The Evolving Emotional Experience with Portable Interactive Devices

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Abstract

Emotions play a significant role in people’s lives, including interactions with portable devices. The research aimed to understand the evolving emotional experience between people and portable interactive devices (PIs). Activity Theory was the theoretical framework used to contextualise the research approach and findings. Two longitudinal experiments were conducted investigating emotional experiences with PIs over six months. Experiment 1 focused on media / entertainment PIs while Experiment 2 focused on medical / health PIs. Mixed research methods consisting of diaries, interviews and co-discovery sessions were used to collect data. Results identified that more social interactions were experienced with media PIs than medical PIs. Different Task Categories, and their emotional responses, were also revealed including Features, Functional, Mediation and Auxiliary Categories. Functional and Mediation categories were characterised as overall positive while Features and Auxiliary Categories were characterised as overall negative. Further, the consequences of Negative Personal and Social interactions on the overall emotional experience were determined. For media PIs, Negative Social experiences adversely impacted the evolving emotional experience. For medical PIs, both Negative Social and Negative Personal experiences adversely impacted the evolving emotional experience. As a result of the findings the Designing for Evolving Emotional Experience framework was developed, outlining principles to promote positive, and avoid negative, emotional experiences with PIs. Contributions to knowledge from the research include methodological contributions, advancing understanding of emotional experiences with PIs, expanding the taxonomy of emotional interactions with PIs and broadening emotion design theory and principles. The thesis concludes with an outline of implications to design research, design and related fields, future research potentials, as well as the positive contributions to designing for meaningful and enjoyable experiences in everyday life.
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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature

Date
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Chapter 1

1.0 Introduction

1.1 Introduction

Experience is prime, and the product only a means.

(Hassenzahl, 2010 p.63).

Life is a collection of perpetual experiences, impacting people’s emotions positively, negatively and everything in-between. Experiences can be private, social; can occur during interactions with friends and family and with the objects and artefacts in the world. All of these experiences impact people’s lives to a great extent, including their emotions. At its core the field of Design is, and always will be, about creating a better life for people. As such, designed artefacts should facilitate and mediate emotionally meaningful experiences so as to positively impact people’s lives.

In recent years there has been a significant focus on the emotional aspects of the human-artefact relationship (Green & Jordan, 2002; Hummels, 2000; Jordan, 1998; Manzari, 2003). This can be demonstrated in recent literature (Ho & Siu, 2012; Hassenzahl, 2010; Blythe, 2003; Chang, Lai, & Chang, 2006; Chapman, 2005; Demirbilek & Bahar, 2003; Fulton, 2002; Green & Jordan, 2002; Jiao, Zhang, & Helander, 2006; Jordan, 1998; Kikin-Gil, 2006; Norman, 2004) and conferences (Design and Emotion Conference, Conference on Designing Pleasurable Products)
and Interfaces, International Design for Engagability Conference, Kansei Engineering and Emotion Research Conference) centred on the theme of design and emotion.

Technologies, and the devices that employ them, have also been through a recent change (Bergman, 2000; luppa, 2001; McCarthy & Wright, 2004; Shneiderman, 2002). Technology has advanced to a stage where electronics are small enough to add unprecedented functionality and versatility to an array of products that are personal, mobile and completely portable (Jones & Marsden, 2006). As Dourish outlines “…we are increasingly encountering computation that moves beyond the traditional confines of the desk and attempts to incorporate itself more richly into our daily experience of the physical and social world” (2001b p.15).

Because of this, most people nowadays are aware of, surrounded by, and/or interact with portable interactive devices (known as PIDs). These devices may include mobile phones, portable music players, portable digital video players, personal digital assistants, portable medical products and many more. They present new means of interacting with the world; allowing people to communicate and interact with entertainment, news, information, other people and their health and wellbeing virtually anytime, anywhere in the world. Never before have humans been able to interact with information and with each other in this manner. PIDs were touted as opening up entire new worlds of exciting and life-changing opportunities. Has this vision come to be? As Jones and Marsden (2006) report, a possible answer to this question can be found in statistics dating from the early years of mobile phone research. Jones and Marsden identify that the use of very advanced
technology such as WAP (wireless application protocol), video calling and mobile payment schemes failed while the use of very basic applications such as voice calling and text-based messaging thrived. Why would these very advanced, supposedly appropriate and useful applications fail while the basic ones succeed? The answer: the latter “meet basic human desires in simple, direct ways” (Jones & Marsden, 2006 p.5). This alludes to the idea that if the devices people interact with do not target human emotional desires, they will not enhance or facilitate positive experiences. As Picard and Wexelblat (2002) state, systems that ignore the emotional components of human life are inevitably incomplete and inferior.

The approach taken in this research considers people and their emotional experiences with products in real life social and emotional settings as the fundamental starting point. The fundamental step in making technology usable, practical and most of all enjoyable involves investigating and understanding people and their experiences with products in everyday environments, and designing the product based on the critical understanding of people’s experience.

Why is all of this important? It underscores the idea that to create enjoyable and positive interactions between people and products, it is first and foremost essential to understand the ways in which people find happiness in everyday life. Regardless of how appealing a device looks aesthetically, or how practical or usable it may be, or how precisely engineered it is, without an understanding of what makes people happy it is difficult to ensure interactions with the artefact will positively impact emotional experiences.
The person-product relationship is at the core of the experience design approach. It proposes to focus on emotional, social and enjoyable aspects of interactions as the starting point. Waibel & Stiefelhagen (2009) outline this line of thought:

Considerable human attention is expended on operating and attending to computers, and humans are forced to spend precious time fighting technological artefacts rather than doing what they enjoy and do well: human-human interaction and communication (p.v).

Thus, the driving question should not be “how can this device make life more enjoyable?” but rather “what types of experiences make people happy in life?” followed by “how can this product facilitate or enhance these experiences through everyday use?” This shifts the focus away from the product and draws attention to people and their experiences, which they are intended to support. This is an important distinction to make, as the focus should be about fitting the product around the lives of people, not the other way around.

Another important issue to consider is that interactions, including interactions with products, continuously evolve over time. Experiences in the world never occur simply in a single moment but rather are experienced over time. During these experiences, new characteristics develop and old ones fade in continuous transitions (Petersen, Madsen, & Kjaer, 2002). Contemporary theories in design, design methodologies and design approaches provide little support in
understanding how these emotional experiences evolve over time and across contexts and how this evolution may be supported and enhanced.

Portable devices pose a challenge as they are used in various kinds of situations and across different contexts, demanding different interaction modes depending on the situation. Different social settings, including other people, will also influence how the user interacts with and experiences the product at any given time. It is vital to understand how these products fit into the social and cultural lives of individuals.

This thesis explores the broader relationships between humans and portable interactive devices (PIDs) over the course of time. Its context is broad and situates, explores and aims to gain a better understanding of people’s activities with their portable devices in real life situations. Despite the current focus on emotions and the advent of PIDs within society, it is important to note that limited research has been conducted in this particular area. Although researchers in Design, Human-Computer Interaction (HCI) and other related fields have alluded to the fact that PIDs indeed present a new way of interaction (Bergman, 2000; Helal, Haskell, Carter, Brice, Woelk, & Rusinkiewicz, 1999; Jones & Marsden, 2006) there has been limited reported research on the effects PIDs have on the emotional experience in everyday situations. This research targets the gap identified in the literature regarding emotional experiences of PIDs.
1.2 Background Research and Proposition

Certain aspects of emotional experiences between people and artefacts can be summarised by analysing and applying findings from previous research and other relevant literature (Dourish, 2001b; Gomez, 2005; Hummels, 2000; Nardi, 1996b; Petersen et al., 2002). A critical aspect that was found to determine the overall emotional experience perceived by a human user during interaction is the context in which the activity is performed. This has been outlined in previous publications by the author (Gomez, 2005; Gomez, Popovic, & Bucolo, 2004a; 2004b; 2008). In this case context referred to the surrounding environment, situation and time of day. The emotional condition of the user prior to an activity will influence how the individual perceives the overall emotional experience due to the fact that emotional experiences evolve and change over time (Gomez, Popovic, & Bucolo, 2004a). Therefore, it can be hypothesised that the:

- Emotional experience between human user and product will evolve and transform over time; and
- Context and activity will affect the emotional experience of the human user.

This research explores and examines these issues within the context of emotional experiences with PIDs. Further, it proposes to do this through the comparison of two PID types to determine the similarities and differences between product types.
1.3 Aims and Objectives

The aim of the research was to support and enhance the evolving emotional experience between people and portable interactive devices. This builds on previous research on emotional experiences with a focus on media / entertainment and medical / health devices. People use media / entertainment PIDs on a daily basis including mobile telephones, smart phones, PDAs and Mp3 players among others. Medical / health devices represent an emerging PID category including heart-rate and blood-glucose monitors and pedometers among others. Together, these categories capture a good selection of the different PIDs that currently exist in the market. The research objectives were as follows:

- Explore the evolving emotional experience between human user and media / entertainment PIDs over time in real life contexts
- Explore the evolving emotional experience between human user and medical / health PIDs over time in real life contexts
- Compare evolving emotional experience between the two PID categories

1.4 Research Question

The research question driving the study was:

*What are the differences between emotional experiences across different product categories and how do these emotional experiences change over time and across contexts?*
This question was derived specifically from the hypothesis and findings from previous research in that it deals with different product types, an evolving emotional experience and focuses on the aspect of context. It deals with two interrelated issues, which can be expressed as sub-questions: what are the differences and/or similarities between the emotional experiences of media / entertainment and medical / health PIDs? and: how do these emotional experiences change over time and across different contexts of use?

The focus was primarily on these two issues. First, the research explored interactions between users and their PIDs over the course of six months. Second, these interactions were situated within the social and cultural context of people’s everyday interactions with PIDs and the diverse activities performed. The approach reflects Dourish’s (2001b) work in that the concern is not only the PID’s physical interface or its usability aspects, but rather with the ways in which PIDs are manifest in the environment and are experienced and integrated into everyday activities. The focus was on portable technologies, objects carried around by people to diverse locations and contexts at varying times. Attention to the “portable” means dealing with the interaction between the user and object within the socio-cultural environment of everyday use. The findings and implications presented within this research will assist in better understanding people’s experiences and relationship with PIDs in everyday life. The implications from the study will be useful for designers and design researchers in their endeavours to design usable, beautiful and enjoyable devices.
1.5 Findings and Contributions to Knowledge

There are various contributions to knowledge that emerged from the findings of the research. Overall the study contributes to knowledge in several ways, including advancing understanding of emotional experiences with PIDs, expanding the taxonomy of emotional interactions with PIDs, methodological contributions and broadening design theory.

**Advancing understanding and taxonomy of emotional experiences**

This study contributes to and supports existing research that proposes people interact with PIDs consciously both at a personal level and at a social level (Stelmaszewska, Blanford & Fields, 2005; Gomez, Popovic & Blackler, 2009, 2010, 2011, 2012; Hassenzahl, Diefenbach & Görtitz, 2010). It also demonstrates that the extent to which people interact with PIDs at a personal and social level differs depending on the product category. Further, the study identified different Task Categories including Functional, Features, Mediation and Auxiliary. The emotional responses associated with each Category were also established. The identified Task Categories expand the taxonomy of emotional experiences with portable devices as well as advance understanding of emotional experiences associated with PIDs during interactions. The study also confirmed the Peak-End rule for evolving emotional experiences with PIDs. The Peak-End rule states that people’s judgement of the overall emotional experience is determined by the average of the most extreme emotional experience, or the peak, and the end emotion experienced (Kahneman, 2000; Fredrickson & Kahneman, 1993). This rule applied for most
participants with some limitations. This finding is an advancement of existing theory regarding emotional experiences between people and portable devices.

Further, the findings established that the social level is critical in influencing the evolving emotional experience (Gomez, Popovic & Blackler 2010, 2011). It was established that negative social experiences impact the evolving emotional experience in a detrimental way. For media / entertainment PID s the relationship between Negative Social and Negative Personal experiences was important. For medical / health PID s there was a direct relationship between Negative Social experiences and the overall emotional experience. The impact of the social level, and the ways in which it influences the overall emotional experience, contributes to knowledge regarding emotional experiences over time in context. These findings have not been reported previously in the literature and represent a significant contribution to advancing understanding knowledge of emotional experiences with PID s.

Methodological Contributions to Knowledge

A further contribution of the study is in the research approach and method employed to analyse the emotional experience of interaction (Wrigley & Gomez 2010). Through the review of available literature, it was found that there were limited studies specifically exploring the emotional experience with portable devices, especially with medical / health PID s. Moreover, there were even fewer studies exploring the emotional experience through time in real life contexts. The research approach, focusing on mixed methods consisting of interviews, diaries and co-
discoveries, is a novel way of capturing emotional experiences through time. It permits identification of the public experiences but also of the private settings in which PID\textregistered s are used. Further, the use of the Emotional Chart in combination with the mixed data collection methods utilised is transferable for other devices beyond PID\textregistered s to explore and assess people’s emotional experiences.

*Theoretical Contributions to Knowledge*

The study contributes to design theory in the area of emotion design research, specifically the evolving emotional experiences with PID\textregistered s (Gomez, Popovic & Blacker 2009, 2010, 2011, 2012). The differences and similarities of emotional experiences between the two product types, the utilisation of Activity Theory to contextualise different levels of interactions, and the identification of the impact of the social element, broaden design theory. These theoretical advancements in emotional experiences assisted in the development of the *Designing for Evolving Emotional Experiences* (DE\textsuperscript{3}) framework (Figure 28), which provides a set of principles for evolving emotional experiences in context.

1.6 Thesis Structure

The thesis structure presented in Figure 1 illustrates relationships between the various chapters that help to form a coherent framework for the research.
Figure 1 illustrates how each chapter in the thesis is supported and links to other chapters to focus on the aims and objectives of the study and answer the research question. Chapter 1 introduces the study and outlines background research.
conducted on emotion and experience design as well as the aims and objectives of the current study. Chapters 2 and 3 represent a comprehensive literature review that encompassed four broad areas: (i) emotions, (ii) experience design, (iii) portable interactive devices (PIDs) and (iv) future technologies.

Chapter 2 outlines the core component of the research, emotions. First, emotion is defined within the context of this study, while the difference between emotions, moods, feelings and affect is also discussed. Basic and complex emotions are outlined and the theory of the Peak-End rule is introduced and contextualised within the research. Experience design is also discussed within the context of the research. Chapter 3 focuses on PIDs and begins with a brief discussion as to how they represent a novel form of interaction in the contemporary world. Further, the future trajectories of computing devices are outlined, including context-aware, ubiquitous computing and ambient intelligence.

Converging the previous information, Chapter 4 outlines current available research on emotional experiences and PID design for both categories of products: media / entertainment and medical / health. Figure 2 encapsulates the literature review construct. The overall purpose was to outline the main areas in the literature that came together to comprehensively conceptualise the evolving emotional experience of interacting with PIDs. To contextualise the literature review section, Activity Theory was also reviewed and summarised. Activity Theory is introduced in Chapter 5 and provides the research with a theoretical foundation for the underlying approach of the study. This framework was used to support the research approach
as well as the findings and recommendations. Figure 2 illustrates how all major areas reviewed come together with the Activity Theory framework to develop a solid foundation for contextualising the evolving emotional experience of interacting with PID.

Figure 2. Literature review construct

The experimental rationale of the research is outlined in Chapter 6. The methodological rationale is presented with a discussion about longitudinal, qualitative study. Moreover, the research design is outlined with a discussion on the structure, approach and reasoning behind the experiment design.

Chapters 7 and 8 discuss the two experiments: Chapter 7 covers the media / entertainment experiment while Chapter 8 details the medical / health experiment.
These chapters also describe the method, participants, equipment and procedure conducted. The coding scheme, analysis and findings of the experiments are also highlighted with specific focus on personal and social interactions as well as the four Task Categories identified, which include Features, Functional, Mediation and Auxiliary. Chapters 7 and 8 also include a discussion regarding the Peak-End rule and how the findings from the experiments conducted support and enhance this rule within the context of evolving emotional experiences with portable interactive devices. Comparisons between the findings of the two PID types are discussed in Chapter 9, specifically focusing on findings at the micro and macro-levels.

Chapter 10 presents the discussions and the implications of the findings. The discussion centres on how findings relate to the design field as well as potential PID design and related fields. This section is divided into two main sections with the first focusing on the implications at the micro-level (interface between user-product) while the second focuses on implications at the macro-level (interface within user-product in context).

Finally Chapter 11 concludes the thesis by outlining the outcome of the research, contributions to knowledge and limitations, and suggests future research potentials. The outcome consists of a framework labelled Designing for Evolving Emotional Experience (DE³). The framework situates the findings from the research and provides suggestions to design for evolving emotional experiences with portable devices. The DE³ framework is also validated through initial experimentation and the
findings of the validation are presented. Contributions to knowledge include advancing understanding of emotional experiences with PIDs, expanding the taxonomy of emotional interactions with PIDs, methodological contributions and broadening design theory. Limitations of the study are also discussed. Future research directions are outlined including potential further analysis on the data to identify additional relationships at different levels of interaction, studying other PID categories as well as other areas of design including non-portable device design, interface design, interaction design, web-design and software design, and finally employing these findings to related fields including business, marketing and advertising, and engineering present further avenues of exploration.

1.7 Summary

This chapter introduced the research and the background of the current study including the aims and objectives. The research question driving the study was also presented as well as the findings and contributions to knowledge. Finally the structure of the thesis was summarised. Chapter 2 proceeds with the literature review focusing on emotions and experience design.
Chapter 2
2.0 Emotions and Experience Design

2.1 Introduction

This chapter explores emotions, including the difference between emotions, moods, feelings and affect, and discusses basic and complex emotions including the Peak-End rule. Additionally the relationship between emotions and design is examined through the lens of what has been termed in the literature as the experience design approach.

2.2 Emotions

Your intellect may be confused, but your emotions will never lie to you.

(Ebert, n.d.).

Emotions are central to human experience. People experience a multitude of emotions in daily life, in the faces and attitudes of people, in movies, books and experiences each and every day. Whether consciously or not, emotions filter people’s thoughts, behaviours, attention, perception, memory and decision-making through everyday activities (Damasio, 1994; LeDoux, 1996; Brave and Nass, 2002; Russell, 2003). It is through these diverse interactions that humans experience moments of frustration, heartache, joy and delight. Philosophers, theologians,
theorists, academics and scientists have all tried to arrive at an answer to what is
an emotion for thousands of years; from the time of Socrates and the great Greek
philosophers (Oatley, 2004; Lewis, Haviland-Jones & Barrett, 2008), and even
today there is no commonly agreed definition. To understand emotions within the
human-product interaction it is important to study, define and understand emotions
and their implication to the design fields.

Although there is no universally agreed definition there are certain aspects of
emotions that are generally agreed upon. Something that is commonly accepted is
that emotions are affected by an evaluation of an experience in relation to goals,
motives or concerns (Oatley, 2004; Frijda, 1986; Brave & Nass, 2002). This
particular aspect of emotion is normally referred to as the *appraisal theory* of
emotion. Oatley (2004) describes it as follows:

> Emotions occur at the juncture of our inner concerns with the outer world;
> they are evaluations of events in terms of their importance for our concerns
> (p. 43).

For instance, if an experience or event is moving favourably toward a person’s goal
or concern then the emotional reaction will be a positive one. If, on the other hand,
an experience or event is not moving toward the person’s goal or concern
favourably then the emotional reaction will be negative. Of course emotions are
more complex than this, but at the simplest level this is a good starting point for
understanding the basis of emotions.
Another important characteristic of emotions is that they generate affective, cognitive, physiological and behavioural responses (Brave & Nass, 2002; Kleinginna & Kleinginna, 1981). This denotes that emotions have a multifaceted nature that produces various reactions depending on the situation. The affective aspect is to do with experiencing a basic emotion. The cognitive element refers to the conscious acknowledgement or understanding of the emotional experience by the mind. The physiological refers to the bodily reaction to emotions driven by the nervous and autonomous physical response. Finally the behavioural aspect has to do with a physical manifestation in response to an emotional experience. For example, the experience of watching a sad movie may engage all these facets of an emotional experience. While the story unfolds, the viewer observes and understands the situation (cognitive acknowledgement), begins to feel a sense of sadness (affective response) and may show signs of sadness through facial expressions potentially leading to crying or sobbing (physiological and behavioural responses).

Perhaps a definition that encapsulates the two concepts regarding emotions, namely the appraisal theory and the multifaceted nature of an emotional experience, is best described by Griffiths (2003):

Emotion is an extended mental episode that originates when events in the world frustrate or satisfy a pre-existing desire… this leads the subject to form an attitude to the world which colors their future experience, leading them to attend to one aspect of things rather than another, and to view the things they attend to in one light rather than another (p.2).
Understanding these characteristics, where (i) emotions are coupled to some particular concern and (ii) generate various physical and cognitive responses, is important for the purposes of this study since a key component of the research involves exploring people’s emotional experiences with portable devices. As such, it is important to comprehend how emotional experiences are perceived so as to be able to better determine how they relate to people’s lives. The idea that emotions relate to a goal or intention implies that if a product or device does not satisfy an expected goal then it will adversely affect emotions. If the product or device facilitates or promotes a goal then it will positively influence emotions. The fact that emotions generate affective, cognitive, physiological and behavioural responses also helps to determine or predict user reactions to interactions at a given moment.

2.2.1 Emotion, Mood, Feeling and Affect

The terms emotion, mood, feeling and affect are often used interchangeably. However, it is useful to distinguish between these different terms as they refer to and define different parts of an emotional experience.

*Emotion*

An emotion is often characterised as relating to or directed at a specific object of interest (Frijda, 1986; Brave & Nass, 2002). As explained in Section 2.2, this is one of the defining characteristics of emotions that many researchers agree upon. This suggests that emotions are intentional and are related to an event or object; people feel *sad* about a loved one being sick, feel *happy* if a sport team wins, get *frustrated*
with a computer that does not function in the way they expected. As a result of this object-directness, emotions are short-lived experiences and may be replaced or forgotten with time. Due to these characteristics emotions are, in many cases, attributed to products or systems people are currently interacting with which may inhibit or benefit their experiences. And although they are short-lived, emotions still play an important role in determining mood states over time (Frijda, 1986).

*Mood*

Moods, as opposed to emotions, are more diffused and longer lasting experiences. Moods are not directly related to a specific event or object, although they can be indirectly caused by an event or object (Brave & Nass, 2002). Moods are linked to emotions in that a consistent activation of one type of emotion may lead to a certain type of mood (Picard, 1997). For instance, if a person reads a sad book, then watches a sad television program, then listens to a sad song, it may be likely that the person will begin to get depressed or sad. One interesting feature of moods, given they are not directed at a specific event or object, is that they can be described as free-floating; that is, sometimes people can be in a particular mood without knowing why or the cause of the mood (Russell, 2003). Another characteristic of mood is that people generally tend to focus on stimuli that will sustain a current mood state (Bower & Forgas, 2000). Nevertheless, people can also consciously regulate moods toward a more desired alternative. In the context of daily life, moods play an important role, and products people interact with may impact the general mood.
**Feeling**

Although the term “feeling” is often used interchangeably with the word “emotion”, within psychology feelings are regarded as a subset, or specific part, of an overall emotion (Scherer, 2005). Feelings are generally defined as the sensation (sometimes bodily sensation, although not exclusively) and evaluation associated with an emotion. Unlike emotions, feelings do not necessarily have to be directed to an event or object and are not necessarily cognitively activated or acknowledged (Russell, 2003). For instance, the sense of excitement about a rollercoaster ride is composed of the feeling and sensations associated with excitement, while the rollercoaster ride itself is a separate cognitive component of the experience.

Feelings, as described here, are relevant for design as they are part of the emotion associated with an experience. When interacting with products, feelings and sensations may be activated almost instantly through looking at the product or touching it, which could influence the experience in a positive or negative way.

**Affect**

Affect is a more specific term that is used within the field of psychology to define a neurophysiologic state that is closely related to an emotion (Russell, 2003; Watson & Tellegen, 1985). As outlined by Russell (2003), core affect is the simplest raw feeling in moods and emotions and is not necessarily directed at an event or object. It is measured across two dimensions: pleasure-displeasure on the one scale, and activation-deactivation (arousal and drowsiness) on the other scale. Thus, affect is the instantaneous conscious experience of a blend of those two dimensions. This particular characteristic of affect (that it can be described in two dimensions) makes
it a useful concept for the measurement and description of an emotion at any one
given time. A revised chart, based on the model of Core Affect was adopted within
this study. The model is labelled as the Emotional Chart (Figure 8) and used by
participants to record their emotional reactions. A detailed discussion of the
Emotional Chart and how it was used is presented in Chapter 6.

2.2.2 Basic and Complex Emotions

While some researchers argue that a straightforward set of basic emotions is
difficult to determine (Ortony & Turner, 1990), there are many researchers who
agree that all humans posses an instinctual set of basic emotions that are used to
form socially-based complex emotions (Lewis et al., 2008; Ekman, 1992; Plutchik,
Tomkins, 1984; Panksepp, 1992; Goleman, 1995).

*Basic Emotions*

As Ekman & Cordaro (2011) argue, basic emotions display common features that
distinguish them from other affective states. They can arise from rudimentary
appraisals of events and may also be experienced for no known reason (Johnson-
Laird & Oatley, 2008). Basic emotions are defined by unique characteristics
including distinctive universal signals, display of distinctive physiology, automatic
appraisal, the presence in other primates, capability of quick onset and distinctive
subjective experience, among others (2008). Ekman and Cordaro (2011) go on to
posit a set of basic emotions consisting of anger, fear, surprise, sadness, disgust,
contempt and happiness. These basic emotions represent “families” of emotion categories, which many other affective states belong or spring from (Table 1).

Table 1. Basic Emotions and their respective descriptions (adapted from Ekman and Cordaro, 2011)

<table>
<thead>
<tr>
<th>Emotion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger</td>
<td>The response to interference with pursuit of a goal humans care about. Anger can also be triggered by someone attempting direct harm (physically or psychologically) to an individual or someone they care about. In addition to removing the obstacle or stopping the harm, anger often involves the wish to hurt the target.</td>
</tr>
<tr>
<td>Fear</td>
<td>The response to the threat of harm, physical or psychological. Fear activates impulses to freeze or flee. Often fear triggers anger.</td>
</tr>
<tr>
<td>Surprise</td>
<td>The response to a sudden unexpected event. It is the briefest emotion.</td>
</tr>
<tr>
<td>Sadness</td>
<td>The response to the loss of an object or person to which humans are very attached. The prototypical experience is the death of a loved child, parent, or spouse. In sadness there is resignation, but it can turn into anguish in which there is agitation and protest over the loss and then return to sadness again.</td>
</tr>
<tr>
<td>Disgust</td>
<td>Repulsion by the sight, smell or taste of something. Disgust may also be provoked by people whose actions are revolting or by ideas that are offensive.</td>
</tr>
<tr>
<td>Contempt</td>
<td>Feeling morally superior to another person.</td>
</tr>
<tr>
<td>Happiness</td>
<td>Feelings that are enjoyed, that are sought by the person. There are a number of quite different enjoyable emotions, each triggered by a different event, involving a different signal and likely behaviour.</td>
</tr>
</tbody>
</table>

It is interesting to note that the basic emotions consist of an overwhelming amount of negative emotions compared to positive emotions. There is some research to support that humans are born to be inclined to experience, and be more sensitive to, negative emotions (Campos, Thein & Owen, 2003; Fredrickson, 2000) because they serve as a primary survival mechanism to avoid and escape from unwanted circumstances. Fredrickson (1998) proposes several reasons for the lack of positive emotions, suggesting that (i) positive emotions are fewer in number and less differentiated than negative emotions, (ii) psychologists focus on solving problems
and therefore concentrate on negative emotions, and (iii) research into emotions focuses on building theory based on emotion prototypes, inadvertently focusing on negative emotions over positive emotions. Nevertheless, the positive emotions should not be dismissed or disregarded. Positive emotions are important as they form part of everyday life as well as being a crucial part of a good quality of life and mental health (Fredrickson, 1998; Diener, 2000).

Complex Emotions

Basic emotions are seen as the biological basis, or foundation, of complex emotions (Johnson-Laird & Oatley, 2008). Complex emotions appear to be unique to humans as they are formed as part of higher-level conscious appraisals (2008). They have also been described as socially learned (Brave & Nass, 2002; Griffiths, 2003) and are said to only exist because of people’s interpretation of events through social or cultural experiences in daily life and are thus seen as forming later in life. They include emotions such as grief, guilt, empathy, jealousy and pride, among others (Brave & Nass, 2002; Lewis et al., 2008). One characteristic of complex emotions is that they are often distinctly subjective emotional states since they are elicited by specific situations and contexts (Lewis et al., 2008). They are often related to the evaluation of the self within the environment and context. As Lewis et al. explain:

Pride occurs when one makes a comparison or evaluates one’s behaviour vis-à-vis some standard, rule, or goal… and finds that one has succeeded.
Shame or guilt, on the other hand, occurs when such an evaluation leads to the conclusion that one has failed (2008 p.742).

Complex emotions are important to consider, as the user-product relationship exists within the social-cultural sphere and as such has to be situated within this broader context. Although basic emotions are crucial, in real life contexts people also react emotionally in complex ways relevant within the social and cultural context in which they are involved. Complex, as well as basic, emotions are relevant for the study as both types of emotions are elicited during user-product interactions.

2.2.3 The Peak-End Rule

A central aspect of this research focuses on exploring emotional experiences through time (six months). This represents a substantial amount of time that relates to information about people’s experience, not just during one episode or through the initial stages of interaction, but also the ongoing evolution of an experience. The implication of this is that emotions need to be understood within the context of experiences through time. Although the understanding of basic and complex emotions as separate entities is important, they also need to be understood as ongoing and evolving phenomena that take into account aspects of time, context and perception relevant to the individual involved.
Frijda (1986) states, “Most emotions, being interactions, are events over time and are felt as events over time. They not only have a beginning and an end, but also an initiation and a resolution, or an explicit nonresolution.” (p.249). Here, Frijda highlights an important characteristic of emotions as experienced in real life; they are evolving, changing and must always be understood within context and as being part of a much longer ongoing life experience. When situating emotions in this way, it becomes important to understand that people are not just experiencing emotions in a direct linear fashion but are instead constantly regulating their emotional state with an understanding of what has previously happened, what is currently occurring and what is about to happen. As Griffiths (2003) asserts, the emotional experience exists in a continual updating mode, leading to a diverse emotional experience.

An interesting theory that is relevant for this research is the Peak-End rule (Kahneman, 2000; Fredrickson & Kahneman, 1993). The Peak-End rule is based on what Fredrickson and Kahneman (1993) call the “snapshot model of remembered utility”. The model states that an emotional experience is evaluated by constructing a representative model (or snapshot) that combines or merges attributes of significant moments of the overall experience. This model argues that overall emotional experiences are not necessarily determined by the duration or amount of positive or negative emotions experienced. Rather they are perceived by the average of a select few emotional ‘snapshots’ experienced during the course of the event, specifically the most extreme emotional experience (peak) and the emotion experienced near the end (end).
Kahneman, Fredrickson, Schrieber & Redelmeier (1993) conducted an experiment in which 32 participants were asked to rate their level of discomfort while exposed to two separate painful experiences. In the first experiment, they were asked to immerse their hand into painfully cold water (14 degrees Celsius) for 60 seconds. In the second experiment they were asked to immerse their hand into cold water (14 degrees Celsius) for 60 seconds and for the next 30 seconds the water temperature was slowly raised slightly (15 degrees Celsius). It was found that even though the second experiment still included all the pain of the first experiment plus an extra period of slowly diminishing pain, participants judged the second experiment as less painful overall. Further, when asked which of the two experiments they would undergo again (to judge which of the two was perceived as less painful and the better of the two options) 69% of participants chose the second experiment. As Fredrickson (2000) states:

People’s global evaluations of their past affective experiences, as well as their choices about the future, can often be well predicted by a simple average of two moments: the most intense affective moment of that experience and the affect experienced at its end. One curious consequence of the peak-and-end rule is that the duration of past affective experiences carries hardly any weight at all (p.585).

