 68% of all of the interviewees found the design unnerving. Although the specific character was revered in stories, the largest portion of the interviewees identified the agent with the emotional response of fear or being unnerved.

Another design attempt was made and an agent, presented in Figure 4.17, was developed with the same functionality as the "healer agent", but 57% of the interviewees did not report a positive emotional experience. The main reason given was that the respondents could not identify with the agent and felt confused by it.

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Figure 4.17 The interactive agent "Stetti" failed to prove effective as an elicitor of emotions.

A third session of interviews was driven by the fact that the attempt to assign human-like characteristics to an inanimate object was less than successful. The third interview session was conducted while the healthcare provider related to the study was physically visiting the community. The researcher observed the obvious respect and love that the community members had for the healthcare provider and his pharmacist partner. The observation brought about the development of animated representations of the healthcare provider and the relevant partner in the form of interactive agents.

In total, 72% of the interviewees responded positively to these agents. Emotional responses of enjoyment and trust were pointed out as obvious by the psychologist who assisted the researcher with the data analysis of the video recordings.

Figure 4.18 depicts the agent developed as digital representations of the healthcare provider and the relevant partner. Notably, the community members did not want the verbal feedback to be in Tswana, but rather in English and in the voice of the people of whom the representations where constructed.

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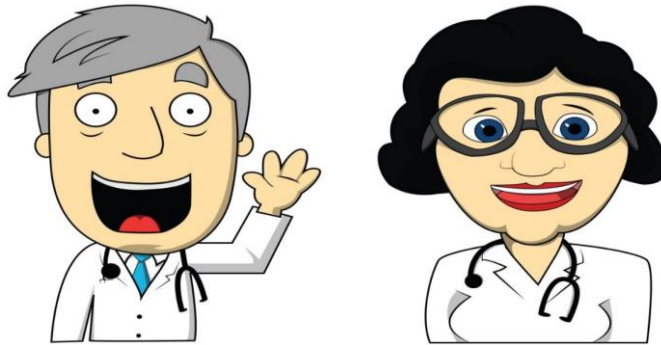
Figure 4.18 Interactive agent representations of the healthcare provider team proved most successful.

Data was collected after the deployment of the anthropomorphically designed interface in terms of the agents and predetermined usage period concluded. The data is presented in Figures 4.19 to 4.23.
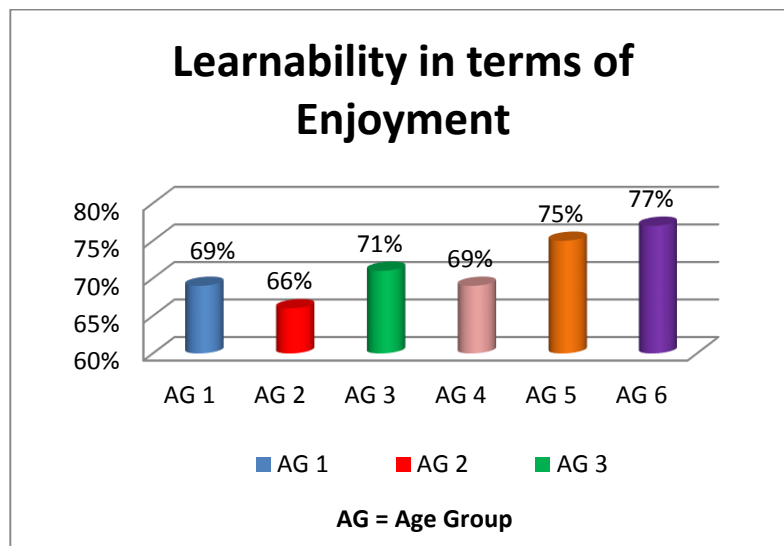
Figure 4.19 Learnability in terms of enjoyment as elicited by the anthropomorphic design.

The data confirms an improved emotional experience in terms of enjoyment and the usability goal of learnability across all age groupings.

