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171

Rebekah Rousi

# From Cute to Content

## User Experience from a Cognitive Semiotic Perspective


JYVÄSKYLÄN YLIOPISTO

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Esitetään Jyväskylän yliopiston informaatioteknologian tiedekunnan suostumuksella
julkisesti tarkastettavaksi yliopiston Agora-rakennuksen Lea Pulkkisen salissa
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UNIVERSITY OF JYVÄSKYLÄ

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## ABSTRACT

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User experience has been a popular topic in human-technology interaction design for several decades. Understandings of the concept range from studies involving human-technology interaction, processes, perception and experiences to design methods intended to encourage particular emotional experiences. This dissertation presents ten articles written in response to adopting, devising and developing techniques to systematically analyse user experience from a cognitive experiential perspective. Through undertaking user-interaction studies it was noticed that the key to understanding what people were experiencing rested in *how* they represented their thoughts. Thus, a cognitive semiotic approach was taken in the selection of methods and analysis of findings to understand the semantic connection between design syntax, context and the mentally represented experience. The methods adopted and developed are based on Personal Construct Psychology (PCP), which stipulates that people make sense of the world through mental constructs. These constructs exist according to mentally allocated categories. Therefore, the methods included in this research – pictures sorts, repertory grid, and the self-developed succinct qualitative analysis technique (SQAT) – are designed to systematically analyse the way users categorise designs and associated attributes according to how they experience them. The semiotic nature of the output that users provide in light of its relationship to interactional elements such as design syntax, context and user characteristics drew attention to the fact that the study of user experience is in fact the study of signs. Semiotics has been used to examine the practical dimension of usability, but its implementation to study experience and thought itself via the utilisation of century-old philosophical principles of the mind and logic is cutting edge in user experience research.

Keywords: User experience, Semiotics, Cognitive Science, Design, User Psychology

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Many thanks go to Agora Center and the University of Jyväskylä for funding my PhD as a Rector's PhD Student, as well as to the Nokia Foundation for their 2011 PhD study grant. Thank you TEKES and members of the ITEA2 board for funding the Easy Interactions and Theseus (I and II) projects. Also, I would like to thank the reviewers Prof. Christopher Crouch and Prof. R. Ignacio Madrid López very much for taking the time to read and comment on this dissertation. And a super big thank you goes to series editor Prof. Seppo Puuronen for reading my manuscript, taking the time to highlight matters and discuss them with me. You have gone above and beyond your call of duty and for that I am extremely grateful. Lastly, I would really like to thank my family and friends for being there, and supporting me through this. Mostly I want to thank my daughter Arja, for sharing me with this research. You are as mighty as a two year old can be, as well as my husband Arttu, for his encouragement and lack of doubt, in times when I seriously wondered what I was doing. My families in both Australia and Finland are just the best, and their enthusiasm in the progress of this process has been inspiring. Also, the numerous lunch dates I've had with colleagues and friends have kept the ball rolling.

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## PREFACE

In the context of user experience (UX), we may observe that the first step towards developing an understanding of how the mind works, and what experience is in relation to human-technology interaction (HTI), is achieved through signs, the nature of signs and how they operate in specific contexts. By referring to Charles Sanders Peirce's (1998, 273-275) basic semiotic theory for example which comprises the representamen (the signifying element), object and interpretant, HTI can be viewed as a process of signification. Further, signification can be used to describe cognition or the psychical world in relation to the physical. That is, designs in themselves should be viewed as symbolic manifestations of various *signifying elements* (representamen) representing designer, corporate, societal and/or political ideas. These designs refer to *objects* (material or immaterial) outside the immediate form and its application. Subsequently, experience occurs in the mind, and this can be seen as the *interpretant* of the sign. This interpretant or mental representation is the sense-making component of the sign interaction – the UX. It is within the mind that meaning exists, without this there is no sign, and therefore no conscious experience.

This dissertation is the result of four years of research mostly undertaken as a part of the Theseus, Theseus II and ITEA2 – Easy Interactions projects investigating HTI and user-centred design from a user psychology perspective. The research began with the examination of notions of attractiveness in design objects – notably smart phone icons. As the research progressed, and new studies were undertaken, the research focus shifted from the positive aspects of affection, towards a more holistic cognitive psychological perspective on design experience in general. From the outset, qualitative data provided by users was seen as invaluable in terms of its capacity to explain what users felt about designs and why, as well as how the designs were being *re*-presented and categorised in the mind. One question which kept emerging during qualitative analysis related to whether or not the studies' participants' understandings of the words they supplied corresponded with my own understanding of the words. Furthermore, if for example, 20 participants state that they experience an icon's design as "clear", does clear describe the same thing – i.e. is the meaning clear in reference to the function? Is the design devoid of unnecessary clutter? Or am I in fact being provided with 20 different imaginings of the word "clear"? That is, despite the correlation between what is described as clear and positive valence, is the mental representation and experience of the word "clear" different from one individual to the next?

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## ORIGINAL ARTICLES

I Rousi, R. 2009. "Cute" displays: Developing an emotional bond with your mobile interface. After mobile media. In S. Penny (Ed.), Proceedings of Digital Arts and Culture Conference, 2009. Irvine: University of California. Available at http://escholarship.org/uc/item/9xz0m8mn.

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*I have never doubted the truth of signs, Adso; they are the only things man has with which to orient himself in the world. What I did not understand is the relation among signs. . . . I behaved stubbornly, pursuing a semblance of order, when I should have known well that there is no order in the universe.*

*But in imagining an erroneous order you still found something. . . .*

*What you say is very fine, Adso, and I thank you. The order that our mind imagines is like a net, or like a ladder, built to attain something. But afterward you must throw the ladder away, because you discover that, even if it was useful, it was meaningless . . . The only truths that are useful are instruments to be thrown away.*

Umberto Eco (1994), The Name of the Rose

# 1 INTRODUCTION

The mind, its contents, its presence, its consciousness and its relationship to the physical world can be categorised as the greatest mystery faced by scientific communities throughout the ages. The mind is the most familiar element we know. It defines who we are and determines what and how we think, in addition to how we react and behave. Yet, the nature in which the mind exists can still not comprehensively be described. Furthermore, the mind's contents and how these contents are experienced are entirely personal – they cannot be duplicated or experienced by anyone else but us. By taking human-technology interaction (HTI) issues from pure usability towards user experience (UX), one can say that designers and researchers alike have paradigmatically opened Pandora's Box. Research and design focus has shifted from matters such as cognitive load, memory capacity, observable behaviour and usage outcomes, towards a field which is much more philosophical in its endeavours. Designers and researchers are now interested in precisely knowing what users think and *how* they experience. Moreover, of practical interest has been the categorisation and analysis of factors which influence the way in which phenomena are encountered and experienced. These factors are mainly: time, space, place (environment and context), culture, as well as psychological and social aspects.

Scholars have noted that the more we understand about users, particularly in relation to the above mentioned factors, the more likely designers are able to achieve desired outcomes. That is, in our current climate of an experience driven economy (Pine and Gilmore 1999), the more that is known about people, the more likely it is that specific experiences can be designed for, and the more likely it is that products 'speak' to consumers.

In order to address the issue of understanding "how the mind works" (Pinker, 1997) in relation to product design, this PhD research takes a semiotic approach. This specific work does not treat the mind as a computer. For as we know, the mind is a far more complicated and sophisticated information processor than artificial intelligence (AI) programme developers still can ever dream of. However, for understandability purposes we may treat the mind,

similarly to a computer, as a symbol processor and generator. Computers, like the mind, process symbols. Yet, computers are reliant on symbol input by human users (programmers and designers) based on their interpretations of the symbols and how these should operate in the information technology environment. Subsequently, human end users interpret the symbolic output via peripheries and operation outcomes. Thus, even in the computing context, signs operate via the human mind (Fodor 1975; Putnam 1961; Saariluoma 2012). The mind is not simply a symbol processor, but also a symbol generator or composer, which has contributed to the establishment and development of complex sets of codes and communication over thousands of years.

One point of departure for this research, and possibly also a conclusion, is the fact that syntax, or symbolic expression (the bearer of a sign) will always possess different meaning and value from one individual to the next. This is explained in terms of mental representation and its construction (apperception) through mental contents. Of interest here and throughout this dissertation are the types of mental contents expressed through qualitative constructs that emerge in relation to encounters with specific designs and their properties. The research focus therefore, is on the ways in which people qualitatively represent their experiences. In particular, focus is placed on the constructs (words and phrases) which are used, as well as the similarities and differences that can be observed amongst study participants. All of the studies mentioned in the articles have aimed at developing a framework of the content categories generated in relation to the specific design products examined.

Qualitative data and technological design are explicit communicative devices, however, experience is by nature a psychological phenomenon. Despite UX themes such as 'experience design' (Shedroff 2001), experience is not generated or projected from a designed object, system or event. Of course, the hopes of designers are that their designs will activate certain experiential processes. For this reason scholars more recently prefer to speak of 'designing for experience' or 'experience-based design' (Hassenzahl 2003; McCarthy and Wright 2004; Roto 2006a, 2007).

Experience takes place within the human mind. Additionally, experiences are not tangible or permanent in any way. Instead, they are fluid and dynamic. Our impressions of occurances, things or interactions are forever changing. For example, our emotions towards events and people change with time for a number of reasons (biological, psychological, social etc.). Experiences are momentary or ephemeral (Kuniavsky 2007), it is the impressions or sentiments (Brave and Nass 2007) of these experiences that we recall at later points in time. These impressions and their meanings morph and adjust depending on the moment and context in which we re-call them. To illustrate this, we only have to think of the death of a loved one or the break-up of a relationship. At the time that these occur, the events are incredibly emotionally painful. Grief is a state of high negative arousal which is triggered by a sense of loss. During states of grief, people are mostly focused on the factor of loss. However, as time progresses, gradually the state of grief subsides and allows a person to

concentrate on different aspects pertaining to the lost loved one, such as happy memories and humorous encounters. In turn, other emotions related to that person, framing the relationship, can subsequently be experienced[1] (Bonano 2001; Shuchter & Zisook 1993).

Much research has been allocated towards investigating the broader concerns and influential factors of UX (Arhippainen 2010; Forlizzi and Battarbee 2004; Hassenzahl and Tractinsky 2006; Kuniavsky 2003, 2007; Law, Roto, Hassenzahl, Vermeeren and Kort 2009; Roto 2006a, 2006b; Vermeeren, Law, Roto, Obrist, Hoonhout and Väänänen-Vainio-Mattila 2010). This PhD research has focused on examining how the psychological properties of experience in UX are reconstructed in qualitative data. Given experience's psychological nature, a starting point for this research has been the question: What *is* user experience? The main approach of this work has been the development of empirical and analytic methods for evaluating qualitative representations of UXs. The idea is that qualitative data, in terms of content and structure, provides valuable insight into the types of content and organisation that occurs mentally when a person experiences design.

A number of case studies contributed to the development of this research, most of which are featured in the summarised articles. All but one of the cases were undertaken as a part of project work through the User Psychology Laboratory at the Agora Center, University of Jyväskylä. The projects hosting these case studies were the Theseus project (I and II) and the Easy Interactions ITEA2 project – all of which were funded by Tekes, the Finnish Funding Agency for Technology and Innovation. The case studies mentioned in this dissertation are: the smartphone icon study; the elevator user experience study; and the home décor semantic design experience study (self-initiative). The smartphone icon study was the brainchild of research partners who were interested in developing methods to measure the level of attractiveness reflected by smartphone icons. Likewise, industry partners were also interested in testing new ways to measure the UX of elevator design. The home décor study was designed to examine contents triggered via multi-sensory perception of design products.

The progression of the case studies and discussions related to them, demarcate the process that has been undertaken to examine one core question: What *is* user experience? The answer arrived at is *semiotics*. This dissertation presents the nature of UX and user-design discussions both in the introduction as well as in the theoretical framework chapter. The research scope maps out the key objectives of the research, the research focus and questions. The theoretical framework concentrates on discussing theories which are seen as critical for the comprehension of experience in relation to a psychological

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[1] In his early attempt at writing "The Law of Mind" (2009, 126), Charles Sanders Peirce refers to this characteristic as "continuous affectibility". Continuous affectibility refers to Peirce's a law of the mind which alludes to the spreading of ideas. Thus, the death or separation from a loved one is considered one idea. Yet, as time progresses this idea is affected by other ideas, which results in feelings losing their intensity, and instead gaining generality.

semiotic perspective on UX. Constant reference is made to Charles Sanders Peirce throughout the dissertation, due to the role that his semiotic theories play in understanding not just the semiotic approach of this research, but also the workings of the mind and experience. With this said, semiotics is presented through reference to Peirce, as well as Ferdinand de Saussure and Charles Morris. Peirce's simple triadic semiotic model (1998, 275) is presented as his means by which to exemplify the relationship between the physical and psychical worlds. While de Saussure's (1983) and Morris' (1971a) theories are used to illustrate other semiotic perspectives – the conceptual (Saussure 1983) and the expanded psychical-physical model (Morris 1971). Following this, an original theoretical semiotic model of UX is introduced. User psychology is described in terms of key cognitive scientific and psychological understandings of emotions and aesthetics, consciousness, embodiment and mental representational theory. Further, design semantics and cognitive semantics are discussed as related theoretical fields. Personal Construct Psychology/Theory (PCP/PCT – Kelly 1955) is outlined in the methodological chapter as it provided the basis for the empirical work, both through specific empirical techniques (picture sorts and repertory grid) as well as in terms of a framework for analysis and further technique development. The next section of this introduction describes the nature of human-design relationships and the relevance of this current research.

## 1.1 The design and I – why this and why now?

Humans are socially-motivated, emotional-psychological beings. A great part of our existence is hinged upon the relationships we form with other people, and the position we establish within our communities. We find it difficult not to have opinions about things or people, as our entire world view is more or less structured by our emotions. Our relational connection to objects can be explained in terms of genuine emotional connections experienced in response to the object's design and properties. The design itself may appeal aesthetically to the tastes of the individual, to the person's needs or even to the person's level of skills. The design may also fulfil a social need aiding the person in establishing relationships with people and articulating their position within society. Arguably also, aesthetic tastes may be influenced by societal discourse and events. The social need to be accepted may in fact influence what a person finds to be attractive. Thus, design attraction is two-fold: it may firstly appeal to a personal psychological need in and of itself, whether that be through e.g. fun and the need to detach from work or other stressful matters; or it may secondly address a social need – the need to fit in and participate in social discourse through shared (product/technological) experiences – which also produces individual psychological outcomes.

For the above mentioned reasons pertaining to the social-psychological nature of human users, designers and scholars have recognised the importance

in studying how human beings react to and experience design in a variety of ways. Approaching this topic from a semiotic perspective is not only insightful, but highly relevant in today's highly competitive and symbolic market. Now more than ever before consumers are inundated with products which are identical in terms of functions, performance and quality. Never before have consumers needed to make decisions between so many of ultimately the same product, which means that decision-making mechanisms shift away from the cognitive and move more towards the emotional. Yet, this does not mean that decision-making has moved away from the rational towards the irrational. In the theoretical chapter of this dissertation, emotions are recognised for the role they play in reason, and how they act as a director for psychological and physiological responses (Ekman 1999; Frijda 1988; Smith and Lazarus 1990). Thus, emotions may be interpreted as the 'seat of rationality'. However, what this means is that designers are faced with the task of designing products which are not simply supreme functionally (and perhaps successful products are not necessarily supreme at all in terms of function) and usability-wise, rather they are faced with the challenge of generating designs which are semantically appealing to consumers on an aesthetic and emotional level (Desmet 2002; Jordan 2000; Karjalainen 2004).