As the above examples show, adding more negative emotional events to an experience does not necessarily make the overall emotional experience worse. This
creates an interesting phenomenon regarding people’s perception of experiences in which:

Adding more pain to the end of an episode can actually improve its retrospective global evaluation as long as the end pain represents an improvement over the peak pain (p.583).

Fredrickson (2000) labels this phenomenon as “duration neglect” and adds:

The odd implication of duration neglect is that, from hindsight, people do not seem to care whether an unpleasant episode continues, or a pleasant episode stops (p.582).

Varey and Kahneman (1992) conducted two experiments that showed that from a psychological perspective people do not adhere to the idea that adding moments of pain at the end of an experience do not make it worse, or conversely adding moments of pleasure at the end do not make it better. They also identified that retrospective evaluations were well predicted by a weighted average of the peak affect rating and the final rating of an emotional experience. These findings form the basis of the Peak-End rule. Likewise Ariely (1998) conducted two experiments that focused on examining the effects of various factors on pain evaluation. The first conclusion from the experiments was that retrospective evaluations of negative experiences were influenced by a combination of the experience of the final pain intensity and the intensity trend during the latter part of the experience. Further,
results showed that the duration of the event had little effect on experiences with constant intensities, whereas duration did have an effect on experiences with changing intensities over time. Again, these findings discussed by Ariely (1998) support the general idea of the Peak-End rule and its particular aspects relating to evaluation of emotional experiences over time.

The Peak-End rule might have consequences for the design of products and systems, especially with emotional experiences. This rule has implications for how people perceive their overall emotional experiences with products over time and this will be discussed in relation to overall emotional experiences in Chapters 10.

2.3 Experience Design Approach

For over a decade, the field of design has seen an emerging interest in emotions. The thrust behind the focus on emotions can be attributed to a new emphasis on the overall user experience during human-product interaction. This has led to what has been termed as experience design; a design approach that attempts to move beyond usability, functionality, effectiveness, and cognition toward a better understanding of the emotional and affective aspects within human-product interaction (Desmet & Hekkert, 2007; Suri, 2002; Budd, Taylor, Wakkary & Evernden, 2005; Overbeeke, Djajaningrat, Hummels & Wensveen, 2002; Schifferstein & Hekkert, 2008). As Hassenzahl outlines:
Experience Design asserts design not to be about products anymore but about the experiences they deliver. This requires a broadened perspective, with the fulfillment of psychological needs (values), which in turn creates meaning and emotion, as the prime design objective (2010 p.75).

Experience Design stands on the premise that users of products in everyday life, although concerned about practical issues including functionality, effectiveness and efficiency, also care about how products enhance and mediate daily experiences in a positive or negative manner. This view is similar to what Yoo (2010) terms experiential computing:

...in experiential computing, artefacts with embedded computing capabilities directly mediate the user’s experience... experiential computing calls for a reorientation of our focus from task performance and information processing to lived experiences of everyday life activities that are digitally mediated. User needs are, therefore, much broader than informational needs for task performance in organizations, reflecting deeper basic human needs and values (p.217).

Within the field of design much of this interest has come through research focused on emotions and affect in ergonomics and human-computer interaction. Gomez (2005) discussed the historical development of these fields and their relationships with the field of design. Interest in affect, emotions and people’s emotional
experience has also come from other fields including marketing and advertising, economics, and more broadly from the business world.

Within marketing and advertising, emotions have been extensively researched for over twenty years (Huang, 2001; Poels & Dewitte, 2006), focusing on many areas including the consumption experience, consumer behaviour, and consumer response, among others (Poels & Dewitte, 2006; Richins, 1997). It is interesting to note that within the marketing and advertising fields the arguments for focusing on emotions are similar to those advocated by design. As O’Shaughnessy and O’Shaughnessy (2003) contend:

In marketing, there is a large and growing body of academics who are anxious to move away from the view of the highly rational consumer… to formally concede that the calculating-machine model of the consumer is a myth (p.v).

They go on to explain the central tenet of their discussion:

…emotion is always a factor in decision-making and that rationality will always be invaded by emotional influences… It sees consumer experience as emotion-drenched; no experience is completely empty of emotion, and no pure rationality is ever at work. Emotion is never a semidetached adjunct to consumer processes (p.vi).
Likewise, Poels and Dewitte (2006) propose that emotions need to be considered as one of the most crucial aspects of advertising. Poels and Dewitte outline that emotional reactions are filters for other cognitive or behavioural reactions, which are critical components for all fields including marketing and advertising.

In the same vein, Gobe (2001) puts people and emotions at the centre of his book, *Emotional Branding: The new paradigm for connecting brands to people*. Gobe highlights that “The traditional supply/demand economic models are being completely reevaluated…” and states that the new models should take into account the “…emotional aspects of products and their distributed systems…” (p. xviii) arguing that this will be the key differentiator to determine consumer choice. As Gobe explains

> By emotional, I mean how a brand engages consumers on the level of the senses and emotions; how a brand comes alive for people and forges a deeper, lasting connection (p.xviii).

Economics is another field that has recently begun to take notice and pay attention to experiences and emotions (Kaufman, 2006). Hill (2008) discusses the significance of emotions for economics and argues that it is the emotional connection with customers that is “…the key to long-term, sustainable success” (2008 p.3). He goes on to state that to be successful companies need to connect with people on an emotional level, understand how emotions matter and realise when they are invoked in the economic and business process. Loewenstein (2000)
also discusses the importance of emotions for economic theory by arguing that emotions play three important roles in economics; first, emotions influence people’s bargaining behaviour; second, emotions play a critical role in decision-making that has future implications; and third, emotions play an important role in decision-making under risk and uncertainty. Loewenstein outlines that to truly understand people and their behaviour in the economic context, emotions and affective issues need to be considered.

A seminal book by Pine and Gilmore (1999) discusses a closely related aspect to emotions: the importance of ‘experiences’ for people. The experience economy (which represents the current economic situation) moves the offering from tangible goods or services toward memorable and enjoyable events and experiences. Pine and Gilmore propose that companies succeed in providing experiences when they engage customers in a memorable way. They explain that, since experiences are inherently personal, they engage people on an emotional, physical, intellectual and even spiritual level. This distinction between experiences and other types of interactions is the inherent nature of experiences evolving and revealing themselves over time. As Pine and Gilmore clarify:

While commodities are fungible, goods tangible, and services intangible, experiences are memorable. Buyers of experience... value being engaged by what the company reveals over a duration of time (p.11-12).
Within the context of design an important question is how are goods, which are tangible and manufactured, intended to fit within the context of this new experience economy? Pine and Gilmore offer a strategy stating that manufacturers should focus on designing for experiences while using their products or goods. As they explain:

Most product designers focus primarily on the internal mechanics of the good itself: how it performs. What if the attention centred instead on the individual’s use of the good? The focus would then shift to the user: how the individual performs while using the good (p.15).

Similarly to these other fields, the focus on emotions and experience in design research and practice is based on attempting to enhance the overall emotional experience between humans, products and their environment of use (Gomez, 2005; Hummels, 2000; Jordan, 2000). Merholz, Schauer, Verba & Wilkens (2008) discuss this specific aspect from a product design point of view.

Rather than stating that the focus should be on people’s experience, Merholz et al. (2008) propose that the experience is the product. Similar to Pine and Gilmore’s (1999) point about dealing with people as they are, Merholz et al. explain that designers and businesses need to truly understand and consider people as having abilities, needs and desires that go beyond the functional and deal with the emotive and experiential aspects of interaction. As Merholz et al. explain, people’s experience emerges from the way certain qualities combine and interact during an
experience (Table 2). Merholz et al. argue that it is these qualities that people value during interactions with products in everyday life. It is this understanding that constitutes the basis of experience design and forms valuable and emotional connections to products. From a design perspective, products can elicit emotional reactions from the way they look, the way they feel, through their interaction as well as through their association with broader social and cultural factors (Wiberg, 2005).

Table 2. Qualities of experiences (adapted from Merholz et al., 2008)

<table>
<thead>
<tr>
<th>Qualities</th>
<th>Definition in terms of experience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motivations</strong></td>
<td>Why they are engaged with the offering, and what they hope to get out of it.</td>
</tr>
<tr>
<td><strong>Expectations</strong></td>
<td>The preconceptions they bring to how some things work.</td>
</tr>
<tr>
<td><strong>Perceptions</strong></td>
<td>The ways in which the offering affects their senses (see, hear, touch, smell, taste).</td>
</tr>
<tr>
<td><strong>Abilities</strong></td>
<td>How they are able to cognitively and physically interact with the offering.</td>
</tr>
<tr>
<td><strong>Flow</strong></td>
<td>How they engage with the offering over time.</td>
</tr>
<tr>
<td><strong>Culture</strong></td>
<td>The framework of codes (manners, language, rituals), behavioural norms, and systems of belief within which the person operates.</td>
</tr>
</tbody>
</table>

The rationale of this thesis is that since the research focus is on PIDs, which are used in varying social contexts, powerful emotional connections will be elicited not just through the way the products look and feel but also through broader social and cultural situations and experiences (Jones & Marsden, 2006).
2.3.1 Attributes of Experience Design

Having discussed the experience design approach in general terms, it is important to examine the components of an experience. Hassenzahl (2010) outlines four elements that constitute the main properties of an experience. These include:

1. **Subjective (versus objective):** Experience is subjective. It emerges through situations, objects, people, interrelationships, and relationship to the experiencer, but it is created and remains in his or her head. Given that, it may not matter how good a product is objectively, its quality must also be experienced to have impact.

2. **Holistic (versus instrumental):** Experience is holistic. It comprises perception, action, motivation, and cognition. It emerges from the simultaneous activation of those processes and integrates them into a meaningful, inseparable whole.

3. **Situated (versus abstract):** Experiences are situated. They emerge from the integration of action, perception, motivation, and emotion, all being in a dialogue with the world at a particular place and time.

4. **Dynamic (versus static):** Experience is dynamic, extended over time. The order, the timing, and the saliency of single moments impact the overall experience.

Hassenzahl (2010) discusses the importance of positive experiences. As he points out “although experience can obviously be bad or good, painful or pleasurable, I
believe positive to be an attribute worth stressing” (2010 p.27). By ‘positive’ Hassenzahl means that it is not about trying to design trivial amusement but rather about creating worthwhile, valuable experiences and improving people’s lives.

Although these aspects outline the properties of experience, for the purposes of this research, the focus is on three aspects: (i) time, (ii) context and (iii) perception. It is proposed that these three issues cover the properties and attributes of experience discussed by Hassenzahl. The issue of time covers the two properties: (i) holistic and (ii) dynamic. The issue of context deals with the two properties: (i) situated and (ii) dynamic. Finally perception encapsulates: (i) subjective and (ii) positive. It is argued that these three elements (time, context and perception) form the core components of experiences within the context of this study.

Due to their very nature, PIDs must be understood within an evolving interaction between user and product over the course of time. Since the devices are taken to different places and situations, the progression and evolution of the relationship between user and product is significant. Second, as a direct result of focusing on the issue of time, the socio-cultural and environmental circumstances also become vital. Third, as discussed in Section 2.2, when considering interactions through time it is important to not only understand the aspect of emotions independently but also understand how people perceive and judge overall emotional experience. Thus, the issue of perception becomes relevant. These three aspects: time, context and perception, form the basis of contextualising experience design within the scope of this research and will be discussed in the following sections.
2.3.2 Experience and Time

Research specifically studying the evolving interaction between user and product has been previously explored (Nardi, 1996b; Petersen et al., 2002). Nevertheless, the topic is still in its early stages within the design field and there are still areas not well researched. There is a common understanding that over time a person’s relationship with a product evolves and progresses (Petersen et al., 2002). This progression begins before the product is used through to the moment of interaction and continues evolving for weeks, months and even years. An evolving experience refers to the changing experience between a user and a product over the course of time. The fundamental idea is that the connection a user has with a product may be different between its first use, compared to one month after purchase, which may differ again six months later and so on. Until now, there has been limited research into how time affects the human-product relationship as research has tended to focus on snapshots of use rather than on the complexity of the evolving experience of interactions through time.

A recent study exploring this particular aspect was conducted by Karapanos, Zimmerman, Forlizzi and Martens (2009). Karapanos et al. conducted a study exploring people’s experience with the Apple iPhone over a five week period aimed at understanding how user experiences and evaluative judgments of the iPhone develop over time. Participant’s experiences were recorded using a Day Reconstruction Method (DRM), which permits participants to record their experiences at the end of a reported day or at the beginning of the next day.
Further, they were asked to perform an experience narration, which required participants to pick the three most impactful, either satisfying or dissatisfying, experiences of that day and write a story that described in detail the situation, their feelings and their momentary perceptions of the product. Karapanos et al. identified three phases for adoption of products including (i) *Orientation*, (ii) *Incorporation*, and (iii) *Identification* (Figure 3).

![Figure 3. Temporality of experience (Karapanos, Zimmerman, Forlizzi and Martens 2009 p.732)](image)

These phases reflected different qualities of the product from before product purchase through to several weeks after the product was interacted with. Further, three main forces were identified as motivators for transition between the three phases over time including (i) *increasing familiarity*, (ii) *functional dependency* and (iii) *emotional attachment*. The study by Karapanos et al. is closely related to the current research, with the exception of focusing on only one portable product.
instead of two different product categories and looking at a five-week period rather than six months.

Another study that has looked at this area was conducted by Petersen, Madsen and Kjaer (2002). Petersen et al. explored the progressive interaction between people and their television use over several months from a usability perspective. They tracked participants' connections with and expectations of their television from before they purchased the product right through to the detailed use of the product over the course of four to six months. Through their study they identified four types of learning ‘artefacts’, or elements, including: (i) what, (ii) how, (iii) why and (iii) where to artefacts.

*What* artefacts refer to the limitations and conditions inherent in the product itself such as the buttons on the remote control and television. *How* artefacts refer to procedural instructions, such as the ones found in manuals. *Why* artefacts are general models and principles that offer explanations of how the products work, such as the modes on a remote control. *Where to* artefacts are the imaginative visions, which help change and redefine a person’s understanding of the overall activity, such as the desire for a movie theatre experience when watching television. It is suggested that these artefacts are useful in understanding use and development in use.

Petersen et al.’s (2002) conclusions indicated that products should contain a combination of all of these types of learning artefacts to make the experience of
interacting with the product easier and more usable. In addition they suggested that these learning artefacts are not static during interactions, instead they develop, become modified and sometimes fade away and then come back again due to factors both inside (the product itself) and outside (surrounding context) the design. Although their conclusions are relevant to this study, Petersen et al.’s (2002) study does not focus on portable devices.

A few other studies have looked at evolving interactions between people and products (Eronen, 2004; Gauntlett & Hill, 1999; O’Brien, Rodden, Rouncefield, & Hughes, 1999) but these focused on non-portable products. For instance, Eronen’s (2004) study aimed to explore people’s use of interactive digital televisions and proposals for future television use. The study included an experiment in which participants were asked to document their television use over three days using a modified cultural probe technique followed by a one-hour interview. Results from the study identified 75 innovations for both present and future television use. Gauntlett and Hill (1999) explored television use in a family context over a much longer timeframe. The study involved 500 participants completing detailed questionnaire-diaries over a five-year period. Among a host of detailed findings from this vast study, Gauntlett and Hill identified some key issues including people’s tendency to use television programming to organise their lives, the television set as an integral part of the household’s social interaction and television’s ability to become the central focus of organisation of geographic and everyday timetables. O’Brien et al. (1999) utilised an ethnographic approach to study people’s use and interaction with a set-top box that controlled a range of digital services for the home.
in a natural setting. The study identified several aspects of use including the importance of flexibility with regard to use and interaction, the integration of technology into home life and tailorability and management of domestic environments. These studies have influenced the direction and the methodological approach used in the current research, specifically with regard to a focus on the social aspect of product interaction as well as the longitudinal aspects of interaction.

2.3.3 Experience and Context

Although it has been acknowledged that there is a link between the surrounding context and user’s emotions (Dey, Abowd, & Salber, 2001; Gallagher, 1994), there has been limited research on how contexts-of-use specifically affect the emotional experience of interactions (Jones & Marsden, 2006). Context-of-use has been of interest for design research since without that context it is difficult to understand people’s actions and behaviours. Kuutti (1996) argues, “actions are always situated into a context, and they are impossible to understand without that context” (p.26). Context refers to a variety of elements in the external and internal environment which may include the surrounding environment, the time of day, the social setting, the activity being performed in that situation and any relevant cultural issues pertaining to the moment of interaction. The experiences of interactions are influenced by the surrounding context in which they occur. Context has the power to enhance or detract from the emotional experience of interactions as feelings and
emotions are shaped by the surrounding situations (Dey et al., 2001; Gallagher, 1994).

There is a general understanding that products should not be designed in isolation. Instead they are always going to be used in a specific context. As researchers in this field outline (Bargas-Avila & Hornbaek, 2011; Korhonen, Arrasvuori & Väänänen-Vainio-Mattila, 2010), one of the core aspects of experience design is the situational and dynamic aspect of using interactive products and the importance of context. Context is central for portable devices since it is shifting and changing in terms of its location, other people and cultural, social and environmental factors.

Although context is known to influence emotions, there is a limited amount of information defining how the shifting context-of-use affects the emotional experiences with portable computing. One study that has reported specifically on the issue of context and its implications for portable devices is the work conducted by Korhonen et al. (2010). The authors explored the experience of 21 users interacting with PIDs, including smart phones, tablets, Mp3 players, heart rate monitors, miniature translators, and digital cameras, over ten days. Korhonen et al. used experience reports to collect the data during the study. Participants were asked to record their positive and negative experiences of using the products throughout the ten-day period, with a specific focus on the context of use. In the study the authors discussed the following context categories: environmental, personal, task, social, spatio-temporal, device, service and access network. Findings indicated that the main context categories that influenced their experience
were the device, task and social categories. Korhonen et al (2010) identified that the device interface, the task performance and the social context in which activities occurred were the main contributing contexts that impacted on the overall experience.

Although it is only recently that context has been researched within design, there has been a call for understanding the broader social, cultural and environmental context of interacting with PIDs for some time in human-computer interaction circles (Schmidt, Beigl, & Gellersen, 1998; Wiberg, 2005; Orbist, Meschtscherjakov & Tscheligi, 2010). Dourish (2001b) described how in the previous decade attention was paid to social aspects of computing. He illustrated various ways in which HCI has focused on the social aspects. One approach has concerned itself with incorporating social understanding into interactive systems; in other words trying to understand how interactive systems can resemble human-to-human social interaction.

Another approach involves understanding how people organise their daily lives and the role social and organisational settings play in this situation. Still, a vast majority of the research within HCI has been limited to determine the physical context of use in portable computing and limited actual experiments have been reported on the socio-cultural aspects of interaction (Ito et al., 2005; Jones & Marsden, 2006; Ling, 2004) or on the environmental aspect of PIDs.
The social and environmental aspects of interacting with computing devices are currently seen as an important area of research within HCI and design in general (Arvola, 2004). Jessup and Robey (2002) describe an instance in which a new portable product was introduced into the airport check-in procedure. The intent was to eliminate or at least alleviate waiting times at check-in counters at airports. The airline personnel were given mobile devices so they could roam and check people in. Although the idea seemed appropriate, it caused unintended problems as passengers were not used to this procedure and they simply lined up behind the drifting personnel. As Jessup and Robey describe:

The scene quickly took in the appearance of the Pied Piper as the employee with the wireless computer walked around the concourse with a growing, snaking line of travellers desperately trying to follow the only norm they knew for that context, forming a line behind her (2002 p.89).

Another study focusing on the socio-cultural aspects of portable computing was conducted by Ling (1997). Ling studied the effects of mobile phone use in public settings. Ling found that respondents were quick to point out inappropriate use of mobile phones in different social settings. One of the reasons people found mobile use obtrusive was the invasion of the voice of the speaker into their private space. Also, the ringing of the mobile phone was seen as an intrusion into other people’s privacy. As Ling (1997) points out with regard to technology use in social settings, “While there are unimagined possibilities there are also unimagined complications”
This suggests the need to understand aspects of product use, especially portable devices, within the socio-cultural settings they are interacted with.

2.3.4 Experience and Perception

A critical factor of experiences that has long been ignored but has recently begun to capture the attention of researchers in the design field is the aspect of perception and judgement. Norman (2009) discusses this particular aspect and labels the phenomenon as the distancing effect. He describes this as a particular aspect of memory about past experiences and outlines that in these instances details fall away faster than higher-level constructs and emotions fade away faster than cognition. What does this phenomenon have to do with design? As Norman outlines, designers:

...should not be devoting all of our time to providing a perfect experience. Why not? Well, perfection is seldom possible. More important, perfection is seldom worth the effort. So what if people have some problems with an application, a website, a product, or a service? What matters is the total experience. Furthermore, the actual experience is not as important as the way in which it is remembered (p.24).

At first glance this appears to go against good design practice but when considering experiences over time in real life contexts this approach holds true.
Norman is arguing that it is the overall experience that is important to people, not just the moment-by-moment interactions. It is critical to identify and target how the experience is perceived and remembered at a subjective level rather than the objective experience that occurs. This relates closely with the Peak-End rule discussed by Kahneman (2000) outlined earlier in this chapter. As the Peak-End rule stated, overall experiences are not necessarily determined by the duration or amount of positive or negative emotions experienced. This ties in closely with Norman’s argument that it is the overall experience that people care about, not the momentary experiences. The Peak-End rule provides a theoretical grounding for this particular aspect of judgement and perception.

Further, within psychology an important concept that needs to be considered is primacy and recency effects of memory (Redelmeier & Kahneman, 1996; Ariely & Zauberman, 1999; Montgomery & Unnava, 2009). This concept essentially states that when it comes to memory the ending of an event stands clearly in people’s mind, followed by the beginning of an event. The middle parts of an experience are important, but it is the end primarily, and the beginning to a certain extent, that tends to impact the subjective recollection of events. Primacy and recency effects also relate to the Peak-End rule (Section 2.2.3). The fact that people remember the end part of an event appears somewhat understandable given that when people are asked to report on their experience, those parts of the experience that occurred most recently will be recalled more readily. Nevertheless, this is an important aspect of memory recall that needs to be considered within the context of the research since the research asked users about an extended emotional experience.
2.4 Summary

This chapter focused on introducing emotions and their basis in experience design. Emotions are critical components of human-product interactions and influence many aspects of the relationship. The term emotion was differentiated from mood, feeling and affect within the literature (Frijda, 1986; Brave & Nass, 2002; Scherer, 2005; Russell, 2003; Watson & Tellegen, 1985). Within the context of this study they are all involved in an emotional experience during human-product interaction.

The difference between basic and complex emotions was outlined (Lewis et al., 2008; Plutchik, 2003; Frijda, 1986; Izard, 1991; Russell, 2003; Oatley & Johnson-Laird, 1987; Tomkins, 1984; Panksepp, 1982; Goleman, 1995; Ekman & Cordaro, 2003). The Peak-End rule was also introduced, which states that overall emotional experiences are not necessarily determined by the duration or amount of positive or negative emotions experienced, but rather by the average of a select few emotional ‘snapshots’ experienced during the course of the event (Kahneman & Tversky, 2000; Fredrickson and Kahneman, 1993). Specifically, the snapshots of interest are the most extreme emotional experience (peak) and the emotion experienced near the end (end).

The second part of the chapter examined what has been termed as experience design, an approach to design that attempts to move beyond usability, functionality, effectiveness and cognition toward a better understanding of the emotional and affective aspects within the human-product interaction through time (Desmet & Hekkert, 2007; Fulton, 2002; Gomez, 2005; Gomez et al., 2008).
Three critical aspects were discussed. First, due to the very nature of experiences, they must be understood as an evolving interaction between user and product over the course of time (Karapanos, Zimmerman, Forlizzi & Martens, 2009). Second, as a direct result of focusing on the aspect of time, the socio-cultural and environmental circumstances also become vital and therefore the issue of context needs to be considered (Dey et al., 2001; Bargas-Avila & Hornbaek, 2011; Korhonen, Arrasvuori & Väänänen-Vainio-Mattila, 2010). Third, how people perceive and judge overall emotional experience, or their perception of events becomes relevant (Norman, 2009; Karapanos, Martens & Hassenzahl, 2010). These three issues—time, context and perception—form the basis of contextualising experience design within the scope of this research.

These two areas—emotions and experience design—form the basis and the significant part of the overall framework that constitutes the study. It was crucial to outline these concepts in detail so as to apply them together with an understanding of PID's to properly approach the research and generate relevant and useful findings applicable for design research.
Chapter 3
3.0 Portable Interactive Devices

3.1 Introduction

Portable Interactive Devices (PIDs) can be described as electronic products that are specifically designed to be transported, carried around and used by people at any time in diverse locations. PIDs have given rise to novel means of interaction. Prior to the portable age, the place and time in which interaction with computing devices occurred was dependant on the location of the device itself. The nature of portable devices opens up new ways of interaction in varying social, cultural and personal contexts. This chapter explores the area of portable interactive device design within the media / entertainment and medical / health product categories. Further, it outlines and identifies the latest developments, technologies and possible future of the industry including context-aware, adaptive, ubiquitous and ambient environments.

3.2 Portable Devices: Novel Means of Interaction

The field of portable device design is still in its early stages (Jones & Marsden, 2006). Research into portable media / entertainment devices has primarily focussed on mobile phones and to a certain extent more recently, PDAs and Mp3 players (Ito et al., 2005; Wiberg, 2005; Ling, 2004; Bergman, 2000; Jones & Marsden, 2006; Kangas & Kinnunen, 2005; Kiljander, 2004; Sarker & Wells, 2003; Siewiorek et al.,
Research into the emotional experience of interacting with portable medical / health devices is limited (Young & Cameron, 2006). Even within general medical products there is limited mention of the emotional aspects of interacting with those products. Reviewing the Handbook of Medical Device Design (Fries, 2001), there is little mention of considerations for the emotional aspects of design or issues regarding design for portability. Young and Cameron (2006) refer to the need to consider the emotional aspects of medical product use. They comment on recent research that reports a direct relationship between the patient’s emotional condition and their physical health. They call for designers to have a keen understanding of patients’ emotional needs and to create devices that help patients feel confident, calm and comfortable. To achieve this, Young and Cameron suggest not to rely too heavily on quantitative research, but rather to approach from a qualitative perspective.

3.2.1 Media / Entertainment Portable Devices

Jones and Marsden (2006) provide an overview of PIDs and divide them up in terms of the functions they provide. Some offer information management capabilities like organising appointments, creating to-do lists, providing desktop-type applications and access to the Internet and associated applications. Others provide entertainment like games, music, sounds, picture and video capabilities. There are also portable devices that provide functions to monitor vital signs on a daily basis. From this description, it can be noted that portable computing products can be categorised into three main areas: (i) office-type products, (ii) entertainment-
type products and (iii) medical-type products. These categories are not clear-cut. For instance, mobile phones that may include functions such as appointments lists, to-do lists and diary systems also include cameras, music players, games and a host of other non-business related functions. Nevertheless, these categories serve as a good starting point to categorise the various portable devices in the market.

In the main, early users of portable devices were business professionals (Bergman, 2000; Ito et al., 2005). Nowadays, the users of PIDs have become wide-ranging and diverse in many respects. This implies that a new understanding of users and their interactions with PIDs is required. Van `t Hooft, Brown-Martin and Swan (2008) outline the development of handheld media / entertainment devices could be traced back to the early 1970’s and the vision proposed by Alan Kay for the design of a portable child-friendly notebook called the Dynabook. This was followed by further developments and designs of portable devices including the Sony Walkman in 1979, Apple Newton in 1993 and the eMate in 1997 (van `t Hooft et al., 2008), among others. During the 1990’s, Palm was responsible for the development of a range of breakthrough portable handheld devices that consolidated and established the portable device market. Since then there has been a proliferation of portable media / entertainment devices introduced into the market, including laptops and more recently tablets and e-readers. These types of portable computing products pose challenges for the field of design because they are specifically designed to be transported and utilised across a variety of locations and situations. These diverse settings demand different ways of interaction between human user and product. For instance, mobile phones allow people to communicate with others in an
emergency situation in remote locations. Personal Digital Assistants (PDAs) offer opportunities to work and access information ‘on-the-go’. Mp3 players facilitate listening to music and other types of audio information (such as podcasts) on public transport or in remote areas. These types of media and entertainment PDs allow people to interact with entertainment, news, information and a whole subset of personal and business communications in ways never before possible (Cairncross, 1997; Hamill & Lasen, 2005; Jones & Marsden 2006). These devices open up novel means of communication, that relate not just to technological capabilities of the product, but also impact personal and social relationships (Wiberg, 2005).

3.2.2 Medical / Health Portable Devices

Likewise, there has been a sudden expansion of portable devices in the health field even though the health sector has only recently had access to advanced technology to support this expansion (Oddershede & Carrasco, 2008). As Scheffler and Hirt (2005) observe, medical device manufacturers have, for many years, produced laboratory and hospital type equipment. Recently though, due to microelectronics, miniaturisation, and new communications technology, this has expanded to the design of portable medical / health devices. Some of these include basic health devices including pedometers and heart-rate monitors, blood-glucose monitors and so on. More and more there is a call for portable health devices that monitor people’s health and become “health-aware” in a more fundamental way (Varshney, 2007). Merritt (2004) outlines the opportunities for health-monitoring
devices to be embedded in shirts, wristwatches, armbands and rings with smart
technology and embedded sensors to monitor heart, lung, temperature and motion
data and pass this information on to medical professionals. Portable medical
devices allow people to monitor their health in private as well as public situations
and permit people to autonomously strive to achieve a better quality of life.

It seems the proliferation of these types of devices is set to continue, with various
health-care companies investing in portable health device technologies (Dean,
2009; Dolan, 2009; Hattangady, 2009; Wong, n.d.). Frog Design, a leading design
company based in the United States, published an article in collaboration with
health-care providers, insurers, employers, consumers, governments, and
technology companies illustrating a vision of the future for health care, which
included significant application and use of portable devices for personal and social
use (Kilian & Pantuso, 2009).

Research in this area has focused on developing infrastructure and associated
systems for wireless telemedicine (Dean, 2009; Lymberis & Dittmar, 2007;
Varshney, 2007; Park & Jayaraman, 2003). These reports have mainly been
produced to make the case for a shift in resources and research to support this
potential future. Gartner, a leading information technology research and advisory
company, identify mobile health monitoring as one of the top ten consumer mobile
applications for 2012 and beyond, stating, “Currently, mobile health monitoring is at
an early stage of market maturity and implementation, and project rollouts have so
far been limited to pilot projects. In the future, the industry will be able to monetize
the service by offering mobile healthcare monitoring products, services and solutions…” (Pettey, 2001 para.8).