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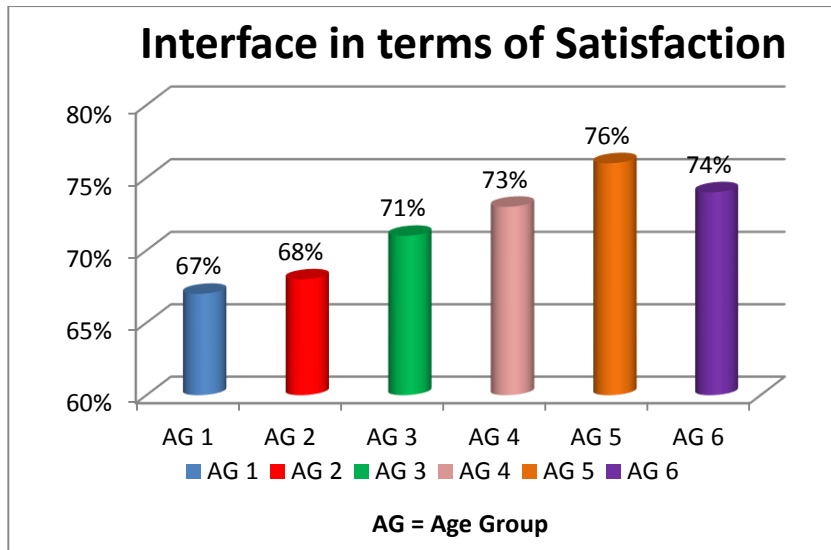
Figure 4.20 The percentage value of how many users felt satisfied by the
anthropomorphic design.

The core emotion of satisfaction also related a more positive experience amongst more interviewees than estimated.
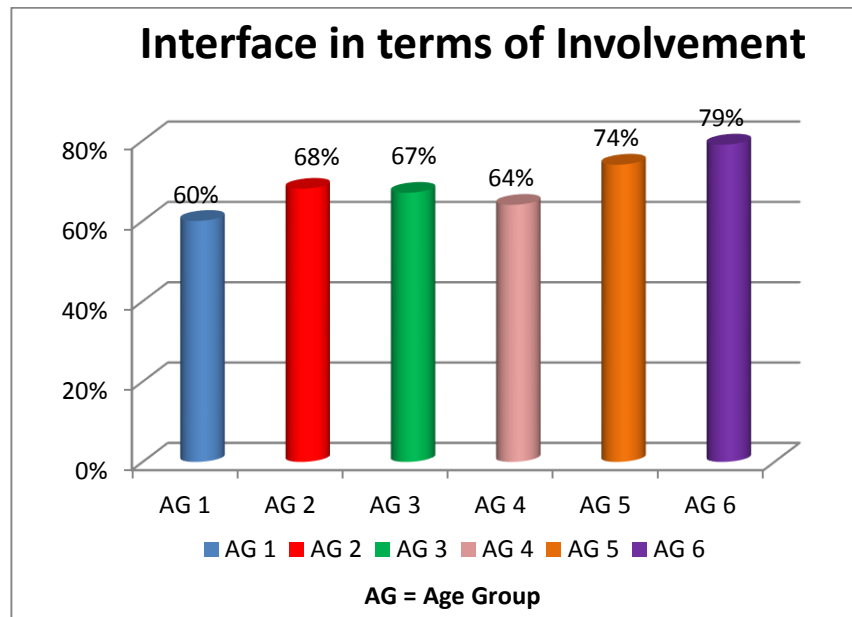
Figure 4.21 Involvement as experienced by a percentage of the interviewees.

This was an important emotion to address as neither the initial design nor the affectively designed interface addressed it very well. According to the data presented in the figure, the