Victor Margolin (1997) has proposed that the product-user relationship comprises four main dimensions. These dimensions include: the social, the inventive, the operational and the aesthetic. What this means is that the relationship between the user and product is not solely contingent on the social, operational (usability, functions and performance) and inventive (new attributes or capabilities), but also the aesthetic experience gained from interaction. A paradigm shift may be observed in the present economy that is invested in generating experiences. This shift can be seen in the symbolic domain, whereby rather than emphasising the social and communicative factors of consumption, more and more focus is being placed on what the products *mean* to the user/consumer (Karjalainen 2004), and how this makes them feel (Warell and Young 2011).

Ultimately in this research's discussion on UX, reference is made to designed objects as well as connections, impressions, interactions and relationships which are formed between users and designs. The relationship does not have to be one of *affection* or meaningful and memorable interactions, but it does highlight the interactive dynamics established by a number of factors: the user, the design and the context (purpose and environment). Reference to Marc Hassenzahl's (2003) article "The thing and I" is no coincidence. Hassenzahl's article can be viewed as an important contribution to the understanding of user-product relational dynamics in the realm of UX. In his article, Hassenzahl notes that experience itself is subjective – it occurs within the human mind and cannot be transferred to or generated from an object. Thus, the relationship between a design and a person is always subjective, it involves sensory perception and subsequent apperception, or sense-making (implicit and explicit representation), of the product (Saariluoma 1992, 2003;

Saariluoma and Kalakoski 1998; Hekkert 2006). In other words, an individual encounters the object via one or more of the five senses (sense-data obtained through sight, auditory, taste, touch or olfactory) and then establishes a mental representation based on the data perceived (Saariluoma 1992, 2003; Saariluoma and Kalakoski 1998; Russell 1997).

Disagreement regarding sense-data (Russell 1997), and the mind's ability to actually perceive the physical world has been around as long as philosophy. This is specifically present regarding mind-body dualism as seen in René Descartes' (2009, 17) claim that what is represented in the mind and what exists in the physical world are two separate materialisms (physical and metaphysical). Furthermore, Frank Jackson (1977) describes what is termed as *perception by virtue*, whereby a person perceives phenomena according to relationships (physical, social and psychological) they hold to phenomena – this is discussed in the theory sub-chapter on embodiment. Regardless of whether or not the mind processes data directly from the physical senses, or as psychological manifestations of sensory data, the issue here is that through looking at human-design encounters we may see that design perception and interaction, triggers a cognitive process which draws on mental information contents, comprising memories, recognition and associations, emotions and sentiments, to create an overall impression or mental representation of the design. This representation is the experience, which inevitably is framed by an overall emotion (or set of emotions) and valence (positive, negative or indifferent).

As will be discussed in relation to the case studies, the emotional framing of an experience is not necessarily either positive or negative, it may be both, and it may also be what is considered as neutral. Yet, as the theory chapter addresses, supposed neutrality also plays a crucial role in UX. The experience and the human-product relationship are heavily dependent on context, which in turn defines social conditions, purposes and connections implicated in the interactive transactions.

## 1.2 Human-system interaction terminology

Terminology regarding human-system interaction models can be confusing. Traditionally, UX has been developed within the field of human-computer interaction (HCI). Thus, much is owed to scholars of HCI for their contributions of theories, methods and understandings of UX which are commonly drawn on across disciplines. Human-technology interaction (HTI) is a more generic term, applied within the fields of user psychology and cognitive science. While 'technology' can be seen as referring to any device or object which is human-made – tools, machines, clothing, housing etc. (Bain 1937) - it still possesses a distinctly technical and engineering oriented connotation. Use of the term 'technology' was vastly different a few centuries ago. In earlier times the word referred to the study of useful arts (Crabb 1823). It was also linked to technical

education (Stratton and Mannix 2005). But, as the result of the second industrial revolution the term changed from the study of industrial arts to the industrial arts itself (Schatzberg 2006). These days dictionaries such as AskOxford (2013f) define technology as "the application of scientific knowledge for practical purposes" this is accompanied by a description of "advances in computer technology." The dictionary also defines it as being a "branch of knowledge dealing with engineering and applied sciences".

As this PhD work deals with the research and development of methods to study how people represent their experiences with various types of design, the term human-design interaction (HDI) is preferred. This is due to the fact that as with 'technology,' 'design' can be applied to any product which has been intentionally developed and manufactured. Design describes both high-technological products, such as any hardware or software technology, as well as non-digital designs such as home décor, clothing and even architecture. Further, the term 'design' does not necessarily refer to objects or technological systems (such as software), but can be applied to, for example services. Design is a way of thinking, it is about producing practical solutions for everyday, and perhaps not so everyday problems (Crouch and Pearce 2012).

By emphasizing 'design', attention is drawn towards the thought, planning and problem-solving process behind products (Warell 2001; Crouch and Pearce 2012). In other words, designs are expressions or representations made by designers, encompassing numerous background factors which are corporately, practically and imaginatively derived. Thus, HDI can be interpreted in terms of how people (users) interact with other people's (designer's) solutions to everyday problems. This casts an interesting light on the contents of design interaction, as it can be seen as the conceptual meeting point between user and designer.

## 1.3 Incentives for the research

There are a number of incentives for this research, which exist on both theoretical and practical levels. Firstly, this work theoretically frames UX as a cognitive semiotic phenomenon. The research focuses on the cognitive psychological nature of experience and its production in HDI, where this is located (spatially and temporally) and how it exists within a sign system. Secondly, theoretically this research illustrates the semiotic relationships between design as a signifying element (or sign vehicle), the object (the physical and metaphysical properties that the design refers to), the interpretant or mental representation – experience – of the design and its interpreted relationship to the object, as well as the way in which the user explicitly represents this experience in interaction with other people. Thirdly, through understanding these connections designers and researchers can design appropriate empirical approaches which engage and examine these relationships across diverse user samples. Fourthly, and most significantly

during the course of this research several practical data collection and analytical tools have been developed.

Two main objectives for these developments have been to: 1) develop a qualitative sampling and analysis means enabling for the generalisation of qualitative data – that is, to treat qualitative data as a means for observing similarities and differences of information content triggered during design interactions by larger quantities of users; and 2) to develop techniques which are simple, efficient and cost effective for application by both designers and researchers in industry and academia. Traditional means of qualitative data collection such as interviews and subsequent audio-visual data are insightful, yet time-taking and arduous to analyse. In particular, industry professionals need evaluation and analysis methods that reveal the most detail with the least amount of time and effort. In order for any of this scientific research into UX to take effect, practical factors such as time and ease need to be considered, so that practitioners can implement evaluation and analysis methods in conjunction with their design practice, rather than instead of.

## 1.4 Thesis structure

The topic of examining UX from a semiotic user psychology perspective has been described in this introduction. Here, the project background of studies discussed in the attached articles has been outlined, and the representational approach towards experience and meaning-making has been presented. Following this introduction the research scope of the PhD is described. In this chapter the research objective is outlined, and is followed by the description of a threefold research focus: 1) developing methods for evaluating UX from a user psychology perspective; 2) examining explicit qualitative representations of UX; and 3) presenting UX as a semiotic system. The research questions are also subsequently presented in terms of three queries which have guided the project studies, and one overarching research question: how can qualitative data as explicit representations of UX, shed light on how users mentally represent and experience designs?

The chapter on theoretical framework presents the main theoretical fields of concern pertaining to and influencing the approach of this research. Firstly, semiotics is described in reference to basic models provided by Charles Sanders Peirce, Ferdinand de Saussure and Charles Morris. This is followed by the introduction of a semiotic model of UX that has been developed specifically within this research. Following this, UX is described in terms of its multi-faceted reference and scope. To characterise the extent to which UX may be applied, the concept is described in terms of some major models of UX research and design, notions of experience, pragmatism and emotional aesthetic meaning-making in UX, as well as the implications of UX from a cross-cultural perspective. User psychology and cognitive science is a sub-chapter in which psychological and cognitive scientific viewpoints on HDI and UX are discussed.

Here, the main theoretical components include emotions and aesthetics, consciousness, embodiment, and mental representations. The related theoretical fields of design semantics and cognitive semantics are used to illustrate two areas which overlap with the intentions of this study: 1) design semantics aims to examine the semantic connections attributed to specific design properties and factors influencing the communication process in the scope of design; and 2) cognitive semantics recognises the value in systematically analysing linguistic representations in order to gain insight into mental content and cognitive structures. This research into the semiotics of UX combines both of these perspectives.

The methodology chapter explains the theoretical logic behind the empirical methods, which pertains to Personal Construct Psychology (PCP). Figure 1 illustrates some examples of the stimuli that were used during the research, and which are referred to in the article discussions. Picture sorts (featured in the smartphone icon study) and repertory grids (in a study not included in this dissertation) are described in terms of their procedures and application in HDI research. The repertory grid is included in the methodological chapter as it provides background to the development of the succinct qualitative analysis technology (SQAT) established in this research. Field observation of elevator usage behaviour is described as an ethnographic based technique that was implemented in a study examining elevator UX. This method is seen as useful in obtaining data of contextualised HDI. Further, this approach allows the researcher to compare user representations of UX, with their own observations, interactions and subsequent experiential representations. Finally, SQAT is explained in reference to a study examining the multi-sensory experiences of three home decor objects. This is an evaluative and analytical technique developed within this research for application in industry and academia alike.

Chapter five presents the summary of articles. The article summary structure can be seen in Figure 2. The articles progress from: initial theorisations regarding the concept of attractiveness in relation to design (article I), and the background of approaching user psychology and cognitive science from an artist perspective (article II); to cross-cultural notions of smartphone icon attractiveness (article III). This then leads to the presentation of the cognitive content categories models presented in articles IV and V. Based on ethnographic style field observations and interviews, article VI examines elevator UX and emphasises the role that user mental contents should play in product development management. Article VII discusses the elevator UX study further by referring to the role of conscious and unconscious experience in technology interaction, drawing attention to the importance of including unconscious experience as a design goal in relevant design contexts. Article VIII presents the semiotic cognitive model of UX, or the C-model, and article IX offers further detail regarding this model. Article X serves as a final umbrella article characterising the semiotic nature of HTI and the role of mental contents

in recognising, interpreting and utilising technology via appropriate symbolic communication.


FIGURE 1 Project user-design studies: a) Four of the 22 picture sort cards featured in the Smartphone Icon Design study; b) elevators featured in the elevator interaction study; c) three home decor design objects used in the multi-sensory experience study.

Chapter six on the concluding models, discussion and conclusion, presents the resulting content category frameworks and a cognitive model of UX based on semiotic principles (the C-model). These frameworks are both theoretical and empirical in nature. They conceptually categorise contents provided through user constructs (qualitative data or explicit representations) and locate these in relation to the user innate properties (cognitive and emotional) and design

innate properties (aesthetic and practical). The cognitive content categories model discussed in articles IV, V and VI, specifically outlines contents referring to what is interpreted by the user as the mental aspects of experience, and the design (or sign vehicle) component of the experience. The C-model (cognitive model) described in articles VIII and IX presents a cognitive semiotic communication model illustrating the circular process of design signification. This model emphasises the non-linear nature of signification between designer, design and user, and highlights the character of design as existing within a chain of signification with no traceable origins or finality. Design always refers to something else, and interpretation within the user and designer facilitates the flow of this chain.

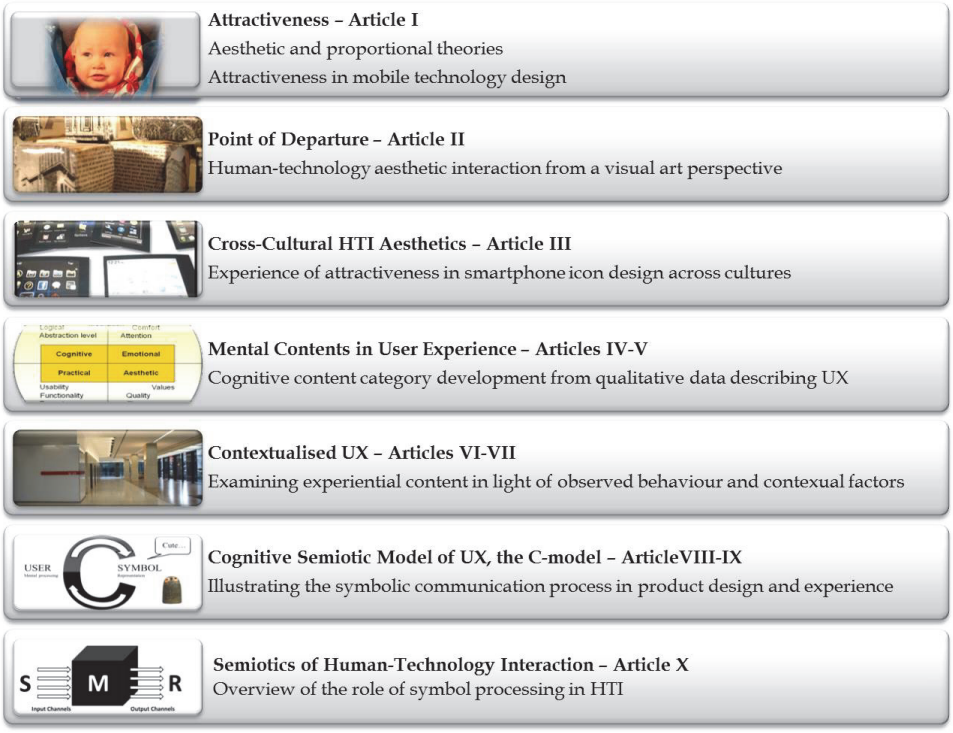


FIGURE 2 Article summary structure

The discussion expands upon the findings set forth in the summarised articles. Here, the theoretical concepts described in the theoretical framework chapter are re-articulated in relation to the articles included. Details are given regarding the strengths and developmental areas discovered in relation to the studies. Additionally, further applications and future directions of this research are discussed. The discussion characterises UX as a semiotic issue, highlighting all thought and interaction as being based on re-presentation, or the formulation and reformulation (interpretation) of signs. Moreover, the discussion serves to show the connection between these isolated project studies and work being

undertaken in the broader fields of HTI in relation to artificial intelligence (AI), multi-sensory UX and embodied interfaces. In the conclusion the dissertation is summarised. Emphasis is placed on the theoretical framework in light of the empirical method development and findings.

## 1.5 Research scope

### 1.5.1 Research Objective

This research has aimed at understanding the connection between explicit representations of UX – or qualitative data – and experiential content generated in design interaction. The dissertation characterises the highly subjective nature of experience and its associated mental content, while also highlighting the usefulness of qualitative data and its application in order to gain conceptual insight into the types of content present in mental representations of UX. Here, qualitative data is seen as instrumental in not just explaining specific UXs, but rather illustrating common themes through which numerous users define their experiences – both implicitly and explicitly. Thus, one major objective of this research is also to show that in UX, qualitative material should not just be used descriptively at face value. Instead, it should be used for its capacity to reveal similarities and differences in categorisation, establishing a broader picture of semantic relationships between design and experiential contents.

Qualitative data is semantic in nature. It is produced to explicitly represent thoughts and ideas (mental representations) in relation to real world phenomena and events, or internal cognitive events. Based on the findings and reflections of this PhD research, one major problem may be observed in relation to qualitative data, and that is *interpretation*. Explicit representations – words, narratives, music, images etc. – possess different meanings for each person who interprets and produces them. That is, based on cognitive notions of mental representation, and apperception (as discussed in the theoretical framework chapter) meanings of signified phenomena vary from one individual to the next. Meanings are in themselves mental symbols (representations) which are influenced and composed of contents deriving from past memories, experiences and ultimately pre-established representations (Fodor 1975; McCarthy and Wright 2004; Schindler and Case 1996; Stoof, Martens, van Merriënboer and Bastiaens 2002). This is why purely recounting qualitative data without further analysing semantic connections and shared relationships between subjects is not so insightful. Qualitative data can and should be treated via methods such as content analysis and even e.g. discourse or protocol analysis (not mentioned in this dissertation) to reveal patterns of content and their application in connection to e.g. design interaction.