This highlights the fact that portable devices across various industries are not only permeating modern life but will continue to do so for many years to come. As such, the design of these devices has a significant impact on the daily lives of people. People use these products for many different reasons: to achieve specific tasks, to communicate with others, to assist in daily activities and to ultimately enhance everyday living. There is an important relationship that exists between people and the portable devices they use because they are carried, utilised, interacted with, maintained and appropriated in a variety of situations. People care about portable devices because they reflect to others something about who they are, or who they want to be (Jones & Marsden, 2006).

Although there are attractive sides to portable devices, there are also certain challenges that need to be addressed. Some of these issues relate to the social aspects of using PIDs in everyday social and cultural situations and the problems this might cause. For instance, studies have revealed that using a mobile phone in different social situations can impact its perceived acceptability (Campbell, 2007) and can even be perceived as bad manners (Ling, 1997). Similarly, there is a general understanding that when dealing with medical and health related issues it is not just about the physical pain but also about the social, emotional and intellectual experience (Dearden, Wright, Bowen, Rahman, Cobb & Wolstenholme, 2010).
These are examples of many potential challenges that are still to be comprehensively addressed. It is also important to identify the current and future technology that may impact these types of devices. The next section discusses this particular aspect and identifies three categories of technology that have the potential to significantly impact PID design in the near future.

### 3.3 Future Directions in PID Technologies

An important aspect that offers a vision of the future in this area is that devices should behave differently and offer different interactions depending on the context-of-use (Bergman, 2000; Dey et al., 2001; Dourish, 2001a). Regarding the future of PIDs, Jones and Marsden (2006) comment that people require devices that are a marriage between communication and sophisticated information devices. Thus, the future success of PIDs rests in providing novel, interesting and suitable human-to-human social communication capabilities that need to be delivered through the correct application of technology. These include context-aware, ubiquitous computing and ambient intelligence. These terms are often used interchangeably within the literature even though they refer to different aspects of the technological landscape. There is a vast amount of literature available on these future technologies (Aarts & Encarnacao, 2008; Hong, Suh & Kim, 2009; Dey et al., 2001; Dey & Mankoff, 2005; Greenberg, 2001; Lieberman & Selker, 2000; Maguire, 2001, 2002; Sato, 2003; Siewiorek et al., 2003; Tamminen, Oulasvirta, Toiskallio, & Kankainen, 2004; Van den Bergh & Coninx, 2005). The following sections will discuss them broadly.
3.3.1 Context-Aware Technologies

Context-aware and adaptable technologies refer to systems that can detect, analyse and appropriately adapt to a particular situation (Dey, 2000; Poslad, 2009). The fundamental premise of context-awareness is that if the situation, place or activity changes within an interaction then the product should adapt to the changes and react, behave or provide feedback appropriately in response to the specific context. Schimdt et al. (1999) state:

People take their phones and PDA’s everywhere using them in various environments and situations to perform different tasks. The user’s expectation towards the device also changes with the situation (e.g. the user would like different ring tones for a phone in a meeting than on a noisy road). Ideally, devices that know about the situational context… could transparently adapt to the situation (p.90).

Brown, Burleso, Lamming, Rahlf, Romano, Scholtz & Snowdon (2000) proposed an interesting classification of context-aware applications by dividing them into: proactive triggering, streamlining interaction, memory for past events, reminders for future contexts, optimising patterns of behaviour, and sharing experiences. Although the idea of context-awareness provides a suitable solution for supporting and enhancing human-product experience, there are still concerns about how this can be achieved.
One of the major hurdles relates to the problem of defining ‘context’ (Schmidt et al., 1998). Greenberg (2001) comments that designers of context-aware applications may find it difficult to define the number of contextual states that may exist for a particular situation. As such, it is problematic to know what type of information is needed to determine the appropriate action that should be taken in a particular situation. Most context-aware systems focus on the external context as this is not so difficult to detect, including physical environment, location data, distance, temperature, sound, air pressure, time and lighting levels surrounding users, among other aspects (Hong, Suh & Kim, 2009). Nevertheless, to make services truly personal and appropriate for the task and emotional state of the user, the cognitive domains, such as information retrieval, decision making, situation monitoring, and so on, are needed (2009; Gay, 2009). Dey et al. (2001) outlines particular challenges faced by developers and designers of context-aware products:

Context-aware applications promise richer and easier interaction, but the current state of research in this field is still far removed from that vision. This is due to three main problems: (a) the notion of context is still ill defined, (b) there is a lack of conceptual models and methods to help drive the design of context-aware applications, and (c) no tools are available to jump-start the development of context-aware applications (p.97-99).

The researchers go on to suggest a definition for context, a conceptual model for context-awareness and a toolkit for context-aware applications. As a conceptual model, Dey et al. describe five technical elements to achieve context-awareness,
including (i) ‘Widgets’ for acquiring contextual information, (ii) ‘Interpreters’ to transform and possibly combine contextual information into usable data, (iii) ‘Aggregators’ to gather context information related to an entity for easy access by applications, (iv) ‘Services’ to execute behaviours on environment using acquired contextual data, and (v) ‘Discoverers’ to allow applications to determine the capabilities of the environment and take advantage of them. This conceptual model is implemented in a toolkit to develop useable and workable context-aware programs that can be implemented into products. The study by Dey et al. (2001) provides a useful basis for context-aware conceptual models and products because it thoroughly outlines the elements that need to be considered.

Another noteworthy case from the literature that has evaluated a context-aware device is the Sensay mobile phone (Siewiorek et al., 2003). Sensay is a context-aware mobile phone that adapts to the changing environment and physiological state of the user. It combines sensory data, user information and historical information to eliminate unwanted interruptions or notify the user of an incoming call by adjusting ringer tone and vibrations according to the user context. Sensay includes four primary states, which it alters between different contexts, including (i) Uninterrupted, (ii) Idle, (iii) Active, and (iv) Normal. Each state changes the product interface according to the context. For instance, in the Uninterrupted state, the ringer is turned off. The study by Siewiorek et al. reports on the design and initial testing of the product. The product has five units: a (i) sensor box, (ii) sensor module, (iii) decision module, (iv) action module, and (v) phone module. The sensor box collects physical data from the surrounding context, the sensor module is
software that queries the data, the decision module detects the phone’s state, the action module sets the state and the phone module provides access to the mobile phone operating system and interface. The system also allows the user’s contextual information to be transmitted to the caller when the user is unavailable and permits the device to make call suggestions based on call history.

PersonalSoundtrack is another example of a context-aware system for media and entertainment devices (Elliot & Tomlinson, 2006). The PersonalSoundtrack is a mobile music player that performs real-time choices of music based on user context, specifically the user’s activity level. Elliot and Tomlinson (2006) tested a prototype system that used an accelerometer to match the user’s step rate to a song’s beat per minute. The intent is to allow the music to be in-tune with the user’s pace and thus fit in with the user’s context with regard to activity level. Further, the prototype used a context-aware system to learn inappropriate song choices should users decide to explicitly skip songs that were not wanted. As Elliot and Tomlinson (2006) argue, the intention of the prototype was to create a context-aware device that can meaningfully and independently adapt to users in order to improve the human computer interaction.

There have been further developments in context-aware computing including systems such as Lifetrak, DJogger, Pampalk and XPod (Omojokun, Genovese & Isbell, 2008). These systems were designed and prototyped as automated devices to assist in user-product interaction. More recently, rather than the development of specific context-aware devices, the field has been focused on developing and
implementing context-aware systems into existing mobile devices (Hong et al., 2009).

Context-aware has also infiltrated the health related fields. Varshney (2007) states there is a need to identify context within the healthcare environment so that devices are able to deliver information, healthcare and resources more efficiently and appropriately. He states that context-aware devices and systems are still at the concept level and goes on to describe a context-aware system called Lifeminder used by patients to detect their actions and postures as well as capturing photos and voice information (Varshney, 2004). Lifeminder is used to detect highly stressful situations by analysing the contextual information it captures. Another example of a context-aware health device is outlined by Vaara, Hook and Tholander (2009), which is called the Affective Health System. This particular concept is a mobile phone application that aims to permit people to better deal with stressful situations. As the authors describe:

It is a tool for visualizing patterns and trends of bodily and contextual information over time. This information is intended to empower users to reflect on their behavior in everyday life. The data is not intended to give users an entirely true or full story about their everyday behaviors, stress reactions or life styles, but the material can let users link the data to their subjective experiences (p.4472).
One of the key components of the device is the way it provides feedback of the person’s stress situations in a unique manner through highly visual pictorial displays on the mobile phone screen. The authors propose that given a person’s concept of time is very individualistic, then the visualisation of stressful situations through time needs to be displayed in a distinct manner. The idea behind the Affective Health System is that by making users aware of their stress levels in a format that is interesting and engaging they will be able to self-monitor their reactions to situations in the hope that they can improve over time.

3.3.2 Ubiquitous Computing

Ubiquitous computing is another concept that is relevant within the context of this research. The term ‘ubiquitous computing’ was coined by Mark Weiser (Muhlhauser & Gurevych, 2008). The term can be interpreted to mean ‘computers everywhere’, and is closely related to the term ‘pervasive computing’. Weisers’ vision can be captured by this famous quote:

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it (p.2).

Due to the fact that context-aware technology could be utilised within a ubiquitous system it could be argued that context-aware technology is subsumed by the concept of ubiquitous computing (Gay, 2009).
One interesting aspect regarding ubiquitous computing is the fact that it could be distributed among a collection of portable devices and other products, among devices and the built environment or completely integrated within the built environment and become almost invisible in the environment. Poslad (2009) outlines some possible scenarios where ubiquitous computing could be applied. He described a vision for the future of taking photos:

A digital camera automatically captures a visual part of the physical world…

The camera can autofocus and auto-expose recorded images and videos so that recordings are automatically in focus and selected parts of the scene are lit to the optimum degree. The context of the recording such as location and date/time is also automatically captured using inbuilt location and clock systems. The camera is aware that the person making a recording is perhaps interested in capturing people in the scene, in focus, even if they are off centre. It uses an enhanced user interface to do this which involves automatically overlaying the view of the physical world, whether on an inbuilt display or through a lens or viewfinder, with markers for parts of the face such as the eyes and mouth. It then automatically focuses the lens so faces are in focus in the visual recording (p.3-4).

Poslad (2009) describes how a ubiquitous system would allow the automatic distribution of the recorded content among friends and family across a communications network while being archived in an external content database. Image processing can be used to tag people through face-recognition technology
using friends and family database. This vision describes a system in which portable devices are integrated into an ‘invisible’ network for seamless transfer of information, data and content. Three other ubiquitous scenarios are described including (i) a 21st century adaptive transport scheduling system that can re-route public transport networks automatically based on user demand; (ii) a foodstuff management system for the home that can monitor and control the intake, purchase and planning of food in the home to support healthy eating and weight regulation; and (iii) a utility regulation system for the home that automatically regulates the consumption of a utility (water, energy, heating). As these examples indicate, although the technology for a ubiquitous society is theoretically attainable, the vision is currently not economically feasible due to cost and applicability of certain technologies, although it is not far away (Poslad, 2009).

Some challenges do exist with the general idea of ubiquitous computing (Davies & Gellersen, 2002). Edwards and Grinter (2001) outline some challenges of the application of ubiquitous computing in the home. Although the focus of their paper is on the home context, they Van ’t Hooft, Brown-Martin and Swan outline some important hurdles relevant for all contexts including the technical challenge of being able to truly create systems where all components integrate seamlessly; the problem of having no system administrator to fix problems; the issue of privacy in ubiquitous systems; dealing with reliability for highly complex systems; and finally, the problem of smart-systems interfering in people’s lives when it is not wanted.
Although the difference between ubiquitous computing and ambient intelligence has been described as a purely academic distinction (Ronzani, 2009), within the context of the study, ambient intelligence is positioned as the potential end point, or future, of portable devices. The reason being that by definition, ambient intelligence, as opposed to ubiquitous computing, is almost completely devoid of physical devices. Thus, the human user interacts with a virtually “invisible” environment in which context-aware, smart and adaptable technology is embedded seamlessly (Aarts, Harwig & Schuurmans, 2002; Cook, Augusto & Jakkula, 2009). By “invisible”, the idea is that people interact with technology in a seamless and effortless manner with almost no direct interaction with physical products other than a simple interface that transfers and communicates relevant information. Weber, Rabaey and Aarts (2005) outline that ambient intelligence is characterised by an environment:

- Where technology is embedded, hidden in the background
- That is sensitive, adaptive, and responsive to the presence of people and objects
- That augments activities through smart non-explicit assistance
- That preserves security, privacy and trustworthiness while utilising information when needed and appropriate (2005 p.1).

Aarts, Harwig and Schuurmans (2002) also state that an ambient intelligent environment exhibits three features including (i) ubiquity, (ii) transparency and (iii)
intelligence. Ubiquity denotes that the environment would be embedded with a multitude of high-performance computing technology; transparency refers to a surrounding system that is virtually invisible to the user; while intelligence means that the system would behave and respond in a socially and emotionally appropriate manner for the situation.

Another important feature is that the devices are integrated into the environment and automatically adapt themselves to users and anticipate their needs (Vasilakos & Pedrycz, 2006). As Vasilikos and Pedrycz state:

The focus is on the users and their experiences from a consumer electronics perspective, which introduces several new basic problems related to natural user interaction and context-aware architectures supporting human-centred information, communication, service and entertainment (2006 p.1).

Pragmatically speaking, the process and key features of ambient intelligence is similar to ubiquitous computing. Aarts and Marzano (2003) describe the five key features including (i) an embedded network of integrated devices, (ii) context-aware technology that can recognise the physical, social and personal context, (iii) a personalised system tailored to individual needs, (iv) an adaptive system that responds automatically, and (v) an anticipatory environment that anticipates users’ needs and desires without conscious mediation.
Although ambient intelligence is establishing itself as the future of computing, much of the technology and potential applications are still in their infancy (Aarts et al., 2002; Cook et al., 2009; Aarts & Ruyter, 2009). Some parts are possible while others are still in the developmental phase. For instance, sensors to detect information in the environment already exist and are available for deployment; miniature computers are also available but need development, while technologies like ‘smart dust’, tiny microelectronic sensors that detect everything from light to vibrations, are still in the very early phase of development (Vasilakos & Pedrycz, 2006; Aarts & Ruyter, 2009). Similar to ubiquitous computing, at a conceptual level the idea of ambient intelligence is possible but not yet viable and the repercussions of such extensive integration of computing in the environment and daily life are difficult to predict. Further, there are some challenges beyond the technical issues (which are significant) within the ambient intelligence context (Weber et al., 2005).

One of the issues regarding these automatic and self-managing systems is the aspect of relying on technology to make decisions. As Weber et al. state:

Under “normal” circumstances, automated control processes increase system stability – machines are certainly much better than humans if they have to devote their whole attention to a particularly boring task. But situations that have not been anticipated in the software can easily have disastrous consequences if they are not directly controlled by humans (as tragic accidents involving airplane autopilots have shown in the past).

(2005 p.13)
Weber et al. also identify the issue of privacy and surveillance as a particular hurdle to overcome in automated, smart, self-managed ambient system. Nevertheless, the idea of ambient intelligence is an interesting one and proposes an exciting vision for designers of interactive, experience driven systems. Ambient intelligence focuses on the interaction between people and experiences rather than on people and products, which is at the core of the experience design approach.

### 3.4 Summary

The area of PID design is still in its early stages of development, however there is a general understanding that PIDs will influence and create a connection to emotional aspects in the human-product relationship (Wiberg, 2005; Jones & Marsden, 2006). PIDs are unique in that they are used at any given time and across varying contexts and situations. This chapter has discussed the area of portable media / entertainment and portable medical / health computing products where there are attempts at exploring and investigating the emotional aspects of interaction, although little research or specific findings have been published (with the exception of the mobile telephone).

Further, the chapter also identified the idea that context-aware, ubiquitous computing and ambient intelligence, although in their infancy, fit well within portable interactive device applications and appear to be a novel approach to achieving enhanced interactions for portable product design. These visions outline and
provide a potential future for PIDs. Alongside this there are technical, ethical and social challenges to the use of these technologies (Edwards & Grinter, 2001; Weber, Rabey and Aarts, 2005; Davies & Gellersen, 2002). Nevertheless, these challenges are seen as aspects to be overcome rather than permanent stumbling blocks, as the general consensus within the research domain in the area of computing is that they represent the future.

Although there is an abundance of research into the possibilities afforded by context-aware, ubiquitous computing and ambient intelligent technologies, limited research has been conducted about how this can be applied to support and enhance the emotional aspects of interaction. Nevertheless, these future technology visions provide a promising direction for future portable interactive devices and systems that can support and enhance the evolving emotional experience. The following chapter (Chapter 4) discusses the existing and current literature on the topic of emotional experiences with portable devices.
Chapter 4
4.0 Emotional Experience and PID Design

4.1 Introduction

As discussed in Chapter 3, PIDs are becoming more and more a part of people’s everyday lives:

Use of mobile devices for supporting our everyday communication has become part of our daily routine. Recent statistics illustrate that the penetration of mobile devices in everyday use has reached (and in some cases even surpassed) the penetration of fixed communication devices.
(Patrikakis, Fafali, Minogiannis & Kourbelis, 2009 p.1)

Ideally, PIDs offer a whole new world of effective, efficient and enjoyable interaction possibilities. This is the promise that portable computing device designers advocate. The overarching idea is that due to their nature portable interactive devices, more so than other products, have the opportunity to ultimately support and enhance everyday life in a meaningful and positive way because they are situated and used in context. Taking this into consideration, it is surprising to note that little research has been conducted into the emotional considerations of portable computing product design (Jones & Marsden, 2006).
Before any of these claims can be met, the questions that need to be asked are many and varied. For instance, how will these devices change people’s daily lives? How do people use these products within everyday situations? In what way will they affect the way people interact with the products themselves as well as other people? Additionally another question is how PIDs—products that are carried on people’s bodies, across different situations, on a daily basis—affect the way people feel about themselves and toward others? Since these types of products allow for continuous interaction, it is suggested that they will also affect the way people feel on an inherent emotional level.

The focus of these products should be on how to enhance and facilitate positive emotional experiences. At face value there appears to be the potential for negative emotions to be elicited during interaction with portable computing products. Negative emotions are elicited and remembered more easily when performing a critical task or activity (Gomez, 2005), and people rely on PIDs to perform tasks immediately, in any time and in many different situations. At their most basic, within the context of this research, emotions are elicited during instances where products, services or systems achieve or do not achieve an intended goal or intention (Oatley, 2004; Frijda, 1986; Brave & Nass, 2002). Accordingly, if a product or device facilitates or promotes a goal it will positively influence emotions. If it does not facilitate a goal, it will adversely affect the experience. This suggests that a focus on the emotional aspects of interaction is vital within the area of portable computing.
Chapters 2 and 3 explored two focal areas including emotion and experience design, and portable interactive devices and future technology in the portable computing field. This chapter presents current research focusing on the evolving emotional experience between people and portable interactive devices.

4.2 Current Research in Emotional Design and PIDs

As outlined in Chapter 2, the main aspects of experience design (and thus in this research) are the elements of time, context and perception. Within the context of this study these three elements deal directly with the evolving emotional experience with PIDs in real life situations.

It is argued that different portable devices demand different emotional relationships with their users because of their specified purpose. Norman (2000) observes that “each product category poses novel challenges” (cited in Bergman, 2000 p.vi). For instance, medical products demand a different type of relationship and thus a different type of interaction style than media or entertainment products. It has been noted that a patient’s sense of health can be determined by several factors including how they perceived their own health as well as how others perceive them:

Patients can feel branded as sick when attached to wires and tubes, patients’ families grow anxious when looking at their loved one who is bound to an intimidating device, and healthcare workers resist using treatments that cause unnecessary emotional stress. In one situation, a product should
seem light and mobile, while in another, it should blend into the surrounding, not attracting attention. Through form, color, detail, and feel, a product can help all persons involved in healthcare have a greater sense of ease and normalcy (Young & Cameron, 2006 para.3).

Users interacting with office-style products may require the product to support different needs like communication with others, scheduling and time management capabilities, reliable access to information and so on. These different requirements create a necessity for a different type of interaction (Young & Cameron, 2006). The next sections will explore the latest research relating to the evolving emotional experience of interaction with media / entertainment devices and medical / health devices respectively.

4.2.1 Media / Entertainment PIDs

Despite the advent and proliferation of PIDs within society, research focusing on emotions combined with contextual and longitudinal factors with PIDs appears to be limited, with the exception of the mobile telephone (Ling, 2001, 2004; Ito et al., 2005; Jones & Marsden, 2006; Palen, Salzman & Youngs, 2001; Plant, 2001).

Ling (2001) examined the meaning of mobile telephone adoption and use in Norway. Ling reported on a study that utilised survey questionnaires and interviews of Norwegian youths based on how they used and adopted mobile telephones. The study identified two broad aspects regarding youth experiences with mobiles,
including the facilitation of an adolescent’s coming of age and how the role of the mobile telephone is different for both genders.

Ito et al. (2005) report on a variety of experiments studying Japanese mobile telephone use. The studies presented in the book used a variety of ethnographic approaches including diary-based studies, user shadowing, interviews, and observations. Some of the themes discussed include manners in public space while using mobile telephones, mobile phone use in domestic settings by Japanese housewives, the creation of new forms of communication by technicians, and texting as a practice for generating online chat.

Palen et al. (2001) report on a study of 19 mobile telephone users for the first six weeks of use through interviews and voice-mail diaries. Findings showed that novices tend to rapidly modify their perceptions of appropriate social use, the actual nature of use frequently differs from initial predictions, and comprehension of service-based technologies can be problematic.

Plant (2001) also conducted a study into mobile phone use for Motorola utilising interviews with a wide range of users including schoolchildren, teenagers, blue-collar workers and business professionals. Research methods included field studies and observations. The study identified emerging aspects of mobile telephone use including rituals in mobile phone use, the impact of context on behavior of mobile interaction, differences in the way men and women use and relate to mobile telephones, the phenomenon and intrusion of overhearing conversations in public
spaces, facilitation of faithful or illicit relationships through mobile telephones and
the introduction of a new sense of speed of communication and information
sharing. Some relevant aspects from these studies in mobile telephones include the
importance of context, significance of social dimensions, the differences in gender
and the significant impact of the mobile telephone on people’s everyday activities.
These studies, although relevant in providing knowledge of interactions with PIDs
over time, did not specifically focus on emotional interactions as a fundamental
component of the research.

The study conducted by Karapano et al. (2009) is perhaps the most comparable
and most recent study exploring the evolving emotional experience of portable
interactive devices. An ethnographic study followed six individuals from purchase
through to five weeks of use of an Apple iPhone. Participants were asked about
their activities and experiences by using the Day Reconstruction Method. This data
collection method asks participants to mentally reconstruct their experiences at the
end of each day or start of the next day of use. One of the primary findings
indicated that time has a significant affect on the way people experience portable
products (in this case an iPhone). Further, they identified three distinct phases of
experience over time: (i) orientation (becoming familiar with the product), (ii)
incorporation (functional and long term usability issues become important), and (iii)
identification (where people accept the product as part of personal, social and
emotional life).
From the findings the authors suggested three areas that need to be considered for future design of portable devices. First, *design for meaningful mediation* refers to designing the product to be useful within intended contexts. Second, *designing for daily rituals* is about understanding how people appropriate products into their daily routines and how these products mediate and support these interactions. Third, *Designing for the self* relates to how products support self-identity that they wish to communicate to others in specific contexts. The study by Karapanos et al. is closely related to the current research. The main difference is that Karapanos et al. focused purely on the Apple iPhone across a five-week period while the current study focuses on two different product categories and explores interactions with these devices over the course of six months.

Another study conducted by Karapanos, Zimmerman, Forlizzi and Martens (2010) is relevant to discuss. In this study, Karapanos et al. (2010) explored people’s experiences with mobile telephones across a period of six months. Instead of using the Day Reconstruction Method, which focuses on daily recording of experiences by users, this study asked participants to assess the most meaningful experiences with products retrospectively through the use of what the researchers call the iScale. iScale asks participants to narrate their experiences and to provide an estimation of when each experience took place, thus resulting in a temporal structure. The authors argue that even though there might be a question regarding how the experience was remembered and what actually happened, these memories are more important than the actual experiences as the memories and not the actual experiences affect an individual’s attitude toward a product. Findings for
this study generated similar results to the previous study that only focused on the first month of use (Karapanos et al., 2009). They found that most of the critical experiences (75%) occurred within the first month of use. The authors argue that this might suggest that after a certain time the product becomes a commodity and stops providing users with meaningful experiences. The study is an important contribution to the field, especially with regard to the development of a retrospective tool (iScale) to assess user experiences with products longitudinally. However, the results presented do not necessarily concur with the findings in this research, especially when it comes to the impact of experiences after the first month of use. Further, although the study explored the first six months of use, it did so through one retrospective analysis at the end of the six-month period as opposed to observing the experience at various stages to determine the causes of those variations over time more accurately.

Fenko, Hendrik, Schifferstein and Hekkert (2010) explored the sensory modality (vision, audition, touch, olfaction and taste) of product experience across various situations including while buying the product, after one week, after one month and after one year. Participants were asked to retrospectively categorise their ratings of different sensory modality dominance (which sense dominated) at each of these intervals. The products were varied but also included PIDs such as mobile phones and Mp3 players. Although the study did not specifically look at the interaction between user and product, it is still interesting in that it was longitudinal in nature and explored the emotional level of sensory modality. Results showed that the dominant sensory modality depends on the period of product usage and the
product type. At the purchase moment, vision is the most important modality. After one month of usage, touch becomes more important than vision, and after one year, vision, touch and audition appear to be equally important. The reason that the dominant modality changes is due to the different roles they play in life depending on context:

Vision can be important in the situation of buying, when people have to compare multiple slightly different products to make an optimal decision, because it gathers the largest amount of information on a product within the shortest time frame… When the user becomes acquainted with the product, the need for other types of information increases (Fenko et al., 2010 p.39).

The results of the study, although not specifically looking at the interaction between person and product, are relevant, as the differing importance of sensory modalities should have a relationship with how people’s emotional experience changes over time.

In another closely related study, Stelmaszewska, Blanford and Fields (2005) studied people’s experiences and emotions when using technology; including PDAs, mobile telephones and Mp3 players. Two studies were conducted, the first consisting of 13 interviews and the second of 2 focus groups. Findings identified specific aspects relating to the emotional experience and technology, including functionality, usability, aesthetics, physical factors and social elements. Further, the authors identified that technology changes people’s emotional experience when used in
social contexts. Within the social sphere, participants identified three settings including work environment, public spaces and private spaces. The findings outlined in the study are meaningful for the current research as most of the aspects relating to emotional experiences closely relate to the findings described in this study. Further, the relevance of the social dimension on the overall experience is also compatible with the findings in the current research. Nevertheless, although unique aspects in relation to emotional experiences of interaction were reported including the identification of the relevance of the social level, the research did not focus on the longitudinal aspect of interaction in context.

Similarly a study by Geisler and Golden (2007) reported on results from interviews conducted with users of personal digital assistants (PDAs). 42 users were interviewed using close-ended and open-ended questionnaires to examine how they used and interpreted PDAs as a management resource. The study identified four categories of PDA-mediated work-life boundary management including (i) containing work, (ii) integrating the self, (iii) transitioning work, and (iv) protecting the private. Containing work is about the way users utilised the PDA to set limits, control the flow of information and consciously stop engagement with the device. Integrating the self related to the ways in which the PDA was used to shift attention between work and personal life, interactions that permit the PDA to be a constant companion in all work and personal life activities and using the PDA to enhance quality of life in various ways. Transitioning work involved using the PDA to bring work related activities together and merge them into personal life spaces, and the use of work related activities in public spaces not conventionally associated with
either work or personal life. Finally, protecting the private referred to entering private related future events into the PDA’s calendar or datebook, as well as protecting private information in the PDA from public access. Overall, the findings from the study highlighted that people used their PDAs to control their work-life balance activities in various ways. In this case neither the emotional experiences nor the longitudinal aspects of use were specifically observed.

These studies represent a cross-section of the current available literature on emotional experiences with portable media / entertainment PIDs. As the various studies show, there is a growing interest and focus in this area but no studies available that specifically explore the emotional experience of Mp3 and PDAs (with mobile telephone capabilities) over time in context.

4.2.2 Medical / Health PIDs

As outlined in Chapter 3, in recent years there has been a call for a shift in healthcare service provisions from large centralised institutions to healthcare systems and devices that are distributed and accessible to everyone anytime, anywhere (Hattangady, 2009; Liebhold, Maguire & Townsend, 2009; Lymberis & Dittmar, 2007). This shift has been driven by the increasing cost of healthcare in the United States (Varshney, 2007) and Europe (Lymberis & Dittmar, 2007) as well as a cultural change, with people actively becoming more eager to participate in their own health management. This has steered investment, research and development
into portable and wireless technologies focusing on health status monitoring, healthy lifestyle and overall quality of life (Lymberis & Dittmar, 2007).

Emotions have a significant role to play in how people feel about themselves and about their health (Mayne, 2001). There is evidence to suggest that negative emotions play an important role in the development of a variety of diseases, such as diabetes and hypertension (Richman, Kubzansky, Maselko, Kawachi, Choo & Bauer, 2005). Thus, devices that assist in the health process should be designed to support and improve the recovery and quality of life of people through their interactions in everyday life. Currently, there exists a multitude of portable interactive devices (PIDs) that are said to assist with personal health, including heart rate monitors, pedometers, and blood-glucose monitors among others.

Current research in this area has focused on developing infrastructure and associated systems for wireless telemedicine (Dean, 2009; Lymberis & Dittmar, 2007; Varshney, 2007; Park & Jayaraman, 2003). Other research has centred on the design of portable medical monitoring devices (Anliker, Ward, Lukowicz, Tröster, Dolveck, Baer, Keita, Schenker, Catarsi, Coluccini, Belardinelli, Shklarski, Alon, Hirt, & Vuskovic, 2004; Raskovic, Martin & Jovanov, 2004) mainly focused on developing, implementing, analysing and validating the functional aspects of the device, including its effectiveness and efficiency in operation.

Pentland (2004) reports on the opportunities of future wearable and portable health devices but does not refer to the emotional effects these devices might have on
potential users during interaction and what that might mean for the design of the devices. O’Sullivan, O’Donoghue, Herbert, and Studdert (2006) also report on certain aspects of the development, use and testing of context-aware wearable medical devices; however the devices are specifically designed for healthcare professionals and doctors, not for patients. Likewise, Reiner (2008) conducted a study of a portable respiratory assistance device over a three-week period with participants, but focused mainly on the effectiveness of the device for treatment of particular anxiety disorders. Although there was an examination of emotional aspects of using the device this had more to do with the patient’s response to the treatment rather than how they felt about their use of the product and how it fitted into their daily lives.

Perhaps the work conducted by Shah (2005) best relates to the approach taken in this study. Shah conducted a qualitative study involving a series of interviews and shadowing techniques (following participants inconspicuously during their everyday activities) to explore how diabetic patients perform their day-to-day activities and how they use their health products. The study identified that it is important for diabetic patients to be provided with pertinent information when and where they are going about their routine to better support their health-related decision-making processes. Shah developed what was termed the DiabetesFridge to assist diabetic patients during the planning and preparation of meals with the aim of creating a more pleasurable user interaction to assist patients to make better, and less stressful, decisions about their health.
Within the medical / health device design area there is a lack of available literature exploring the impact that portable device design has on the emotional experience of users. Although there appears to be a substantial shift in investment toward portable medical devices (Lymeris & Dittmar, 2007) and there is recognition that positive emotions with devices leads to improved medical adherence and improved patient feelings regarding themselves and their health (Mayne, 2001), there is minimal literature available in this area.