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anthropomorphic interface design had the most positive effect on the emotions of the largest number of interviewees, surpassing that of the other design.
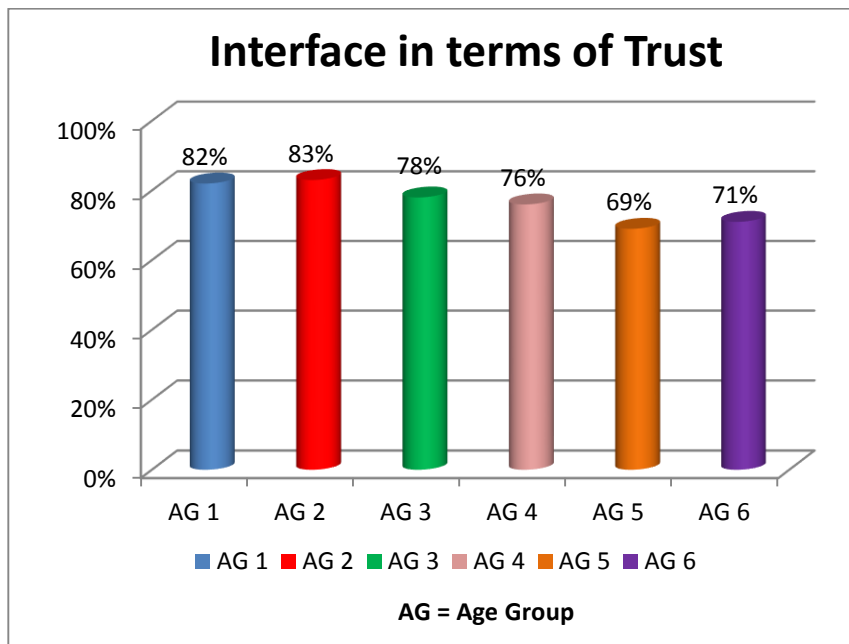
Figure 4.22 The percentage of users who experienced the feeling of trust where the anthropomorphic design is concerned.

The data indicates that the anthropomorphic design elicited trust from the largest number of participants when considering all three designs.
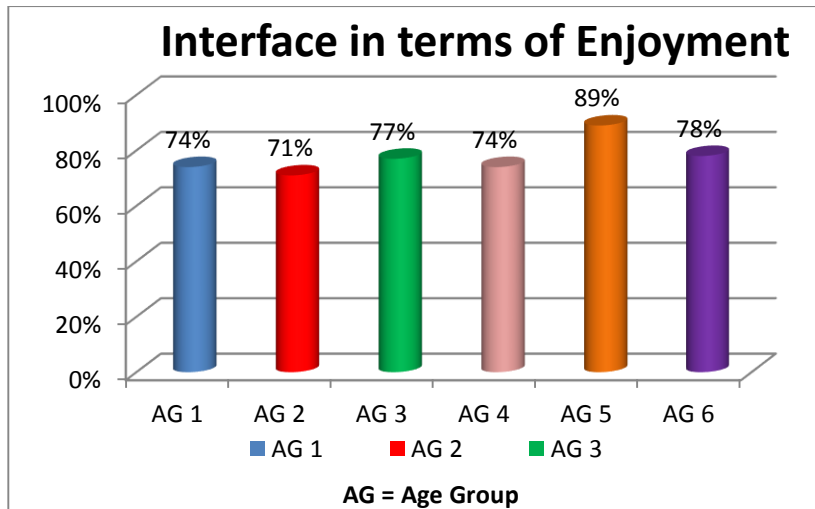
Figure 4.23 *The percentage of users who experienced enjoyment where the anthropomorphic design is concerned.*

The data reveals that, in total, the anthropomorphic design proved to be the most successful, albeit over a three-month period, in soliciting the core emotions from the users in question. This fact can be attributed to strong feelings of involvement and trust that the other designs were not able to elicit as successfully. This, together with the high level of enjoyment and satisfaction experienced, caused the community members to associate with and respond to this design on a deeper level than with the other designs.

4.11   Cloudware Data

The application records different sets of data on a cloud service. The data comprises historical data (from the day the application was launched), live data, login numbers, the services accessed, number of medical issues reported, and so forth.

Although it was not possible to use the data recorded to accurately deduce which of the designs were found most engaging and emotionally satisfying, two variables in particular were reviewed by the researcher and compared across the three designs for the same period of time. These two variables were the number of times each age group logged in and how many medical issues were reported by each group via the application during the initial three-month period of use for each design. A summary of the data is given in Tables 4.1 to 4.3.

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- *Age group 1*: The senior males, logged in 12 times over the initial three-month period following the launch of the application with the initial version of the design. Only 1 medical issue was reported during this time.

- *Age group 2*: The senior females, logged in 11 times during the three-month period succeeding the launch of the initial version of the application. From the 11 login times, no medical issue was reported.

- *Age group 3*: The middle-aged males recorded a total of 14 login times, with 3 medical issues reported over the first three months after the launch of the initial version of the design.