The semiotic model of UX that is explained in the theoretical framework chapter, illustrating the basis of logic which rationalises UX as a semiotic process was not arrived at instantaneously. Instead, this logic and its associated

research have emerged as the result of an empirical and analytical process. The process was initiated via several case studies undertaken through the Theseus I and II, as well as ITEA2 Easy Interactions projects. Thus, the articles are represented in terms of seven main objective themes:

Theme one, *Attractiveness* - focuses on the attractiveness of smartphone icons. The objective of this piece of work was to define and develop methods for measuring what users experienced as attractiveness in these designs.

Theme two, *Point of Departure* – this theme highlights the interdisciplinary nature of a cognitive scientific, user psychology approach to examining user experience. It explains the connection between previous studies and experience in the visual arts industry and how this translates to the study of representations of experience of attractiveness.

Theme three, *Cross-Cultural HTI Aesthetics* – describes the similarities and differences in aesthetic experience of smartphone icons from one national setting to the next. Here a cross-cultural study of experience of attractiveness of smartphone icons is used to illustrate issues that should be taken into consideration when designing for the international market.

Theme four, *Mental Contents in UX* - introduces theoretical models for interpreting qualitative data according to experiential content categories: cognitive, emotional, aesthetic and practical. The objective was to establish a theoretical model based on the findings of the attractiveness case studies.

Theme five, *Contextualised UX* – the objective of this theme was to highlight the role of mental contents within the design communication process via examination of both user and researcher experience. The method of field observation is explained in the associated articles emphasising the explanatory capacity afforded by combining participant insight with observed contextual factors.

Theme six, *Cognitive Semiotic Model of UX (C-model)* – treats design experience as a semiotic communication process. The C-model provides a circulatory representation of signification, in which UX exists in a permanent conceptual state. The C-model has informed the final semiotic model of UX that is referred to in the theoretical framework chapter.

Theme seven, *Semiotics of Human-Technology Interaction* – observes the nature of HTI as based on symbols. Here, traditional models of computation and symbol processing such as Minsky's (1967) M-Machine are used to exemplify the relationship between formal symbolism and logic as represented in design, and human mental contents. This theme locates arguments presented in this dissertation in relation to broader HTI discussions.

There have been two main purposes of this research. The first has been to theoretically explain UX from a cognitive scientific user psychology perspective. This has been achieved in reference to semiotics and articulating experience as a representational process in which one representational manifestation of ideas and concepts (design) is mentally (apperceived) and subsequently explicitly *re*-presented as another representational manifestation. The second has been to devise and develop methods: 1) for measuring attractiveness (emotions with positive valence) and experience in design and its interaction; and 2) for efficiently and effectively analysing data in order to gain insight into key content categories through which people define their design experiences.

The core overall objectives of this research are summarised as follows to:

1) Deepen understanding of the syntactic and semantic nature of designs and their contexts.
2) Enhance understanding of the types of linguistic content, or representations, presented by users to express their experiences.
3) Establish empirical methods and theoretical models that best measure the connection between how users experience design and how they represent their experiences.
4) And thus, begin development of a schema that connects qualitative user feedback to specific experiential qualities in relation to design elements and contexts.

### 1.5.2 Research Focus

The focus of this research has been on investigating the nature of qualitative data as representational constructs of mental information contents. In particular, this research has not been simply concerned with what the users are saying about design products – thus, traditional paraphrasing of interviews is insufficient. Rather, of interest here is what the words, or content, of qualitative descriptions say about the user and their experiences with specific designs and design elements. Qualitative data is capable of giving rich insight into deep thought structures and mental contents (Kuuva 2007; Saariluoma 1992, 2003; Saariluoma and Kalakoski 1998). Yet as researchers, we who interpret the qualitative material are also human beings with our own unique mental processes of interpretation and meaning-making schema. Thus, some kind of semantic anchor is needed for the analysis of this material. This is why the

semiotic nature of HDI is brought to the fore. Figure 3 presents a semiotic model in which both the design product and qualitative feedback act as signifiers or signifying elements. The object to which these signifiers refer can be seen to exist within the mind. The design, particularly the design syntax, operates as a signifier for the information contents and ideas (mental representations) of the designer, and other parties involved in the product development. User or consumer feedback of the product refers to the mental contents and ideas (mental representations) of the user in relation to the product.

Thus, UX is the interaction between minds, which is facilitated by a range of vehicles, frames and associations. In the UX context, generally the designer is only represented by the product which physically exists and comprises particular materials, forms, colours, scale and texture. Connected to the physical form are identifiers and properties that attach the product with another body – the company and brand – which also carries associations often times significant to the user. Thus, both the qualitative and quantitative feedback of the user is expressed through language and semantic understanding which are generated through cultural and social agreement and norms. Both the design syntax (its physical characteristics) and associations portray values and ideologies which either appeal to or disagree with the user's values, beliefs and ideologies. In inevitably emotional appraisal always involves ranking, categorisation or ordering phenomena in some form of hierarchy of preferences according to how well the phenomena match with the user's values etc.

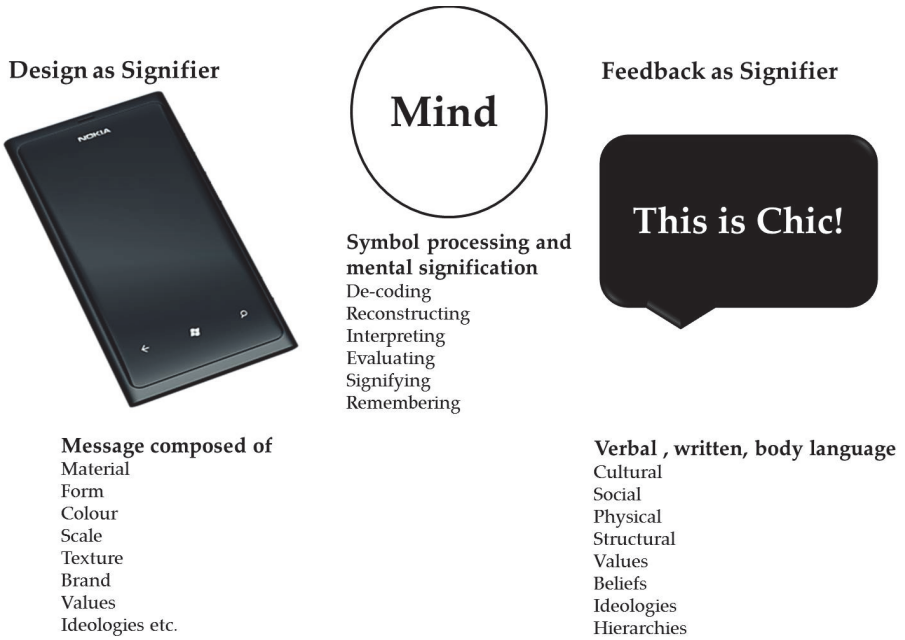


FIGURE 3 UX from a semiotic perspective

Thus, there are two main focal points in this research. One is the user and how they qualitatively represent or relate their experiences and the other is the design, design elements and associated attributes – the contextually-situated product of designers' representations. Thus, signification or representation is seen as a cyclical process in regards to HDI and the study of UX (Krippendorff and Butter 1984). The designer constructs a representation (design product) based on a number of factors including: company requirements, brand image, consumer demand and own imagination. Then the user encounters the design product through perception or utilisation, and in turn mentally processes (apperceives) the product and interaction situation – they *experience* HDI. The user's experience is that of mental representation, which is subsequently *re*-presented to the researcher, designer or other people/users within their social networks.

**Focus 1: Developing methods for evaluating UX from a user psychology perspective**

Quantitative opinion scales represent quantitative or numerical weightings people attribute to certain factors, i.e. how highly they value specific qualities and experiences, or how related certain qualitative statements are to their experience of particular design attributes (as in for instance the case of semantic differential). Semantic differential (SD) methods have been used in user-design research since the 1950s (see Osgood, Suci and Tannenbaum 1957). There are different variations of the method. However, the main idea behind SD is to measure the semantic relationship between people's interpretations of designs, design elements and characteristics, and designer/marketer/researcher given attributes. These are generally presented in the form of adjectives that people must rate via measurement instruments such as Likert Scales or Visual Analogue Scales (VAS[2] - Warell 2008, 361). Likewise, neural research employing analytic technologies such as functional magnetic resonance imaging (fMRI) etc. can show what parts of the brain are activated when processing various HDI experiences – e.g. based on emotions evocated through encounters with certain design elements etc. However, neither of these types of methods provides insight regarding how users are mentally constructing their experiences. They do not offer a view in regards to what design elements or qualities a person is drawn to most, nor do they tell us anything about how users make sense of the HDI situation. Instead, explanations are often based on researchers' interpretations rather than the users'.

The material which exists in closest relation to *how* a person makes sense of phenomena is qualitative data, and explicit representations provided during social interaction. Qualitative representations such as speech (or even expressions in pictures and music) provide the most detailed accounts regarding the content of thought (Pinker 2005). A more explanatory means of

2 Visual Analogue Scales measure attributes and characteristics that span sets of values, but are not easily measured (Gould, Dieffenbach and Moffett 2002, 706).

gaining understanding pertaining to how people make sense of their encounters and interactions is to ask people to describe what they are thinking. In this research, verbal or written explanations are treated as user-generated representations (information content constructs). They are linguistic constructs of mental representations, or mental meaning-making. These representations of the experiences can be viewed as micro-narratives within the much longer life narrative of the person. The life narrative comprises elements which need to be considered in order to contextualise the HDI situation, and identify the personality type of the user. Life-based design (Leikas 2009; Leikas, Saariluoma, Heinilä and Ylikauppila 2013; Saariluoma and Leikas 2010) for example considers people's life experiences and narratives as a key tool in user-centred design.

However, of particular interest here is *how* users qualitatively *re*-present their experiences, as well as what design elements and qualities are present within these *re*-presentations. In other words, from the design perspective this research is concerned with knowing which design elements and qualities, in relation to specific design artefacts and contexts, hold the most impact – and of course, to whom? And from the user psychology perspective, it is concerned with understanding how the individual makes sense of their HDI experiences, both to others as well as to themselves.

**Focus 2: Representation of user experiences**

The term "*re*-presentation" draws on Charles Sanders Peirce's semiotic philosophy regarding presentation and representation (2009, 1998). Presentation can also be seen in light of the referent or object in other semiotic models (i.e. Ogden and Richards 1969 and de Saussure 1983), whereby an object or occurrence is presented, or encountered, and the sign process is initiated. Thus, presentation acts as the basis upon which someone mentally processes information: forming an impression and interpretation of what is being perceived (or apperceived). Saariluoma, Nevala and Karvinen (2006) talk of this mental processing, or mentally based perception as apperception. In other words, apperception is the process of mentally *re*-constructing an object or phenomenon to oneself. Representation in Peirce's model, similar to the signifier or sign (symbol) in de Saussure's model, is how this original object or occurrence is re-presented – re-configured and once again presented in some way such as mentally, pictorially or verbally/literally linguistically. Likewise, a user's qualitative linguistic feedback of their HDI experience is a representation of that experience. In this way users represent not simply the object or occurrence that has been presented, but the way in which they themselves have apperceived these designs and their associated interactions.

Anders Warell's (2001, 2004, 2008) models of visual product experience (VPE) and perceived product experience (PPE – Warell and Young 2011) succinctly illustrate this process with three components: presentation, experience and representation. Each of the components or core modes has three sub-modes. Attached to presentation are impression, appreciation and emotion.

Experience is accompanied by sensory, cognitive and effective. Finally, representation is accompanied by recognition, comprehension and association. Figure 4 is an interpretation of Warell's VPE and PPE models. Please note that there is no hierarchy between the modes. In this interpretation, the model is seen more as a cycle.

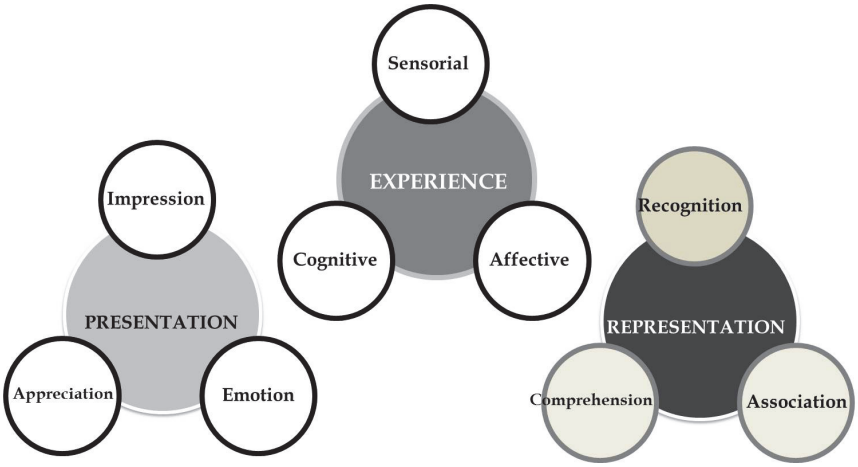


FIGURE 4 Interpretation of Anders Warell's (2008) and Warell and Young's (2011) Perceived Product Experience (PPE) model

The mode of particular interest in this PhD research is "representation." Yet, where in this diagram representation focuses on the way in which a user/consumer recognises, comprehends and associates a product, this current research looks at representation of the experience – mentally and explicitly in social interaction. That is, emphasis is placed on the way a user represents sensory, cognitive, emotional, appreciative and associative content. Figure 5 is an illustration of a re-formulation of Warell's model to suit the context of this research.

The upper half of the diagram represents the experience, or the mental processes occurring during HDI. The lower half of the diagram represents the qualitative representation of the user when commenting on their experiences with the design products. The mental experience component of the model implies that the impression is sensory, in other words, we react to our experiences based on data obtained through the senses that we employ during interaction (i.e. according to sight, touch, taste, smell, sound). Differences in the experiences based on sensory data are described in articles VIII and IX. The experience is recognised and comprehended (or interpreted). The experience is affective on some level even if this is interpreted as neutral, allowing for affective interactions from other channels – this is discussed in light of an elevator UX study in articles VI and VII. Finally, an impression is made – this is what is recalled and remembered. Yet, it must be noted, and as is discussed later, the way in which this event is remembered and recalled changes over

time and according to varying contexts. This is explained through reference to apperception and its constant re-composition of mental contents.