4.3 Summary

The studies presented outline some of the relevant and significant research conducted in the area of media / entertainment and medical / health PIDs focused on emotional experience. For the media / entertainment PIDs, various studies report on interesting aspects relating to various experience categories, the effect of the senses on the emotional experience of portable device design, the social aspect of interacting with PIDs and the use of PDAs to control people’s work-life activities.

For medical / health PIDs, studies in the literature report on the deployment of portable health devices in the industry as well as the infrastructure supporting this development. Even though there are no reported studies that focus on the emotional experience of using medical / health PIDs there does appears to be a need for further research in this area.

Although relevant aspects of PID use were outlined in existing literature none were found that specifically explored the emotional experience of interaction with PIDs.
over time in real life contexts. This study aims to bridge the gap found in the available literature with regard to media / entertainment and medical / health PIDs. Chapter 5 describes the theoretical framework used to support the research and guide the experimental approach.
Chapter 5

5.0 Theoretical Framework: Activity Theory

5.1 Introduction

As outlined in the introductory chapter, the research aims at exploring interactions between people and PIDS in everyday situations. This chapter describes the theoretical framework for situating the literature, the methodological approach and the findings of the current study. Activity Theory within the context of the human-product relationship has been discussed elsewhere (Gomez, 2005). The main aspects discussed previously included the outlining of operations and actions as sub-set components of activities and the propositions; artefacts are mediators of activities; a focus on activities over time; people drive activities with motives and intentions; activities occur within context; and the reciprocal relationship between human, artefact, and environment. This section builds on this knowledge and positions the Activity Theory framework within a broader context of activities through time.

5.2 Activity Theory

The traditional cognitive theory view of human-machine interaction suggested that activities and interactions with artefacts were driven by logical, rational human
processes; in other words, cognition. In cognitive science, cognition was thought to replicate closely a computational process where human thought is much like a computer information processor (Bannon, 1990; Nardi, 1998). From the very beginning cognitive theory took a computational view of interactions that consisted of plans, procedures, tasks and goals; in other words, fixed modes of understanding the human-artefact relationship (Suchman, 1987). Nardi (1998) expands on this concept and outlines that traditionally cognitive scientists:

firmly locate cognition “beneath the skin”… there is a neat input-output loop between external stimuli and the resulting representations that the individual creates, stores and manipulates. The body, other people and things like tools are not especially interesting for a cognitivist account, except as "stimuli." (1998 p.65)

This particular view has been criticised by many authors (Brave & Nass, 2002; Dourish, 2001b; Nardi, 1996b; Suchman, 1987) for being too restrictive and simplistic with regard to its analysis of the human thought process, especially in relation to everyday experience. These researchers and practitioners in technology studies have called for a new approach to studying the human-artefact relationship; one which takes into account a much broader and more comprehensive view of technology use, activity and experience within a social and environmental context. It deals with attempting to understand, and study, people and their experiences with other people, their external environment and the artefacts they engage with. Nardi (1998) asserts that Activity Theory is one such theory that deals with people’s
experience and activities where other people, artefacts and context are taken into account.

Thus, the theoretical framework for this research is based on Activity Theory. This theory is concerned with understanding the relationships between people’s thoughts and awareness of their lives and the activities and actions performed in the real world (Nardi, 1996b). It is about the practical aspects of interaction. One of the more pertinent aspects of Activity Theory is that although it focuses on artefacts it takes artefacts as mediators for human experience. The focus is not on the artefact per se; rather it is on the human experience within everyday life and how artefacts can mediate and possibly enhance this experience. As Kaptelinin (1996) argues, Activity Theory holds the most promising conceptual model for studies of the human-computer interaction. This is a good starting point considering the focus of the research is on exploring and understanding broader issues including social and contextual aspects concerning the human-product interaction.

5.2.1 Structuring Activities

If one views artefacts as mediators of human activity, they become an intermediate to achieve a greater goal that usually exists beyond the individual (Kaptelinin, 1996). Artefacts simply mediate interactions instead of being the central focus of attention; they exist to achieve a greater goal. The focus for design should be on the overall activity rather than solely on the actions between person and artefact. Activities are long-term formations within interactions, while actions are small, discreet.
components of activities. As Kuutti (1996) explains, “actions cannot be understood… without a frame of reference created by the corresponding activity” (1996 p.30). In other words, experiences do not occur in discreet moments of action, but rather form over longer periods of time. Thus, to study real life situations, instead of focusing on the actions of users, as in the case of many laboratory experiments, it is the user’s activities (in context) which should be the basic unit of investigation (Bannon & Bodker, 1991; Kuutti, 1996). Activity Theory proposes that activities consist of three levels: (i) operations, (ii) actions, and (iii) activities (Kuutti, 1996). Activities are always situated in a surrounding context of some description; that is, they happen in the real world (Figure 4).

![Figure 4. Levels of activities (Gomez, 2005) within Activity Theory](image)
Activities are driven by human motives and intentions. Looking at the different activity levels, actions are defined as behaviours that help to construct these broader activities. Actions are in-themselves formed through sets of well-defined, habitual (or learned) routines called operations (Kuutti, 1996). As such, artefacts in the environment are simply seen as mediators to achieve these broad activities. Further, people operate artefacts through habitual or learned actions to perform activities in the world. These relationships work in various ways during interactions. It is important to note that each of these aspects—operations, actions, activities and surrounding context—are in constant flux.

For example, during the activity of searching for a particular website on the Internet, if a person is familiar with this process, the computer, mouse and keyboard (artefacts) are operated to search the Internet for the particular website. In this scenario, the operations consist of pushing buttons on the keyboard and mouse to create discrete actions, such as accessing a particular website, to perform the overall activity of searching for the desired website. As can be seen in this example, the activity level is driven by some sort of motive on the person’s behalf, presumably to find particular information. Of course, in the real world, all of this happens in some sort of context, whether it is the person’s home, office or somewhere else. This external environment is crucial in the initiation, establishment, mediation, development and possible disruption of an activity.

To expand this further, activities are not considered fixed or definitive; as in real life, they are in constant flux. An important aspect of Figure 4 is its flexibility, which takes
into account the unpredictable nature of everyday interactions, called disruptions (Engestrom, 2000). For instance, while searching the website, problems with the keyboard may be encountered. The focus in this case is drawn away from the activity of accessing the internet toward solving the problem of the keyboard. In this case, the activity shifts to identifying and solving the keyboard crisis. Actions may involve looking for the plugs, looking for lights to indicate the keyboard is turned on, while the operations involve reaching for the connection and checking if the keyboard is plugged in properly. When the problem is resolved, the activity reverts back to searching the Internet for the desired website. The framework described in Figure 4 can be applied effectively to help understand and explain the evolving experiences in context.

5.3 Micro and Macro Levels

One of the important features of Figure 4 is that it can be used to separate and explore two levels of interaction with the world (Figure 5). First, at the micro-level (local-level) operations and actions can be identified. These are the routines, basic components of experiences in everyday life, and often the physical parts of an experience. Observed by themselves, these components, although important, can be misunderstood and their value lost without putting them into the broader context of people’s lives as they only tell part of the story. Second, the macro-level (global-level) activities describe the more general and higher level components and experiences of people’s actions over time in context.
Ryle (1999) contends that within Activity Theory the concept of activities relate to high-level thinking, doing and being an individual within a given social context. Take, for example, the previous scenario of a person interacting with a computer to search for an Internet website. Observing that experience through this new lens the *operations* and *actions* consist of typing on a keyboard, clicking on the mouse, opening web-browser software, searching the URL, and so on. This can be observed and analysed, but it only captures the micro-level of the experience and can only be understood independently to a limited degree. It can be noted that observation at this level can only lead to the *what* and maybe the *how* of an experience and tells the viewer little about *why* or the purpose or reason behind the person’s actions and activity.

![Diagram](image)

Figure 5. Holistic experience conceptualisation through micro and macro level interactions
Now to contextualise the experience within the macro-level, the activity is something more general, including looking for specific information on a website or a company address, while the context could be the person’s office or home. Here, at this level, the motives, purpose and reason behind the person’s interaction can begin to be understood; in other words, the why of the experience begins to be observed. Although this is important, it is relevant to note that by themselves these aspects of the experience, although critical, provide information that is nonspecific without an understanding of the pragmatic components of an experience: the actual physical actions.

Once the macro-level is linked and understood in unison with the micro-level, a more holistic picture of the overall experience and activity occurring can begin to be understood. The strength of a concept like this one (Figure 5) comes when both levels are conceptualised and understood together. Separately they can be observed but only by exploring both levels can the basic micro-level interactions be understood within the broader macro-level aspects of an activity. Engestrom (2000) outlines the importance of understanding both levels because without integration either level only provides part of the overall story:

In activity theory, the distinction between short-lived goal-directed action and durable, object-oriented activity is of central importance. A historically evolving collective activity system, seen in its network relations to other activity systems, is taken as the prime unit of analysis. Goal-directed actions, as well as automatic operations, are relatively independent but subordinate
units of analysis, eventually understandable only when interpreted against the background of entire activity systems (2000 p.964).

The breakdown of activities presented in Figure 4 and integration of these two levels of an experience (Figure 5) has implications for this study as the purpose was to gather an understanding of people’s emotional experiences over time in context. Situating emotional experiences within this model assists in identifying people’s motives and drives for their activities but also in linking that within the specific categories of interactions.

5.3.1 Activities in Everyday Life

The current research is based on the argument that people’s actions cannot be separated from the meanings attached to them through daily activities. Activity Theory suggests that products can only truly be understood in use within real life contexts (Bannon & Bodker, 1991; Nardi, 1996b). It deals with engagement in the real world, rather than abstract ideas about interactions (Dourish, 2001b). As Bannon and Bodker (1991) explain, it is difficult to understand artefacts in isolation, without considering the actions and activities occurring within the settings of use. It is understood that these settings of use are always changing and evolving, they are not static. To study interactions between humans and products they must be situated within a framework that takes this changing interrelationship into account. As mentioned previously, Activity Theory proposes to understand the relationship between thoughts and activity. Activity Theory argues that thoughts are not
arbitrary, disembodied cognitive acts; instead they are situated and formed by actions in everyday practice (Kuutti, 1996). In other words, everyday practices influence, shape and alter thoughts. Everyday practice is always situated in a social, cultural and environmental context. This context involves other artefacts, objects and other people. As such, from an Activity Theory standpoint, understanding how people perceive and act in real life contexts is crucial (Nardi, 1996b).

Research on human-computer relationships was traditionally based on the theoretical foundations of information processing psychology (Bannon & Bodker, 1991; Nardi, 1996a, 1996b). From the very beginning, these studies took a computational view of interactions that consisted of plans, procedures, tasks and goals; in other words, fixed modes of understanding the human-artefact relationship (Dourish, 2001b). This led to research that dealt with the mental aspects of human interaction, delving into the subjects of human cognition and information processing. It was believed that human thought processes resembled that of advanced computers, which functioned in a purely systematic and digital manner.

Theories found in earlier HCI literature tended to simplify the user-artefact interaction to minute levels and forget about the meaning behind the activities and the broader aspects of interactions (Brave & Nass, 2002; Nardi, 1996b). As a result, other aspects of the interactions including emotions and social and cultural aspects “…seemed at best marginally relevant to human-computer interaction” (Brave & Nass, 2002 p.3).
More recently, this trend seems to have shifted (Kuutti, 1996). Activity Theory and other theoretical concepts, including situated action theory (Suchman, 1987), distributed cognition (Holland, Hutchins, & Kirsh, 2000), computer-supported cooperative work (CSCW) (Gerson & Star, 1986) and Situation Awareness (Endsley & Garland, 2000) have moved toward understanding interaction in real life contexts. By viewing interactions between people and artefacts in this light, a new understanding of the human-product interaction arises. Artefacts become the means to an end, not the end itself.

5.4 Summary

Activity Theory proposes an emphasis on activities and experiences as the basic unit of study. This affects the approach to the human-product environment relationship in four basic ways. First, if one considers everyday interactions, the focus for the interactions between human and products is not solely on efficiency, effectiveness and satisfaction, which are the basic tenets of usability (ISO, 2011), but also includes issues of emotions, enjoyment, enhancement and even challenging interactions. Second, quantitative data and laboratory studies are replaced with qualitative information and contextual, real life studies because without contextualising knowledge in real situations the value, motives and drivers of activities are lost. Third, the concern is no longer on momentary experiences with products, as was the case with laboratory-based experiments; rather the focus is on evolving experiences in everyday life over extended periods of time. Fourth, the emphasis moves beyond individual actors toward situating the human users within
the social, cultural and environmental context in which they interact in the world. These aspects situate the current study within a theoretical framework. Activity theory helps to position the current literature on emotions and design and portable computing within everyday life. It helps to open up everyday situations, which include emotions, enjoyment and challenges among a host of other aspects, into the arena of human-computer interaction (Nardi, 1996). It also assists in supporting the research approach by taking everyday social, cultural and environmental contexts as well as qualitative information as the relevant starting point of investigation.

Finally, the simple figure described in this chapter (Figure 4) intends to capture more complex experiences in the real world. The model, consisting of operations, actions, and activities situated within an overall context, captures dynamic and evolving relationships between people, and objects, artefacts, other people and internal and external situations. Further, the model can be broken into micro-level (local-level) and macro-level (global-level), helping to conceptualise a more holistic and comprehensive understanding of the evolving experience between human and products within context (Figure 5).
6.0 Research Design

6.1 Introduction

This chapter outlines the methodological rationale and details the research approach for the experiments conducted. One of the critical challenges of this study was to design a research methodology that captured the evolving emotional experience of interaction in real life contexts. This chapter outlines the challenges faced and how the study was designed to mitigate these challenges.

6.2 Methodological Rationale: The Relevance of Qualitative Data

The limitations of statistically based quantitative techniques for studying interactive devices have been previously outlined (Silverman, 2009; Dourish, 2001; Gomez, 2005). As Merholz et al. (2008) argue, quantitative research inevitably reduces complex, intricate and rich activities to units and numbers, thus separating the results from any context that makes them meaningful. It follows then that to understand the richness of the relationship between people and PIDs it is important to examine them in real life contexts over extended periods of time.
This presents some methodological challenges, including the collection of data when the study stretches over the course of time. Also, PIDs are carried around and are used at random times and in different places. As Arhippainen and Tahti (2003) outline, it is difficult to collect and measure emotions during user-product interactions, especially in real life contexts. Studies exploring experiences over time can be laborious as the more people that are observed the longer it takes to collect the data (Karaponas, Martens & Hassenzahl, 2010). The challenge for the current study is to find a suitable methodology able to capture the emotional experience and relationship between participant and product over the course of six months.

Longitudinal studies are relevant for measuring change and making strong causal interpretations between events (Flick, 2006; Menard, 2002), which this study attempts to do to some degree. A qualitative approach is necessary as it is important to analyse the why and how, not just the what, of interaction between people and PIDs. Qualitative research is defined by Oliveto (2008) as the use of unstructured exploratory techniques to understand a problem in greater depth. Flick (2006) points out that a qualitative approach acknowledges the complexities of objects and phenomena in real life and does not reduce these complexities to single variables, instead representing them in their entirety in everyday contexts. As Merholz et al. (2008) explain, “Qualitative research… is concerned with the qualities of an experience, situation, set of behaviours, and so on” (p.61).

This approach toward attempting to understand people and their experiences is starting to be seen as important even in the HCI field. Dourish (2001b) describes
how computer science has moved from a positivist, reductionist tradition toward one where practical and everyday experience has become the cornerstone of technological studies. Dourish (2001b) labels a new approach for interacting with computers as “embodied interactions” which relate to interactions with technological systems that “occupy our world, a world of physical and social reality” and how these technological systems “exploit this fact in how they interact with us” (2001b p.3).

Dourish maintains that HCI research is based on the formalisation of human cognition and activity in the world. HCI should be concerned with the relationship between the minds and thoughts of individuals and their actions and experience in the real world. McCarthy and Wright (2004) clarify this view as follows:

Sensitivity to the particular circumstances of use invokes a qualitative shift in thinking about the design and use of technology. Simple observation demonstrates that technology gets a mixed reception in people’s lives. Different individuals or even the same individual at different times, may experience technology in quite different ways and that is not easy to capture in rationalist models (McCarthy & Wright, 2004 p.26).

This perspective suggests a move away from a traditional rationalist standpoint to critically re-examine how and why people interact with technology and their world the way they do. To do this, it is also necessary to use and apply relevant and
perhaps novel theories and methods. This suggests a change, not only in a theoretical standpoint, but also a methodological one. As Ito et al. (2005) point out:

…it is becoming clear that mobile communication studies need to engage with a reconfigured methodological toolkit that takes into account both public and private communications and their layering within any given situation (2005 p.11).

This further strengthens a push toward re-evaluating existing methods and applying novel theories and methods for understanding mobile communication devices. As such, this research attempts to apply a qualitative approach to studying PIDs in the context of everyday life, so as to be able to focus on the relevance and richness of real world experiences between people and PIDs.

6.2.1 Capturing Evolving Emotional Experiences

A qualitative approach to the methodology is appropriate to capture the complexity of emotional aspects of interaction. But how should the research be structured and what specific methods should be applied to capture the evolving emotional experience in context? This section explores these two questions within the context of the research.
Karapanos et al. (2010) discuss four dominant methodological paradigms in understanding longitudinal experiences including: (i) cross-sectional, (ii) within-subject repeated sampling, (iii) longitudinal, and (iv) retrospective approaches (Figure 6).

![Figure 6. Longitudinal paradigms in HCI (Karapanos et al., 2010)](image)

Karapanos et al. explain that a cross-sectional approach (top left) is the most popular in HCI and usually distinguishes between user groups of differing expertise level (novice and expert) or different length of ownership of a product. According to Karapanos et al (2010), there are limitations to this approach in that it may fail to control or capture aspects of context, among other problems. Within-subject repeated sampling approach (bottom left) studies the same participants at two different points in time. The hurdle with this approach is that it is difficult to infer the reasons for changes across time, as there are only two measurements to go by.
Longitudinal approach (top right) takes more than two measurements of the participant across time, enabling greater insight into the cause of change over time. The only concern about this approach has to do with the fact that the studies are time consuming to undertake. Finally, the retrospective approach (bottom right) relies on the participant’s ability to remember the experience. Participants are asked to recall the most relevant parts of their experience within a given time period and provide details of that experience. This approach may be affected by retrospective bias but it is the fact that the participant only remembers the most important aspects that makes it worthwhile. An interesting comment made by Karapanos et al. is that they consider the longitudinal approach as the “…gold standard in studying changes in users’ behaviours and experiences over time” (p.4076). The methodology used in this study and the relationship to the discussion outlined by Karapanos et al. will be explained in Section 7.2.3.

The work of Morley (1992) has also provided impetus for the current research approach. Morley’s studies represent two of the more significant qualitative and longitudinal studies of modern media consumption and its relationship to people’s daily lives, which the current research reflects to some degree. Morley conducted two major studies involving people, their families and television viewing, known as the Nationwide and Family Television studies (1992). Nationwide involved the study of the audience for a British news magazine program called ‘Nationwide’ using a qualitative methodology involving interviews and discussions with viewers over the course of several months. Family Television explored the relationship between the family structure and domestic television viewing through qualitative methodology
involving extended, unstructured interviews. The significance of the approach of the studies are described by Hall (in Morley, 1999):

> The approach was differentiated from other work... by its persistent attention to the social dimensions of viewing and interpreting... (p.v)

Hall continues to outline that Morley’s research situated television viewing less as an individualistic and isolated activity, but rather as a social and collective activity:

Morley’s work underlines the significance of situating media consumption as an activity within a broader social and cultural dynamic rather than a static occurrence. As Gauntlett and Hill (1999) highlight:

> Rather than examine people’s responses to the content of particular TV programmes... Morley turned his attention to the activity of viewing, for whole families. In doing so he emphasised, implicitly and explicitly, the need to understand individuals in the social context of their everyday domestic lives (p.3-4).

This phrase identifies two critical issues that have impacted the current research approach. First, rather than examine people’s responses to particular TV programmes, as Morley had done in an earlier study (1980), he moved toward studying the activity of television viewing. This leads to the second point: by focusing on the activity of what was occurring, Morley was compelled to
understand the individual viewer within the social context of everyday domestic life in a more comprehensive and thus contextually appropriate manner.

Likewise, Gauntlett and Hill (1999) explored the relationship between families and their television use in a real life context. Although their study was very similar to Morley’s, the unique aspect of it was the method employed by the researchers to gather the data. This study utilised questionnaire diaries to collect information about respondents over the course of five years.

The study conducted by Petersen et al. (2002) focused on exploring the progressive interaction between people and their television use over several months. They tracked participant’s expectations of, and relationship with, their television usage from before they purchased the product right through to the detailed use of the product over the course of four to six months. The research utilised diaries and interviews as the instruments of data collection. Although the diaries were not relevant in the end, the interviews were still used as a successful tool for data collection.

Although the studies described above all focused on the domestic environment, the current study, with its focus on portable devices that are used anytime-anywhere, focuses on a broader social-cultural environment of use. Thus, rather than examining the interaction between user and device in isolation and out of context, one of the primary objectives was to explore and understand interaction of the
activity between user and product within the social context as it would occur over a period of six months.

### 6.3 Research Design

The research design contextualised all of the above issues, regarding qualitative research and capturing evolving experiences, into a coherent research methodology. To be able to capture the evolving emotional experience of interaction between people and PIDs in context, a qualitative longitudinal study needed to be conducted. To strengthen the research approach even further, the study attempted to not only use one method to capture the complexity of experiences, but rather utilised a triangulation approach (Robson, 2002; Denzin, 2009) to collect data and verify it via several techniques including interviews, diaries and co-discovery. Triangulation helps to counteract possible threats to the validity of the experiment as it offers multiple channels to acquire, analyse, and compare data (Denzin & Lincoln, 2003; Robson, 2002), making the research and the end results more reliable and valid. Also, triangulation of methods can increase the theoretical generalisations emerging from the study (Flick, 2006). The benefit and relevance of the triangulation approach has been previously discussed and used to successfully capture emotional experiences of interactions between people and products over time (Gomez et al., 2005, 2008, 2010).

Further, the approach for the methodology of the research was one in which as much information as possible about experience in relation to real world use was
collected. It captured and specifically queried people’s use of PIDs regarding activities, context and emotional experience. By doing so, a better understanding of the relationships between experiences, emotions and context was gained.

Fundamentally, the reason for the approach taken for the current study can be broken down into three main aspects:

1. Utilising qualitative methods is critical to probe and focus on the intricate and multifaceted nature of emotions.
2. Using a combination of methods (triangulation) can assist in identifying and analysing the complexities of emotional experiences and increases rigour.
3. Studying emotions in real life situations as much as possible is fundamental to ascertain findings relevant for the research.

The research was designed to qualitatively analyse the evolving emotional experience with portable interactive devices (PID) over a six-month period in real contexts. As discussed in Section 6.2.1, there are potential issues with attempting to gather information of this kind as the timeframe is long and the information collected is subjective. Nevertheless, through the methodology applied, it is argued that these issues have been addressed and overcome. The overall research plan included the following three phases:

Phase 1 – Literature review consisting of Emotions, Experience Design, Portable Interactive Devices and Future PID Technologies (Chapter 2, Figure 2)
Phase 2 – Experimental method and outcomes consisting of four stages

Stage 1: Exploring the evolving emotional experience of media / entertainment PIDs (Experiment 1)

Stage 2: Exploring the evolving emotional experience of medical / health PIDs (Experiment 2)

Stage 3: Compare findings

Stage 4: Develop a framework for designing for evolving emotional experiences

Phase 3 – Implications and Future work

Figure 7 illustrates the research plan and contextualises it into the overall framework of the study.

6.3.1 Research Stages 1 and 2

Two experiments were conducted as part of the research. Experiment 1 involved studying the evolving emotional experience with media / entertainment over a six-month period in real life contexts. Experiment 2 involved studying the evolving emotional experience with medical / health over a six-month period in real life contexts. A triangulation of methods was used consisting of interviews, experience diaries and co-discovery (Chapters 7 and 8).
Figure 7. Research plan

Explore, research and summarise the key issues found in literature. To inform the following stage of the research and serve as foundation elements.

**Stage 1**
Studying the evolving emotional experience of media / entertainment portable interacting devices over a six month period

**Stage 2**
Studying the evolving emotional experience of medical / health portable interacting devices over a six month period

**Stage 3**
Identify the critical findings from experiments regarding evolving emotional experience of interacting with PIDs

**Stage 4**
Develop a framework for designing emotionally appropriate PIDs through human-device experience over time in context

Implications, contributions of study to design and other fields, Possible future directions.
The experiments (Stages 1 and 2) required participants to report on their experiences with the products. This stands on the premise that the experiences participants discuss and report should reflect what would occur in real life as closely as possible since the contexts and experiences form a critical part of the evolving emotional experience. Participants also characterised the overall emotional experience by relating the way they feel emotionally about the experience. Russell’s model of core affect (Russell, 2003) was used as the set of basic emotions the participants refer to in the interviews and diaries (Figure 8). Russell’s model has been used as an effective self-reporting method in other studies investigating emotional reactions to products and has been used by the author in previous research (Desmet, 2002; Fagerberg, Stahl, & Hook, 2004; Gomez, 2005).

Figure 8. Emotional Chart (after Russell, 2003)
The Emotional Chart was included in the Experience Diaries so that participants could annotate their emotional reaction to their experiences. The model is broken up into negative and positive emotions on the left and right hemisphere respectively. Negative emotions range from calm (bottom) to unhappy calm (bottom left) to unhappy (far left) to unhappy excited (top left) through to excited (top). Positive emotions range from calm (at the bottom) to happy calm (bottom right) to happy (far right) to happy excited (top right) through to excited (top). For instance, if participants wanted to denote an emotion of being content, it would be recorded on the bottom right hand quadrant of the Emotional Chart (orange diamond). If participants wanted to denote an emotion of being frustrated or annoyed it would be recorded on the top left hand quadrant of the chart (orange circle). Alongside the Emotional Chart, participants had the opportunity to write down and describe their emotional reactions to support their annotations on the Emotional Chart. For a detailed description and proposition for using this model refer to Gomez (2005).

*Interviews and Co-discovery*

Interviews are founded on the idea of conversations and as a research method they generally involve a face-to-face discussion between two people guided by a set of pre-determined questions (Gubrium & Holstein, 2002). The flexibility of the interview allows it to be applied in many circumstances and as such it has been used to investigate a range of topics in the design domain including usability concerns, user attitudes, perceptions and reactions, errors and other aspects of user-product interaction (Stanton, Salmon, Walker, Baber & Jenkins, 2005).
A co-discovery session between two and three participants moderated by the researcher was also conducted at the end of the six-month period. The co-discovery permitted more in-depth discussion and analysis as it allows participants to question and reconcile their own assumptions, knowledge or beliefs as they discuss them with another participant (Lim, Ward & Benbasat, 1997).

*Experience Diaries*

Diaries are data collection instruments used to examine and explore ongoing experiences within everyday situations. The fundamental strength of diaries is that they allow the capture of changes and patterns of experiences in real life contexts and help in determining the factors that affect this change (Bolger, Davis & Rafaeli, 2003). This is especially relevant for this particular research where the purpose is to study people’s emotional experience within everyday contexts. Various aspects of interaction have been the focus of study in design ranging from people’s informal use of computers in the workplace (Rieman, 1993) through to exploring the use of mobile technology in everyday settings (Sohn, Li, Griswold & Hollan, 2008).

Table 3 presents a summary of the research design including the setting of each of the stages, the duration for each section, data collection methods used, the issues being observed / asked and the data analyses tools being applied.
Table 3. Research Design: Stage 1 and 2

<table>
<thead>
<tr>
<th>Interviews</th>
<th>Experience Diary</th>
<th>Co-discovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>Intermittent</td>
<td></td>
</tr>
</tbody>
</table>

**Setting**
People and System Lab at Queensland University of Technology

<table>
<thead>
<tr>
<th>Duration</th>
<th>Intermittent Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mins</td>
<td>15-30 mins</td>
</tr>
<tr>
<td></td>
<td>At participant’s discretion</td>
</tr>
<tr>
<td>45 mins</td>
<td></td>
</tr>
</tbody>
</table>

**Data collection technique**

<table>
<thead>
<tr>
<th>What is being observed / asked?</th>
<th>Interview</th>
<th>Experience Diary</th>
<th>Co-discovery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intermittent</td>
<td>Written</td>
<td>Audio and written</td>
</tr>
<tr>
<td>Introduce participants to experiment.</td>
<td>Monitor progress. Semi-structured interview:</td>
<td>Participant experiences with product:</td>
<td>Participants discuss:</td>
</tr>
<tr>
<td>Semi-structured interview on:</td>
<td>- Have expectations changed?</td>
<td>- Emotions toward product prior to use</td>
<td>- Emotions toward product prior to use</td>
</tr>
<tr>
<td>- Emotions toward product</td>
<td>- How do they feel about product now?</td>
<td>- Expectations of product before using it</td>
<td>- Expectations of product before using it</td>
</tr>
<tr>
<td>- Anticipation about using product</td>
<td>- What problems have been encountered?</td>
<td>- How their expectations and emotions toward product changed as they used it</td>
<td>- How their expectations and emotions toward product changed as they used it</td>
</tr>
<tr>
<td>- Opinion of expected benefits</td>
<td></td>
<td>- Their feelings toward product after six months of use</td>
<td>- Their feelings toward product after six months of use</td>
</tr>
</tbody>
</table>

**Analysis tools**
Atlas.ti used to analyse the verbal and written data

6.3.2 Research Stage 3

The data were analysed using a content analysis technique (Bauer & Gaskell, 2000; Flick, 2006) using Atlas.ti software. Analysis and comparisons of the data from Stages 1 and 2 led to conclusions about the design of future PIDs. Once the experiments were completed, relevant findings could be identified. The focus of the findings revolved around identifying:
• Emotional experiences occurring at the micro-level of interactions between user and PIDs
• Emotional experiences occurring at the macro-level of interactions between user and PIDs
• Relationships between micro and macro level
• Similarities and differences between the two device categories
• Peak-End rule within the experiments conducted

Activity Theory was used to form a framework of the evolving interactivity between human user and product over time and across contexts. Activity Theory served as a fundamental basis to highlight and consequently situate how experiences developed over time, how context affected this experience and how the user’s emotional condition influenced the experience perceived (Nardi, 1996b; Petersen et al., 2002).

The analysis focused on interpreting the written and transcribed verbal data collected through the experiment using Atlas.ti software. To arrive at a coding scheme it was important to identify different categories and sub-categories relating to the data sets. Once these categories and sub-categories were defined, they were then grouped into larger sets of coding groups, or themes, relating to similar sets of categories existing in the data. Once these groups had been established, the data could be observed again and generalisations deduced. These generalisations assisted in defining some guidelines about the use of PIDs in
everyday life situations. The coding scheme for each experiment is discussed further in Chapters 7 and 8.

6.4 Summary

This chapter has outlined the research approach and methodological rationale for the current study. A qualitative research approach was used as it allows rich and complex data to be elicited relevant to the evolving emotional experiences of interactions in everyday contexts. Further, the research strategy and structure for capturing this complexity was outlined using a triangulation approach consisting of interviews (initial and intermittent), experience diaries and co-discoveries over the six-month period. The type of data accessed through the experiments as well as the data collection techniques and aspects being observed during the experiment were outlined. Chapter 7 discusses Experiment 1.
Chapter 7
7.0 Experiment 1: Media / Entertainment PID

7.1 Introduction

This chapter presents the first of two experiments conducted focusing on the emotional experience of interacting with PID. The focus was on exploring people’s emotional experiences with portable media and entertainment devices over a six-month period within the context of everyday life. In this chapter the concept of emotional experiences in everyday life is outlined, followed by the experiment method, including participant recruitment, equipment and procedure.