- *Age group 4*: The middle-aged females logged in a total of 8 times over the same period as mentioned above, with 1 reported medical issue.

- *Age group 5:* The young males logged in 19 times over the three-month period related to the initial version of the application and no medical issues were reported.

- *Age group 6*: The young female members logged in 21 times and reported 1 medical issue, which later proved to have been a prank.

Table 4.1 Cloudware data indicating number of times logged in and number of medical issues reported using the INITIAL version of the design

Age Group	Times logged in	Medical Issues reported
AG 1 – senior males	12	1
AG 2 – senior females	11	0
AG 3 – middle-aged males	14	3
AG 4 – middle-aged females	8	1
AG 5 – young males	19	0
AG 6 – young females	21	1

When the affectively designed version of the application was launched, the following was recorded over the three-month period following the launch (See Table 4.2):

- *Age group 1*: The senior males logged in 12 times over the initial three-month period following the launch of the application with the initial version of the design. Only 1 medical issue was reported during this time.

- *Age group 2*: The senior females logged in 11 times during the three-month period succeeding the launch of the initial version of the application. From the 11 login times, no medical issue was reported.

- *Age group 3*: The middle-aged males totaled 13 login times with 2 medical issues reported over the first three months after the launch of the initial version of the design.

- *Age group 4:* The middle-aged females logged in a total of 8 times over the same period as mentioned above with 1 reported medical issue.

- *Age group 5:* The young males logged in 19 times over the three-month period related to the initial version of the application and no medical issues were reported.

- *Age group 6*: the young female members logged in 21 times and reported 1 medical issue, which later proved to have been a prank.

Table 4.2 Cloudware data indicating number of times logged in and number of medical issues reported using the AFFECTIVE version of the design

Age Group	Times logged in	Medical Issues reported
AG 1 – senior males	12	1
AG 2 – senior females	11	3
AG 3 – middle-aged males	13	2
AG 4 – middle-aged females	8	1
AG 5 – young males	19	0
AG 6 – young females	21	1

When the data for the anthropomorphically designed interface was retrieved, the following was found:

- *Age group 1:* The senior males logged in a total of 19 times. Of these recorded logins, 3 medical issues were reported.

- *Age group 2*: The senior females logged in 20 times. From the recorded login sessions, 3 were used to report medical issues.

- *Age group 3:* The middle-aged males logged in 21 times with 0 medical issues reported.
- *Age group 4:* Cloudware recorded 18 logins for the middle-aged females. No medical issues were reported.
- *Age group 5:* The young males logged in 28 times over the three-month period and 4 medical issues were reported.
- *Age group 6*: The young female members of the community logged in 27 times and reported no medical issues.

Table 4.3 Cloudware data indicating number of times logged in and number of medical issues reported using the ANTHROPOMORPHICAL version of the design

Age Group	Times logged in	Medical Issues reported
AG 1 – senior males	19	3
AG 2 – senior females	20	3
AG 3 – middle-aged males	21	0
AG 4 – middle-aged females	18	0
AG 5 – young males	28	4
AG 6 – young females	27	0

From this subset of data, it is not possible to determine why the members of the community logged in each time, but of interest was the data showing higher numbers of logins for the anthropomorphic design than for the others.

4.12 Guidelines Developed for the Contextual Design of an Emotionally-Driven Interactive Interface

One of the objectives of this study was to develop a set of guidelines to assist prospective developers of mobile application interfaces elicit emotional responses from users, albeit delineated to M-Health applications and a particular community. The researcher is still of the opinion that the lessons learnt and the guidelines developed could prove useful to prospective developers.

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The guidelines are:

- ***Identify and get to know the users.*** Those who directly interact with the application. Any prospective developer is encouraged to explore a little deeper by also looking at indirect users and other stakeholders who depend on the application being used correctly. Users of different ages and gender may have to use the application to accomplish the same task, try to find a common middle ground in terms of design. Also, know the users. Find out about cultural aspects, beliefs, and customs, for what the users will or would like to use the application, how and where it will be used.

- ***Establish the user requirements as early as possible.*** Identifying the needs is not simply asking what a user wants, but also informing him or her of what is possible in terms of design and technology in your capacity as a specialist. Evaluate that you understand what the user expects from you before commencing with design.