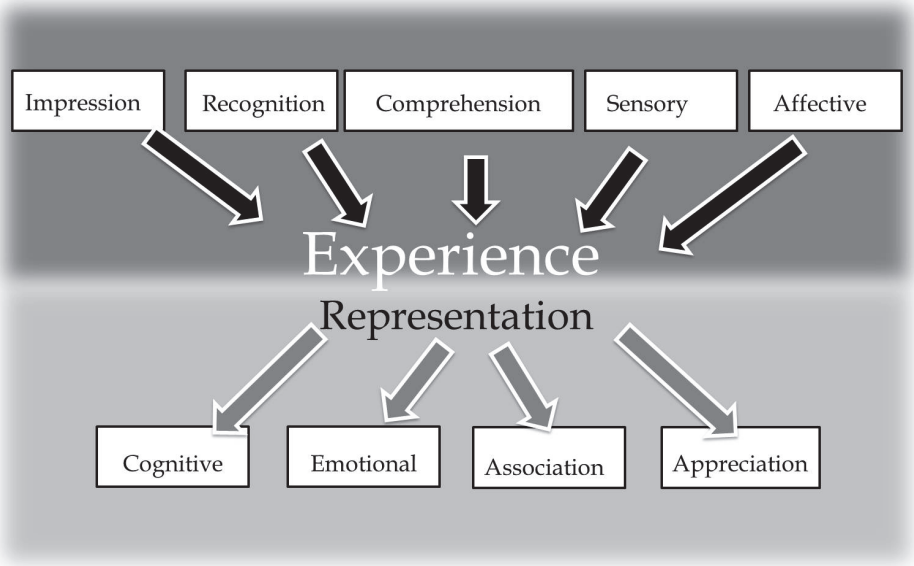


FIGURE 5 Reformulation of Warell's (2008) and Warell and Young's (2011) perceived product experience model

**Focus 3: Context and UX as a semiotic system**

Everything occurs within a context. The AskOxford.com (2013a) dictionary defines "context" as being the circumstances which create a setting for something, be that an event, thought, idea, or statement etc. In other words, a context provides the backdrop for any human generated transaction or interpretation. Toni-Matti Karjalainen (2004, 20) states that products acquire different meanings in various contexts and that meaning creation is always dependent on context. Contexts are environmental – social, cultural and physical – as well as psychological. People perceive the same products differently due to their unique psychological make-up of varied past experiences and acquired knowledge. The interaction between psychologically-based pre-conditions and environmental context generates certain preconceptions and anticipations within the user or design perceiver (Karjalainen 2004, 21). This anticipation factor plays a major role in UX (McCarthy and Wright 2004, 42). People respond to things (objects and events) based on the meanings they have already pre-assigned them (Blumer 1969).

Thus, UX cannot be thoroughly analysed without regard for context, as meaning is not possessed within the designs themselves, rather, it is created

within the minds of the perceivers and users (Krippendorff and Butter 1984) in relation to context. To take this further, Mike Kuniavsky (2007) has stated that UX *is* context. Experience is continuous and exists as the continual interaction between design products, their immediate environment and the user's life (circumstances and narratives). This is why during the course of the current research, it has been discovered that one concrete unified framework to assist designers in designing for specific experiences cannot be established. Through undertaking project case studies which involved various other designs such as professional tools (handheld moisture meters) and social media (Facebook), it was soon discovered that what is desirable within the designs of one device, is not desirable in relation to another. Thus, purpose of use also affects the way in which people experience designs. Accompanying each use purpose and context is a different vocabulary or set of design language requirements and expectations. Designs need to *speak* or communicate the design language in accordance with the user's expectations based on the context.

Communication and language are meaning systems which operate through culture and social interaction in contextual relationships. Ludwig Wittgenstein (1953) used the term language games to emphasise the dependency of linguistic constructions upon contexts of use. Or, in other words, Wittgenstein recognised variations of meaning that occur in accordance with the communicator, and/or the context in which they use the words, and with *whom* they use them. A simple example can be seen in the language and types of symbols used in communication between family members as compared to language used, for instance in the work place. Members of the same family are more likely to have additional shared experiences, or at least memories of the same events. Generally, anecdotes, stories and 'inside' jokes, which do not necessarily comprise a traditional narrative structure, trigger particular mental associations and understandings among these family members. For instance, reference to "a bus", may be linked to the understanding of a humorous incident involving a bus that all family members are aware of. If an individual takes that understanding and refers to "a bus" in discourse with work friends for example, the entire story needs to be recounted, with the increased possibility that co-workers do not see the humour in the statement.

Design objects are social and cultural symbols (Karjalainen 2004, 20) and these symbols operate through associations made socially and psychologically (1931-66, 367 & 392). In other words, semiotic systems operate via meanings generated in social interaction which are then internalised and again processed according to an individual's own experiences and relationships. Designs can be viewed as an interface between materials, attributes and organisation of the product, or the "inner" environment, and its use setting, or the "outer" environment (Simon 1996, 6; Karjalainen 2004, 21). This is shown in the theoretical framework chapter whereby designs are interpreted as sign vehicles, or signifying elements. These signifying elements refer to something else, which is termed in traditional semiotics (1998, 9) as the object. Important to note, is that the object does not necessarily mean a physical object. It can instead be

seen in terms of physical action or function, as well as metaphysical notions of for example quality, values, beliefs etc. Associations between these two components and interpretations of the sign in general occur in the mind. The mental representation derived from the interaction is a sense-making symbol in itself, and then finally, the symbolic element which is under study, arguably in any UX study which asks users to provide feedback and evaluate is the representation of their experience. These four elements provide the foundations of the semiotic model of UX discussed in the theoretical framework chapter.

### 1.5.3 Research Questions

This research was undertaken in a series of project case studies for the Tekes funded Theseus I and II, as well as ITEA2 Easy Interactions projects. The studies investigated user perceptions and evaluations of design products including: smartphone icon designs, fry pans, handheld moisture meters, social media (Facebook), and elevators. Plus, a final self-initiated study saw users provide qualitative data in response to multi-sensory evaluations of home décor design. These design products differ vastly in nature, not just in terms of form but in terms of use context, purpose and social dynamics. The articles featured in this thesis address the smartphone icon design, elevator and home décor studies. For confidentiality reasons results of the other studies cannot be published. Yet, it should be noted that the studies which are not mentioned here also play a vital role in shaping the findings of this PhD research.

As the research comprises various studies, different questions have been posed in relation to each. Here, the questions are presented in chronological order according to when the study took place. This is done for the purpose of highlighting the constructive progression of thought process and theorisation that has occurred during the research. Following the case related questions, one overarching question is presented which characterises the nature of this research in general.

**Question 1** (*smartphone icon design case study*). How can the attractiveness of smartphone icon designs be measured?

This is a method-based question that required the exploration of alternative methods for evaluating aesthetic-emotional reactions towards designs. In order to address this question, notions of attractiveness and beauty were first theorised and defined (article I). Through undertaking the empirical studies, variations in what is considered to be attractive in various design contexts arose. Thus, sub-questions of this problem which ultimately carry through the rest of this research are:

- What is experienced as attractive?
- In regards to what product?
- In which context and when?

**Question 2** (*cognitive dimensions and the C-model*). What types of representations of mental contents can be witnessed in qualitative data produced during UX studies – how can this be categorised and modelled?

This question was posed when analysing the qualitative material generated during the smartphone icon design study. Content analysis of the qualitative data revealed not only repetitions in the information constructs provided by participants but also dominant themes – or criteria through which participants evaluated designs.

**Question 3** (*elevator UX case study*). How do people interact with and experience elevator design and how can this be studied?

This case study was undertaken in the proper use context of two high rise office buildings in Adelaide, Australia. The nature of the problem demanded that methods be explored which incorporate user evaluations and interactions with the designs themselves, in light of the greater design (architecture) and socio-cultural contexts.

**Main research question:** How can qualitative data as explicit representations of UX, shed light on the ways in which users mentally represent and experience designs?

This is followed by the sub-questions:

- What are the relations between design syntax and representational accounts of user experiences?
- How can categories of information content constructs (qualitative representations) be used to create an understanding of mental impressions of HDI?

As said above, this main question has derived through the process of undertaking project studies and noticing relationships in the results. Starting from observing emotional content and its associated positive-negative valence, which ultimately lead to study of UX as a whole, the research questions have in turn progressed from methodological concerns to practical and theoretical concerns regarding UX as a contextualised semiotic exchange.

# 2 THEORETICAL FRAMEWORK

This chapter presents the theoretical framework illustrating the semiotic nature of UX from a cognitive scientific and user psychology perspective. Structuring relevant theories in one chapter is a feat in itself. This has been approached by firstly providing a background on semiotics through reference to the key theoretical influences of Charles Sanders Peirce (1931-66), Ferdinand de Saussure (1983), and Charles Morris (1971a, 1971b). Semiotic analysis is then mentioned, which is followed by a description of the semiotic model of UX – developed specifically in this research. With the backdrop of semiotics, UX is then described. Here, the major models are outlined and then the culturally dependent character of UX and product design is emphasised through outlining cross-cultural UX. This leads into discussion regarding the psychological components of experience, pragmatism and emotional aesthetic meaning-making.

User psychology is subsequently introduced in relation to cognitive science, providing the perspective from which this research has been undertaken. Under this sub-chapter key cognitive scientific and psychological concepts are explained. Concepts described are emotions and aesthetics in UX, consciousness, embodiment and mental representations. The concept of mental representations in particular is illustrated through reference to the semiotic model of UX. The chapter is concluded by outlining two theoretical fields existing in close connection to this research: design semantics and cognitive semantics. These fields are described as they can be seen to represent two representational components featured in this current semiotic model of UX: the design as a signifying element (design semantics) and qualitative data/ language as an explicit representation of the user's experience, or thought (cognitive semantics).

## 2.1 Semiotics

Attempting to explain semiotics has been likened to describing a country that many people believe exists, yet no one has any precise knowledge of (Nöth 1995, ix). Everyone who describes this country claims it to be their own. However, no one knows exactly whether or not it is the same country that everyone is talking about. Due to the multiplicity of understandings, attempting to describe semiotics is challenging. In any attempt to characterise semiotics, some scholars will argue that not enough has been mentioned regarding the diverse perspectives and theories, and some will claim that too much is discussed (Nöth 1995). What this sub-chapter aims at, is giving a general overview of traditional semiotic thought from the perspectives of Charles Sanders Peirce, Ferdinand de Saussure and Charles Morris, in kin with how their semiotic theories have been interpreted within this research. Due to the influence that Peirce's work has had in terms of shaping both the semiotic approach of this research, as well as philosophical understanding of cognition in light of interpretation and pragmatics, more emphasis is placed on explaining the logic behind Peirce's semiotic theories. However, it also seems important to locate Peirce in relation to other semiotic traditions, and for this reason de Saussure's and Morris' theoretical perspectives are also outlined.

The chapter progresses from these traditional standpoints to contemporary applications of semiotics in the field of HCI in relation to user interface and interaction design. In particular, attention is placed on explaining the concept of semiotic engineering and techniques for its empirical implementation (de Souza 1993, 2012, 2013; de Souza and Leitão 2009). Semiotic engineering is interesting from the point of view of this research as it actively utilises semiotic principles for the purposes of planning, developing and evaluating design. Finally, the chapter introduces the Semiotic Model of User Experience, which has been specifically developed for the purposes of observing the signification process in the context of UX.

### 2.1.1 What is semiotics?

De Saussure (1983) characterised semiotics as a science which examines the life of signs in the greater landscape of society. More often semiotics or semiology is used to describe the science of signs and sign systems (Eco 1976). In 1938, Charles Morris envisioned that semiotics would at some stage be a unified science of signs (Nöth 1995). However, as Pelc (2012) points out, there are no less than 16 differing definitions of semiotics. Semiotics, or the science of signs, was described for the first time as "semiotike" in "An Essay Concerning Human Understanding" (Locke 1997). The term "semeiotike" referred to the Greek word "semeion" which means "mark," "sign," or "token." The term derived from John Locke's theorisation of science in general. He divided science into three distinct parts, these were: 1) human understanding – of the things themselves, their relationships, and the way they operate; 2) human

responsibilities (or what should be done) – in order to achieve an end; and 3) the way that knowledge regarding both of the former can be attained and communicated (Locke 1963, 174). This third part relating to communication was allocated the name "semeiotike" or "the doctrine of signs."

Umberto Eco (1976) defines semiotics as the study of "all cultural processes *as processes of communication*" (Italics used in original text, p. 8). In other words, each of the processes is seen as possessing its own underlying system of signification. This leads to the view of semiotics as being a science which focuses on meaning production in society (Elam 1980, 1). De Saussure (1983) talked of semiotics and semiology as the science of sign systems which encompasses disciplines such as linguistics (pp. 16-17). De Saussure argues that in order to truly examine language systems, one should recognise key features which are shared with other systems of a similar kind. These features encompass cultural components such as customs, rituals, behaviours, rites and practices which are representative of signs. Included within semiotic study, is consideration for the way in which cultures produce specific signs and subsequently attribute meaning (Eco 1976, 7). Design is communication, and communication is the process of sending and interpreting messages. All messages are composed of signs. Semiotics aims at revealing the underlying principles of sign structures and the way in which they operate within messages (Jakobson 1971, 698). Subsequently, communication is the process of information exchange and flow between actors (individuals) via common systems of signs, symbols and behaviour (Merriam-Webster Dictionary 2013). Or in other words, communication is "human minds interacting with one another" through signs (Pinker 2005).

Similarly to discussions on UX, semiotics can also be seen as a discipline of specific methodology or a field of study, which allows for consideration of the numerous theories and perspectives on semiotics. Semiotics focuses on signs, or signifying systems, and subsequently anything can be considered a sign (Eco 1976, 7). As Eco (1976, 8) states, a sign which is passed from machine to machine does not possess the ability to signify. A machine addressee simply receives the sign as input, or a command, and processes it accordingly. It is however, the human users such as programmers, designers and end-users who possess interpretational capacity. For instance, it is the programmers who design the machine to process signs in certain ways according to certain rules. However, the meaning of these signs is inherent within the human users alone. Thus, signification itself occurs within the human mind (article X). The sign only has the power to signify when the addressee is a person. This is due to the human ability to recognise, interpret, associate and reflect.

One important criterion is that the sign or signal adheres to a system of rules which are recognised by the person who perceives it (Saariluoma 2012). Good examples of where signals can remain undetected or un-interpretable can be seen for example where: someone who has never used a computer is unaware of the devices used to input (i.e. the mouse or the keyboard/keypad) and the signals the user needs to perform in order to active input mechanisms

(i.e. double left click); the interface and icons and what they refer to; and how a computer operates in general (usage and operation logic). Likewise, tools and devices used in one cultural setting may not be known in another, quite often due to unfamiliarity. An example of this can be seen in relation to natural signs (Eco 1988)[3]. For instance, a 'lay-person' may be walking through a forest admiring the peace and quiet that the nature has to offer. At the same time, in an identical place, a biologist is busy listening to the discussions of particular bird species, predicting the change of seasons and weather circumstances. The natural signs (or non-intentional signs, see Eco 1976, 17) remain undetected to the lay-person, but are perfectly present and interpretable in the consciousness of the biologist. This matter is discussed further in the section on mental representation.

The following sections give an overview of the basic Peircean, Saussurean and Morrisian semiotic theories. These theories demarcate key components of a sign – its system – and demonstrate the relationship between communicative devices (signifying elements) and mental representations (thought and interpretation). Charles Morris is further referred to in order to illustrate the theoretic relationships between syntactics (representamen or signifying element), semantics (object) and pragmatics (mental representation) – as seen in the diagram below. All of these elements are critical to the understanding of this research on the levels of not simply UX, and design semantics, but more importantly experience – conscious experience and embodiment. Morris' explicit articulation of these semiotic dimensions highlights the intricate relationship between semiotics and the psychological foundations of UX.

### 2.1.2 The Peircean, Saussurean and Morrisian models

**Charles Peirce**

Throughout this dissertation Charles Sanders Peirce is referred to for his contributions to semiotics, in addition to his insight into the philosophy of the mind. Through tracing Peirce's work particularly in the areas of logic (1998, 42-56), the mind and its laws, consciousness, pragmatism and phenomenology, it may be observed that his theory of signs was in fact developed not simply as a theory of communication, but as a theory of the way the mind works in response to the outside world. In other words, Peirce's sign theories from the basic sign, object and interpretant model onwards can be seen as his way of challenging schools of thought such as *monism*[4] – the belief that everything (including body and soul) can be traced back to one specific source (Cross and Livingstone 1974) – which was prominent during his time amongst the advocates of positivism and most notably positivist psychology (2009, 553-56).

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3 Eco (1988) defines natural signs according to two categories: 1) signs which pertain to natural phenomena; and 2) signs which are unintentionally generated by humans.