Experiment 1 explored the evolving emotional experience of interacting with media / entertainment PID in everyday life. The purpose was to identify aspects that influenced the emotional experience over the course of interaction in a positive or negative manner. This included exploring the following aspects:

- Classifying Task Categories and their relationship to the emotional experiences
- Determining how and why the emotional experiences changed, evolved, emerged and declined over time
- Determining whether a relationship exists between personal and social interactions and emotional experiences.
Due to these aspects and the overall aim of the research (Section 1.4) the experiment was focused on attempting to capture people’s experiences with products in real life situations. Findings from the experiment provide important insights into the emotional experience of interacting with media / entertainment PIDs. They identify influential factors that impact on the emotional experience as well as how these experiences evolve and change over time.

7.2 Method

The experiment was structured to capture participants’ emotional relationships with media / entertainment PIDs before, during and at the end of the six-month study through interviews, diaries and co-discovery methods throughout various stages of the experiment (Section 6.3). By setting out the experiment in this manner, the participant’s emotional reaction could be determined at different stages and its progress over the course of six months could also be observed.

The resulting data in this experiment was derived from self-report techniques consisting mainly of verbal and textual information. In previous studies (Gomez 2005; Gomez et al., 2008), it was identified that the use of more than one type of data assisted in making the data more reliable because of the multifaceted nature of emotions. To assist in making the data more reliable, the experiment was structured as a continuous process of reporting, questioning and clarifying over the course of six months. This iterative process permitted the researcher to verify with each
participant the exact nature of reported emotional experiences more than once over
the course of the experiment.

7.2.1 Participants

Overall, 426 experiences were collected and analysed for Experiment 1. Nine
participants each with no more than two months experience with the portable
device were recruited; thus attempting to capture the initial stages of interaction
and how it evolved over the first few months of use.

Participants ranged from full-time academics, professional staff and students of
Queensland University of Technology (QUT). They represented a good cross-
section of the population who use media / entertainment devices with ages ranging
from 22 to 60. Further, the gender distribution was almost even with five males and
four females participating. Participant recruitment was initiated by sending out an
electronic mail request for participation to staff members at QUT. Ten participants
initially accepted to perform the experiment, although only nine completed the
experiment.

7.2.2 Equipment

Data collection and analysis including initial Interviews, intermittent interviews and
co-discoveries were conducted at the Queensland University of Technology People
and Systems Laboratory. All interviews were recorded onto audio tape. Participants were also given paper-based diaries to take away with them (Appendix A) and they recorded written answers or submitted their responses via electronic mail.

7.2.3 Procedure

Volunteers that fit the necessary requirements were sent an information package explaining the aims, methods and expected results of the experiment. This helped the participants understand from an early stage what the experiment was about, as well as their involvement in the experiment. Also, they were asked to sign a consent form, which they were required to bring with them to the initial interview.

As discussed earlier (Chapter 6), the experiment was organised into three phases consisting of (i) an initial interview, (ii) intermittent interviews and experience diary entries, and concluding with (iii) a co-discovery session with a fellow participant. The purpose of this procedure was to determine the evolving emotional experience of interacting with PIDs over six months. Following are the details of each of the three phases performed during the experiment.

Part 1: Initial Interview

Prior to beginning the six-month study participants undertook a short semi-structured interview (Appendix B). The initial interview served two purposes: to collect basic information about the participant, including his/her expectations about
future use of the product, and to ask about how he/she felt about the product at
the early stage of use with it.

Part 2: (a) Experience Diary and (b) Intermittent Interview

Over the course of six months participants were asked to fill out experience diaries
and attend intermittent interviews. The interviews were performed throughout the
six month period including two weeks after the initial interview and then one every
month for the remaining period (Figure 9).

(a) Experience Diary

Participants used the experience diaries to record what they considered to be the
most crucial interactions with the products as they experienced them over six
months. Participants were asked to fill out the diary once a week. The structure of
the diary provided for up to three experiences per week (participants could record
any amount up to three experiences). They were asked to submit their diaries each
time they came for their intermittent interview.

Figure 9. Timeline outlining Experience Diary (dotted lines) submission and Interviews (full lines)
conducted throughout the six-month study
Participants were asked to reflect primarily on the emotional experiences with the product during interactions by answering the following pre-set questions:

- What did you do with the product on this particular occasion?
- Please describe the setting / time of day.
- Who else was there and did their presence affect your use?
- Overall, how do you feel about this particular experience with the product?
- Please explain why you felt this way.

As discussed in Chapter 6, participants recorded the main details of their interactions with the product and rated the overall emotional experience using the Emotional Chart (Figure 8). The Emotional Chart is based on Russel’s (2003) model of Core Affect and has been used effectively as a self-reporting tool in other studies investigating design and emotions (Gomez, 2005; Desmet, 2002).

(b) Intermittent Interviews

Between six and eight intermittent semi-structured interviews were conducted with participants over the six-month period. The interviews took 15-20 minutes on average, and were recorded through audio and note taking. Two intermittent interviews were performed within the first month followed by one a month for the remaining five months (Figure 9). The purpose was twofold: to regularly be in contact with participants and check their progress with the diary and to record more detailed information about the experiences. Participants were asked the following questions during the intermittent interviews:
• On average how often have you used the product?
• Overall how would you characterise your feelings about the product at this stage?
• What have been some positive experiences of using the product?
• What have been some negative experiences of using the product?
• Did the surrounding context (environmental or social) affect the use of the product in a positive or negative way?

The semi-structured interviews permitted the researcher and participant to expand on their answers to the pre-set questions whenever necessary or when something interesting arose during the interviews.

Part 3: Co-discovery

The final part of the study involved a co-discovery session between two participants (one was conducted with three participants due to the uneven numbers) at the end of the six-month study (Appendix C). This part of the investigation focused on how their expectations in the beginning changed as their experiences with the products evolved over the six-month period. Participants were asked to reflect and discuss their overall experience over six months. The experimenter was present during the co-discovery but apart from asking questions to prompt discussion did not interfere with the discussion. Prompting questions included:

• Overall how do you feel about the product and it use?
• How do you remember feeling about the product originally?
• Has this feeling changed? If so, why do you think so? If not, why not?
• Can you talk about some of the positive moments or experiences about the product’s use?
• Can you talk about some of the negative moments or experiences about the product’s use?
• Anything else to add?

The co-discovery session allowed participants to discuss their six-month experience freely and openly, thus attempting to capture the true emotions and experiences of participants. The results from the co-discovery were used to identify participant’s overall emotional characterisation of the six-month study as well as providing an opportunity to review and discuss the positive and negative experiences that was prominent in the participants’ memory.

7.3 Coding Scheme

The data collection instruments were verbal transcripts, written information and notes. All data were analysed using a content analysis technique (Bauer & Gaskell, 2000; Flick, 2006), in combination with thematic analysis (Boyatzis, 1998). To assist with contextualising the findings, the data sets were split into two categories. First, data relating to specific tasks within the overall six-month timeframe were referred to as micro-level interactions. A participant using the Mp3 player to listen to a song on a train would be an example of a micro-level experience. During the intermittent interviews a participant may be asked how he/she felt about the product over the
previous month. In this case, the response would be characterised as a macro-level experience as it reflects a general response about the participant’s feeling at that point in time. As such, these macro-level experiences were composed of many micro-level experiences throughout the six-month period. Table 4 shows the relationship between data collection techniques and how data was categorised.

Table 4. Macro-level and Micro-level experiences

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Macro-level experiences</th>
<th>Micro-level experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial interviews</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Experience Diaries</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Intermittent interviews</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Co-discoveries</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

The experiment employed a triangulation method approach, which meant that some data was provided more than once during the experiment. For instance, a participant could record something about an experience in the diary and then report it again during the interview session. These experiences were not coded twice. Instead, the primary source of data was accessed from the interviews, while the diaries and co-discovery sessions were used as supporting information to verify or confirm any confusion in the data.

To arrive at a coding scheme, it was important to identify different categories and sub-categories relating to the data sets (Table 5). Once these categories and sub-categories were defined, they were collected into larger sets of coding groups (Themes) relating to similar sets of categories existing in the data.
Table 5. Media / Entertainment PIDs Coding Scheme

<table>
<thead>
<tr>
<th>Themes</th>
<th>Category</th>
<th>Sub-Category</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context (aspects of setting)</td>
<td>Location</td>
<td>Private (Home, Office, alone, etc)</td>
<td>CLP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public (Public Transport, Public Space, etc)</td>
<td>CLC</td>
</tr>
<tr>
<td></td>
<td>Human Interaction</td>
<td>Personal (Activity performed alone)</td>
<td>CHI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social (Activity performed alone)</td>
<td>CHS</td>
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<tr>
<td></td>
<td>Time of day</td>
<td>Day</td>
<td>CTD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Night</td>
<td>CN</td>
</tr>
<tr>
<td>Emotional perception of experience</td>
<td>Neutral</td>
<td>Neutral</td>
<td>ENN</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Happy excited</td>
<td>EPE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Happy</td>
<td>EPH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Happy calm</td>
<td>EPC</td>
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<tr>
<td></td>
<td>Relaxed</td>
<td>Calm</td>
<td>ERC</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>Unhappy calm</td>
<td>ENC</td>
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<td>AMB</td>
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<td>Music / Songs</td>
<td>AMS</td>
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<td>Podcasts / Sound files</td>
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<td></td>
<td>Calendar</td>
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<td>Calculator</td>
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<td></td>
<td>Generic work function</td>
<td>AMW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transporting product</td>
<td>AMTR</td>
<td></td>
</tr>
<tr>
<td>Mediation</td>
<td>Relaxation</td>
<td>AMR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Escape</td>
<td>AME</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distraction</td>
<td>AMDT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Companionship</td>
<td>AMCF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Product becomes part of background use</td>
<td>AMZ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conscious awareness of product</td>
<td>AMCS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Association of particular cultural group</td>
<td>AMAS</td>
<td></td>
</tr>
<tr>
<td>Auxiliary</td>
<td>Mobile phone (cell) reception</td>
<td>AMRN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Battery</td>
<td>AMBT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loosing product</td>
<td>AML</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Damaging product</td>
<td>AMD</td>
<td></td>
</tr>
</tbody>
</table>
Once these Themes were established the data were again analysed and inferences about the experience were deduced. These inferences helped to define relevant findings about the use of media / entertainment PIDs in everyday life situations. The coding scheme was broken down into three broad Themes including (i) Context, (ii) Emotional Perception of Experience and (iii) Tasks. Contextual aspects of setting were broken down to different types including Private or Public, the level of human interaction involved including Personal or Social, and the time of day including Day or Night.

Emotional characteristics were broken into the nine sections of the Emotional Chart (Figure 8) including Neutral (the centre of the Emotional Chart), Happy excited, Happy, Happy calm, Calm, Unhappy calm, Unhappy, Unhappy excited and Excited. The final category consisted of tasks performed with the device over the course of six months. Tasks were broken into Features, Functional, Mediation and Auxiliary each of which was further broken down into more detailed Sub-Categories.

The coding scheme was developed from the data obtained through the diary and transcripts of the recorded interviews. Since the diary questions were already established and participants were asked to fill out the questions in a structured format, the main categories were easily defined. These included the themes and categories for Context, Emotional Perception of Experience and the Tasks theme. The questions during the semi-structured interviews also followed the same structure as the experience diary, and participants had more scope to elaborate on
their responses. The Sub-Categories for Tasks were developed from the diary and interview data.

To establish more clearly how the coding was established some characteristic examples are outlined. Figure 10 illustrates a diary entry from a participant with the coding scheme included.

As Figure 10 shows, participant 9B described the location as “home”. This was coded as Context, Location, Private (CLP) and established Private as a subcategory. Also, the fact she is alone; “no-one was around”, gave a clue as to the type of interaction that was happening at the time, in this case coded as Context, Human-Interaction, Personal (CHI). The participant also identified her emotional experience as “Happy calm” by using the categories on the Emotional Chart (Figure 8) coded as Emotional Perception of Experience, Positive, Happy Calm (EPC).
An excerpt from a participant that identifies the Interface Sub-category code is illustrated in Figure 11. It shows the participant identifying the device’s interface, the buttons in this case, as an aspect influencing the experience.

![Figure 11. A section from interview transcript from Participant 5B](image)

Another excerpt from the interviews outlines an example of the Calendar Sub-Category code as the participant makes reference to the device’s calendar function (Figure 12).

![Figure 12. A section from interview transcript from Participant 8A](image)

Data from the interviews and diaries were used to develop the Sub-Categories of Tasks. All of the Sub-Categories for Tasks were established using this process of analysis described above. The Sub-Categories for the Tasks were developed first. Once the Sub-Categories were coded they were grouped into related areas that formed the broader Categories (Table 6). Table 6 outlines the Categories, the associated Sub-Categories and a description of each group. To add rigour and
validate the coding, the researcher performed the coding of two experiments twice with several months break in-between.

Table 6. Description and groupings of Sub-Categories for Media / Entertainment PIDs

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>Interface, Headphones, Sound Quality, Portability, Technology, Aesthetics, Memory capacity</td>
<td>Tasks relating to the features of the products</td>
</tr>
<tr>
<td>Functional</td>
<td>Music / Songs, Podcasts / Sound files, Calendar, Contacting people, GPS, Calculator, Pictures / camera, TV, Games, Generic work function, Transporting product</td>
<td>Tasks relating to functions of the products to achieve a particular action</td>
</tr>
<tr>
<td>Mediation</td>
<td>Relaxation, Escape, Distraction, Companionship, Product becomes part of background use, Conscious awareness of product, Association to particular cultural group</td>
<td>Tasks that mediated or facilitated a broader experience beyond the physical aspects of the product</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>Mobile phone (cell) reception, Battery, Losing product, Damaging product</td>
<td>Tasks peripheral, or tertiary, to core functions of the product</td>
</tr>
</tbody>
</table>

7.4 Analysis and Results

This section outlines how the data collected were analysed including results from the analysis. All data were analysed using Atlas.ti software (Muhr & Friese, 2004).

7.4.1 Micro-level Experiences

Once the textual data were coded using the software, some general results regarding emotional experiences were generated. To achieve this, the codes were counted according to Positive or Negative within each Task Category: Functional, Features, Mediation and Auxiliary (as defined previously in Section 7.3). This was
accomplished by analysing the Task Sub-Categories in relation to the Emotional Perception of Experience Sub-Categories categorised as either positive or negative according to the Emotional Chart (Figure 8).

Table 7 shows the overall numbers of positive and negative emotional experiences of the Task Categories across all participants for the media / entertainment PID category. Further, the table also outlines the percentage of the emotional experiences recorded across each of these categories.

Table 7. Overall results for Task Categories as positive or negative for Media / Entertainment PIDs

| Category  | Positive |  | Negative |  | Overall |  |
|-----------|----------|  |----------|  |---------|  |
|           | Number   | % | Number   | % | Number  | % |
| Functional| 101      | 60%| 68       | 40%| 169     | 40%|
| Feature   | 66       | 37%| 112      | 63%| 178     | 42%|
| Mediation | 37       | 80%| 9        | 20%| 46      | 11%|
| Auxiliary | 4        | 12%| 29       | 88%| 33      | 7% |
| Total     | 208      |  | 218      |  | 426     |  |

It can be noted by observing the Overall column that both Features (42%) and Functional (40%) are the most prominent categories and together account for 82% of all Tasks experienced. Mediation is next with 11%, while Auxiliary is last with 7% of experiences recorded. It can be noted that Features are composed mainly of negative experiences (63%), while Functional, the second most prominent category, is comprised mainly of positive experiences (60%). Mediation was also comprised mainly of positive experiences (80%) and Auxiliary mainly of negative experiences (88%).
These results suggest that people interact with media / entertainment PIDs mainly for very pragmatic and utilitarian purposes, as evidenced by the amount of Features and Functions Tasks recorded. Unexpectedly, the findings indicate that Tasks used to facilitate a broader experience under Mediation were not as common for media PIDs over the six month period. It is possible that although media / entertainment PIDs are used for facilitating broader experiences, they are mainly used for achieving a specific purpose or intent. The focus of the experience appeared to be on the product and its utilitarian capabilities. Finally, it was no surprise that there were minimal numbers of Auxiliary Tasks as by their very nature they are infrequent. Nevertheless, these types of Tasks form very important parts of the overall experience and cannot be ignored. For instance, experiences regarding batteries, although mentioned rarely during the experiment, are core to the use of PIDs.

Table 8 breaks this down further by representing the positive and negative experiences filtered through the Human Interaction Sub-Category of Personal or Social. Also displayed are the overall percentages of positive and negative emotions for Personal and Social Sub-Categories. As discussed earlier, this category is an important element of the analysis as it was hypothesised that the Personal and Social level plays an important role in influencing the emotional experience.

It can be noted in Table 8 that the Functional row Personal, Positive outweighed the Personal, Negative (68% and 32% respectively). Feature shows that Personal, Positive were outweighed by Personal, Negative (31% and 69% respectively).
Mediation shows Personal, Positive overwhelmingly outweighing Personal, Negative (94% and 8% respectively). Finally, Auxiliary demonstrates that Personal, Positive is significantly outweighed by Personal, Negative (13% and 87% respectively).

Table 8. Results for Human Interaction Sub-Categories: Personal or Social coded positive or negative for Media / Entertainment PIDs

<table>
<thead>
<tr>
<th>Category</th>
<th>Personal</th>
<th></th>
<th></th>
<th>Social</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
<td>Overall</td>
<td>Positive</td>
<td>Negative</td>
<td>Overall</td>
</tr>
<tr>
<td></td>
<td>Num</td>
<td>%</td>
<td>Num</td>
<td>%</td>
<td>Num</td>
<td>%</td>
</tr>
<tr>
<td>Functional</td>
<td>71</td>
<td>68%</td>
<td>34</td>
<td>32%</td>
<td>105</td>
<td>35%</td>
</tr>
<tr>
<td>Feature</td>
<td>39</td>
<td>31%</td>
<td>86</td>
<td>69%</td>
<td>125</td>
<td>43%</td>
</tr>
<tr>
<td>Mediation</td>
<td>29</td>
<td>94%</td>
<td>2</td>
<td>8%</td>
<td>31</td>
<td>11%</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>4</td>
<td>13%</td>
<td>27</td>
<td>87%</td>
<td>31</td>
<td>11%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td></td>
<td>149</td>
<td></td>
<td>292</td>
<td></td>
</tr>
</tbody>
</table>

Under Social, the Functional Category shows that Social, Positive is almost even with Social, Negative (47% and 53% respectively). Likewise, Features highlights that Social, Positive is on par with Social, Negative (51% and 49% respectively).

Mediation also shows that Social, Positive is almost even with Social, Negative (53% and 47% respectively). Finally Auxiliary, although minimal in number of experiences, shows all experiences characterised as Social, Negative (100%).

These findings suggest that users reported much more varied Personal experiences compared to Social experiences. All of the four Task Categories under Personal were weighted as either more positive or negative, depending on the Category. For Social experiences (with the exception of Auxiliary, which represented only 1% of
experiences), positive and negative emotional experiences were distributed virtually evenly across the four Task Categories. This indicates that people, in private and personal situations, might be more open to experiencing a multitude of experiences and not overly concerned with the result of those experiences. This might change in social circumstances where people might be more inclined to be conscious of their reaction to experiences and thus tend to want to balance their overall emotional experience.

7.4.2 Gender Breakdown

Since Experiment 1 was structured in such a way as to have almost an even split in gender (4 females and 5 males) the results were analysed by dividing the data across the two gender groups. Table 9 shows the gender breakdown coded as Positive and Negative with regard to emotional experience for the Personal and Social Sub-Categories. Table 9 shows that males and females reported similar results for positive and negative experiences.

Table 9. Results based on gender coded positive or negative for Human Interaction Sub-Categories: Personal or Social for Media / Entertainment PIDs

<table>
<thead>
<tr>
<th>Category</th>
<th>Positive</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Negative</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Personal</td>
<td>Social</td>
<td>Overall</td>
<td></td>
<td>Personal</td>
<td>Social</td>
<td>Overall</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Num</td>
<td>%</td>
<td>Num</td>
<td>%</td>
<td>Num</td>
<td>%</td>
<td>Num</td>
<td>%</td>
<td>Num</td>
</tr>
<tr>
<td>Female</td>
<td>71</td>
<td>79%</td>
<td>19</td>
<td>21%</td>
<td>90</td>
<td>43%</td>
<td>63</td>
<td>66%</td>
<td>32</td>
</tr>
<tr>
<td>Male</td>
<td>72</td>
<td>61%</td>
<td>46</td>
<td>39%</td>
<td>118</td>
<td>57%</td>
<td>86</td>
<td>70%</td>
<td>37</td>
</tr>
</tbody>
</table>


For instance, females reported more Positive, Personal experiences compared to Positive, Social experiences (79% and 21% respectively). Similarly, males reported more Positive, Personal compared to Positive, Social (61% and 39% respectively). For the Negative Category females documented more Negative, Personal experiences compared to Negative, Social (66% and 34% respectively) and males documented more Negative, Personal experiences compared to Negative, Social experiences (70% and 30% respectively).

The findings indicate that for media / entertainment PIDs there does not seem to be a difference between the genders when it comes to emotional experiences, even when broken down to the Personal and Social Categories.

7.4.3 Overall Experiences Over Time

Another aspect analysed was the overall emotional experience reported by the participants across time (macro-level interactions). During the interview and the final co-discovery session participants were asked to characterise their emotions toward the product based on the Emotional Chart (Figure 8). Once this data was collected a macro-level graph of each participant’s experience across the six months could be plotted.

*Peak-End rule for Media / Entertainment PIDs*

One aspect to be analysed as part of this experiment was the Peak-End rule to determine whether, after six months, the rule was applicable to the findings for the
overall emotional experience with media / entertainment PID types. It was discovered that the Peak-End rule was applicable to a large extent across the findings for Experiment 1 (Appendix D). As discussed in Chapter 2 (Section 2.2.3) the Peak-End rule states the overall emotional experiences are determined by the average of the most extreme emotional experiences (peak) and the emotion experienced at the end (end).

For instance, Figure 13 demonstrates the macro-level experience for participant 1B. The X axis represents the emotional response during the interviews ranging from intense negative through neutral all the way to intense positive, mirroring the quadrants represented on the Emotional Chart. The Y axis denotes time in months. As Figure 13 shows, the overall emotional experience perceived by the participant is the exact average of the peak and end emotional experience. The peak emotion was determined by the most extreme emotional experience over the course of six months as defined by the participant during the interviews. The end emotion as well as the overall emotional experience was determined during the co-discovery. For example when participant 1B was asked to determine her overall emotional evaluation and her answer defined it as moderately positive:

I would say the fact that I have feelings for it, positive feelings is something unusual because I don’t have this kind of attachment to any device before. So I’m very happy with my Shuffle.
Figure 13 shows the overall emotional experience as the average of peak and end emotions, confirming the Peak-End rule.

![Graph showing emotional response over time](image)

Figure 13. Participant 1B macro-level graph showing overall emotional experience as average of peak and end emotions

This trend was, to a large degree, evident for all participants with the exception of participant 9B for Experiment 1 (Figure 14). A potential reason for why participant 9B did not fit the trend is that throughout the experiment the participant changed her primary use of the device from a music player to a storage device. As she points out during an interview:

… I don’t use it as much for the purpose that it’s intended, like listening to music, watching stuff. It’s more of a storage device now but because I’m going from Apply to Apply now there’s no problem with using it as a storage device…
Her comments during the co-discovery session confirm the fact that her use changed from being a music player to a storage device:

It’s more, like I use it as a storage device and using it for uni, like I have all my stuff on. Big files, all that sort of stuff. And it’s just convenient. And it’s not that, it is a little bit big but it fits my bag fine, I just carry it… but I just guess it’s sort of more of a neutral thing. Like I’m not so excited about it anymore.

This change in use with the device is predicted to be the cause of the negative dip in emotional experience (Figure 14) causing a deviation on the overall emotional experience. It is predicted that this particular situation distorted the overall emotional experience perceived by participant 9B, which is the potential reason why it does not represent the Peak-End rule accurately.

![Figure 14. Participant 9B macro-level graph showing overall emotional experience is not reflected as the average of peak and end emotions](image-url)
One aspect to note is that the exact average could not be determined precisely for all participants given the coarseness of the emotional responses available but the results are indicative of the Peak-End rule applying for Experiment 2.

**Cumulative Macro-Level Results**

Table 10 summarises the overall numbers of positive and negative experiences for Tasks of all participants in the media / entertainment PID category. The results are distributed according to each of the interview sessions conducted over the six-month period. By looking across the Functional row it can be seen that it is broken into Positive and Negative emotions. The Positive row is broken into Personal, Social and Total, referring to the number of experiences reported under each of those Sub-Categories as well as the total for both. Looking further across the Personal row the number of experiences are recorded during the initial interviews and the intermittent interviews.

For example, it can be noted by looking across the row that 30% of experiences were recorded for the Functional Category as Positive and Personal in the initial interview while 13% were recorded in the second interview and so on. The overall number of experiences is included at the end of the row. By breaking the data down in this way the specific numbers and overall totals for each of the Tasks categories can be observed broken into Positive and Negative experiences as well as Personal and Social.
Table 10. Overall results for Task Categories coded positive or negative for Media / Entertainment PIDs

<table>
<thead>
<tr>
<th>Task Category</th>
<th>Emotion</th>
<th>Human Interaction Sub- Categories</th>
<th>Interview session</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Personal</td>
<td>21</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Functional</td>
<td>Pos</td>
<td>Personal</td>
<td>30% 13% 5% 24% 8% 7% 10% 3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>17% 17% 20% 3% 13% 17% 13%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neg</td>
<td>Personal</td>
<td>26% 12% 15% 9% 6% 23.5% 8.5%</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>12% 15% 6% 20% 15% 15% 8.5% 8.5%</td>
<td>34</td>
</tr>
<tr>
<td>Feature</td>
<td>Pos</td>
<td>Personal</td>
<td>11 10 - 7 5 4 2</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>1 5 11 - 1 5 3 1</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Neg</td>
<td>Personal</td>
<td>14 12 10 11 9 14 10 5</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>3 5 1 5 6 3 2 2</td>
<td>27</td>
</tr>
<tr>
<td>Mediation</td>
<td>Pos</td>
<td>Personal</td>
<td>12 3 1 5 1 1 1 5</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>25% 12.5% 12.5% 37.5% 12.5%</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Neg</td>
<td>Personal</td>
<td>2 - - - - - - -</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>29% 14% 14% 14% 14%</td>
<td>7</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>Pos</td>
<td>Personal</td>
<td>- 1 - 1 1 1 -</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>- - - - - - -</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Neg</td>
<td>Personal</td>
<td>26% 3.5% 15% 7% 15% 15% 18.5%</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social</td>
<td>- - - - - 1 1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50% 50%</td>
<td></td>
</tr>
</tbody>
</table>
Table 10 highlights how the experiences across each Task Category fluctuated over time. It reveals that over the course of six months emotional experiences did not decline over time but rather fluctuated (with the exception of the Mediation, Negative, Personal experiences). Most Categories begin with a large proportion of Tasks reported in the initial interview and then appear to peak again sometime later in the six month timeframe. For example, Functional, Positive, Personal begins with 30% of experiences and then falls to 13% of experiences in interview 2, then falls again to 5% for interview 3 and then peaks again to 24% for interview 4 and slowly falling again to the final interview. Similarly, for Mediation, Positive, Personal interview 1 begins with 41.5% of experiences, falling to 10.5% for interview 2 and falling again to 3.5% for interview 3 only to rise again to 17% for interview 4 and falling again progressively to the end. Although this is not a consistent trajectory for all Task Categories it suggests that users do not, on all occasions, lose interest or attention in their devices over extended interactions. It indicates that emotional experiences with PIDs might rise and fall over time and the initial few weeks might not be the only important period of the experience.

This finding indicates a different result than Karapanos et al. (2009) study that suggested that the first month of use was when most of the critical experiences occurred during user-product interaction. The findings appear to show that other critical and important experiences may reveal themselves later in the experience than the first month of use.
7.5 Summary

This chapter has discussed Experiment 1, focusing on exploring the evolving emotional experience of interacting with media / entertainment PIDs. Firstly it outlined the experiment methods including participants, equipment and procedure for the experiment. Further, it outlined the coding scheme used for the analysis of data and concluded with the results.
Chapter 8

8.0 Experiment 2: Medical / Health PIDs

8.1 Introduction

This chapter describes Experiment 2. This experiment focused on exploring people’s emotional experiences with portable medical and health related devices over a six-month period. Similar to Experiment 1, the purpose of Experiment 2 was to identify aspects that influenced the emotional experience over the course of interaction in a positive or negative manner. This included exploring the following aspects:

- Classifying Task Categories and their relationship to the emotional experiences
- Determining how and why the emotional experiences changed, evolved, emerged and declined over time
- Determining whether a relationship exists between personal and social interactions and emotional experiences.

Due to these aspects and the overall aim of the research (Section 1.4) the experiment was focused on capturing people’s experiences with products in real life situations. Chapter 7 identified and introduced the concept of emotional experience in everyday life. This chapter outlines the experiment method, including participant recruitment, equipment and procedure for Experiment 2 (medical / health related PIDs) including results.
8.2 Method

Since one of the research objectives was to compare and contrast the results across the two product categories, the focus and structure of the second experiment needed to be consistent with the first. The research was qualitative and utilised a triangulation approach of interviews, experience diaries and co-discovery.

8.2.1 Participants

Overall, 225 experiences were collected and analysed for Experiment 1. Six participants were recruited for Experiment 2, each with no more than two months experience with the portable device thus attempting to capture the initial stages of interaction and how it evolved over the first few months of use. Participants ranged from full-time academics to professional staff and students of the Queensland University of Technology (QUT) and full-time professionals. They represented a good cross-section of the population who use medical / health devices with ages ranging from 26 to 50. Further, the gender distribution was even with three males and three females participating and going on to complete the study.

Participant recruitment was initiated by sending out an electronic mail request for participation to staff members at QUT. Further, a hard copy letter and electronic mail request for voluntary participation was sent through Diabetes Australia Queensland Chapter to over 100 addresses. Also, flyers and notices were posted
at three chemist stores and two gymnasiums located near Brisbane city central business district. This recruitment was consistently performed over the course of several months. Out of these attempts nine participants agreed to participate in the experiment, although only six went on to complete the study over the six-month period.

8.2.2 Equipment

The data collection and analysis were performed at the Queensland University of Technology People and Systems Laboratory. Initial interviews, intermittent interviews and co-discoveries were recorded using audio tapes. Participants were given paper-based diaries and they recorded written answers (Appendix A) or submitted their responses via electronic mail.

8.2.3 Procedure

Participants were sent an information package explaining the aims, methods and expected benefits of the experiment. Further, they were asked to sign a consent form, which they were required to bring with them to the initial interview. As outlined for Experiment 1, the study was organised into three phases consisting of (i) an initial interview, (ii) intermittent interviews and experience diary, and (iii) co-discovery. The three phases were identical to Experiment 1 (Chapter 7).
8.3 Coding Scheme

The data attained from the experiment were textual in format, gathered from verbal transcripts, written information and notes. The data from Experiment 2 was analysed using a content analysis technique (Bauer & Gaskell, 2000; Flick, 2006). To assist in contextualising the findings, the same technique as Experiment 1 was developed. Table 4 (Chapter 7) summarises the relationship between data gathering techniques and how data were categorised. For Experiment 2, a coding scheme was also developed to identify different Themes, Categories and Sub-Categories relating to the data sets. The coding scheme was broken down into three broad themes including (i) Context, (ii) Emotional Perception of Experience and (iii) Tasks, following the Experiment 1 approach (Table 11).