- ***If possible, engage in a facilitated co-design process with regard to the interface.***

- ***Make use of low-fidelity prototyping to relate design ideas quickly.*** Guide users with knowledge and be open to suggestions and input. Try to base aspects of the design on something unique to the user, company or entity if developing for someone or something specific.

- ***Create alternative designs and observe users, their environment and what they do with what carefully.*** Emotional cues are not always obvious and not always easy to communicate verbally.

- ***Assess empirically.*** Find a way to assess the final designs empirically with the aim to choose the design that fulfils the user requirements the best, in terms of emotional connections and responses. This will enhance feelings of trust and loyalty.

- ***Consider existing knowledge to invoke emotion.*** Represent available knowledge in such a way as to trigger the cognitive processes that call related knowledge to mind.

- ***Always consider context.*** The context of the entity will determine and dictate many of the design aspects. This study indicates that social elements in design seem to be of specific importance to female members of society. Men, on the other hand, do not seem to care so much about the social elements of design, but rather how design and functionality are linked. To increase feelings of enjoyment, involvement, trust and

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satisfaction, the prospective designer will not err by designing an interface with social aspects in mind whilst making sure the design appropriately reflects and connects the functionality.

- ***When designing for emotion, attempt to identify ways to elicit the basic core emotions.*** Many, if not most human feelings, positive or negative, can be linked to enjoyment, involvement, satisfaction and trust. For example, if a child is not involved in playing a game with other children for not having being asked, what will this child most likely feel? What will the child feel if he or she is included i.e. involved?

- ***Recognize functionality.*** Functionality, the interaction types and interaction medium also drive design.

- ***Take literacy into account when designing.*** This not only includes the ability to read and write, but also subjective categories of literacy like technological literacy, for one.

- ***If agents are designed as solicitors of emotion, make sure that the functionality which relates positive messages to the user is included.***

These guidelines were developed from information gathered during the course of this study, from various notes, recordings as well as from investigated literature. These guidelines should provide the prospective designer with some insights into emotional design.

4.13 Conclusion

This chapter focused on relaying the data gathered throughout the course of the study and subsequently discussed and explained the analyzed data. In addition to highlighting the initial design of the interface, the chapter also included a summarized discussion of the M-Health application, its aims and functional aspects.

It was found that an affectively designed interface was more acceptable to the community members than a functional design and that the former design elicited emotions from users. The data also indicated that it is advantageous when considering an affectively designed interface to include the users, in this case, community members in the design process. In this study, the

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community members' involvement in the design were limited to identifying colours, patterns and objects they value, but the design would have been worse off without their input. The researcher also realized that much could be learned from observation in general and not just when in "research mode".

Of the investigated designs, anthropomorphism proved to be the one that elicited the core emotions the best. The researcher learned that as far as anthropomorphism is concerned, designs benefit from high levels of interactivity, which means the appropriate functionality should be catered for as well.

When participants were asked which design would encourage them to use the application more, 73% of the interviewees opted for the anthropomorphic interface design; 20% for the affectively designed interface; and 7% for the initial, functional design of the interface.

It was also possible to identify development issues, albeit contextually limiting, and put forward a set of guidelines that might be utilized by prospective designers for emotion. The data indicated that if an application conformed to the usability goals, like being effective, it could stir up emotional reactions such as enjoyment, involvement, trust and satisfaction in users. In the study, the researcher aimed to improve the current existing design of an M-Health application while addressing all of the variables mentioned in this chapter in order for the users to have a positive feeling towards the application, use it for improving their healthcare and have regular real time access to healthcare professionals.

It was found that design aspects that resulted in feelings of satisfaction were ease of navigating the application, the layout and organization of menus, screens and information, and the overall aesthetics of the application. Although users of the current version of the application experienced it as helpful and exciting, the overall experience was found to be greatly improved by implementing affective or anthropomorphic design principles to enhance emotional responses of satisfaction, loyalty, trust, involvement and enjoyment.

CHAPTER 5
Conclusion

5.1   Introduction

The ultimate goal of the study was to explore emotional design and how the re-design of an M-Health application's interface would influence the adoption of such an application amongst community members in a rural Tswana community context. In addition, the study aimed to provide a set of design guidelines based on data collected from the community setting as well as that which the researcher experienced whilst executing the research work.