4 This can be seen directly in Peirce's articles pertaining to the Monist Metaphysical Project (in 2009, 82-189), particularly in his development of the "Architecture of Theories," which emphasise the then often ignored character of science, the arbitrary element of a "point of view" (2009, xxxi).

He does this repeatedly throughout his work by stressing the role of chance, arbitrary understanding, feelings[5], and as we finally see in his semiotic theories, interpretation. Even though this interpretive element, or the contribution of a feeling laden consciousness was used to counter the idea that everything could be described in terms of the same matter and chemical substance (2009, 63-77), Peirce was not a promoter of dualism. While recognising the unexplainable or seemingly arbitrary nature of thought that could not be defined by laws[6] (2009, 136-157) he also recognised the importance of causality. The intermeshing of feelings with ideas and memories in response to external stimuli is explained in more detail in the section on mental representation. Peirce's basic principles of logic pertained to the fact that in order to have a thought or to construct an idea in the psychical world, there must be a corresponding element or point of reference in the physical world (2009, 16). This is where we may recognise the development of his semiotic theories to explain the realm of thought.

Charles Sanders Peirce approached semiotics through triads. Peirce defined semiosis as an action or an influence composed of three subjects – the sign, the object and its interpretant (Peirce 1931-66, 484). In fact, the prominence of triads throughout Peirce's work (i.e. the trichotomies of the simple sign (Peirce 1998, 275), the three classes of sign (Peirce 1998, 13), the eight (Peirce 1998, xxx) and ten (Peirce 1998, xxx, 480-81) trichotomies of a sign, the sign's three connections to truth (Peirce 1998, 303-4), and its three modes of being (Peirce 1998, 480) etc.), can be seen as Peirce's attempts to characterise an inbetweeness that can neither be explained by monism (or physicalism), nor dualism. This inbetweeness is described in conjunction with what is known as Peirce's Universes of Experience, as the "Universe of the power to establish interconnections among things and ideas" (Chiasson 1999). The other two Universes of Experience being: "the Universe of Ideas;" and the "Universe of Brute Actuality of things and facts." Or in other words the universes of dualism and monism.

Signs themselves were divided into three types: icon, index and symbol (Peirce 1931-66, 228). Peirce's work on semiotics underwent major development and change during his lifetime, but an underlying factor was his concentration on the ontology of signs. This means in essence that his scholarship was not

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5 In Peirce's texts the term "feelings" appears to be used interchangeably to describe emotions and moods. Yet, it must be stated that emotions and moods differ. In comparison to moods, emotions are said to comprise increased excitatory intensity, a stronger focus on motivational influences and causal circumstances, and to be experienced in shorter durations. Whereas, moods are described as lasting for longer durations and are experienced via less excitable intensity, with less of a connection to causal circumstances (Damasio 2000; Frijda 1993; Zillmann 2003). Peirce's "feelings" may be interpreted as mood, or state of mind (Peirce 1998, 4) when reading his accounts of the overlaying of feeling shown in an example where he explains that the feeling of blue, experienced at an earlier time (e.g. in the day) may continue on and influence for instance an encounter with red, and its feeling (Peirce 2009, 95). Peirce's feelings may also be translated into emotional mental contents where he explains feelings in light of interpretants – thus, the meaningful impression of the sign (Peirce 1998, 409).

6 Although as a mathematician he tried.

bound to any specific type of sign system such as language (Pirhonen, Murphy, McAllister and Yu 2006). In fact, his emphasis was quite the contrary. From the outset in his "On Framing Philosophical Theories" (Peirce 2009, 24), Peirce defines logic and reason in light of their Greek and Latin origins, whereby the Greek notion of logic refers to "word" and "reason," alluding to the idea that reasoning cannot be achieved without language. In terms of its Latin routes, the word "reason" (from "ratio") means an account of, implying that the act of reasoning is similar to computation. Here, the Latin version of reason, which instead of words requires images or diagrams, is considered more favourable than the Greek idea of logic. In other words, Peirce saw figures, diagrams and examples as possessing greater ability to express thought and ideas than words. Furthermore, the ultimate emphasis in Peirce's work is placed on thought, or the function of the mind and its connection to the physical world.

Peirce's work was extensive and highly complex. For this reason perhaps in research such as design experience and semantics, attention is often placed on the earlier, basic triadic model mentioned above (for instance see Vihma 1995, Warell 2001 and Karjalainen 2004). Moreover, attention seems to remain on his semiotic models and ideas of presentation and representation, in which emphasis is placed on their ability to explain communication processes. In Peirce's basic model the object is the thing or phenomenon (even thought or quality) that is being referred to by the sign (Vihma 1995). Although the object is something that is referred to, not everything about the object is used in signification (Atkin 2013). In other words, there are just a few specific features that enable an object to be signified by a sign. According to Peirce, an object determines or places constraints on the sign (Peirce 1998, 380-381). Thus, the object does not generate a sign, rather it determines the limitations of what a sign represents. Signs are constrained by the fact that they need to indicate the object within the mind of the interpreter, otherwise they cannot be considered signs.

According to Peirce, a sign is "something which stands to somebody for something in some respects or capacity" (Peirce 1931-66, 228). The only way in which a sign can operate in terms of standing for something else, is via the interpretant. The interpretant (interpretation) is another sign, or a psychological sign (thought or mental representation) that interprets or translates the sign that is presented. Anything can be a sign, symbol or signifying element if it is recognised as standing for (signifying) something else, other than itself (Peirce 1931-66, 172; Eco 1976, 16).

Peirce's terminology is somewhat confusing in that he refers to the whole communicative process or relationship of object, interpretant and representamen (signifying element or sign-vehicle) as a sign (Peirce 1998, 275; Warell 2001, 53), in addition to referring to the signifying element alone as a sign (Atkin 2013). Peirce's earlier works on semiotics and pragmatism (seen in Peirce 1998, 4-26, 208-225, 371-462) identify three types of sign vehicles: iconic, indexical and symbolic. The iconic sign vehicle or representamen demonstrates a direct relationship to some specific (physical) quality of the object in terms of

likeness. An indexical sign vehicle can be seen to possess a causal relationship to that which is being represented. In other words it *indicates* the particulars of an object (Peirce 1998, 7). An indexical sign vehicle bears a relationship with a particular fact about the object. For example, speed in itself cannot physically be seen. A car travelling at great speed can be seen, but speed as a concept is intangible and can only be visually represented in relation to properties such as measurement. Therefore, a speedometer represents speed according to numbers (miles per hour, or kilometres per hour), and speed is understood according to these properties. A symbolic sign vehicle is that which maintains some form of conventional connection between the sign and the object. The words "homme" and "man" were used by Peirce (1984, 53-4) to illustrate how through convention, language establishes connections between words and phenomena.

Lange (2001) combined Peirce's basic or simple model with Morris' (1971a and 1971b) theory of sign semiosis to explain the signification relationships between the elements of sign. This explanation can be seen in Figure 6.

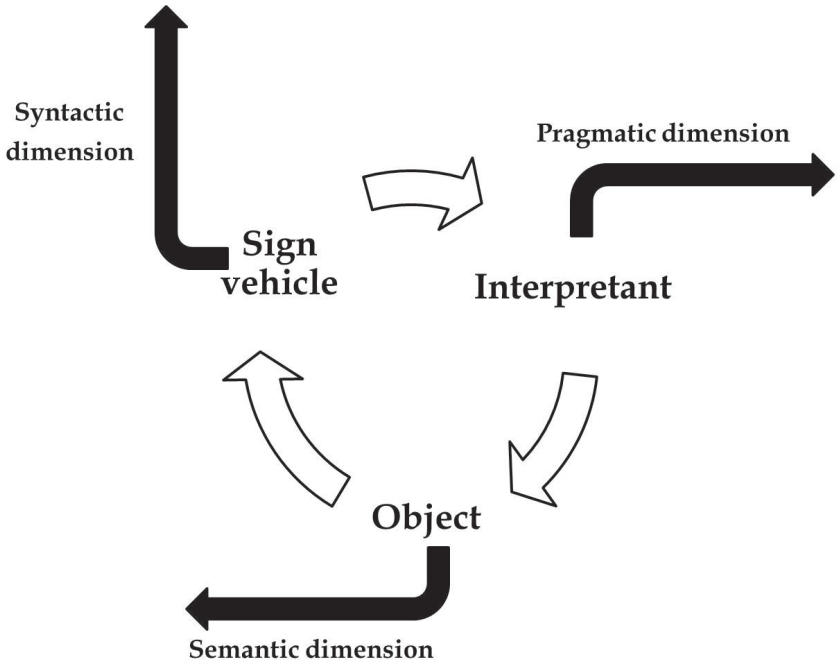


FIGURE 6 Adaptation of Lange's (2001) combination of models by Peirce (simple sign in "Sundry Logical Conceptions" 1998, 275) and Morris (1971a, 1971b)

Figure 6 illustrates how Peirce's triadic model can be interpreted in terms of communicative functions. The object represents the semantic dimension. The term semantic is defined as an adjective which refers to linguistic or logical meaning (AskOxford 2013e). Therefore, the semantic dimension relates to the dimension that holds meaning and significance in the sign relationship. The interpretant, pertains to the pragmatic dimension or the experiential dimension.

This is where individuals construct and interpret reality. Finally, the sign vehicle belongs to the syntactic dimension. Design objects for instance, are analysed in terms of their signifying nature as sign vehicles (Warell 2001). Design forms communicate a variety of simultaneous messages ranging from utility purpose, usability and functionality, to ideologies, values and status. Yet, it must be articulated that Peirce did not intend signs to be understood as specific types of objects, rather signification exists within the human mind – allowing for anything to be interpreted as a sign. Thus, it is this interpretation (interpretant) that *is* the sign.

The sign as a whole can be seen as the relationship between the presented and the represented – presentation and representation (Vihma 1995). The presentational and representational relationship is also complex, in that presentation occurs on the level of the object, as well as on the level of the sign vehicle. Further, representation occurs on the level of the sign vehicle and the interpretant (Vihma 1995, Warell 2001). The object in itself may refer to something else, which often inevitably occurs. This is what Peirce had referred to in terms of infinite semiosis (1931-66, 339-343). For this reason de Saussure's semiotic theory is discussed in the next section. At the core of Peirce's philosophy lay the idea that cognition and thought and even human beings in general are in essence semiotic (Nöth 1995, 41). Similarly to a sign, thoughts refer to other thoughts and ideas, as well as to phenomena in the external (physical) world. Peirce likened people to signs (Peirce 1931-66, 228). This is due to the fact that each thought represents a sign, constant thought or constant streams of consciousness are how people experience life, meaning that life and experience are essentially semiotic.

**Ferdinand de Saussure**

The work of Ferdinand de Saussure has by and large been applied to the study of language in the traditions of European structuralism. Unlike Peirce, de Saussure's theories are mainly concentrated on the specifics of language and its ability to convey concepts. Saussurean semiotics, or semiology, originated as the study of the role of signs in social life (Chandler 2013). It was intended to investigate the intricate nature of signs and principles determining them (de Saussure 1983, 15-16). In de Saussure's (1983) account of semiotics or semiosis, a sign exists as a two-fold entity: a signifier or sign-vehicle, and the signified or meaning (Eco 1976, 14). The signified can be interpreted as a mental representation, psychological reality and a concept (Eco 1976). In other words, the signified is the mental activity of a perceiver/message receiver in response to a signifier. The signifier, or sign vehicle, is the form in which the message takes shape (Chandler 2013). To de Saussure it was clear that a sign needs to possess these two basic elements of signifier and signified, in so far as a signifier cannot exist as a signifier without meaning, and the signified cannot be communicated or understood without a sign-vehicle.

De Saussure's semiotic theory is explicitly conceptually and psychologically oriented, in that he saw signs as expressing ideas, ideas in themselves being "mental events" (Eco 1976, 15). This is intriguing considering

that contemporary scholars often link his sign theory to materialistic understandings (Chandler 2013). Thus, the signifier is often attached to a material form. This is opposed to de Saussure's own understanding whereby both the signifier and the signified were conceptual (Saussure 1983, 12 & 14-15, 66). Where Peirce's model allows for anything to be considered as a sign, as long as it holds the power to signify, de Saussure's model recognises signs as being generated for the deliberate purpose of communication between people. Therefore, studies incorporating de Saussure's approach to semiotics always note as to whether a sign is intentional or unintentional (natural – which are not generally seen as deserving the title of sign, Eco 1976).

Of interest to this research in relation to what is discussed in the experience, psychology and cognitive science section, is that according to de Saussure (1983) the physical should not be considered a part of the sign at all. De Saussure gives an example demonstrating this understanding whereby a linguistic sign does not exist as the relation between an object and a name. Rather, the sign exists as a relationship between a concept and a sound pattern. The sound pattern is the perceived sound which mentally exists within the perceiver (for more about this see the sub-sections on mental contents and qualia). It is not the physical sound itself. Thus, a sound pattern is the mental impression of a sound as witnessed by the senses. In other words, de Saussure focuses on the link between mental impressions of sensory stimuli and the abstract elements of mental concepts, which comes quite close to Descartes' (1998) views on conscious experience and perception. This has also been referred to by Bertrand Russell (1927) in his theorisations of sense-data.

While this research views the material element of design and technological products as important within the UX experiential process, it also understands that experience is housed within the human mind. Human beings encounter designs which are also symbolic within themselves via sensory perception (sight, sound, taste, touch, smell). Information of phenomena is obtained through the senses according to relationships which are environmental, social and contextual etc. (see the sub-chapter on embodiment), but what is understood and how these sensory perceptions are experienced are highly subjective and psychological. Thus, de Saussure's theory of sign concentrates on this psychological relationship between sensory perception and conceptualisation of experience.

**Charles Morris**

Charles Morris' influences included Peirce and George H. Mead (1967, 2007), who had written extensively about matters such as social behaviourism and symbolic interaction theory, logical positivism, and American pragmatism (Morris 1970; Nöth 1995, 48; Posner 1981). As mentioned above, Morris (1971a) had strived for semiotics to be developed into a "Unified Science." While this has never materialised, some of his contributions such as his threefold semiotic theory dividing the sign into syntactic (sign vehicle), semantic (object) and pragmatic (interpretant) dimensions has been highly influential among scholars of semiotic aesthetics and iconicity theory (Nöth 1995, 98). In Morris' view,

semiotics extends beyond purely linguistic signs. Instead, semiotics includes perceptual and aesthetic signs, in addition to general linguistics and the practical use of signs (Morris 1971a).

Being influenced by Peirce, Morris' theories shared many similarities with those of Peirce. Notably, both theorists considered semiotics to be the study of any kind of sign, linguistic or otherwise (Morris 1946; Nöth 1995). Where Peirce had considered semiotics to be "a science of man" (Nöth 1995, 49) Morris broadened this towards signifying practice and sign systems of any biological organism (for example zoosemiotics). Morris concentrated on finding the connections between biology and physiology and sign systems, whereas Peirce centred his theories on thought (the mind). This example of the two semiotic approaches - biological-physiological versus mental – typifies what is also seen regarding theories in conscious experience (see the user psychology and cognitive science sub-chapter). Morris recognised that the significance of signs in human life was not purely psychological. Rather signs more specifically play an instrumental role regarding the physical wellbeing of all animals. This is particularly important when considering notions such as embodied experience, due to the fact that human beings, or technology users, also read and sense designs in terms of benefits and disadvantages (or harm). The case study on elevators in particular (featured in articles VI and VII), readily demonstrates how even unconscious registration of symbolic elements within the design's and surrounding architectural aesthetics contribute to feelings of safety and security.