For Experiment 2 the Categories and Sub-Categories were identical to Experiment 1 and the only aspect that changed were the Sub-Categories in the Task Theme. Since most of the coding scheme was already established from Experiment 1 (Chapter 7), the only aspects that require further elaboration for Experiment 2 were the sub-categories for the Task Theme.

Data from the interviews were the primary source to develop these Sub-Categories. For example, Figure 15 is an excerpt from a participant that identifies both the Interface and Data storage Sub-Categories code.
### Table 11. Medical / Health PIDs Coding Scheme

<table>
<thead>
<tr>
<th>Themes</th>
<th>Category</th>
<th>Sub-category</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Context</strong></td>
<td>Location</td>
<td>Private (Home, Office alone, etc)</td>
<td>CLP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public (Public Transport, Public Space, etc)</td>
<td>CLC</td>
</tr>
<tr>
<td></td>
<td>Human Interaction</td>
<td>Individual (Activity performed alone)</td>
<td>CHI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social (Activity performed alone)</td>
<td>CHS</td>
</tr>
<tr>
<td><strong>Time of day</strong></td>
<td>Day</td>
<td>CTD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>CN</td>
<td></td>
</tr>
<tr>
<td><strong>Emotional perception</strong></td>
<td>Neutral</td>
<td>Neutral</td>
<td>ENN</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Happy excited</td>
<td>EPE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Happy</td>
<td>EPH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Happy calm</td>
<td>EPC</td>
</tr>
<tr>
<td></td>
<td>Relaxed</td>
<td>Calm</td>
<td>ERC</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>Unhappy calm</td>
<td>ENC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unhappy</td>
<td>ENU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unhappy excited</td>
<td>ENE</td>
</tr>
<tr>
<td></td>
<td>Energised</td>
<td>Excited</td>
<td>EEE</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>Comfort</td>
<td>AHU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data storage</td>
<td>AHDS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aesthetics</td>
<td>AHA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Portability</td>
<td>AHB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quality of mechanism / product</td>
<td>AHQ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interface</td>
<td>AHI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>AHT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rattling</td>
<td>AHR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alarm</td>
<td>AHAL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Changing needle</td>
<td>AHN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Changing strips</td>
<td>AHST</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Logging of data</td>
<td>AHLG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strap</td>
<td>AHSP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beeping</td>
<td>AHBP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clip</td>
<td>AHC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resetting</td>
<td>AHRS</td>
<td></td>
</tr>
<tr>
<td><strong>Tasks</strong></td>
<td>Recording steps</td>
<td>AHS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Taking blood sample</td>
<td>AHP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reading hear rate</td>
<td>AHH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tread function</td>
<td>AHFI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reading VO2 max</td>
<td>AHVO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Timing</td>
<td>AHTM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telling time</td>
<td>AHTT</td>
<td></td>
</tr>
<tr>
<td><strong>Mediation</strong></td>
<td>Monitoring fitness</td>
<td>AHF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Another item to carry</td>
<td>AHW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Motivator</td>
<td>AHM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Consciousness of product</td>
<td>AHCS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Becomes part of background</td>
<td>AHZ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forgotten product</td>
<td>AHFT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monitoring health</td>
<td>AHMH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reliance on product</td>
<td>AHRL</td>
<td></td>
</tr>
<tr>
<td><strong>Auxiliary</strong></td>
<td>Loosing product</td>
<td>AHL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brochure / manual</td>
<td>AHBR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Damaging product</td>
<td>AHD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
<td>AHWM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Product broken</td>
<td>AHBK</td>
<td></td>
</tr>
</tbody>
</table>
Figure 15. A section from interview transcript from Participant 12C

Figure 16 shows participant 12C identified an aspect relating to the product’s Interface as well as the Data storage capabilities of the product itself. Another excerpt from the interviews outlines an example of the Monitoring Health Sub-Categories code (Figure 16).

Figure 16. A section from interview transcript from Participant 13D/E

Figure 16 identifies that participant 13D/E is using the product for health monitoring so as to have a better understanding of eating or exercise habits. This helped to determine the Monitoring Health Sub-Category under Mediation. All of the Sub-Categories for medical / health PID Tasks were developed using this technique of analysing the transcripts (Table 12). The Sub-Categories for the Task Themes were developed first. Once the Sub-Categories were coded, the broad Categories could be determined by grouping the common Sub-Categories into logical related groupings.
Table 12. Description and groupings of Sub-Categories for Medical / Health PIDs

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>Comfort, Data storage, Aesthetics, Portability, Quality of mechanism / product, Interface, Technology, Rattling, Alarm, Changing needle, Changing strips, Logging of data, Strap, Beeping, Resetting</td>
<td>Tasks relating to the features of the products</td>
</tr>
<tr>
<td>Functional</td>
<td>Recording steps, Taking blood sample, Reading heart rate, Tread function, Timing, Telling the time</td>
<td>Tasks relating to functions of the products to achieve a particular action</td>
</tr>
<tr>
<td>Mediation</td>
<td>Monitoring fitness, Another item to carry, Motivator, Consciousness of product, Product becomes part of background use, Forgotten product, Monitoring health, Reliance on product</td>
<td>Tasks that mediated or facilitated a broader experience beyond the physical aspects of the product</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>Loosing product, Brochure / manual, Damaging product, Maintenance, Product broken</td>
<td>Tasks peripheral, or tertiary, to core functions of the product</td>
</tr>
</tbody>
</table>

8.4 Analysis and Results

This section outlines how the data collected were analysed and results from the analysis. All data were analysed using Atlas.ti software (Muhr & Fries, 2004).

8.4.1 Micro-level Experiences

Table 13 shows the overall numbers of positive and negative emotional experiences of the Task Categories across all participants for the medical / health PID category. Further, the table indicates the percentage of emotional experiences recorded across each Category. It can be seen that Features is the most prominent category and accounts for 53.5% of all Tasks experienced. Mediation is next with 23%,
Functional is third with 17.5% and Auxiliary makes up the remaining 6% of Tasks experienced.

Table 13. Overall results for Task Categories as positive or negative for Medical / Health PIDs

<table>
<thead>
<tr>
<th>Category</th>
<th>Positive</th>
<th>Negative</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td>Functional</td>
<td>23</td>
<td>59%</td>
<td>16</td>
</tr>
<tr>
<td>Feature</td>
<td>45</td>
<td>37.5%</td>
<td>75</td>
</tr>
<tr>
<td>Mediation</td>
<td>44</td>
<td>85%</td>
<td>8</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>1</td>
<td>7%</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td></td>
<td>112</td>
</tr>
</tbody>
</table>

It can be noted, similar to Experiment 1 results, that Features are composed mainly of negative experiences (62.5%), while Mediation—the second most prominent category for the medical / health PIDs—is overwhelmingly comprised of positive experiences. Functional is also comprised of slightly more positive experiences (59%) and Auxiliary is noticeably comprised of negative experiences (93%).

These results indicate that people interact with medical / health PIDs not just for utilitarian purposes but also for mediation purposes as evidenced by the number of Feature and Mediation Tasks recorded. Feature Tasks account for the largest proportion of the experiences, which indicates that first and foremost medical / health PIDs are experienced for pragmatic purposes through product features. With Mediation type Tasks accounting for 23% of experiences, it seems that medical PIDs are used for facilitating broader experiences not directly related to the practical aspects of the product (although are indirectly related to those aspects). It
was surprising to note that Functional Tasks did not appear to represent a significant amount of experiences, which suggests that the Functional components of medical PIDs are not the main focus of user interactions. It was no surprise that there were a small number of Auxiliary Tasks, nevertheless these types of Tasks form important parts of the overall experience. For instance, experiences regarding Brochure / manual or Maintenance might represent an important part of experiences with medical and health related PIDs.

Table 14 breaks this down further by representing the positive and negative experiences for the Human Interaction category, coded as Personal or Social.

Table 14. Results for Personal or Social category coded positive or negative for Medical / Health PIDs

<table>
<thead>
<tr>
<th>Category</th>
<th>Personal</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Num</td>
<td>%</td>
</tr>
<tr>
<td>Functional</td>
<td>21</td>
<td>58%</td>
</tr>
<tr>
<td>Feature</td>
<td>39</td>
<td>41%</td>
</tr>
<tr>
<td>Mediation</td>
<td>40</td>
<td>91%</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>1</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>101</td>
<td>87%</td>
</tr>
</tbody>
</table>

It can be noted in Table 14 that for the Functional row Personal, Positive slightly outweighed the Personal, Negative (58% and 42% respectively). Feature shows that Personal, Positive were moderately outweighed by Personal, Negative (41% and 59% respectively). Mediation shows Personal, Positive overwhelmingly
outweighing Personal, Negative (91% and 9% respectively). Finally, Auxiliary demonstrates that Personal, Positive is significantly outweighed by Personal, Negative (8% and 92% respectively).

Under Social, the Functional Category shows that Social, Positive outweighed Social, Negative (67% and 33% respectively). Feature highlights that Social, Positive was significantly outweighed by Social, Negative (25% and 75% respectively). Mediation shows that Social, Positive is perfectly even with Social, Negative (50% and 50% respectively). Finally Auxiliary, although minimal in number of experiences, shows all experiences characterised as Social, Negative (100%).

These findings demonstrate that users reported distinct experiences for both Personal and Social Categories. Private and personal experiences are composed of an even distribution of positive and negative experiences relating to device features and functions, overwhelmingly positive for mediation type tasks and significantly negative for auxiliary type tasks. With social experience, the breakdown is somewhat different with features, functional and auxiliary tasks being either positive or negative and mediation evenly distributed. This indicates that mediation tasks are potentially perceived as positive in nature in personal settings where people might appreciate these types of Tasks. This might be perceived differently in social circumstances in which mediation tasks might be considered positive or negative depending on other circumstances existing in the social environment.
One other important aspect to consider here is the overwhelming volume of Personal experiences compared to Social experiences. Overall, Personal experiences represent 84% of all Tasks and Social experiences represent 16%. This indicates that users are more inclined to interact with medical / health PIDs in personal settings and less inclined to engage in social settings with these types of devices.

8.4.2 Gender Breakdown

Since Experiment 2 was structured in such a way as to have an even split in gender (3 females and 3 males) the results were analysed by dividing the data across the two gender groups. Table 15 shows the gender breakdown of Positive and Negative emotional experiences across the Personal and Social Sub-Categories.

| Category | Positive | | | | Negative | | | |
|----------|----------| | | |----------| | | |
|          | Personal | Social | Overall |             | Personal | Social | Overall |             |
|          | Num  | %    | Num  | %    | Num  | %    | Num  | %    |
| Female   | 68   | 91   | 7    | 9    | 75   | 66   | 34   | 64   |
| Male     | 33   | 87   | 5    | 13   | 38   | 34   | 53   | 90   |

Table 15 shows that males and females reported similar results for Positive experiences. Females reported more Positive Personal experiences compared to Positive Social experiences (91% and 9% respectively). Similarly, males reported
more Positive Personal compared to Positive Social (87% and 13% respectively). Results were different for Negative experiences. For the Negative Category, females documented more Negative Personal experiences compared to Negative Social (64% and 36% respectively) while males documented substantially more Negative Personal experiences compared to Negative Social experiences (90% and 10% respectively).

The findings indicate that males displayed significantly more Negative Personal than Negative Social experiences compared to females. For Positive Personal and Positive Social there appears to be similar results for both male and female. It is difficult to ascertain why this might be the case, but it suggests that males and females might discuss and consider negative experiences with medical and health related devices in distinct ways.

8.4.3 Overall Experiences Over Time

In the same way as Experiment 1, another aspect analysed was the overall emotional experience reported by the participants across time (macro-level interactions). During the interview and the final co-discovery session, participants were asked to characterise their emotions toward the product based on the Emotional Chart (Figure 8). Once this data was collected, a macro-level graph of each participant’s experience across the six months could be plotted for the medical / health category.
One aspect to be analysed as part of this experiment was the Peak-End rule to determine whether, after six months, the rule was applicable to the findings for the overall emotional experience with medical / health PID types. It was discovered that the Peak-End rule was applicable to a large extent across the findings for Experiment 2 (Appendix E). As discussed in Chapter 2 (Section 2.2.3), the Peak-End rule states that overall emotional experiences are determined by the average of the most extreme emotional experiences (peak) and the emotion experienced at the end (end).

As an example, Figure 17 demonstrates the macro-level experience for participant 13D. The X axis represents the emotional response during the interviews ranging from intense negative through neutral all the way to intense positive, mirroring the quadrants represented on the Emotional Chart. The Y axis denotes time in months. As Figure 16 shows, the overall emotional experience perceived by the participant is the average of the peak and end emotional experience. The peak emotion was determined by the most extreme emotional experience over the course of six months as defined by the participant during the interviews. The end emotion as well as the overall emotional experience was determined during the co-discovery. To determine the overall emotional experience, participants were asked what they felt about the overall emotional experience. For example, when participant 13D was asked to determine his overall emotional evaluation, his answer defined it as neutral positive:
Neutral to positive I guess. It does the job. I guess the analogy is it’s probably a Ford Falcon. You know, it’s not a Mercedes but, you know, it collects the glucose levels that I can analyse myself and also pass on to my specialist and GP.

Figure 17 shows the overall emotional experience as the average of peak and end emotions, confirming the Peak-End rule.

![Figure 17. Participant 13D macro-level graph showing overall emotional experience as average of peak and end emotions](image)

This trend was, to a large degree, evident for all participants with the exception of participant 15C for Experiment 2 (Figure 18). A potential reason why participant 15C did not fit the trend is that she had to replace her device because of a malfunction with the original. When participant 15C was asked during the co-discovery how she felt she noted:

… I suppose with mine there’s a couple of different aspects. Because the product broke halfway through, I haven’t actually, I’ve actually got the new
one, like the replacement one… originally, I think when we first started this study I was a bit neutral towards it… feeling more positive towards it [now]

The product malfunctioning during the experiment created a very negative recording in the second month interview (Figure 18), which created a significant deviation from the rest of the experience. As she highlights during the co-discovery session:

I was really annoyed that it broke halfway through…

It is predicted that this particular situation distorted the overall emotional experience perceived by participant 15C, which is the potential reason why it does not represent the Peak-End rule accurately.

Figure 18. Participant 15C macro-level graph showing overall emotional experience is not reflected as the average of peak and end emotions

One aspect to note is that the exact average could not be determined precisely for all participants given the coarseness of the emotional responses available, but the results are indicative of the Peak-End rule applying for Experiment 2.
**Cumulative Macro-Level Results**

Table 16 summarises the overall numbers of positive and negative experiences for Task Categories for all participants in the medical / health PID category captured for each of the interview sessions. Looking across the Functional row it can be seen that it is broken into Positive and Negative emotions. The Positive row is broken into Personal, Social and Total, referring to the number of experiences reported under each of those Sub-Categories as well as the total for both.

Looking further across the Personal row the number of experiences are recorded during the initial interviews and the intermittent interviews. For instance, it can be noted by looking across the row that 29% of experiences were recorded for the Functional Category as Positive Personal in the initial interview while 5% were recorded in interview 2 and so on. The overall number of experiences are included at the end of the row. By breaking the data down in this way, the specific numbers and overall totals for each of the Task Categories can be observed broken into Positive and Negative experiences as well as Personal and Social.

It is clear there are few experiences recorded over the six month period for certain Task Categories including Functional and Auxiliary. It is also evident that over time all experiences across the four Task Categories reduce in amount.
Table 16. Overall results for Task Categories coded as positive or negative for Medical / Health PIDs

<table>
<thead>
<tr>
<th>Task Category</th>
<th>Emotion</th>
<th>Human Interaction</th>
<th>Sub-Categories</th>
<th>Interview session</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Initial</td>
<td>Int. 2</td>
</tr>
<tr>
<td></td>
<td>Pos</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Social</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Functional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Social</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Feature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>13</td>
<td>18</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Social</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Mediation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>11</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Social</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Auxiliary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Social</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Percentages are calculated based on the total observations for each category in the respective session or overall.
Across the Task Categories most experiences are reported within the first two or three interviews (initial interview and interview two) and then slowly reduce over time. For example, for Feature Category under Positive, Personal 33% of experiences are recorded for the initial interview followed by 46% for interview 2, reducing to 5% for interview 3 and continuing to reduce over time. Similarly, for Mediation under Positive, Personal 27.5% of experiences are recorded during the initial interview, dropping to 10% for interview 2, then 17.5% for interview 3 and continuing to slowly drop over the ongoing interviews. This finding does not confirm that in reality people stop interacting with medical / health PIDs after a few months, rather it suggests that users stopped identifying relevant or significant emotional experiences to mention with these types of devices after a few months. In other words, users may have experienced more experiences but when asked about them they were not considered to be impacting emotional experiences, or perhaps not significant enough to be remembered, and thus were not mentioned.

8.5 Summary

This chapter has discussed Experiment 2, focusing on exploring the evolving emotional experience of interacting with medical / health PIDs. First, the experiment methods including participants, equipment and procedure for the experiment were described.
Further, it presented the coding scheme used for the analysis of data and concluded with the description of findings from the results. Chapter 9 discusses the comparison of results for media / entertainment and medical / health PIDs.
9.0 Comparison of PID Categories

9.1 Introduction

Chapter 7 and 8 focused on establishing and outlining the results from each of the experiments. This chapter aims to compare the similarities and differences in the results for both PID types. It begins with a comparison of the four Task Categories at the micro-level followed by Personal and Social Tasks at the macro-level and concludes with the combinations of gender results and combined overall numbers plotted over time.

9.2 Comparison of Task Categories

The first sets of results to compare are the overall Task Categories for both product types occurring at the micro-level. As discussed previously (Chapter 7, Table 7), for the media / entertainment category the most prominent Categories in descending order were Feature, Functional, Mediation and Auxiliary. It was also noted that Features and Auxiliary Tasks were mainly reported as negative while the Functional and Mediation were more overall more positive. For the medical / health category (Chapter 8, Table 13) the most prominent categories in descending order were Features, Mediation, Functional and Auxiliary. It was noted that Features and Auxiliary were mainly negative in nature while Mediation and Functional were
reported as overall positive. This indicates a difference in the product categories regarding the most mentioned Tasks experienced but similarities in their evaluation across both product categories.

*Feature category*

Findings show that the Feature category is the most mentioned by all participants and characterised as Negative in nature (Figure 19). Figure 19 illustrates that results are very similar for both PID types over the six-month period.

![Graph showing overall percentage of Feature Tasks characterised Positive and Negative for Media / Entertainment (left) and Medical / Health PIDs (right)](image)

Figure 19. Overall percentage of Feature Tasks characterised Positive and Negative for Media / Entertainment (left) and Medical / Health PIDs (right)
When users mentioned Feature Tasks they were often characterised as negative, suggesting that users relate to these types of Tasks generally in an unfavourable way. An example from participant interviews highlights how these types of Tasks are often discussed in a negative light for both PID types. Participant 5B describes a common experience he has to deal with regarding his portable music player:

The headphones are always tangled which is a gigantic pain, but it seems everyone has this problem not just me. You see people on the station platform untangling headphones… doing the drop to see where the knot is.

Another participant using his PDA outlines how accessing extra features on the device can be difficult and complicated when other functions are required to be performed:

…the menu with commands like copy or paste or edit or purge is in a sort of secondary button on the phone and you have to raise a separate pull down menu in order to do those other things. And occasionally a call or a message has come in, and it has happened on two occasions now, and I have inadvertently operated the pop-down menu and I have just obviously pressed the wrong button to get rid of it… So I have had kind of a lot of negative experiences with it…
For participants using medical / health devices similar experiences are discussed regarding the device features. In this case participant 11D discusses size and build quality as a negative aspect of the device:

It’s not practical because (sighs) oh, like it just, it’s because of its size. That’s definitely it. Because it just clunks… I walk about the house and it makes this noise. It ticks. Like it ticks quite loud.

Similarly participant 13D comments how the blood glucose monitor he is using can be burdensome when it comes to some of its features that he views as impractical:

… well I should say that every week I actually have to um, go onto my computer, onto a spreadsheet that I’ve created, and I have to back through the device’s memory and manually type in the data twice a day… All I’ve done is, you know, just track back through its memory and write down the time and then the reading. So that I guess is a bit of a pain that I have to do that every week.

These excerpts highlight how product features appeared to be remembered in a negative fashion by highlighting that in many cases participants referred to these types of Tasks to point out negative aspects of the experience. Participant 11D comments on the device’s impracticality because of its size and poor build quality while 13D stated how inconvenient it is that he has to input the data manually. This is not to say that all experiences with product features are negative, but rather,
when users choose to discuss them, or are asked to remember these types of Tasks, the focus is often on the negative aspects of the experience.

Functional category

Looking at the Functional categories for each product type it can be noted that these were characterised as Positive again to the same degree across both product types.

Within the media / entertainment PIDs the Functional category accounted for 40% of all Tasks and was overall more Positive with 60% of experiences rated positive.
(Figure 20, left). With the medical / health PIDs, the Functional category represented a smaller portion of all Tasks at 17.5% but was also characterised as positive in nature with 59% positive experiences overall (Figure 20, right).

The Functional Tasks were assessed overall the same for both PID categories, although they represented a higher proportion for media / entertainment than medical / health PIDs. It appears that users relate to these types of Tasks in a positive light such that experiences that permit them to engage with a specified functional goal are remembered, or perceived, as positive in nature. Many of these positive experiences had to do with core functions of the device and are closely linked with Mediation type Tasks. The Function Tasks are very simple and straightforward but they were often mentioned in a positive fashion. For instance, participants enjoyed simply the fact that they could listen to music, as participant 7B briefly comments:

In the morning I like listening to it walking in or whatever…

In a similar fashion participant 5B, when asked what kind of experiences have been positive with his use of the portable music player, highlights:

… a song will come on and you go ‘I love this song’ and it works with whatever you are seeing or where you are walking.
For medical / health devices comparable comments were made regarding Functional Tasks. For instance, during the interviews when asked about some of the positive experiences with a pedometer, participant 14D comments:

Well just knowing that I was getting more and more steps each day. I was pushing up my highest day and pushing up my average. And that was good. And it was good recording how far I’d been walking...

An equivalent experience is described by participant 15C when talking about her experience with a heart rate monitor that had a specific timing function:

… I’m happy with the product. I really like the functionality and being able to do (unclear) the split timing and, you know, you can save the, you know, the session and go back and look at it.

These comments highlight that participants perceived Functional Tasks in a positive manner and generally these related to very basic, specific core functions of the device. For participant 14D it related to the pedometer’s core function of counting steps while for participant 15C it had to do with the basic function of being able to time herself during her exercise. If the PIDs performed their core function well then it was often seen as a positive experience. As these comments show, this was consistent for both PID types. The only difference between the two PID types was the proportion of Functional Tasks mentioned. A possible reason why there is a difference in the proportion across the product types is that media / entertainment
devices have many more functions and more possibility of exploration while medical / health devices are primarily used for more specific purposes.

**Mediation Category**

Mediation Tasks for both product types were characterised as overwhelmingly positive in nature. Mediation Tasks accounted for 11% of all experiences mentioned for the media / entertainment PIDs with 80% characterised as positive (Figure 21, left). Mediation Tasks, accounting for 23% of all experiences in the medical / health PIDs category, were characterised as 85% positive in nature (Figure 21, right).

![Figure 21. Overall percentage of Mediation Tasks characterized Positive and Negative for Media/Entertainment (left) and Medical/Health PIDs (right)](image_url)
Mediation Tasks facilitate experiences beyond the practical and utilitarian and relate to higher-level user wants and needs. It is proposed the reason why they are perceived as positive is that these Tasks relate closely to fundamental human desires and if PiDs mediate them they will be characterised, and remembered, in a positive light. Further, it is speculated that in many of these cases users are assessing a combination of the satisfaction of experiencing the Task itself and the product’s ability to allow them to perform the Task through its interaction.

An example of this can be seen in many of the comments made by participants when discussing Mediation experiences during the interviews. A very common example of a Mediation Task for media / entertainment device was relaxation and escape. As outlined by Participant 3B when asked how the device benefits his life he mentioned how he uses it to help him relax:

...I suppose just by using it for relaxation... I usually listen to inspirational talks and sermons, that sort of stuff while I’m on a run. I enjoy listening to music, I do find it uplifting and encouraging, a positive attitude.

Participant 9B outlines how the portable music player helps her to relax and prevent boredom:

It just helps me relax... at work it's alright because it gets very boring in my room. You sit there and you hear nothing and there’s no sound or music, so
it gives you something to do on a lunch break and puts you in a happier mood.

Another example from Participant 1B shows how the device eventually evolved to help her relax in times of stress:

…it has evolved from just an entertaining me to relaxing me… I was really stressed and I was walking to the bus stop and I remember I have my Shuffle with me and I put it on and I was feeling much better.

Participant 1B comments further about PIDs being used to escape from unwanted crowded situations in public spaces:

…it was valentines Day and it was crowded, the whole city… and I took a different way. All the paths were crowded and I was just trying to pass through and couldn’t. And I wasn’t wearing my iPod and I put on my iPod and I was listening to my music and then I was happy…

What can be seen from these examples is that participants used media / entertainment devices to try and seclude themselves from or somehow alleviate stressful or unwanted circumstances. These examples show clearly how participants used these PIDs to try and manage their circumstances and facilitate positive emotional experiences as a result.
For medical / health devices the types of Mediation Tasks performed differed but they were still used to facilitate positive experiences. The focus was not so much on relaxation or escaping from stress but rather about monitoring fitness or health as well as motivation to exercise. An example from Participant 15C highlights this:

…there’s a correlation between how often I exercise and how fit I’m feeling as to how positive I feel about the product I think… When I am actually using it and using the functions of it, then I’m glad I’ve got it.

Likewise participant 10C, when asked what kind of experiences have been positive while using the heart rate monitor, outlines how the device helps to monitor his fitness level over time:

Being able to monitor my health… being able to keep an eye on progress and things like that.

As a result participant 10C outlines how it helps to motivate him to exercise more often:

Well it’s got me to exercise more regularly… Maybe a little bit of psychological things in my head when I’m out and you go people seeing me what a heart rate monitor, I should be exercising harder to… you know, you kind of… the more gadgets you have the more professional you feel you have to be using it…
Another example regarding monitoring fitness is outlined by participant 12C in which he states that the device allows him to keep a track of data about his fitness:

So it enables me to gather data, this is the other thing I enjoy about it… I can still continue to collect, I can go to the gym and do it, still pick up the data.

These examples from the medical / health PID participants highlight how these positive Mediation Tasks relate more to monitoring fitness and health and motivators to continue to stay healthy as the main drivers.

It is important to highlight that a higher proportion of Mediation Tasks were reported for medical / health PIDs (23%) compared to media / entertainment (11%). This finding reveals that people utilise medical devices for Tasks that focus less on the product itself and more on what the product can facilitate, for instance on Tasks such as monitoring health or monitoring fitness. Although media devices are sometimes used for Tasks that facilitate experiences beyond the product itself, they do so to a lesser extent.

**Auxiliary Category**

For both PID types the least mentioned Task Category was Auxiliary. This is no surprise as these Tasks are specifically tertiary in nature and do not occur often. Auxiliary Tasks accounted for 7% and 6% of all experiences for the media / entertainment and medical / health PIDs respectively. It is worthwhile noting that even though they were rarely mentioned, there was an overwhelming Negative
characterisation of these experiences. For instance, participant 4A comments about his negative feelings regarding charging the batteries on his PDA:

And then there is the minor inconvenience of having to, it's like something else to think about to make sure the battery is changed… It’s like one more thing to remember…

The same participant mentioned the battery issue again later in the experience, once more in a negative light:

… like the battery ran out the other day, that was a negative.

In a very similar way participant 9B describes the problems with batteries when trying to charge her portable music player:

Yes sometimes it’s a bit annoying… Some of my friends [use] their cigarette lighter thing doesn’t actually work so I can’t even recharge it in there either or play the device.

This same negative trend with Auxiliary type Tasks is evident with medical / health type devices. Participant 15C comments on having to take back her product that was damaged during use:
... it’s annoying that I broke. It was a hassle to… to take back (unclear) follow it up. Just takes time out of your day.

Participant 10C points to his negative feelings regarding having to continuously clean and maintain his heart rate monitor:

... mainly I guess the one thing is possibly the, like the number of times you need to, you know, put it through a washing cycle and its kind of got to go through by itself… So I guess that’s probably one thing is the maintenance side of it that’s a bit, a bit annoying.

These tertiary type experiences were commonly mentioned in a negative light for all participants across both categories. These examples highlight how participants did not recall them in a positive way; rather these were always mentioned as a nuisance or frustration that inhibited them from actually performing and interacting with the device in the way they would have liked.

These Auxiliary-type interactions are not often researched or discussed within the literature and although they are seldom performed they still form part of the user-product interaction over time. In fact some of these Tasks form crucial components of interacting with the product, including Tasks like dealing with the product’s battery, any required maintenance, reading the manual or brochure, among others. These types of Tasks, although not considered central or core to the product’s everyday interactions, have the potential to inhibit, or alternatively permit, emotional
experiences. The findings suggest that when asked about these types of Tasks they are perceived, and remembered, in a negative light. A potential reason for these negative associations is that since Auxiliary Tasks are peripheral to the device’s core function, they are perceived as an extra burden on the user’s time, impeding on the experience and influencing it in a negative fashion.

9.3 Comparison of Personal and Social Interactions

Results in Table 8 and 14 indicate there are some similarities and some differences across the two PID types for Personal and Social interactions. There are mainly constant results across the Personal experiences for both product types, while there is a difference between the Social experiences with regard to Positive and Negative experiences recorded.

*Overall Personal and Social Interactions*

Analysis of the data strengthens the idea that PIDs are used both at a Personal level and at a Social level. Out of all the experiences recorded 74% were noted as being Personal while 26% were noted as being Social (Figure 22).

This indicates that, overall, participants identified just over a quarter of their experiences as Social over the course of six months. Thus the social dimension of the user-product interaction plays an important part of the overall experience with PIDs.
It is also relevant to compare the two product types independently in relation to Personal and Social experiences. For media / entertainment PIDs, 69% were reported as Personal while Social accounted for 31% of experiences recorded (Figure 23). For the medical / health category Personal experiences amounted to 84% and Social accounted for 16% of experiences (Figure 24).

The differences between the proportions of Personal and Social experiences for the two PID types suggests that users interact with media / entertainment devices more socially compared to medical / health devices. A possible reason for this difference is that some functions of media / entertainment PIDs are specifically designed to facilitate social interactions while this is not the case with medical / health PIDs. Further, another potential reason might also relate to privacy concerns with medical and health related issues in people’s lives and not having a need to share that kind of information.
Peak-End Rule for both PID categories

It was identified that for both PID categories the Peak-End rule applied, with some limitations. The Peak-End rule states that the overall emotional experiences are determined by the average of the most extreme emotional experiences (peak) and the emotion experienced at the end (end). This suggests that regardless of the
length of the experience, the perceived (or remembered) emotional experience is a combination of the peak emotional experience and the end experience for people’s interactions with PIDs. The implication of this is that experiences with PIDs that are varied over time (up and down, including positive and negative experiences) can be representative of an overall positive emotional experience, even if they include negative experiences throughout. The key aspect to consider is that there are more opportunities for high positive experiences (peaks) compared to low negative experiences so the average between the peak and the end is overall more positive.