The community used in this study is geographically situated in the Northern Cape Province of South Africa, already part of a PhD M-Health application study. The relevant party allowed the researcher to attempt to re-design the interface of the existing application without altering the functionality. Resulting from this, two emotion-driven design methodologies were selected to base the re-designs of the interface on, namely affective design and anthropomorphic design.

Affective design, in general, refers to the way in which an interface is designed to elicit an emotional response from the user through the use of colours, screen layouts, images and so forth. Anthropomorphism also aims to elicit emotional responses from the user, but does so using animation, inanimate or non-human objects and assigning them human characteristics or traits. Another well-known anthropomorphic-based design involves the development and deployment of interactive software agents. Two different designs were ultimately developed and assessed within the community context. Examples of the two design principles were elaborated upon in Chapter 2 which aimed to place the principles in context with regard to the study as well as the ultimate goal of the research related to the singular case study.

The rest of this chapter provides a summary of revisiting and answering the research questions and outlining future work that can be done in line with this study.

5.2 Research Evaluation

All research is driven by the need to answer a specific question and explore or learn about something. This section reviews the research questions posed at the inception of this study and provides answers from the data presented in Chapter 4. In order to provide adequate attention to each question and subsequent answer, each is dealt with separately.

5.2.1 *Response to the Main Research Question*

The main research question that this study aimed to answer was:

- Whether anthropomorphism and affective design influence the adoption of Mobile-Health applications and which of the two would be more effective in designing such applications.

Three action research cycles were engaged in an attempt to answer this question.

The aims of the first action research cycle were to assess the effects related to application adoption and use when the initial interface design of the M-Health application is considered in the community context from an emotional design perspective. A challenge was to ascertain which emotions were triggered amongst the community members when engaging the application in the initial interface design. This process was aided by the developed data collection tools as well as the help of a trained psychologist. During action research cycle one, the researcher also aimed to present the data in terms of emotional design principles and emotional responses in an attempt to identify emotional design cues from the process. This contributed to the development of the proposed design guidelines. Another objective of the first action research cycle was to explore components within the community context that could be utilized in an affectively designed interface.

Action research cycle two focused on developing an affectively designed interface that elicited emotions from users. The aim of research cycle two was to assess the relevant design within the case community and to determine the feelings and perceptions they held in terms of the affectively designed interface of the M-Health application. During action research cycle two,

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the researcher furthermore intended to discover what would be useful for an anthropomorphic interface design within the community context with the objective to re-design the user interface for another cycle of evaluating.

The objectives of the third action research cycle included the development of an anthropomorphic interface design for the M-Health application. During action research cycle three, the researcher assessed the relevant design within the community in terms of emotional responses. The intended goal of research cycle three was to compare the data collected from both the affective and the anthropomorphic interface designs in order to determine which design was superior in the minds of the community members. Another objective of the researcher was to develop guidelines for emotionally-driven design in the context of a rural community that will be used by other designers.

The data allowed the researcher to group the emotional responses of the community members into four distinctive categories, namely the core emotions discussed in Chapter 2: enjoyment; involvement; satisfactions; and trust. Community members were observed and recorded on video (with their permission) in an attempt to extrapolate non-verbal communication during both the interview process and the interaction with the new design. As mentioned, interviews and group discussions were also employed to collect and gauge the opinions of community members regarding the different designs and their associated emotional responses.

Investigated literature suggests that trust, which is also a constituent of the so-called core emotion categories, may be the single most important emotional response an interface can elicit. Not only does trust play a role in a user returning to a particular website or establishing loyalty toward a particular application or program, but it can also trigger other emotional responses. To better illustrate how trust plays a role in adoption, first consider the four core emotion categories. Then, consider your online banking application that you use on your smart device or the website counterpart. Which of the four core emotions played the biggest role in you, as a user, returning to the application or website and using it to ease the process of banking? Trust?

Trust, as an emotional response, is therefore one of the pivotal emotions that has a direct effect on the adoption of an interactive product or service. It was possible to deduce which design was superior when it came to promoting the adoption of the application. This was accomplished by comparing the recorded opinions of the community members' emotional responses to their interaction with the different designs as shown in Table 5.1.