Morris' three semiotic dimensions of syntactic, semantic and pragmatic serve to contextualise the components of a sign. The syntactic dimension was soon renamed syntax (Carnap 1937; Reichenbach 1947). Posner (1985) identified three definitions of syntactics or syntax in Morris' work. These include syntactics as the study of: 1) how signs and combinations of signs follow particular rules (Morris 1938, 14); 2) how different classes of signs may be combined in order to create compound signs (Morris 1946, 367); and 3) how signs are formally connected to each other, with consideration for syntagmatic and paradigmatic relationships (Posner 1982, 1985). According to de Saussure (1983), a syntagmatic relationship describes the positioning of a signifier and a paradigmatic relationship describes how a signifier may be substituted (p. 121). Syntagmatic relations intratextually make reference to other signifiers which are co-present in a text. Paradigmatic relations intertextually make reference to signifiers which are not present within a specific text (Chandler 2013).

Some key contributions to the study of design experience have adopted this syntactic approach to design semiotics. For instance, Vihma (1995, 2003), Monö (1997) and Warell (2001, 2004, 2008) use the syntactic study of "formal relations of signs to one another" (Morris 1946, 367) in order to deduce semantic understandings of how design products operate. Morris' semantic dimension refers to the study of the relationship between signs and the things or the phenomena they stand for (Morris 1971a). That is, semantics is the study of the meaning of signs. Pragmatics on the other hand, studies the relationship

between signs and those who interpret them (Morris 1971a). In its scope, pragmatics includes consideration for the origins of signs, their uses and the way in which they affect people's behaviour (Morris 1946, 219). This approach has been useful particularly when contextually analysing language and other semiotic systems.

Despite criticism towards Morris' account of pragmatics (see e.g. Cherwitz 1981 and Huber 1973), it contains relevance for studies in HTI and UX in particular as reflected in the work of Battarbee (2003), Battarbee and Koskinen (2005), Hassenzahl (2007), Karapanos, Zimmerman, Forlizzi and Martens (2009) and Karapanos (2013) to name some. It is in this instance that semiotic study can specifically be likened to studies in UX whereby "[p]ragmatism reveals itself in all its phases as a series of constantly deepening analyses of a single set of theses" (Morris 1938, 110). That is, the study of a person's mental interpretation of a signifying element is not simply investigating what a person has made of a sign, rather it includes all the influential factors that contribute to this interpretation (environmental - spatial, temporal, social, cultural, psychological, physical etc.). Likewise, the study of UX is not simply that of the interpretation of the design encounter within the mind of the user, rather pragmatic approaches to UX also include consideration for all the influential factors mentioned above.

### 2.1.3 Semiotic Analysis in HCI and Semiotic Engineering

The sub-section above has illustrated three major theoretical semiotic models. Each of these models represents practical applicability to the study and understanding of semiotics in UX. Peirce (1998, 275) highlights three core components of a sign – the object, signifying element (representamen), and the interpretant – as well as explains that anything that is recognised as being a sign, is a sign. This interpretation allows for the understanding of semiotic chains, i.e., if an object (which may not be a physical object, but also conceptual) is a signifying element in itself, the things to which these object initiated significations refer also reference other phenomena. The Saussurean understanding is specifically focused on the sign as a psychological signification process between the signifier, or the perceived sensory experience, and the signified, or the mental concept generating the experience. The Morrisian understanding, quite often termed as a behaviourist approach, situates semiotics in relation to three factors: 1) formal elements such as design form, artwork or linguistic expression, which are used to trigger a communicative process - syntax; 2) the object or idea to which the syntax refers - semantics; and 3) the influential factors that contribute to particular understandings and readings of that which is signified - pragmatics.

The question now pertains to how these theoretical models may be applied to semiotic analysis. Chandler (2002) states that semiotic analytic undertaking entails a researcher to examine beyond texts, practices and objects towards the underlying mechanisms of their operation. As with studies into consciousness, the subjective psychological component of signs can never

entirely be transferred from one individual to another. However, to increase awareness of how semiotic elements operate psychologically, a holistic approach must be adopted.

Peirce's semiotic model has gained popularity more recently in the field of design experience (Vihma 1995, 2003; Warell 2001, 2004, 2008; Warell and Young 2011; Karjalainen 2004). Theories such as Eco's (1976) Theory of Sign Production (TSP) have been used in areas such as Semiotic Engineering, as the basis of semiotic analysis of user interfaces (De Souza 1993, 2006, 2012) as has Peirce's basic semiotic model (Nadin 1988; Goguen 1999; Mullet and Sano 1995). Based on TSP, de Souza (1993) provides an illustration (seen in Figure 7) which depicts two alternative HCI semiotic scenarios.

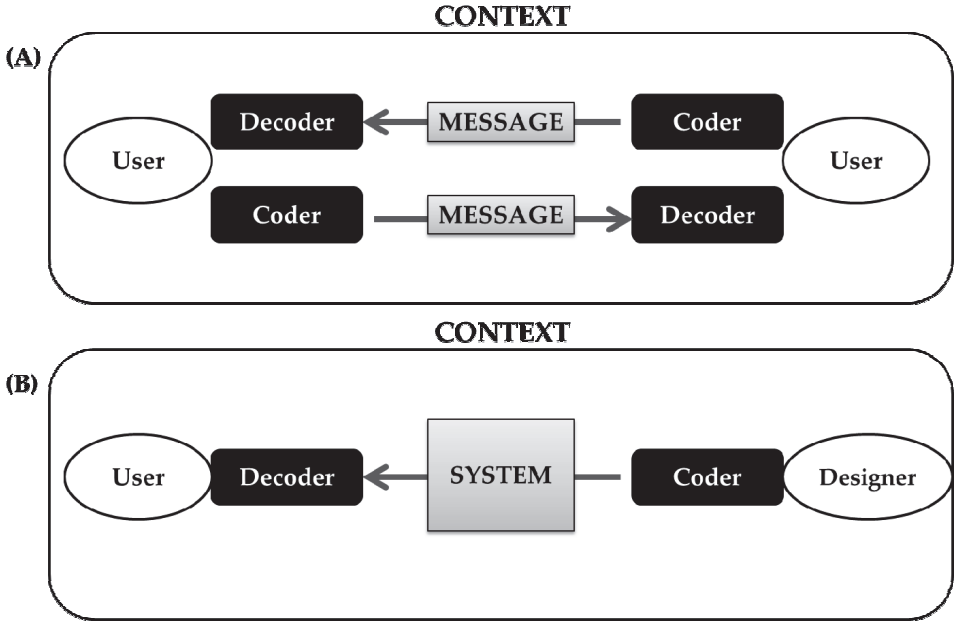


FIGURE 7 De Souza's (1993) possible communicative frameworks in HCI – (A) User-system communication; (B) Designer-user communication system

The diagrams in Figure 7 illustrate scenarios A and B. In scenario A HCI is interpreted as the interaction between users (user-system communication) – information technology design being the vehicle of communication. Here, both users (the programmer and the end-user) are message coders and decoders. Via symbols, the programmer literally codes explicit messages into the design which are then decoded by the end-user. Yet, subsequently, through usage and its associated behaviour and interpretation, the end-user also codes the design (implicitly and explicitly). Scenario B represents a one directional communication pattern from designer to user. Here, the designer is represented as the message coder and the end-user as the message decoder. The stance seen in scenario B would have been particularly significant in the HCI paradigm of

usability. However, in UX focus is especially placed on the user's ability to encode technology, through emphasising the importance of mental representations (experiences) in defining the design's identity and articulating relations. Further, as seen in both scenarios, the function, interpretation and ultimate meaning of the message is always reliant on context.

In the case studies described in this dissertation's articles scenario A can be seen as the analytic semiotic model. While in general, design products can be interpreted as the designer's materialised message to a consumer through providing solutions to everyday problems, the current case studies emphasised how users approached and interpreted design systems. From this semiotic approach of examining not simply UX, but the qualitative representation of UX as expressed by users, users on the one hand decode the designs through recognition and understanding, and also encode the products, psychologically and explicitly, through qualitative re-presentations of the products given during user evaluations. This act is almost always continued and repeated in less formal social interactions. To take this further, when reflecting on all three of the traditional semiotic models represented above, the signs generated through interaction with the studied design objects are ultimately psychological. That is, UX is both the psychological interpretation of the design being perceived, as well as the psychological construction of the design. The design is subsequently mentally decoded and encoded by the user. This *is* the user experience of design and technology.

Clarisse Sieckenius de Souza (1993, 2012, 2013) has been instrumental in demonstrating the relationship between semiotics and HCI. She stresses that the stagnated progress in applying a semiotic approach to studying and designing HCI has been due to differences in interests and view-points when choosing, applying and constructing knowledge within the respective fields. Thus, mutual understanding has been perceived as possessing more cons than pros (de Souza 2013) for researchers and designers. However, de Souza's theoretical and analytical models show how the knowledge from these multiple disciplines can be strategically applied to enhance the understanding of sense-making processes in technology interaction. The Semiotic Engineering (SE) approach treats software artefacts as artefacts of metacommunication (Souza, Barbosa and Prates 2001). Software designs are seen as "one-shot messages" from designers to users (Souza et al. 2001, 55) for the purpose of specific outcomes and effects. In the scope of SE interaction design is considered a two-level communication process: designer-to-user and user-system interaction. In essence, SE considers successful design as the ability to ensure that the user receives the *right* messages. In other words, from an engineering perspective it is concerned with eliminating arbitrary interpretations regarding a specific system in order to increase usability and overall ease-of-use.

SE quite practically observes the connection between system symbols, semantics and functions, recognising the dependence of users in understanding the metacommunication of IT systems to achieve desired end goals. As an evaluative framework, SE draws on theories by Peirce and Eco to understand

the various elements and levels involved in the information systems (IS) communicative process (Souza 2006). SE is specifically intended to bridge the gap between HCI, Computers Science (CS) and IS. The two latter disciplines are known for their criticism towards cognitive science and other HCI approaches due to the absence of mathematics in being the main informing discipline. Thus, SE uses semiotics in the traditions of linguistics and communication studies, to analyse interaction meaning of systems with broader consideration of influential factors (Souza 2006). SE has also been described as the process of establishing semiotic systems which are modelled from the human user's understanding, intelligence or knowledge with respect for the logic of communication and cognition (Holzinger, Searle, Auinger and Ziefle 2011; Zhao 2004).

This research differs from studies in SE in that it specifically focuses on the aspect of experience and ways in which mental representations and associated mental contents of experience can be studied through qualitatively articulated constructs. Thus, while similarly to SE there is the desire to understand how users interpret specific design elements and system languages, there is the additional desire to understand how users re-present these communicative factors, mentally and explicitly. This matter is expressed in the semiotic model of UX, presented in the sub-section below, which emphasises design as a process of constant re-presentation and interpretation. This model expands on Peirce's triadic theory, to introduce a quadratic model of design interaction. There are four elements in this model to express the multidimensional nature of a design product – for designs are not simply objects, rather material manifestations of designer, corporate and cultural ideas. The material forms themselves are conceptual.

### 2.1.4 Semiotic model of user experience

To apply semiotics to this study, a semiotic model needed to be formulated – or reformulated. As seen above, Peirce's basic semiotic model comprises the object or phenomenon (that is referred to), the signifying element (representamen) that refers to the object, and the interpretant (the mental sign or interpretation). Morris (1938) expanded on Peirce's model by claiming that semiosis comprises four components. These components are: 1) the sign vehicle or the phenomenon (object or event) that serves as a sign; 2) the designatum, which is the type of object that the sign designates; 3) the interpretant, which is seen as the disposition of an interpreter when they begin a response-sequence in reaction to perceiving a sign; and finally 4) the interpreter, the one for whom the sign-vehicle operates as a sign (Morris 1971a, 416). This model demonstrates the sign package, the nature of the phenomenon to which the sign refers, the reason for or circumstances under which a sign is perceived, and the perceiver of the sign.

Additionally, the semiotic model of UX, which has been developed specifically for this research, also possesses four components. These components reflect on the nature of the messages or sign vehicles in relation to the mind. Figure 8 illustrates the semiotic model of UX.

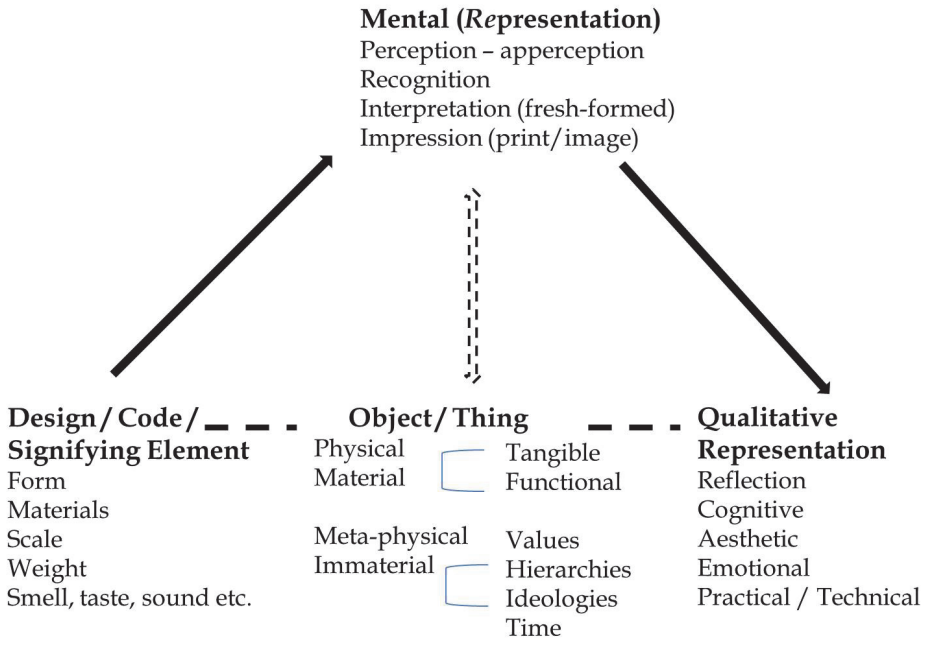


FIGURE 8 Semiotic model of UX

In the semiotic model of UX there are two sign vehicles. There is the sign vehicle generally considered within semiotic models such as Peirce (1998, 478) which can be seen as the design – this is the sign that often triggers the signification process in user evaluations (the presentation). This is the physical manifestation of the designer's (and arguably corporate-societal, or a common understanding) ideas of what an object should look like and how it should be represented. Then there is the sign vehicle which signifies the mental representation or sense-making component of the user. In other words, this second sign vehicle which takes on the form of qualitative (and arguably quantitative) responses from the user can be seen to refer to how the first sign vehicle is mentally experienced by the user. In this research the design/code/signifying element exists via tangible and observable qualities such as materials, form, scale, weight and comprises other sensual qualities such as smell, taste, sound etc. It is in this form that the message is coded and carried. The object, similarly to that of Peirce and Saussure (1983) is that to which the signifying vehicles refer. While existing on the conceptual level, the object comprises physical-material as well as meta-physical and immaterial elements.

For example, as a child I visited a maritime museum in which two engine pistons were exhibited. One was a car engine piston the other was that of a ship. The car's piston must have been approximately seven to ten centimetres long and the ship's over one and a half meters. By juxtaposing two of the same items

of vastly different scales (the composition of which is a signifying element), the viewer and in this case, ten year old me, is able to establish a comparative mental image of the vehicles in which these pistons belong. Thus, the viewer understands that these pistons are a part of a larger physical component, which is the engine. The engine drives an even larger vehicle – the car or the ship. If the car's piston is only approximately seven centimetres and this car is already large in relation to my ten year old body, then the one and a half meter piston of the ship must mean that the engine in which it is normally housed is most likely much larger than the car. In turn, the ship in relation to my ten year old body must be massive. To further explain the object as a concept, through reference to other sources such as text or prior knowledge, the viewer understands that both vehicles are physically intended for transportation. The car transports people on land and the ship transports people or goods on water. Thanks to Henry Ford, family cars in particular are the result of and symbol for mass production, they represent societal ideas of immediate communication and convenience as well as maximised productivity. Likewise, in their day, ships were also a major vehicle for global communication and represented the meta-physical values and qualities of technological superiority in terms of scale, materials, speed and operation.