There are two important aspects to discuss regarding this finding within the context of this study. The first aspect is to highlight that although the findings were representative of the Peak-End rule, they were not always exactly accurately displayed by the macro-level graphs for each participant. The main reason for this is the coarseness of the available responses to the emotional evaluation. Nevertheless the graphs show that the Peak-End rule applied relatively accurately as an average of the peak and end emotional experience given the available recording limitations.

The second aspect to mention is that there were two participants whose macro-level experiences did not fit the Peak-End rule. There was one for the media / entertainment category and one for the medical / health category. It is predicted the reasons why these did not fit were because of significant experiences that occurred to both of the participants. For one participant, using an Mp3 player, it was identified that the main purpose of the device changed during the course of the experience. It was initially purchased as a music player but during the course of six
months the main purpose changed and it became a data storage device and was no longer used as a music player. It is speculated that due to this alteration in the core function of the device the overall emotional experience, and the response to it, deviated from the standard (Figure 14). For the second participant, using a heart-rate monitor, it was determined that a product malfunction, that caused the participant to have to replace the original device with a new one, was the reason for the deviation in the overall emotional experience. The participant reacted very negatively during the experience, however this was not reflected in the overall emotional experience (Figure 18).

An important aspect of this finding is that both of these cases showed a higher overall emotional experience than would be predicted by the Peak-End rule. In other words, although participants described having very negative emotional experiences due to the reasons described above, they were able to distinguish this as a particularly unique experience and not let it affect their overall perception. This finding suggests that within the context of user-product interactions, even if some very negative experiences occur over the course of time, people are able to distinguish these as unique and not permit it to influence the evaluation of the overall experience.

_Media / Entertainment Devices: Personal and Social Interactions_

In Experiment 1 it was noted that if more Negative Social experiences were reported compared to Negative Personal experiences then the overall experience over time became flat (Figure 25). This did not change regardless of how many actual
experiences were recorded. The same did not apply if the Negative Personal experiences outweighed the Social Negative experiences. In these cases the emotional experience varied over time. This relationship was consistent across all participants in the media / entertainment category.

This relationship suggests that Negative Social experiences over the course of time have a distinct influence on the overall emotional experience, while Negative Personal experiences do not appear to have the same effect. Figures 25 and 26 illustrate this particular phenomenon and are typical of all responses. The nature of the participant’s experience over the course of time is plotted on a graph alongside the corresponding reported personal and social negative experiences.

![Graph](image)

Figure 25. Macro-level experiences: Participant 4A (full line) and 5B (dotted line) overall experience

Figure 25 compares the macro-level experiences of participant 4A and 5B and illustrates how the experience is particularly different over time. Figure 26 highlights the difference between the Negative emotional responses for participant 4A and 5B with regard to personal and social interactions.
This particular finding suggests a relationship between the Negative Social and Negative Personal experiences and this relationship has an impact on the overall emotional experience over time. If people experience more Negative Social experiences compared to Negative Personal experiences the overall experience over time becomes regular and flat, in other words the experience becomes uninteresting.

*Medical / Health Devices: Personal and Social Interactions*

Similarly to the media / entertainment category, when participants were analysed individually, it was noted that Negative Social experiences were directly related to the overall emotional experience. Positive Personal and Positive Social experiences did not appear to have a clear relationship with the overall emotional experience. A
potential reason for this is that positive experiences, although perceived as favourable, do not stay in the minds of individuals in the same way that negative emotional experiences do.

There was a direct relationship between Negative Social experiences and the effect on the overall experience reported. For example, if a participant reported Negative Social experiences this would impact negatively on the macro-level experience graph such that there would be a drop in the reported emotional experience and it would fall below the ‘neutral’ line (Figure 27). In contrast, if a participant reported no Negative Social experiences this did not influence negatively on the macro-level emotional experience reported (Figure 28). The graph in this case would stay relatively flat and consistent over the course of six months. This relationship was evident across all participants for the medical / health PIDs.
This relationship indicates that Negative Social experiences for health PIDIs have an immediate influence on the overall emotional experience, while Negative Personal experiences do not appear to have the same effect. This same effect was not evident with the media PIDIs. Figures 27 and 28 illustrate this particular phenomenon and are typical of all responses. The nature of the participant’s experience over the course of time is plotted on a graph also showing corresponding negative social and negative personal experiences. Figure 27 shows the macro-level experiences of participant 15C and illustrates how the experience is influenced in a downward direction by the Negative Social experience reported (labeled ns) while influenced differently by Negative Personal (labeled np). Figure 28 shows the macro-level experiences of participant 13D and illustrates how the experience is generally constant over time and is not particularly influenced by the negative personal experience reported (blue – labeled np). By identifying the Negative Social experiences and the Negative Personal experiences reported across the timeline it could be seen how they influence the reported emotional experience immediately following. As these results show, if Negative Social
experiences are reported there appears to be a negative effect on the overall experience whereas Negative Personal experiences do not appear to influence the graph in the same manner.

The differences between the media / entertainment and medical / health PIDs regarding the impact of Negative Personal and Negative Social on the macro-level experiences suggests a distinct difference in relation to people’s perception for the two PID types. It is predicted that people interacting with medical / health PIDs perceive Negative experiences as detrimental during private, personal situations and very detrimental during social situations. This might have to do with the fact that these types of devices relate to people’s health, an important part of users’ lives. For media / entertainment PIDs Negative experiences are perceived as detrimental in social circumstances while not as detrimental in private, personal circumstances. This suggests that people are more conscious of their interactions with media PIDs in social settings while in private, personal situations this is not a concern for users.

9.4 Combined Overall Results

This section combines results for the overall numbers to help determine whether there are some patterns for the combined overall results. The two important aspects here include overall gender breakdown and the overall cumulative macro-level breakdown of experiences across time.
9.4.1 Overall Gender Breakdown

Since the experiments were structured in such a way as to have an even split in gender across both experiments (7 females and 8 males), the results could be observed by dividing the data across the two gender groups. Table 17 shows the gender breakdown of Positive and Negative emotional experiences across the Individual and Social Sub-Categories.

Table 17. Results based on gender for Human Interaction category coded as either positive or negative

<table>
<thead>
<tr>
<th>Category</th>
<th>Positive</th>
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<th></th>
<th>Negative</th>
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<tbody>
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<td>Num</td>
<td>%</td>
<td>Num</td>
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<td>165</td>
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<td>33%</td>
<td>156</td>
<td>49%</td>
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</table>

Table 17 indicates that when combined and compared there was minimal difference for gender regarding Positive and Negative emotional experiences reported. As the table shows, there were virtually the same Positive experiences reported by females (51%) overall compared to males (49%). There were slightly more Negative emotional experiences reported by males (55%) compared to females (45%), although not significant. Observing the breakdown on Positive experiences a little more closely it can be seen that females identified more Positive Personal experiences than males (84% to 67% respectively) while males reported more Positive Social experiences compared to females (33% to 16% respectively).

Looking at the Negative experiences, males and females reported similar Negative
Personal experiences (76% to 66% respectively) and the same was evident for Negative Social experiences (34% to 24% respectively).

With regard to the gender differences the findings show that the only major difference occurred for the Positive Personal and Positive Social experiences. Females identified more Positive Personal experiences than males, indicating that females might be more inclined to perceive positive experiences during personal or private interactions while males may not perceive this to the same degree in the private context. On the other hand, males reported almost double the proportion of Positive Social experiences, which suggests that males might perceive, or place more value on, perceiving positive experiences in social settings compared to females.

9.4.2 Overall Breakdown Over Time

Table 18 summarises the overall numbers of Positive and Negative experiences for Task Categories of all participants for both PID types. For instance, looking at the Functional Category, it can be noticed that it is first broken into Positive and Negative emotions. Each of these are then divided into Personal and Social Sub-Categories. The number of experiences are then outlined for each interview session with the overall numbers noted on the very far right.

The breakdown of experiences in Table 18 reveals certain detailed aspects of the evolving experience over time. This is a more subtle observation regarding the
Positive and Negative experiences across time. For the Functional category, it is noted that the number of Positive Personal emotional experiences, in almost all cases, outweighed the Negative Personal over time. For instance, during the initial interview 27 experiences (29% of overall experiences) were noted as Positive Personal compared to 12 experiences (24% of overall experiences) as Negative Personal, and so on down the interview sessions. Positive Social and Negative Social showed less deviance and displayed a similar progression over time (with the exception of interview 4). The reason for this may have to do with the idea that in a private or personal situation any negative functional experience may be less inclined to be perceived or remembered as negative, while in a social setting this may not be the case as any negative experience may be remembered due to other people impacting on the perception of that experience.

For the Feature Tasks the number of Negative Personal experiences outweighed Positive Personal over time (with the exception of interview 2). For example, during the initial interview 26 experiences (18.5% of overall experiences) were noted as Negative Personal while 24 experiences (30.5% of overall experiences) were noted as Positive Personal, and so on down the interview sessions. The Negative Social outweighed the Positive Social over time (with the exception of interview 3). As mentioned in Section 9.2, Feature Tasks were characterised as overall more negative than positive but this also suggests that this trend is consistent across both Personal and Social Categories over time. This is based on the idea that the more users interact with the device, negative emotions will surface because of the perception of an overabundance of features. As the number of these types of
interactions increase, the likelihood of negative emotions being experienced will also increase.

In the Mediation Category the Positive Personal significantly outweighed Negative Personal experiences over time. Looking at this Category it can be observed that during the initial interview 23 experiences (33% of overall experiences) were noted as Positive Personal while only 5 experiences (83% of overall experiences) were noted as Negative Personal. The Positive Social and Negative Social were inconsistent over time and did not appear to show a specific trend. This shows that the overwhelming amount of positive emotional experiences reported for Mediation Tasks are generated mainly during personal and private contexts. The reason for this might have to do with the notion that Mediation Tasks are likely to be enjoyed and remembered more clearly in private settings because they relate, generally, to personal wants and needs. In social situations these types of Tasks might not be appreciated as much since they may not necessarily target social wants and needs.

Finally, with the Auxiliary Category, Negative Personal experiences significantly outweighed the Positive Personal across time. For example, inspecting this Category it can be seen that during the initial interview 11 experiences (29% of overall experiences) were noted as Negative Personal while there were no Positive Personal experiences noted. This trend is consistent through the interview sessions. Negative Social slightly outweighed Positive Social. This indicates that the vast majority of negative emotional experiences occur in personal, private contexts for
Auxiliary Tasks with the potential reason being that these tertiary types of Tasks are performed mainly in private settings and are perceived negatively in these settings.

Table 18. Overall results for Task Categories coded as Positive or Negative for all participants combined

<table>
<thead>
<tr>
<th>Task Category</th>
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<th>Human Interaction</th>
<th>Sub- Categories</th>
<th>Interview session</th>
<th>Overall</th>
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<td>Int. 3</td>
<td>Int. 4</td>
<td>Int. 5</td>
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<td>Social</td>
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<td>27.5%</td>
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<tr>
<td>Auxiliary</td>
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<td>Personal</td>
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<td>Social</td>
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<td>Neg</td>
<td>Personal</td>
<td>11</td>
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<td>29%</td>
<td>5.5%</td>
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<td></td>
<td>Social</td>
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<td>1</td>
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</tbody>
</table>

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9.5 Summary

This chapter has outlined the comparisons and contrasts between the results for the two product categories studied, media / entertainment and medical / health PIDs. First, results for both product categories were compared for the four Task Categories at the micro-level. The Personal and Social Categories at the macro-level were then discussed and contrasted. Finally the combinations of gender results and the combined overall numbers plotted over time were combined and compared. The discussions and implications of these findings are outlined in Chapter 10.
Chapter 10

10.0 Discussion and Implications

10.1 Introduction

This chapter examines and discusses the findings from the experiments conducted. It outlines the findings within the context of PID design, and discusses the implications for design and related fields.

10.2 Examining the findings

The breakdown of activities (Chapter 5, Figure 4) consisting of operations at the lowest level through to actions, activities and context at the highest level provides a flexible framework to contextualise and consider the evolving emotional experiences of interaction. As outlined previously this could be broken into micro-level and macro-level that conceptually form a more complete understanding of an experience (Chapter 5, Figure 5). Here, the discussion will be divided into these two levels so as to provide a better understanding of the overall emotional experience at the micro and macro-level.
10.2.1 Discussion and Implications at the Micro-Level

As mentioned in Chapters 7 and 8, four Task Categories were identified from the data analysis including Functional, Features, Mediation and Auxiliary. These categories encapsulated relevant groupings related to the types of Tasks reported by participants through the experiments at the micro-level.

There were similarities for both media /entertainment and medical / health PIDs with regard to these four categories. Functional and Mediation were overall reported as positive in nature while Features and Auxiliary were overall reported as negative across both device types. The discussion will address these findings across the four Tasks Categories.

Features

Feature related Tasks were the most mentioned for both PID types. This suggests that product features play a significant role over time during the user-product relationship and have an impact on the emotional experience of interaction. It is important to note that although there were differences between the two product types with regard to the numbers of experiences outlined under Features, they were both characterised as overall negative to the same degree. This suggests that for both media / entertainment and medical / health devices many Tasks related to Features are remembered, or appear to be perceived as, negative.
This particular finding relates to studies identifying the phenomenon labeled as ‘feature fatigue’ or ‘feature creep’ (Rust, Thompson & Hamilton, 2006; Lee, Woods, & Kidwell, 2006). Essentially feature creep suggests that adding more features to a product may in fact lead to negative experiences between user and product over time. As Rust et al. (2006) argue, “The problem is that tacking features on to products makes them harder to use… the complexity they introduce to the task at hand can be mind-boggling” (p.39). It is argued that the accumulation of features, although useful for a certain number of users that are technological adept, simply increases the likelihood of errors for most users.

In another study conducted by the same authors (Thompson, Hamilton & Rust, 2005) they argued “…too many features can make products overwhelming for consumers, leading to dissatisfaction” (p.431) and continue by pointing out “…empirical evidence indicates that consumers may experience negative emotional reactions, such as anxiety or stress in response to product complexity” (p.431). Interestingly, another study, which focused on user choice before using a product, suggested that:

As the number of features grew, perceived capability increased and perceived usability decreased. And overwhelmingly, participants thought the high-feature model offered the highest overall utility. It was the one they would choose to own (Rust et al., 2006 p.41).
Essentially this showed that people, knowing that more features added complexity, would still make a decision to purchase the feature laden product over the simpler product because it represented increased potential capabilities. Rust et al. (2006) conducted another study exploring how users would assess ratings of capability and usability and their overall product evaluations before and after using products. In this case the findings were a complete contrast to the initial study. As the authors testify:

Before use, capability mattered more to the participants than usability, but after use, usability drove satisfaction rates… in a complete reversal from the earlier studies, the high-feature model was now rejected by most participants (Rust et al., 2006 p.44).

This indicates that once experienced, users chose the products with reduced features. The current research supports this view and goes further by proposing that it is not just usability that is affected but also negative emotional reactions are generated by features for both media / entertainment and medical / health PIDs over an extended period of time.

So, what are the implications of this particular finding? It is not suggested that designers avoid including features completely, but it is about finding the right balance and the correct features for the product in context. Businesses, product developers and designers need to consider the negative long-term effect of increasingly adding unnecessary features and complexity to products on ongoing
customer satisfaction, product returns, future purchase decision and overall brand loyalty (Rust et al., 2006). Rust et al. propose several suggestions including considering users’ long-term experiences, providing users with decision aids during purchase, building simpler products and designing products that do one thing well. This research supports this and recommends that reducing unnecessary product features will also reduce negative emotional experiences with products over time. It is important to consider if adding more features to medical PIDs that the consequences could lead to reduced medical adherence and impact negatively on the user’s overall wellbeing (Mayne, 2001).

Functional
Often in the research literature product ‘features’ and ‘functions’ are used interchangeably and categorised under the same banner (Hassenzahl, 2005; Schmitt, 1999). The distinction between the two tasks is important because, as the findings from this research show, one tends to lead to negative experiences (Features) while another may lead to positive experiences (Functional).

Furthermore, Functional related aspects of product design have previously been categorised as elements that do not promote positive experiences. Nurkka, Kujala and Kemppainen (2009) describe:

By investigating the nature of user experience, we identified factors affecting users’ perception of the experience that are not related to the functional goals of the user. User values, the meanings the user attaches to a certain
product and the emotions related to these were found to be important
(p.462-463).

As the current study suggests this is not necessarily the case when it comes to
tional experiences. Functional type Tasks led to positive experiences over time
while Features related Tasks led to overall negative experiences. These two
categories should not be classified as one and the same, they should be treated as
separate from each other, as there is a difference in the way they are experienced
emotionally.

A point raised by Rust et al. (2006) suggests that products should be designed to
do one function (or a few functions) very well:

Products that perform their central task admirably capture their owners’
hearts. Apple’s iPod, the astoundingly successful, single-purpose personal
music player, performs so well and so simply that sales soared (2006, p.38).

Rust et al. (2006) explain that making products simpler and performing one purpose
very well should be the key to success in the market “Instead of offering complex
products that try to do everything for all customers, provide a variety of simpler
products, each tailored to a particular customer segment.” (p.38). The findings from
this research also indicates that from an emotional experience perspective it is
important that a product performs its core function/s optimally and that any other
peripheral features should be avoided as they may lead to negative experiences.
This relates closely with the research by Hassenzahl (2001) and Hassenzahl et al. (2010). Many studies exploring emotional aspects of the human-product interaction suggested designing satisfactory experiences purely needed to satisfy functional and usability concerns (Hassenzahl 2001). In other words if the product was usable and functional it would also be pleasurable to use. Hassenzahl (2001) proposed that the relationship between usability aspects and emotional aspects of interaction is complex and that the user of a product will normally perceive both the product’s usability aspects and emotional aspects together to form an evaluation of that experience. Hassenzahl et al. (2010) outlines:

…the perceived qualities of an interactive product can be divided into instrumental, pragmatic and non-instrumental, self-referential, hedonic aspects… Pragmatic quality refers to a judgment of a product’s potential to support particular “do-goals” (e.g., to make a telephone call) and is akin to a broad understanding of usability as “quality in use.” Hedonic quality is a judgment with regard to a product’s potential to support pleasure in use and ownership, that is, the fulfilment of so-called “be-goals” (e.g., to be admired, to be stimulated) (p.357).

The results of this research, regarding the impact of functions and features on the emotional experience, support Hassenzahl’s (2001) view. The pragmatic features of a product may in fact directly affect the emotional experience perceived over time.
From a design perspective the implications are that products should be designed to do their core function/s first and foremost. Likewise, from a business and marketing perspective it is important to consider if a product performs its core function well then it may have positive implications on the overall emotional experience of interaction. This could potentially lead to better brand recognition, loyalty and repeat business. For product developers and companies involved in the design of PIDs it is also important to consider focusing resources and finance to producing products that perform a specific set of core functions. The current research suggests that if companies do this it may lead to positive emotions associated with the PID.

Mediation
The experience design approach has, for some time, focused on the idea that products should be designed to mediate and facilitate broader experiences beyond the utilitarian (Desmet & Hekkert, 2007; Overbeeke et al., 2002). The idea of product as mediator links with the Activity Theory (Chapter 5) whereby the role of the device is not only about the operations and actions but also about activities in context (Nardi, 1996a). If the product facilitates genuine user desires and goals then it will lead to positive experiences.

The findings in this research reinforce this particular standpoint when it comes to emotional experiences. It was found that Mediation Tasks were overwhelmingly positive for both media / entertainment and medical / health PIDs. If devices can mediate higher user aspirations the experiences will likely be perceived as positive. As Hassenzahl (2010) advocates:
...one of the basic claims of Experience Design is to consider the experience before products... Experience Design urges us to set the story straight before we start thinking about how we can create this story through a technology (p.63).

Looking at the findings of the current study, if products are designed to mediate experiences, it may impact positively on the overall emotional experience to a large extent. An excerpt from participant 7B stated during her co-discovery session illustrates this:

... what is emotional is not connected as much to the physicality of the object itself but the place I have come to understand it having in my life. When I’m using it regularly it means everything is normal. It means I’m not having a stressful time or a weird time or doing something unusual. It sort of means this is normal routine time. So there’s a kind of affection for it about that, its place. You know, a sense when there’s been a couple of weeks where things have happened for whatever reason. Things have been too busy to walk to work or whatever sometimes. When I return to normal times I sort of think back to normal, I’m charging up my iPod. So there is an emotional attachment to that aspect of it. I’m not sure how much it’s connected to the physicality...

Here, participant 7B encapsulates the essence of the Experience Design approach and the crucial aspect relevant to Mediation Tasks. She specifically identifies that
her attraction toward the device is not purely a physical one, but rather it goes beyond this, and has more to do with a far broader aspect of her life and how the device mediates and facilitates this. It has less to do with the device itself, but rather what the device can facilitate and what it means within her everyday life.

Table 19. Description and groupings of Sub-Categories for Medical / Health PIDs and Media / Entertainment PIDs

<table>
<thead>
<tr>
<th>PID type</th>
<th>Sub-Categories</th>
</tr>
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<tbody>
<tr>
<td>Medical/Health</td>
<td>• Monitoring fitness</td>
</tr>
<tr>
<td></td>
<td>• Monitoring health</td>
</tr>
<tr>
<td></td>
<td>• Motivator</td>
</tr>
<tr>
<td></td>
<td>• Reliance on product</td>
</tr>
<tr>
<td></td>
<td>• Consciousness of product</td>
</tr>
<tr>
<td></td>
<td>• Another item to carry</td>
</tr>
<tr>
<td></td>
<td>• Product becomes part of background use</td>
</tr>
<tr>
<td></td>
<td>• Forgotten product</td>
</tr>
<tr>
<td>Media/Entertainment</td>
<td>• Relaxation</td>
</tr>
<tr>
<td></td>
<td>• Escape</td>
</tr>
<tr>
<td></td>
<td>• Companionship</td>
</tr>
<tr>
<td></td>
<td>• Distraction</td>
</tr>
<tr>
<td></td>
<td>• Product becomes part of background use</td>
</tr>
<tr>
<td></td>
<td>• Conscious awareness of product</td>
</tr>
<tr>
<td></td>
<td>• Association to particular cultural group</td>
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</tbody>
</table>

It is necessary to consider that Mediation Tasks were mentioned in a higher proportion for medical / health than for media / entertainment devices. This suggests two issues regarding Mediation Tasks. First, medical / health PIDs are more likely to be used for Mediation Tasks compared to media / entertainment PIDs. Second, that different product types might be used in different ways when it
comes to Mediation Tasks because of their specific purpose and relationship with users. One potential reason why Mediation Tasks were higher in proportion for medical / health compared to media / entertainment can be explained by looking at the specific Tasks, or Sub-Categories (Table 19).

Looking at these Tasks there appears to be a difference with regard to what these Sub-Categories mean for the two PID types. It appears the medical / health PIDs, with Tasks such as Monitoring fitness, Monitoring health and Motivator, are used to achieve goals that are facilitated directly by the product functions. In other words, there appears to be a direct relationship between the Mediation Tasks identified and the core functions of the device. For instance, ‘Monitoring health’ is an activity that is a direct result of using health devices such as heart-rate monitors or blood-glucose monitors, in other words that is one of their primary functions. ‘Monitoring fitness’ is an activity that is a direct result of using pedometers or heart-rate monitors, once more one of the device’s primary functions.

This direct relationship is not so evident for the media / entertainment Sub-Categories. Relaxation, Escape, Companionship and Distraction Tasks, for example, are much broader experiences that do not necessarily stem directly from the functions of the products. In other words they are indirectly related to the device’s functions. So, while the core function of an Mp3 player is listening to music, this activity could lead to a variety of experiences that may include relaxation, but could also include excitement, passing time or concentration. It is predicted that this particular aspect of the relationship between user and product
might be part of the reason for the difference in Mediation Tasks for medical / health and media / entertainment PIDs.

It is believed that although Mediation Tasks may not be mentioned as often as other Task Categories they still play a vital role in influencing and impacting the overall emotional experience over time. This is not to say that these types of Tasks will always lead to positive experiences, but rather if devices can adapt to, or be designed to facilitate, such experiences then it will open up the chances of enhancing the experience in a positive way. Further, as discussed above, it is relevant to highlight that the positive impact of the Mediation Category differs across PID types as there might be a direct or indirect relationship between Mediation Tasks and the core function of the device.

For designers and service providers it is important to acknowledge Mediation Tasks regarding the user-product relationship, as they have positive implications for the ongoing and overall emotional experience of interaction. These positive emotional experiences have further implications for customer loyalty, retention and repurchase intentions (Chitturi, Raghunathan & Mahajan, 2008). There are also implications for the medical field in that positive emotional experiences with PIDs encourage the use of those products and may promote better health regimes (Mayne, 2001). More broadly, positive emotions may play a variety of roles in people’s health by directly impacting and bolstering the immune system (Richman et al., 2005) and the way they feel about themselves and their health at a psychological level (Fredrickson, 2001). Thus, if the design of PIDs supports and facilitates positive emotional
experiences this could directly and indirectly enhance people’s health and wellbeing.

**Auxiliary**

Although Auxiliary Tasks only represent a small amount of the overall experiences, they were overwhelmingly considered negative in nature for both PID categories. The reason why these types of Tasks were rarely mentioned is no surprise because they are seldom performed. Nevertheless, it is critical to point out that these Tasks form key parts of the user-product relationship. For instance, Tasks such as interacting with the brochure or manual, product maintenance or charging the battery of devices are very important experiences that users have to deal with.

From a design perspective, the overwhelming characterisation of these experiences as negative presents a predicament. How do designers deal with these types of Tasks when people rarely perform them, yet they form crucial parts of the overall experience? One potential way to deal with this is similar to what Merholz et al. (2008) discuss when they describe the breakthrough idea of the film by George Eastman in 1888. Prior to the roll film, users were expected to perform a complicated procedure composed of numerous steps to take a photo. Eastman developed the roll film, which required a much simpler photo-taking process, as well as the service behind processing the film in which users simply sent their roll of film to Kodak to develop. As Merholz et al. explain, this simple idea alleviated the user from having to perform unwanted activities with the camera and permitted the user to do what they wanted, to take photographs. This focus on the user
experience and service design helped Kodak establish itself as one of the first successful consumer technology brands, where they remained for 100 years.

This idea is encapsulated in the advertising slogan that went with the camera “You press the button, we do the rest.” (Merholz et al., 2008 p.5). This particular approach is a promising avenue of exploration for Auxiliary Tasks. For example, instead of relying on users to perform product maintenance or upgrades, the potential exists to consider a service whereby users send or take in their portable devices for maintenance or upgrades and receive a replacement in the meantime. By removing the burden of having to perform Auxiliary Tasks, which potentially lead to negative emotions, more attention could be paid to experiences that generate positive emotional experiences.

The implications of this finding include the re-considering of how these types of Tasks might be delivered, supported and adapted for portable devices. This is relevant for design, service providers, marketing and business since it means a potential refocus of investment, resources and direction. Further, for the medical / health PIDs it is important that these Auxiliary Tasks are minimised since they may impact negatively on the emotional experience of health recovery (Mayne, 2001) and also prevent proper use of the medical product. Section 10.2.2 focuses on discussing the macro-level findings and the implications for design and related fields.
The results at the macro-level relate to the overall emotional experiences in context (Chapter 5, Figure 5). One of the key aspects of the macro-level identified by the research is the importance and impact of the social experience of interaction through time. Another relevant finding was the difference in the way people interact with the two product types over time. For the media / entertainment type devices it seems people experienced more Social interactions compared with medical / health devices. This is particularly important with regard to the influence of Personal and/or Social experiences on the overall emotional experience for each of the product categories.

The social theory of emotion offers an explanation for this phenomenon (Krippendorff, 2004). This theory suggests that the self is nothing if not for social interactions. Emotions occurring at the social level are of primary importance for the development of how people perceive themselves and how they interrelate with the surrounding world. As such, emotions experienced in social contexts are crucial to people’s perception of everyday interactions over time. There is no doubt that PIDs are indeed personal but more importantly there exists the social dimension which impacts considerably on the emotional experience perceived by the user.

Another important aspect to be considered here is the Peak-End rule (Fredrickson & Kahnemann, 1993) as discussed in Section 2.2.3. The Peak-End rule argues that overall emotional experiences are not necessarily determined by the duration or
amount of positive or negative emotions experienced but rather by the average of the most extreme emotional experience (peak) and the emotion experienced near the end (end). This theory suggests that an overall flat emotional experience, even if positive, can lead to a monotonous and uninteresting experience. On the other hand, if the experience is varied then the experience is interesting.

This has implications at the macro-level for both PID types as it provides a guide with regard to the types of overall emotional experience designers should be aiming for and its effect on people's perception of that experience. This implies that it is the variance, or comparison, between emotional experiences that is important for the perceived emotional experience.

This particular aspect of the emotional experience is further supported by what is termed the endowment and contrast theory (Tversky & Griffin, 1991). ‘Endowment’ represents the effect an emotional event has on an individual’s emotional experience, for instance positive experiences will make people happy while negative experiences will make people unhappy. ‘Contrast’ is the impact that comparative emotional states have on emotional experience, for instance a positive experience followed by a slightly less positive experience may result in a less happy evaluation, even though both experiences were positive. As Tversky and Griffin explain, according to this theory, experiences:

…exercise an indirect contrast effect on the evaluation of subsequent events. A positive experience makes us happy, but it also renders similar
experiences less exciting. A negative experience makes us unhappy, but it also helps us appreciate subsequent experiences that are less bad (1991 p.101).

These two theories, the Peak-End rule and Endowment and Contrast, assist in contextualising the overall emotional experiences discussed for both PID categories.

From the findings on the macro-level for media / entertainment PIDs it appears that if people experience more Negative Social experiences compared to Negative Personal experiences the overall experience over time becomes regular and flat, in other words the experience becomes uninteresting. In contrast, if people experience less Negative Social experiences compared to Negative Personal experiences over time the experience creates fluctuations and variance, in other words the experience becomes interesting.

Merholz et al. (2008) address the importance of the overall experience of interaction. They identify that the critical ingredient in creating meaningful experiences between people and artefacts is to create “wow” moments over time; “…create moments of “WOW!” over and over again, it bonds with customers at a level far beyond the realm of gold-colored plastic cards” (p.132). Focusing on the overall experience to create these moments of interest throughout is what Merholz et al. argue to be important for interactions between users and devices. They argue that experiences that are consistent become boring and limited, whereas an
experience that is varied over time can help create an interesting and engaging connection with the user at an emotional level. This links back to the Peak-End rule because as the rule identifies, the length or number of positive and negative experiences is not what is important over time, but rather it is the average of the peak emotional experience and the end emotional experience that will determine the overall experience. With this in mind it seems that permitting the overall emotional experience over time to fluctuate can be a good thing because this will permit positive experiences to occur at the peak and thus potentially push the average higher and higher over time. Thus, according to this theory, trying to reduce Negative Social experiences would assist in creating these moments of wow and make the overall experience interesting.