Table 5.1. Community members' emotional responses with regard to interaction with the different design versions

	AG	**Core Emotions**							
		Afctv Dsgn Enjoyment	Anthro Dsgn Enjoyment	Afctv Dsgn Involvement	Anthro Dsgn Involvement	Afctv Dsgn Satisfaction	Anthro Dsgn Satisfaction	Afctv Dsgn Trust	Anthro Dsgn Trust
CM Opinions: Emotional Responses	1	69%	74%	43%	60%	59%	67%	64%	82%
	2	71%	71%	49%	68%	61%	68%	63%	83%
	3	70%	77%	45%	67%	60%	71%	67%	78%
	4	73%	74%	44%	64%	59%	73%	65%	76%
	5	69%	89%	59%	74%	66%	76%	61%	69%
	6	65%	78%	58%	79%	69%	74%	64%	71%

NOTE: Afctv Dsgn = Affective Design

Anthro Dsgn = Anthropomorphic Design

AG   = Age Groups

CM   = Community Members

The data presented in Table 5.1 supports the deduction that an anthropomorphic interface design is more efficient in eliciting the core emotions from users. Moreover, anthropomorphism has proven to be the superior emotional design paradigm when improved adoption of an M-Health application is considered, albeit in this context only. When asked to

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choose their favourite design, 73% of the community members opted for the anthropomorphic design, which further strengthens the argument that it is the superior emotional design paradigm for this particular application.

5.2.2   *Response to Guidelines and Recommendations when designing applications*

The researcher aimed to develop a list of emotional design guidelines based on real-life practice. As mentioned earlier in this chapter, the researcher aimed to identify and notarize emotional design issues throughout the three action research cycles. The final guidelines are those that truly worked during the design processes of this study. Prospective interaction designers can make use of these guidelines, add to or delete from them, and ultimately use them as a foundation to build their own set of guidelines.

A summary of the guidelines is presented in this section since the full list of guidelines is available for scrutiny in Chapter 4, Section 4.13.

The emotional design guidelines were:

- Identify and get to know the users.
- Establish user requirements as early as possible.
- If possible, engage in a facilitated co-design process with regard to the interface.
- Make use of low-fidelity prototyping to quickly relate design to ideas. Create alternative designs and observe users, their environment and what they do with what carefully.
- Empirical assessment: Find a way to assess the final designs empirically to choose the design that fulfils user requirements the best in terms of emotional connections and responses.
- Consider existing knowledge to invoke emotion.
- Always consider context.
- When designing for emotion, attempt to identify ways to elicit the basic core emotions.
- Recognize that functionality, interaction types and interaction medium also drive design.

- Take literacy into account when designing.
- If agents are designed as solicitors of emotion, make sure that the functionality is included that relates positive messages to the user.

5.3   Contributions

This section focuses on the larger contributions of the study to the general body of "design for emotions" knowledge.

The primary contribution of this research can be divided into two equally important sections:

1. The successful development, deployment and assessment of two emotion-driven interfaces for the same M-Health application. A unique perspective was provided with regard to affective and anthropomorphic design within a rural community context to identify a superior design paradigm for improved application adoption. The evidence from the study indicated that the anthropomorphic design was superior to affective design in the minds of the community members. Even though this finding may be contextual, it was the aim of the study as presented in Chapter 1.
2. The researcher was able to explore, identify, list and develop a set of guidelines for use in the field of emotional design. The hope is that these guidelines will be implemented by future designers in the field, expanded and extended into an emotional design framework or model. Each guideline is based on what worked in practice and was applied successfully throughout this study.

Another contribution may be presented in the form of the unique set of data collection tools that was developed in the form of, for example, the emotional response racquets and observation checklist. These tools proved especially useful in engaging the interviewees and group members during data collection. They were also very useful when different levels of literacy were encountered amongst the community members who had valuable data.

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5.4   Limitations of the study

At the inception of the study, the researcher did not expect that the specific anthropomorphic or affective designed intervention interfaces would be adopted outside of the case area. Also, because the study was specifically delineated to a Mobile-Health intervention, the assumption could not be made that the design principles applied would aid the adoption of any other kind of intervention.