The mental component can be exemplified in that as a child I was fascinated by passenger ships. In particular, I was interested in the Titanic and all its components. When viewing the piston and its size in relation to myself I was able to gain some relative insight into the size that the Titanic must have been in relation to me. I could imagine the pistons moving up and down in the giant engine as it 'sped' across the Atlantic. The piston material might have been copper, but it reminded me of all the fine brass trimmings that must have been present when walking through the decks above. I had visions of ocean, luxury and romance, all through viewing the piston of what most likely had been a cargo ship.

The way that this mental representation and experience was represented, was via a comment to my father: "That must be one big ship. Do you think it was from the Titanic?" This qualitative representation does not represent half of the mental contents that composed the mental representation or interpretant, but it indicates: a) that the sight of the piston and its comparison to that of a car initiated an understanding of the large scale of the ship; and b) that my mental image of or understanding of ships was based on the design of the Titanic. This experience is represented in the semiotic model shown in Figure 9.

The point of this semiotic model of UX is to understand, in practical terms, that other people's experiences of designs and interactions cannot be directly examined. Rather, in a semiotic study of UX researchers are dealing with two types of sign vehicles – explicit representations – that of the design, and that of the information delivered by the user in response to their mental sign (representation). The way that an object is perceived is in relation to already existing information contents in the mind. Meaning that, the object that is perceived in reaction to the interpretation of the design sign vehicle is most

likely different for every individual. The only real access that a listener, researcher or designer – which could be added as the fifth component of a UX sign – can obtain regarding a user's experience, is via their own mental representation or interpretation that is generated in reaction to the user's feedback or evaluation. Qualitative representations offer a descriptive insight into not the nature of mental contents (i.e. how the designs are experienced) but the types of contents the user experiences.

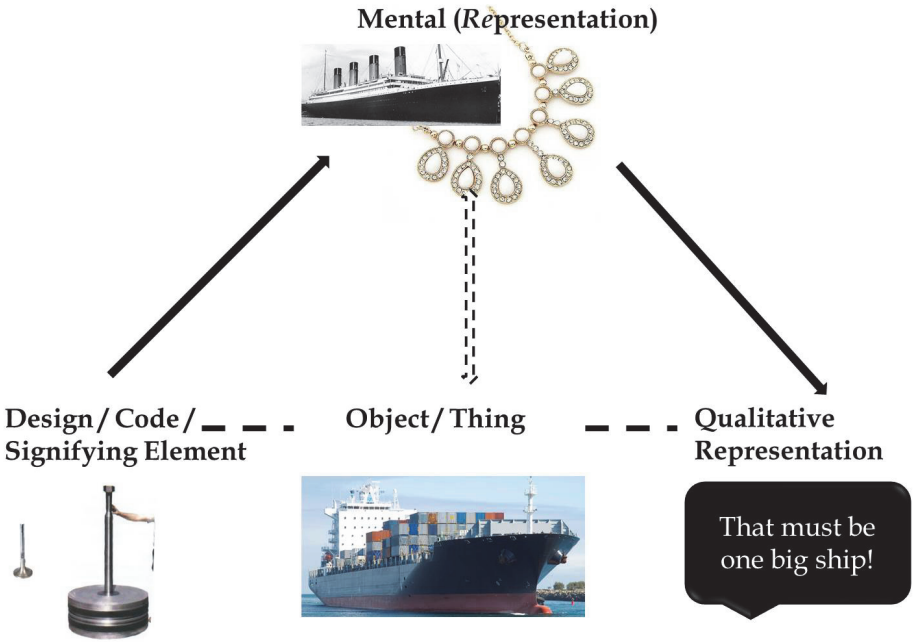


FIGURE 9 Semiotic model of museum artefact experience

Much work regarding similar issues represented in this model is taking place, particularly in the field of artificial intelligence (AI). Loula and Queiroz (2009) describe this fuzzy or flexible nature of mental representation, or the interpretant, as being a "symbol grounding problem" (p. 1545). In other words, scientists have recognised that the key to developing AI is via semiotics. In order to develop a device which is capable of thinking, the device needs be able to process signs. Yet, the challenge is that intelligent beings differ in their interpretations of signs, which means that the defining factor of intelligence is flexibility, multiplicity and diversification in the interpretation of signs and symbols[7] (Loula and Queiroz 2009). However, in order for human developers to

7 Interestingly Descartes also characterises the nature of the human mind as possessing the ability to connect signs and words. He posits that physical machines, even if created in our own liking with the function of uttering specific words with specific actions, can never re-arrange the words and actions to make new combinations, meanings and discourse (Descartes 2005). In other words, Descartes argues that

regulate and programme the machines for such complex signal processing, symbols need to be grounded.

This PhD dissertation does not present a research into AI, however the above example highlights the significance of this study in the context of contemporary HTI discussions. Overall, studies into semiotics are concerned with representation. In this model of the semiotics of UX, representations that are accessible for study are those of the design, and the empirical data given by users. In traditional semiotic models such as those by Peirce (1998, 275), de Saussure (1983) and Morris (1971a) the interpretant, or signified, serve to describe the interpretation or mental representation of the signifying vehicle in relation to the object or concept. But in these models the representation by the sign interpreter can be seen as both mental and explicit. There is no distinction between that which can be witnessed by a third party and that which is only attestable by the interpreter themselves. Perhaps what is intended in these traditional models is that another triangular sign process is triggered when an interpreter recounts their interpretation to another person. But, from a research and design perspective, this attestable representation of the interpretation or experience is of equal importance to consider, as it *is* what is studied and analysed when conducting cognitive scientific UX research.

The next sub-chapter describes user experience, it highlights the nature of UX in current HCI research and goes on to explain UX in terms of major theoretical models, experience itself and UX as a cross-cultural, or culturally based, phenomenon.

## 2.2 User experience

If I only had a dollar for every time a researcher stated that user experience (UX) is a "buzz word" in the field of HCI (or HDI in this instance). While trying to tiptoe around this cliché, it must be mentioned that UX has been the movement, or paradigm of study at the focus of much discussion over the past decades. UX is described as a phenomenon, a field of study, and a practice (Roto, Law, Vermeeren and Hoonhout 2011). The term UX has been used in place of for example usability, user interface design, the "wow effect", emotional usability, interaction design etc. It has also been used as an inclusive term of all of these concepts, plus more.

UX signifies a shift in user-design approaches, which strives to account for the broader questions at play when considering user-design interaction and usage. HCI research has developed from function and goal-oriented origins to a more holistic view on both matters which influence HCI, and the psychological factors at play before, during and after HCI (Hassenzahl 2001; Hassenzahl 2003; Hassenzahl and Tractinsky 2006; Roto et al. 2011). The multi-disciplinary nature

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human intelligence is typified by flexibility and the human mind's unique ability to re-present, and in so doing, re-interpret numerous combinations of signs.

of UX means that approaches and definitions are manifold, and because of this it is difficult to map out a definite illustration of the field's development. However, one trail of progression can be seen in 1996 when Lauralee Alben emphasised beauty (or aesthetics) as being an important quality of technology design. Thus, one critical paradigm shift which has accompanied UX is the identification of HCI factors which exceed instrumentality (Hassenzahl and Tractinsky 2006). Factors which exceed instrumentality include: surprise, intimacy and diversion (Gaver and Martin 2000). Further, all of these factors seek to develop a stronger bond between the user, the product and subsequently the company or brand.

Jordan (2000) takes an organised approach to explaining the hierarchy of user needs, whereby functionality and usability should be incorporated with differing elements of pleasure which include: physio, psycho, socio and ideo-pleasure. These ideas are accompanied by consideration for how the products should appeal to the user in general. In other words, the human user is an embodied being who experiences through information gained via a range of senses (visual, audio, tactile, taste, olfactory) and exists in a physical relationship to their environment, the products and other people. On the socio-pleasure level, people do not just exist in relation to other people, rather they thrive on the pleasure that is obtained through social interaction (Battarbee 2003; Battarbee and Koskinen 2005). As will be seen in the discussion on design semantics, designs (no matter what type) are means of communication. They communicate, and assist our means of articulation with and towards other people, conveying factors such as values, status, and identity to name a few.

Jordan's (2000) view on psycho-pleasure relates to people's cognitive reactions and cognitive demands of product usage. This is where usability factors such as ease-of-use play a role in influencing pleasurable experience. Everyday applications such as text editors and organisers which are easy to use enable higher levels of psycho-pleasure than cumbersome, illogical systems. Ideo-pleasure relates directly to the values that products engender. For example, a hybrid car such as the Toyota Prius does not just represent a fuel efficient car, it additionally represents values such as: concern for the environment, concern for preservation of resources, and even economic values (such as desire to save on petrol). Ideo-pleasure factors also play a major role when approaching the study of UX from a semiotic perspective.

Regarding the paradigm shift in HCI, we can more generally see concern move from the functional to the symbolic. In this respect, paradigmatic shifts the field of HCI can be seen to reflect overall trends in design research in general. Toni-Matti Karjalainen's (2004, 23) model of the fundamental paradigm shifts in consumption, product concept and design research seen in Figure 10 is useful as it illustrates these developments.

Karjalainen's model shows parallel paradigm shifts in consumption, product design and design research. On the left-hand side of the three pillared diagram consumption is shown as having progressed from mass production, to consumer voice and then ultimately experience. Product development has

progressed from functionality, to usability and then to pleasure, highlighting the current emphasis on hedonic qualities. Design research has moved from technics, to ergonomics to semantics (meaning). HCI and HTI seem to incorporate all of these features within their scope, reflecting the paradigm shifts from: the industrial production (mass production cannot be used here as ownership and usage of computers was mostly by large organisations – governmental and educational), functionality and technical triad; to recognition of the user, usability and ergonomics; and currently is in the triadic paradigm of experience, pleasure and semantics (Karjalainen 2004).

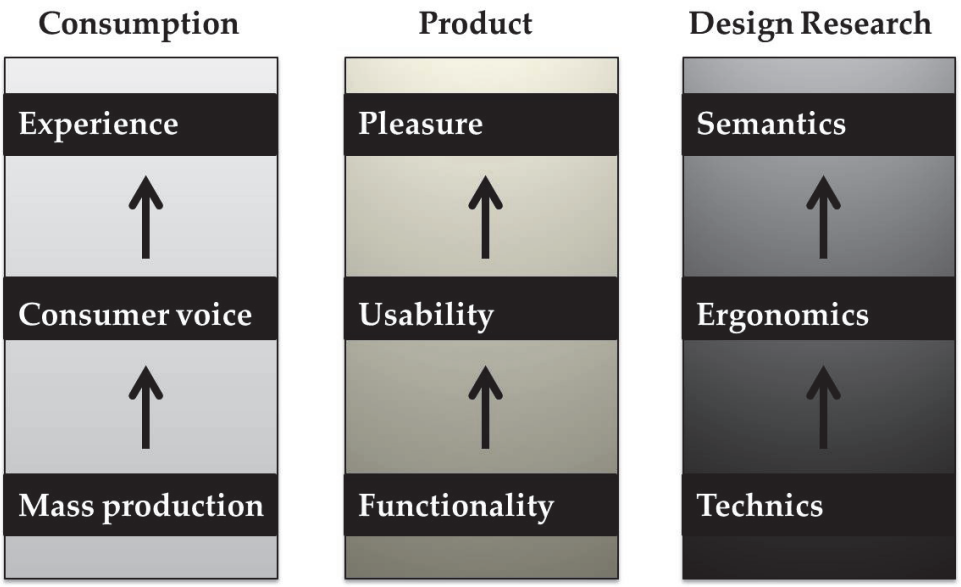


FIGURE 10 Fundamental shifts in nature of consumption according to Karjalainen (2004)

Regarding the paradigm shift, Hassenzahl (2003) mentioned that in the future HCI needed to place more emphasis on recognising the multitude of factors that contribute to interaction and ultimate experience. Back then, he noted that researchers and practitioners should consider: pragmatic factors in interactive products entailing its suitability for behavioural goals etc., hedonic factors (growth and development, knowledge and skills acquisition), identification (factors which express self and feature in interaction with others), as well as evocation (maintaining a sense of self and possessing memories) (Hassenzahl and Tractinsky 2006, 92). The identification factor is quite pertinent when considering UX from a semiotic perspective, as this is the dimension in which components are recognised and assimilated. This is vital for the process of establishing relationships.

It was Umberto Eco (1976) who said that all cultural processes, and undoubtedly cultural products (encompassing information technology and

other design), are seen as communication processes within the field of semiotics (p. 8). Thus, a major component of HCI (HTI or HDI) is identification, expressing and defining oneself to oneself and to others through products and what they communicate. This is in addition to identifying with groups or communities of people through these artefacts, what they stand for, and the ideologies reflected within their design. This observation resonates with Jordan's (2000) ideas on designing pleasurable products, as described above. This is one of the key features contributing to the user-product (or user-corporate) relationship.

The UX White Paper has identified three paradigms of UX, these paradigms relate to: 1) treating UX as a *phenomenon*, whereby parameters of UX are described in addition to identifying particular types of UX and explaining its conditions and implications; 2) viewing UX as a *field of study* in which the phenomenon is examined in terms of design methods, as well as how and what a person experiences; and 3) seeing UX as a *practice* which employs design and evaluation techniques such as prototyping, communication of desired UXs, and designing for specific experiences (Roto et al. 2011). Although, as with any form of categorisation, this research does not comfortably fit within any of these categories, it can be seen to relate more to UX as a field of study. This research is primarily concerned with how a person represents their experiences of design interactions, which is why a semiotic approach has been adopted. This interest spans across all the case studies explained in the articles.

Before moving on to the next section which highlights major models of UX, it is important to look at the word and notion of *experience* itself. The AskOxford online dictionary (2013d) defines "experience" as a noun (two types) and verb (two types). The first noun is defined as being "practical contact with and observation of facts or events…" This noun is further described as comprehension or competence which is gained from a period of exposure to something, usually in relation to professional practice. The second noun definition is that of "an event or occurrence which leaves an impression on someone." Experience as a verb is firstly described as the encountering or undergoing of something such as an event or occurrence. The second verb relates to feelings, emotions and sensations obtained through doing or encountering something. All of these definitions can be seen as relevant to UX research, and can be seen to somewhat reflect some of the different theoretical approaches taken by scholars and practitioners.

The main premise for analysing the term "experience" is to specify the view to experience which is taken in the study in question. What needs to be considered when approaching UX studies is how experience is considered. Is experience being treated as "an experience," the impression of a specific occurrence or interaction that can be re-called like a narrative with a beginning and an end? Or is the UX study in question referring to "experience" as a constantly flowing stream of consciousness and self-talk, making sense out of all situations and encounters (Dewey 1934, 1958; Forlizzi and Battarbee 2004, 263; Battarbee and Koskinen 2005, 7; Hassenzahl and Tractinsky 2006, 94;

Hekkert 2006, 158)? This view corresponds with the UX White Paper's (Roto et al. 2011) stance that researchers should specify the type of UX that is focused on and its time span which are defined as follows: before usage – anticipated UX – imagining experience; during usage – momentary UX – experiencing; after usage – episodic UX – reflecting on *an* experience; and over time – cumulative UX – recollecting multiple usage episodes. Cases can be made which separate and distinguish these varied notions of both experience and UX, but this current study takes the stance that *an experience* cannot be easily separated from *experience*. Based on this, psychological factors influencing pre-, current-, post- and on-going-use cannot be easily distinguished either.