It is hypothesised that Negative Personal experiences do not affect the overall experience in the same way since the media / entertainment PIDs lend themselves to explorations, play, amusement and other types of unconstrained experiences (as the word ‘entertainment’ itself implies). As such, people expect, or may not be so concerned, if certain actions lead to errors, mistakes or unexpected results. When performed in a Personal context there are no other people to judge or impress or feel embarrassed in front of. The design of media / entertainment PIDs needs to take these aspects into account, as any Negative Social interaction appears to distinctly impact unfavourably on the overall experience by creating a flat and uninteresting overall emotional experience.
Although in a distinctly different way to media / entertainment PIDs, emotions occurring at the social level for medical / health PIDs are of primary importance for the development of how people perceive themselves and how they interrelate with the surrounding world. Figures 25 and 26 support the importance of social interactions on the overall emotional experience for medical / health device types. It was noted that Negative Social experiences were directly related to the perceived emotional experience. If Negative Social experiences were reported this would negatively influence the ongoing emotional experience. The same did not occur for Negative Personal experiences.

The difference between media / entertainment and medical / health devices with regard to the impact of Negative Social experiences is subtle but important. Although for the media / entertainment PIDs it was the relationship between Negative Social and Negative Personal that impacted the overall emotional experience, for medical / health PIDs it is the Negative Social that creates a strong negative trajectory to the overall experience while Negative Personal also creates a flat, uninteresting experience. Both of the Negative experiences, Social and Personal, are not ideal in this case.

It seems the reason for this has to do with the type and purpose of medical / health products. Medical / health PIDs relate to people’s physical and psychological wellbeing and negative experiences can result in more serious consequences. For example, in Personal situations if a medical product does not accomplish its purpose then it will create a negative emotional reaction. If this occurs consecutively
over time then the experience is perceived as lacklustre. It is suspected that this effect becomes worse in Social situations because of a cumulative effect. For example, if medical devices are not performing as expected not only does it influence the user’s feelings in a detrimental way, the added social dimension magnifies the negative effect of the emotional experience. If this occurs consecutively over time then there is a distinct adverse effect on the overall experience. The design of medical / health PIDs needs to take these aspects into account, as any Negative Personal interaction experienced appears to impact unfavourably on the overall experience and any Negative Social experiences adds to the problem and creates a distinctly detrimental effect on the overall emotional experience.

The findings discussed for both media / entertainment and medical / health PIDs have implications for design. The social level is important and plays a critical role in determining the overall emotional experience with PIDs. As Wiberg (2005) points out “while the computer of yesterday was occupied with crunching numbers, today and tomorrow’s technology will be occupied with maintaining our social contacts with one another” (p.4). With regard to PIDs, it is not just about maintaining social contacts, it is also about making devices that facilitate positive emotional experiences.

For media / entertainment it is important to consider Negative Social experiences, because if they surpass Negative Personal experiences the overall experience will be detrimental. It seems, from the findings, that negative personal experiences are
not entirely negative to the overall emotional experience. This is not to say that designers should not attempt to design for positive emotional experiences on all levels, rather it is about understanding the relationships between negative emotional experiences and their effect on the overall experience. Emotional experiences are important for media / entertainment PIDs since they are connected with perceived usability, learn-ability, achieving optimal performance, stress levels during use and enhanced user experience among other factors (Zhang & Li, 2005; Hudlicka, 2003). As Norman (2004) points out, positive emotional experiences may lead to greater perceived usability. If media / entertainment PIDs are designed to support positive emotional experiences then it is argued that they can become more usable, easier to learn and interact with, reduce stress levels through interactions and increase overall enjoyment of use.

For medical / health devices it is important to avoid Negative Personal as well as Negative Social experiences. Ongoing negative emotional experiences, at the personal level, lead to an overall flat and uninteresting overall experience. Ongoing negative emotional experiences, at the social level, lead to an overall detrimental and unfavourable experience. As Gloyd (2003) argues “non-adherence with medical recommendations is a major contributor to therapeutic failure, a source of frustration for health care providers, and is considered by many to be one of the most serious problems facing medicine today” (p.17). Gloyd contends that interaction design and the field of industrial design play a crucial role in improving this situation. Likewise Hirsch, Forlizzi, Hyder, Goetz, Kurtz and Stroback (2000) comment that failure to consider emotional aspects of interaction can result not only
in missed opportunities for innovation but also lowers the adoption and use of health devices. As such the importance of positive affect during everyday experiences is a critical component in the process that leads to adherence to medical recommendations and device usage.

The design of future health PIDs needs to take this into account, as any negative social interaction experienced during use contributes directly to a negative perceived emotional experience over the course of time and contributes to the reduction of the adherence and correct use of health devices, with potential harmful effects on the user (Hirsch et al., 2000). Similarly to the media / entertainment category, although in a distinctly different way, emotions occurring at the social level are of primary importance for the development of how people perceive themselves and how they interrelate with the surrounding world.

10.3 Summary

This chapter examined and discussed the findings from the experiments with regard to two levels of interaction: the micro-level and the macro-level. At the micro-level a discussion regarding the different Tasks Categories including Features, Functional, Mediation and Auxiliary were discussed. At the macro-level, the importance of the social component of the user-product relationship was detailed. Further, the implications of these findings for design and related fields were outlined.
11. Conclusion and Future Directions

11.1 Introduction

Emotions are central to everyday experiences including interactions with surrounding products and devices. This research reported on a study that explored people’s emotional experience with media / entertainment devices including PDAs and Mp3 players and medical / health related devices including heart-rate monitors, blood-glucose monitors and pedometers, over the initial six months of use. The users and their emotional experiences with products in everyday settings were the main focus of the research.

The aim of the research was to support and enhance the evolving emotional experience between people and portable interactive devices. It was especially important to investigate this within the portable interactive product category since they are used in various contexts. The research question driving the study was:

What are the differences between emotional experiences across different product categories and how do these emotional experiences change over time and across contexts?

To answer the question, the objectives were to explore the evolving emotional experience between human user and media / entertainment PIDs over time in real
life contexts; explore the evolving emotional experience between human user and medical / health PIDs over time in real life context; and compare evolving emotional experience between media / entertainment and medical / health PIDs.

To contextualise the research, a theoretical framework based on Activity Theory was used. Activity Theory stands on the premise that the surrounding environment, artefacts and other people, mediate people’s activities. As such, to comprehend experiences holistically, activities need to be understood as driven by context, human motives and emotions, and conceptualised within an evolving and changing timeframe. One critical component of Activity Theory is that it proposes to position experiences within a framework consisting of operations, actions and activities that are situated within a context. This framework encapsulates the idea that there exist two levels of interaction in the human-product relationship: (i) a micro-level (operations and actions) and (ii) a macro-level (operations and actions situated within activities in context).

The experimental approach for this study was longitudinal and qualitative. Two experiments were conducted: the first explored media / entertainment devices while the second explored medical / health devices, both across a six-month period. The experiments utilised a triangulation of methods consisting of an initial interview, intermittent interviews, experience diaries and co-discovery. Data were analysed using a content analysis technique. The study identified results on two levels, the micro (local) level and the macro (global) level in relation to the evolving emotional experience of portable interactive devices.
At the micro-level the analysis of the data identified four Task Categories including Features, Functional, Mediation and Auxiliary type Tasks. For media / entertainment PIDs the categories (in descending order of quantity) include Feature, Functional, Mediation and Auxiliary. For the medical / health the categories (in descending order of quantity) include Feature, Mediation, Functional and Auxiliary. Further it was identified that for both product categories Feature was mainly perceived as negative in nature. Functional and Mediation Categories were positive in nature for both PID types with Mediation being overwhelmingly positive. Finally, although the Auxiliary Tasks were small in quantity they were characterised significantly as negative.

On the macro-level the study revealed that the social dimension of interaction with PIDs is critical in determining the overall emotional experience over time. This supports and builds on a previous study conducted (Stelmaszewska et al., 2005). When considering the overall experience the intent is to create ongoing positive relationships with PIDs. The aim is to create engaging experiences with media / entertainment PIDs while also assisting in adherence to proper product use and reducing the chance of non-adherence on behalf of users for medical / health devices (Gloyd, 2003; Hirsch et al., 2000). For media / entertainment devices it was noted that if more negative social experiences were reported compared to negative personal experiences then the overall experience over time became flat. The same did not apply if the negative personal experiences outweighed the social. In these cases the emotional experience varied over time. For medical / health devices if negative social experiences were reported this would negatively influence the ongoing emotional experience. The same did not occur for negative personal
experiences. Consequently it is important to consider how the design of PIDs integrate into, and impact, the social element of interaction since negative experiences on a social level will be counter-productive to the overall emotional experience.

11.2 Outcome: DE³ Framework

An important outcome of this research is the development and recommendation of a framework taking into account the findings (Figure 29). The purpose of the framework is to provide designers, and design researchers, with a set of principles to enable and guide the design of emotional experiences with PIDs.

The framework is named Designing for Evolving Emotional Experiences (DE³). It provides some principles that should be taken into account when designing PIDs considering emotional experiences. It enables designers to consider these principles when designing for the macro-level, the micro-level and how the two levels might be integrated to design for a holistic emotional experience. As such, the DE³ framework is situated within the breakdown of activities discussed earlier (Figure 4) by outlining the macro-level findings and the micro-level findings. Starting at the top, the framework includes the title: DE³ Framework Designing for Evolving Emotional Experiences. The second row includes the two PID categories with media / entertainment on the left and medical / health on the right. The third column includes findings and recommendations regarding the macro-level with regard to the impact of the personal and social context.
The fourth column includes the findings and recommendations regarding the micro-level with regard to the impact of the four Task Categories including Mediation,
Functional, Features and Auxiliary. Finally underneath the fourth column is a description of the terminology used for the four Task Categories.

To explain the framework in more detail, it is broken down into its main components. Figure 30 highlights the macro-level findings and recommendations of the DE³ framework are contextualised within the Activity Theory model taking into account Operations, Actions, Activities and External Context. On the far left is the title Personal or Social context (user-product interface in context), which outlines that this relates to the macro-level. On the left hand side are the findings explained for the media / entertainment PID category. The first line reads: Negative experiences in personal / private context did not negatively influence overall experience. The second line reads: Negative experiences in social contexts did negatively influence overall experience. As explained in Section 10.2, these were the findings relevant for the media / entertainment PID types at the macro-level. On the right side are the findings outlined for the medical / health PID category. The first line reads: Negative experiences in personal and private contexts did negatively influence overall experience. The second line reads: Negative experience in social contexts did negatively influence overall experience. As explained in Section 10.2, these were the findings relevant for the medical / health PID types at the macro-level.
Figure 30. Macro-level within Activity Theory model: Findings relevant to media / entertainment (left) and medical / health (right) for Personal and Social contexts.
The micro-level findings are contextualised within the Activity Theory model in relation to operations and actions (Figure 31). On the far left is the box explaining that these are findings relevant for the User-Product Interface, highlighting that this relates to the micro-level. It encapsulates the findings and implications regarding positive and negative emotional experiences of the four Task Categories. As depicted in Figure 31, the principles outlined for promoting positive experiences and avoiding negative experiences are provided as recommendations regarding designing for evolving emotional experiences. The top box states that to promote positive experiences the following aspects regarding Mediation and Functional Tasks need to be considered:

- Mediation: From the outset consider how device will mediate (facilitate) experiences beyond the functional
- Functional: Make certain that the device performs its core function well

The bottom box states that to avoid negative experiences the following aspects regarding Features and Auxiliary Tasks need to be considered:

- Features: Reduce the number of additional features on the device
- Auxiliary: Consider creating service for auxiliary (tertiary) functions of the device

Under these descriptions are brief definitions of the terminology used for each Task Category so they can always be referred to.
Terminology

Features: Relating to added features of the device.

Functions: Relating to the core functions of the device. For example, ability to play music (mp3 player), ability to allow seamless communication (mobile phone), ability to record timing (heart-rate monitor).

Mediation: Relating to broader experiences beyond the physical aspects/attributes of the device.

Auxiliary: Relating to peripheral (or tertiary) to core functions of the device. For example, reading manual, changing the battery, product upgrade, etc.

Figure 31. Micro-level within Activity Theory model: Findings relevant to Task Categories with Mediation and Functional (top) and Features and Auxiliary (bottom)
The final step in completing the framework is to integrate the two levels. Figure 29 completes the framework by combining the micro and macro-levels to form a holistic relationship between them and providing recommendations. These recommendations and principles are derived from the findings and discussions in Section 10.2 within the context of the Activity Theory model. The DE³ model is designed to enable designers, and design researchers, to conceptualise and frame the design of PIDs to promote positive emotional experiences, and reduce negative emotional experiences, at the micro-level and the macro-level.

11.3 DE³ Framework Preliminary Trial

To validate the DE³ framework, a preliminary trial was conducted with three participants who were experienced industrial designers, each with at least eight years experience in the industry. A convenience sample of colleagues from industry were recruited for the trial. Two participants were provided the trial via electronic mail while a third was conducted at the People and Systems (PAS) Lab at the Queensland University of Technology.

The aim was to trial the DE³ framework with the objective of analysing its effectiveness, efficiency and usefulness in relation to assisting in the development of initial concepts that take into account emotional experiences. The outcomes of the trial included written responses on the questionnaire regarding the framework, while one participant provided sketches of concepts based on the findings and recommendations outlined in the framework (Appendix F).
**Preliminary Trial Method**

The trial involved providing the designers with a scenario in which they were to develop two initial concepts, one for each PID categories: one from media / entertainment (Mp3 player, PDA or mobile phone) and one from medical / health (Blood-glucose monitor, Heart-rate monitor or Pedometer) category and design initial concepts using the DE³ framework (Figure 29).

First, the participants were provided with information and a brief explanation of the task requirements was outlined. The task asked the participants to read and review the recommendations and apply them to their conceptualisation process. They were given up to 30 minutes to perform the trial. Once two initial concepts were considered the participants were asked to answer the questionnaire provided (Appendix G). The questions focused on gathering information to determine (i) the effectiveness of the framework, (ii) how easy the framework was to use, (ii) how the framework facilitated the task, (iv) if the framework introduced new knowledge regarding emotional experiences, and (v) the overall rating of the framework in assisting with concept development.

**Outcomes of DE³ Preliminary Trial**

Some common themes regarding the DE³ framework were outlined in the responses from the questionnaire provided. These include the ease of use of the framework, the effectiveness of the framework in focusing on the personal and social contexts and the positive rating of the framework.
First, the questionnaire asked the participants to outline the framework’s ease of use through a five point likert scale ranging from very easy to use, easy to use, moderate, difficult to use, very difficult to use. One participant identified the framework as moderate while the other two identified the framework as easy to use. For a preliminary trial this is encouraging, especially given the participant’s experience as designers. Nevertheless, as this is a preliminary trial, the responses leave room for improvement for the framework’s ease of use.

Second, one clear theme from the respondents was the positive response to the macro-level recommendations in providing a different way of thinking about developing concepts for emotional experiences. As one participant commented:

"It allowed me to come [at] the problems from the perspective of personal vs social contexts, and how these contexts contribute to the overall experience."

With this response, the participant identifies how the framework permitted him to consider personal and social contexts and how they influence the experience. It suggests that without the framework specifically identifying these two contexts, they would not have been considered at this early stage of concept development. Likewise, another participant commented how the framework permitted him to consider these two contexts:

"… looking at the framework got me thinking about how with media/entertainment products there’s a certain amount of user pride/identity"
tied up in owning and using a product. As such users are willing to be a bit more forgiving of flaws in the product and a bit more willing to learn work around these flaws provided they aren’t displayed in public in a way that might embarrass. Given that the user’s personal identity is tied up in the product a perceived flaw in the product might be seen to reflect a flaw in the user. With medical products it’s more important that they just work. The user may see them more as tools than as extensions of identity.

In this instance the participant’s response explored the idea of personal and social contexts deeper and what it means for product development. The response also outlines the difference between the two device categories and how that might influence the concept development of each PID type. These responses are encouraging for the use of the framework in facilitating designers in developing initial concepts based on emotional experiences, especially in relation to personal and social contexts.

Third, the final outcome identified from the responses was the positive rating of the framework by all participants. The responses relate to the final question that asked how the framework is rated with regard to assisting designers to develop concepts targeting emotional experiences. One participant identified:

I rate it as an effective design tool to help consider the emotional implications of contextual and interaction experiences.
Here, the participant identifies the framework as useful in considering emotional experience at both levels, the contextual (macro) and interaction (micro) levels. Similarly another participant comments:

I think it’s great and would rate it highly… It’s very easy just to start by thinking of technology and functions rather than thinking about the people using it.

Here the participant not only outlines the positive rating but also suggests that the framework assists in considering people and their needs first and foremost rather than the technological or functional aspects of the device. And the third participant identified the following:

The framework is great as another way to think about how a product should be designed. When used it should result in better products, that consider emotional experiences… Thinking about the personal and social contexts ensure[s] that multiple scenarios of use are considered, and the most appropriate solution for both is reached.

Once again this response highlights the positive rating of the framework overall. It indicates that the identification of personal and social experiences (and the differences for each type) is helpful in the process of concept development.
As all these responses show, participants felt that the DE$^3$ framework was useful for thinking about concept development for both PID types. Further, the responses also suggest that the framework permitted them to consider other broader aspects that would otherwise go ignored during concept development.

One of the three participants went on to complete some initial concepts based on the information and recommendations in the framework (Appendix F). The drawings show one concept for an Mp3 player designed for the 20-24 age bracket and one concept for a pedometer for the 45-60 age bracket. As the drawings demonstrate, the designer applied some of the recommendations in the framework to develop the concepts. These mainly include the micro-level recommendations. For instance on the Mp3 concept notes such as “basic buttons” and “simple apps” (applications) indicate a focus on the core function of the device, which falls under the recommendations regarding Functional Tasks. Comments and notes such as “rubber ring for drop protection” and “wireless sync” suggest consideration for tertiary interactions of the device including the product being damaged and updating the device software automatically, which fall under the recommendations for Auxiliary Tasks. Likewise for the pedometer drawings comments and notes including “USB attaches to PC, so software can be upgraded, progress can be synced and shared” is also a consideration for tertiary interactions of the device, which falls under the recommendations for Auxiliary Tasks. These notes and comments on the concept drawings lend further support that the framework was useful for the designer to focus on certain aspects, especially regarding the micro-level interactions with the device.
Overall the feedback from the preliminary trial of the DE³ framework was encouraging. The responses on the questionnaire and the concept drawings suggest that the framework was accessible, rated highly and most importantly permitted the participants, all experienced industrial designers in industry, to consider and think about concept development of PIDs for emotional experiences.

11.4 Contributions to Knowledge

There are several important contributions to knowledge arising from the study. They include contributions advancing understanding of emotional experiences with PIDs, expanding the taxonomy of emotional interactions with PIDs, methodological contributions and theoretical contributions to knowledge. This section outlines contributions in these areas for the emotion design field, design research and design in general.

**Advancing understanding and taxonomy of emotional experiences**

The research contributes to knowledge with regard to advancing understanding of emotional experiences at the micro and macro levels for two PID types. It also contributes by expanding the taxonomy regarding Tasks and associated emotional experiences with PIDs.

**Contributions at the micro-level**

First, the study identified some novel classifications for Tasks with PIDs at the micro-level. The micro-level deals with interactions occurring at the interface
between the user and product; the physical and tangible aspects of devices. Four Task Categories were identified including Features, Functional, Mediation and Auxiliary. They provide a unique contribution as these categories of experiences with portable devices do not appear to be reported in the literature elsewhere. Further, the definitions of these categories have not been characterised in this manner previously. This is relevant especially for the Mediation and Auxiliary categories, which represent previously undefined Tasks with PIDs.

Second, the study contributes to advance understanding of emotional experiences with the four Task Categories. It was identified that Feature and Auxiliary Categories were mainly characterised as negative, while Functional and Mediation Categories were mainly characterised as positive for both PID types. The emotional experiences associated with the different Task Categories advance the understanding of emotional experiences, as these have not been identified in the literature previously.

Third, some aspects of the study also complement existing knowledge relating to Features and Functional Tasks (Rust et al., 2006; Thompson et al., 2008) and Mediation Tasks (Hassenzahl, 2010). The recognition that Mediation is characterised as overwhelmingly positive in nature supports previous studies as well as the experience design approach (Hassenzahl, 2010; Hassenzahl et al., 2010). Outlining the similarities and differences with regard to the PID types also presents new knowledge with regard to the ways in which people relate to media / entertainment and medical / health devices. The fact that these interactions involve
experiences over time is another important contribution since it furthers knowledge of how these Task Categories evolve over the course of time in real life contexts.


text continues here
nature of emotional experiences with portable devices differs across different product types.

Methodological Contributions

This study has also contributed to advance methodological knowledge for design research. The methodology used and the approach taken is unique in relation to capturing the evolving emotional experience with portable devices.

As explained in Chapter 6, Karapanos et al. (2010) observe that most methods studying human-computer interaction from a design perspective use the following approaches: (i) cross-sectional, (ii) within-subject repeated sampling, (iii) longitudinal, or (iv) retrospective (Figure 6). Karapanos et al. explain that each approach has its advantages and disadvantages. This study brought together the two strongest approaches (longitudinal and retrospective). The methodology included a triangulation approach consisting of interview, diary and co-discovery techniques. This particular methodological approach has not been reported elsewhere in the literature in the area of emotional experiences.

It is maintained that the methodology is an important contribution to future studies exploring the evolving emotional experiences of interactions since it provides an avenue for research of emotional experiences with portable devices in real life contexts. Future studies could potentially utilise this methodological approach to investigate and research evolving emotional experiences in context with other PIDs types, as well as other non-interactive portable artefacts.
Theoretical Contributions

The study contributes to theory in the area of design research, specifically to evolving emotional experiences with PIDs. The differences and similarities of Task Categories and associated emotional experiences between the two product types, the use of Activity Theory as the theoretical framework to contextualise Tasks into micro-level and macro-level, and the identification of the impact of the social element all help to broaden theory of emotional experiences.

Also, these theoretical advancements in emotional experiences contribute to the development of the Designing for Evolving Emotional Experiences (DE³) framework (Figure 28). This framework provides a set of principles regarding the design of evolving emotional experiences between user and device in real life contexts. This framework has the capacity to be transferred to other PID types and other research domains regarding understanding evolving emotional experiences in context.

11.5 Limitations

This research is limited to the two PID types, media / entertainment (PDAs and Mp3 players) and medical / health (heart-rate monitor, pedometer and blood-glucose monitor) device categories. Other portable interactive device types may expand the scope of the findings and methodology applied. The participant pool consisting of mostly QUT academics, professional staff and students (with the exception of two being professional workers) is another limitation of the study. A broader cross-section of the population with differing backgrounds and professional careers would
broaden the contributions of the study. The study relied on the participants’ honest and candid responses to the various data collection techniques used in the study to ascertain their thoughts and feelings. Further, the participants’ consistent commitment to accurate responses over the span of six months represents a restriction to the research methodology. Also, the DE³ framework presented although thorough, derived objectively from the findings, and validated through initial experimentation, needs to go through further development and evaluation. Finally, the location of the study, based mainly in and around Brisbane, Australia, represents a limitation with regard to social and cultural influences.

11.6 Future Research Potential

The study opens up some interesting opportunities for further research. Further analysis could be performed on the data to identify additional relationships at different levels of interaction. This includes looking at the micro-level of interactions to determine to what extent elements like context, setting and time of day impact on the overall emotional experience. Another potential area of exploration involves the study of PIDs with more people over a shorter period of time. As an extension of this, it would be interesting to see whether these types of results would be gained if the experience was taken later in the human-product relationship rather than the initial six-months, for example by starting the experiment six months after product purchase.
By identifying the differences between the two PID types in this study, the research opens up the possibility that other PID categories could be researched and expanded on. The research approach and methodology used could permit the study of emotional aspects for other types of PIDs taking into account the real world context. For instance, commercial / industry PIDs (used in commercial settings and industrial contexts) could be explored to determine how the design of these devices could influence the overall emotional experience of interaction in the relevant contexts.

Looking further afield, the potential exists to explore these findings in other areas of design including non-portable device design, interface design, interaction design, web-design and software design. These findings can be transferred successfully between the different areas of design, especially if the concepts of the micro-level and macro-level interaction contexts are considered. It would be worth exploring the possibility of designing a prototype media / entertainment or medical / health PID based on the findings presented and explore whether enhanced emotional experiences could be accomplished during extended interactions with the prototype.

Finally, employing these findings to related fields including business, marketing and advertising, and engineering present further avenues of exploration. For instance, understanding how emotional experiences can be impacted by the overabundance of features may influence business decisions regarding product development. This has implications for the fields of product engineering as it has the potential to
influence manufacturing cycles and scales of production. Future engineering and technology fields could also take into account the findings to explore how the application of the research might impact the development of these areas.

Additionally, acknowledging the positive impact of Mediation type Tasks, and the negative impact of tertiary Tasks, could change the way devices are marketed and advertised from the very beginning, improving the chance of creating an improved perception of the design not just before purchase, but also many months after initial interaction.

11.7 Conclusion

The research centres on the evolving emotional experience with portable interactive devices. It outlines significant contributions to a better understanding of people’s emotional experience with portable devices in real life contexts. The findings advance knowledge about the subtle but different relationships people have with two PID types, media / entertainment and medical / health, at the micro-level and the macro-level. The research contributes new knowledge to advance understanding of how PIDs impact emotional experiences as well as to expand the taxonomy of Tasks with PIDs. This includes the support of existing findings of personal and social interactions with PIDs, the identification of four Task Categories including Features, Functional, Mediation and Auxiliary and the associated emotional experience of each Task Category. Further, the impact of negative personal and social experiences on the evolving emotional experience was outlined as well as the relationship of the Peak-End rule to the emotional experience.
perceived. This research has opened up further avenues of study that could potentially lead to a better understanding of people’s emotional experience with portable devices in real life contexts including further analysis of existing data, exploring other PID types, investigating non-portable devices, systems or virtual interfaces, and employing the findings to other fields including business, marketing and engineering. Additionally, a framework, labelled Designing for Evolving Emotional Experience (DE$^3$) was trialled, which has the potential to be developed further to assist designers and design researchers to consider the findings and recommendations of the research.

It is hoped that the research, findings and discussions around the emotional experience of PIDs will inspire designers, design researchers and related disciplines to explore this emerging area of research. Evolving emotional experiences with portable interactive devices is a complex and rich area of study and the research is a significant step toward a better understanding for the design of portable devices to facilitate positive emotional experiences.
References


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Appendix A

Experience Diary Template
Participant Diary
Week 1

Please don't hesitate to take photographs of any of the situations as you see fit.
Please don't hesitate to contact me if you have any questions about filling out the diary or anything else in relation to the study.
Experience 1

What did you do with the product on this particular occasion?

Please describe the setting / time of day

Who else was there and did their presence affect your use?
Overall, how do you feel about this particular experience with the product?

Why?
Experience 2

What did you do with the product on this particular occasion?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Please describe the setting / time of day

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Who else was there and did their presence affect your use?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Overall, how do you feel about this particular experience with the product?

Why?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Experience 3

What did you do with the product on this particular occasion?

Please describe the setting / time of day

Who else was there and did their presence affect your use?
Overall, how do you feel about this particular experience with the product?

Why?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Appendix B

Initial and Intermittent Interview Template
**Initial Interviews**

What are your feelings about the product at this stage?

What expectations do you have about its use in general?

How do you think it is going to benefit your life?

In contrast, how do you think it is going to inconvenience your life?

In what circumstances do you think the product will make you content?

In what circumstances do you think the product will make you feel discontent?

**Intermittent Semi-structured Interviews**

How often have you used the product in the last month?

<table>
<thead>
<tr>
<th>None  (0)</th>
<th>Rarely (0-5)</th>
<th>Somewhat (5-15)</th>
<th>Often (15-25)</th>
<th>Almost everyday</th>
</tr>
</thead>
</table>

What are your feelings about the product at this stage?

What are some of the positive aspects of using the product?

What are some of the negative aspects of using the product?

Can you remember if the surrounding context (social / environmental) affected your use with the product in a positive / negative way?
Appendix C

Co-discovery Template
Co-discovery

The co-discovery is intended to allow you to discuss your experiences with the product over the last six months with a fellow participant in a retrospective manner.

The session should only take about 20-30 minutes and it will involve each of you responding some initial questions I ask regarding your experience with the product in the last six months.

What I am trying to ascertain from this session is information about how you felt regarding the entire experience with the product from an emotional sense. I want to explore how your remember the experience; how your emotional feelings toward the product have been affected by time as well as how different situations have affected the experiences. This is not a memory test, I am interested in finding how you perceived the experience as a whole and how you remember it now six months after the study began.

Co-discovery session

Overall how do you feel about the product and it use?

How do you remember feeling about the product originally?

Has this feeling change? If so, why do you think so? If not, why not?

(from here the discussion should become more informal and free-flowing)

Can you talk about some of the positive moments or experiences about the products use?

Can you talk about some of the negative moments or experiences about the products use?
Appendix D

Macro-level Graphs for Media / Entertainment PIDs
Participant 2A: Macro-level graph showing peak, end and overall emotional experience

Participant 3B: Macro-level graph showing peak, end and overall emotional experience

Participant 4A: Macro-level graph showing peak, end and overall emotional experience
Participant 5B: Macro-level graph showing peak, end and overall emotional experience

Participant 6B: Macro-level graph showing peak, end and overall emotional experience

Participant 7B: Macro-level graph showing peak, end and overall emotional experience
Participant 8A: Macro-level graph showing peak, end and overall emotional experience
Appendix E

Macro-level Graphs for Medical / Health PIDs
Participant 10C: Macro-level graph showing peak, end and overall emotional experience

Participant 11D: Macro-level graph showing peak, end and overall emotional experience

Participant 12C: Macro-level graph showing peak, end and overall emotional experience
Participant 13D: Macro-level graph showing peak, end and overall emotional experience

Participant 14D: Macro-level graph showing peak, end and overall emotional experience

Participant 15C: Macro-level graph showing peak, end and overall emotional experience
Appendix F

Initial Concept from DE$^3$ Framework Trial
Images of initial concept for media / entertainment PID (Mp3 Player) based on information provided by DE³ Framework
Images of initial concept for medical / health PID (Pedometer) based on information provided by DE³ Framework
Appendix G

DE³ Framework Preliminary Trial Task
DE³ framework trial

This trial asks you, as a practicing designer, to consider a scenario in which you have been asked to design 2 portable devices for a company. The scenario involves a company that has approached you to develop initial concept sketches of one device from each category below (2 concepts all up) for a user group aged anywhere between 20-60 years old.

Category 1 (media / entertainment) includes: Mp3 player, PDA or mobile phone.

Category 2 (medical / health) includes: Heart-rate monitor, Blood-glucose monitor or Pedometer.

The task involves the following steps:

1. Please read and review the Designing for Evolving Emotional Experience Framework.

2. Consider the recommendations of the framework in regards to experiences in everyday personal and social contexts (in blue, on top).

3. Consider the recommendations of the framework in regards to user-product interface (in orange, on bottom).

4. Develop the two concepts in consideration of the recommendations of the framework.

5. Complete the questionnaire and return to r.gomez@qut.edu.au

Thank you for your time!

Rafael
DE³ Framework Questionnaire

1. Generally, how did the framework permit you to perform your task?
   a. It assisted in considering emotional experiences during concept development
   b. It did not assist me in considering emotional experience during concept development

2. How was the framework to use?
   a. Very easy to use
   b. Easy to use
   c. Moderate
   d. Difficult to use
   e. Very difficult to use

3. Do you think the framework facilitated / did not facilitate you to design novel portable products within each category? Please expand briefly.

4. Did the framework introduce new knowledge to you about designing for emotional experiences with portable devices? If so, what exactly?

5. Overall, how would you rate this framework in relation to assisting you to developing initial concepts for novel portable devices taking into consideration emotional experiences. Please expand briefly.