5.5   Future Work

Although research has generally considered the impact of design principles such as colour or images, website design elements and their variance across cultures have enjoyed considerably little attention. This is the case, despite the importance of the cultural sensitivity of website design. Thus, it would be beneficial if both researchers and practitioners were to investigate website localization and the impact it has on perceptions and emotions in diverse cultures. Other characteristics, such as age or gender, likewise, deserve attention concerning the use of colour and imagery.

Despite this, many websites are lacking in this critical element. One way to facilitate this process is to utilize more women in the design process. In addition to considering social elements of website design in domestic markets, there is room for further research and exploration of this topic in international contexts as well. As such, this presents an expansive and greatly varying area for future studies.

As discussed earlier, Cyr et al. (2009) conducted two separate research investigations with Canadian, German, and Japanese users regarding their reaction to visual design website elements. In the first study, survey data indicated that human images universally resulted in image appeal and perceived social presence; while interviews and eye-tracking data suggested participants from different cultures experienced design images differently. In the second study, website colour appeal was found to be a significant determinant of website trust and satisfaction, with differences across cultures (Cyr et al., 2010).

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E-Health is an emerging and important area for the application of social elements for website design. In a study of disclosure and personal health records, Lee and LaRose (2011) studied the impact of personalized social cues for two types of information disclosure (e.g. embarrassing information and descriptive information). Information disclosure was further tested in relation to user outcomes being positive (e.g. social trust and customization of their requests) or negative (embarrassment and information abuse). To manipulate the level of personalized social cues, users in the high immediacy condition were personally greeted using their first name (e.g. "Welcome Lissa"). In addition, the high immediacy website featured an interactive review session during which the user was praised and encouraged (e.g. "Excellent, Lissa! That is the right answer! Or "Try again, Lissa. You can do it!" (Ibid.). Alternatively, the low immediacy website did not host these social cues. An interesting finding from this study was that regardless of the type of information (embarrassing or descriptive), exposure to a high immediacy website with personalized social cues increased the level of information disclosure, signaling this an important element of design in an E-Health context.

Preece et al. (2009) state that the term mobile can and has been used as an adjective to describe a kind of interface or interaction where interaction design is concerned. This term is used to describe the interaction between the user and mobile device, for example cellular phone or smartphone and can include interaction like sending an SMS, using an online banking application or simply dialing a friend. In these cases, the interaction medium is usually the user's finger or a stylus or some kind of action expected from the application or the device itself. A form of instruction or direct manipulation is thus present in the above mentioned examples when one considers the interaction type.

Further research could be conducted to expand on some of the features of the M-Health intervention to include more advanced technology relating to the E-Health context. Implementing the intervention in a wider environment may be a possibility and investigating the results of such an exercise could prove very insightful. This may have a huge impact on other communities faced with similar challenges as the community used in this study.

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Appendix A

Observation Checklist for accessing and using the M-Health Application – Version 2 (affective design)

Emotions displayed	Emotional reaction observed					
	Didn't know what to do	Bored / Dissatisfied	Surprised	Uncertain	Satisfied	Very satisfied
Task						
Accessing the application from the smart device						
Log in screen: Logging in to the application by selecting correct group						
User Menu: Does the user understand the meaning of the icons?						
User Menu: Comments on the use of colour and icons – how does user feel about the elements?						
User Menu: Ability of user to click on the correct and desired action – message, map or info						
Communication Menu: Does the user understand the meaning of the icons?						
Communication Menu: Any comments on the icons used?						

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Communication Menu: Ability of user to click on the correct and desired action - message, voice note, camera, video					
Emergencies Menu: Ability of user to understand the action required					
Contact Doctor: Ability of user to create a message and send to doctor					
Audio Communication: Ability of user to create and send a voice note					
Send Pictures: Did the user understand how to take and send a picture?					
GeoMapping location option: Clarity of process and ability to send location using the option					
Health Info: Ability to understand the purpose of the health info option					
Health Info: Ability to get access to a health topic					
Calendar: Does the user understand the visual presentation and meaning of the calendar					
Comments on the following: Use of language					
Comments on the following: Use of images					