Previous and on-going design experiences not only inform the ways in which we approach present and future interactions, but also affect the ways in which we re-call past experiences (Arhippainen 2010; Law et al. 2009; Wright and Blythe 2007). The reason for this is due to consciousness and the ever changing conditions of our psychological makeup. In this light, it is preferable to view UX as an impression of a design encounter or interaction, or even as a sentiment in Brave and Nass's terms (2007, 56), whereby *an experience* is not so clearly defined for its narrative qualities. I do not believe that we can express all "*an experiences*," or isolated experiences which occur at a moment in time (Whiteside and Wixon 1987), in a narrative fashion with a beginning, middle and end. Yet, in this research "*an experience*" means that an encounter or image of the design is etched in the user's mind, demarcating a specific feeling or thought obtained from the encounter. These impressions or sentiments are somewhat fluid in light of continuous conscious experience. As we live, encounter more products and accumulate more experiences, our needs and desires change (refer to matters on life-based design, i.e. Leikas 2009; Saariluoma and Leikas 2010, 2011; Leikas et al. 2013). Peirce emphasises time in his law of mind, stating that time poses the "continual increase of associations" (Peirce 2009, 128). This means that our sentiments of the experiences and products in question also change (Rhea 1992). Thus, rather than investing great lengths into the compartmentalisation of types of experiences and UX, this research focuses on the psychological properties and cognitive contents triggered in response to particular design interactions, in specific spatial-temporal contexts, from a semiotic perspective.

The following sections on UX can be treated as a literature review outlining the major models of UX, which are frequently mentioned to date. Following this, the culturally-bound nature of UX is explained in reference to cross-cultural UX. The sub-chapter on UX is concluded by describing experience, pragmatism and emotional aesthetic meaning-making in the field of UX.

### 2.2.1 Major models of UX

No matter which approach is taken to UX, whether it is as a phenomenon, field of study or practice, UX in general is expansive. Thus, undoubtedly some major scholars and theories will not be mentioned here. What is aimed at through this

section is to provide an overview of some key scholars and types of issues that have been considered to date in relation to UX. The discussion on UX has been broken down into parts explaining holistic approaches to UX (factors influencing HCI); non-instrumental qualities in UX; psychological approaches to UX (emotions, relationships, and perceived ease-of-use); and social approaches to UX (co-experience). Within these sub-sections, scholars are used to exemplify work undertaken regarding the respective approaches. But, this by no means should be used to categorise their work in general, as can be observed in UX research, the topics and approaches that practitioners and researchers adopt are almost as broad and versatile as UX itself.

**Holistic approaches to UX**

One of the key features defining UX as a paradigm shift in HCI research is its holistic approach to interaction. The holistics of UX can be considered in terms of treating UX as a broad approach to studying HCI, or using holistic approaches to define and describe UX. Relating to the latter, there are many attempts to create a complete picture of UX, and generally these are undertaken by a key group of scholars (this is not all inclusive and in no particular order): Marc Hassenzahl, Katja Battarbee, Ilpo Koskinen, Shannon Ford, Jodi Forlizzi, Noam Tractinsky, Virpi Roto, Effie Lai-Chong Law, Kaisa Väänänen-Vainio-Mattila, Arnold Vermeeren, Joke Kort, Mike Kuniavsky, Mark Blythe and Sari Kujala to name some. Some points of reference for many UX researchers include: "User Experience – A Research Agenda" (Hassenzahl and Tractinsky 2006); *Towards a UX Manifesto* (Law, Vermeeren, Hassenzahl and Blythe 2007); "Understanding, scoping and defining user experience: a survey approach" (Law et al. 2009); *Observing the User Experience – a practitioner's guide to user research* (Kuniavsky 2003); and "User Experience White Paper – bringing clarity to the concept of user experience" (Roto et al. 2011).

Hassenzahl and Tractinsky's (2006) "User Experience – A Research Agenda" maps out the traditions and viewpoints contributing to the field. This article can be seen as providing a holistic perspective on UX. It emphasises *a* UX, or experience, as an ephemeral and dynamic transaction of numerous factors that come together at one specific moment, in one specific place. This dyadic characteristic of technology use comprising temporality and situatedness is superimposed by a triadic model (see Figure 11) featuring components such as: beyond the instrumental (hedonic qualities in design), emotion and affect, and the experiential (both of which are mental factors, yet the experiential may be related to others). Beyond the instrumental is composed of holistic, aesthetic and hedonic factors. Emotion and affect is composed of subjective, positive, antecedents and consequences. Finally, the experiential is seen as dynamic, complex, unique, situated and temporally bound. The main argument within this article is that in order to properly examine HCI, studies need to take place in real usage situations and environments. This is due to the fact, that elements located outside the user and the device also play a major role in shaping the interaction and its experience. For instance, an interface using voice recognition may seem like a good idea in a laboratory, and may even gain

favourable feedback in a controlled test situation. However, once it is utilised in a noisy subway station or on a bus, it may cause numerous problems such as the inability to recognise the user's voice, and inability for the user to hear the device's cues. Subsequently, these usability problems affect the overall user experience by inducing emotions such as frustration and annoyance.

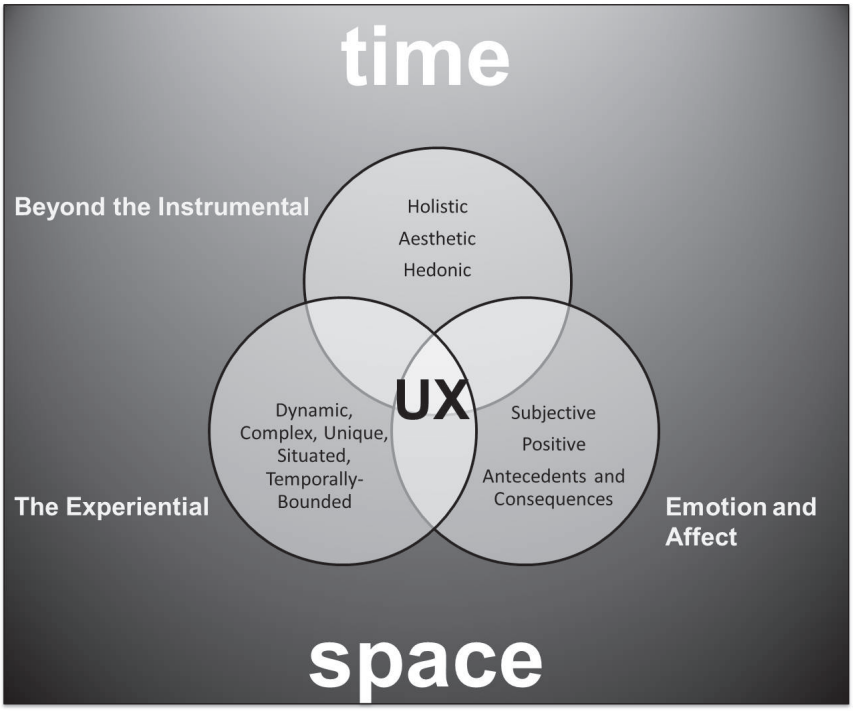


FIGURE 11 Adaptation of Hassenzahl and Tractinsky's (2006) Facets of UX

In this light, Battarbee and Koskinen (2005, 5) describe UX as both subjective and holistic serving as an intersection between utilitarian and emotional factors. Battarbee and Koskinen emphasise the fact that no matter what the approach, emotion is always a factor of consideration when examining UX. They also name three types of UX scholarship: measuring, empathic and pragmatist. Measuring can be seen in light of the above mentioned UX as practice, whereby methods are developed to design and evaluate UX. In particular, evaluative tools have been developed to measure UX via emotional reactions and physiological responses such as changes in galvanic skin response and facial expressions in conjunction with subjective reports (Gonzalez, C., Collazos, Gonzalez, J., Toledo and Blanco 2012; Jordan 2000; Shi 2007). The emotion measuring instrument PrEmo was developed by Desmet (2002), comprising 14 different animated characters which represented varying emotional responses. Experiment participants were able to create emotional profiles by selecting relevant emotional expressions in response to specific design aesthetics. Empathic approaches refer to the motivations, dreams and desires of the user and how these should be matched by product design (Dandavate, Sanders and

Stuart 1996; Black 1998). In this approach, designers are supposed to observe and feel on behalf of the users (Mäkelä and Fulton Suri 2001; Kankainen 2002). Thus, the user's emotions are not the sole focus of consideration, but so too are the emotions of designers.

Finally, Battarbee and Koskinen's (2005) description of the pragmatist approach, can be seen in light of both the ephemeral interaction of numerous dimensions (mental, spatial, temporal) − components that are illustrated in Hassenzahl and Tractinsky's (2006) model − as well as the psychological meaning-making models (i.e. McCarthy and Wright 2004; Dewey 1934; Wright, McCarthy and Meekison 2003), that will be discussed in the sub-section on experience, pragmatism and emotional aesthetic meaning-making of this sub-chapter. The main emphasis of this approach draws on pragmatist philosophy, highlighting the nature of experience as a momentary construction borne from "interaction between people and their environment" (Battarbee and Koskinen 2005, 7).

Wright et al. (2008) describe a holistic approach to UX as one of three main approaches: 1) holistic, 2) continuous engagement and sense-making, and 3) relational or dialogical. These roughly correspond with the approaches outlined in this chapter. In particular, Wright et al.'s description of the holistic approach is that the sensual, emotional and intellectual play equal roles in experience (2008, 18:4). It has been recognised that UX comprises not just cognitive and intellectual (rational) aspects, but also emotional and sensual. Thus, when considering UX there is the need to consider both the mind and the body (Petersen et al. 2004). This is where a pragmatist approach is useful. Pragmatism investigates the interrelations of a person's experience as a whole in terms of actions, senses, thought, emotions and meaning-making within a specific setting (Wright et al. 2008, 18:4). Additionally, people perceive and sense their own actions. This consideration is what Dewey (1958) terms as "an unanalysed totality", in which experience exists through the dynamic interaction of ever-changing relationships between people, other entities and artefacts, environment and context.

Here, a holistic approach to UX comprises a sensual thread, emotional thread, spatio-temporal thread, and compositional thread. The sensual thread describes how the body engages via the senses in every encounter experienced by an individual. Sensory input provides the tangible viscerable part of experience. It is through the senses that our experiences are initiated – via smells, visuals, sounds, tastes and tactile sensations stimulate experience pre-reflectively. Through the senses we are reminded that we have a body (Hekkert 2006; Wright et al. 2008). The emotional thread serves a judgment function. Here, emotions are instrumental in evaluating phenomena (people, artefacts and situations) and prioritising them in terms of needs and desires. Empathy is a key tool in that our emotions do not simply operate in isolation, rather they function in relation to other people's emotions and feelings triggered in connection to particular phenomena and events. There is an intricate relationship between the senses and emotions. Wright et al (2008) talk of

emotional satisfaction in terms of sensual constraint – this may mean refraining from instant gratification that would for example be experienced by eating a chocolate cream bun that smiled at you as you walked by the bakery. Instead, you feel a sense of pride in knowing that you have not just indulged on 219.9 of empty calories. This, reflection on restraint is interesting as up until this point it works in opposite to what many scholars and designers have been hoping to achieve with UX (stronger emotionally driven consumption). However, it is highly related to what Jordan (2000) has termed as psycho-pleasure.

The spatio-temporal thread demonstrates how experiences always exist at specific moments in time at specific locations, even if they are internally stimulated experiences. These internally stimulated experiences are those which are driven by mental contents alone and internal stimuli. Wright et al. (2008) talk of distinctions between private and public space and relate this to comfort zones between the self and another, in addition to accounting for temporal factors such as present and future. This matter is instrumental as it motivates willingness to engage for example. In research undertaken on HCI matters such as e.g. technophobia (Juutinen 2011), we see people's unwillingness to cross the boundaries to engage with information technology based on negative beliefs and prior negative usage experiences. This operates in the same matter with regards to interpersonal relationships between people. Relating to what has already been described regarding "an experience," the compositional thread presents the narrative structure of an experience. It is through this narrative (mental and rhetorical) that experiences are made sense of in accordance with relationships, whereby things, people and situations are understood in connection to one another. This also delineates the 'who,' 'what' and 'how' of an experiential interaction.

Control and agency are also mentioned as critical components of the compositional thread (Wright et al. 2008). For instance, the feeling of control maybe a desired component of experience: in the elevator interaction case study, interview data revealed that people felt more positively towards the design experience if they knew they had control over the vehicle (they understood the control buttons and felt comfortable it the vehicle's operation). Likewise, consumers may enjoy personalised consumption and expression through products such as mobile phones and tailor-made clothing, not simply because these designs reflect them, but because they feel that they have controlled the outcomes of the products.

These were just some examples of how holistic approaches to UX have been interpreted. There has been mention of the way that scholars have worked towards holistically defining UX as a field, phenomenon and practice, in addition to viewing UX as a holistic approach to HCI. UX represents a turn in HCI away from pure task-fulfilment towards holistic consideration for universal human needs which include issues pertaining to psychology and the social-relatedness (Diefenbach and Hassenzahl 2011; Hassenzahl, Diefenbach and Göritz 2010).

**Non-instrumental qualities in UX**

Often in conversation people refer to UX in terms of notions of fun, surprise and the "wow factor," which possibly can be attributed to important contributions such as *Funology – from usability to enjoyment* as a part of the *Human Computer Interaction Series* (Blythe, Overbeeke, Monk and Wright 2003). With these conceptions of fun and surprise, also come ideas of the non-instrumental. That is, attention is drawn to qualities which exceed instrumentality: they do not necessarily serve a functional purpose, yet are appreciated by a user when encountering a design (Tractinsky 1997; Hassenzahl 2003; Hassenzahl and Tractinsky 2006). Non-instrumental qualities include: fun, surprise, intimacy, pleasure, beauty, ludic and diversion (Draper 1999; Gaver 2002; Gaver and Martin 2000; Jordan 1998; Mahlke and Thüring 2007). These non-instrumental qualities were stressed in Jordan's (2000) hierarchy of user needs in terms of enhancing users' interactions with systems. Rafaeli and Vilnai-Yavetz (2004) proposed the consideration of three quality dimensions, which included: instrumentality, symbolism and aesthetics. In the case of this research, symbolism and aesthetics are of particular interest from a semiotic and emotional perspective. In fact, it seems misleading to refer to the above mentioned factors which enhance user-system relationships as "non-instrumental," due to the fact that they are instrumental in instilling notions of usability, ease-or-use, motivation etc. within the user.

In other words, if scholars and designers alike have recognised the importance of features which communicate and project different types of aesthetic schema, they are not non-instrumental at all. They are instrumental in that they: 1) entice a user to engage in interaction (Angeli, Sutcliffe and Hartmann 2006; Overbeeke, Djajadiningrat, Hummels and Wensveen 2002); 2) induce a sense of capability within the user – they feel as if they can utilise the design (Lavie and Tractinsky 2004; Tractinsky, Katz and Ikar 2000; Tractinsky and Zmiri 2006); 3) allude to a sense of quality and thus trust within the user (Dion, Berscheid and Walster 1972; Norman 2002, 2004); and 4) instil a sense of identification – the user (or potential user) can recognise the product, and when using it they identify with and through it, which consolidates the user-design relationship (Hassenzahl 2003). Jordan (2000) stipulates that pleasure in design interaction is reliant on all three of "the emotional, hedonic and practical benefits associated with products" (p. 12).

With all this said, Diefenbach and Hassenzahl (2011) identify an issue called the *Hedonic Dilemma*. In their article they explain that while people are attracted to hedonic attributes in products, they still feel the need to justify their choices through reference to functional or pragmatic characteristics. They refer to studies such as one by Okada (2005) in which participants, given the option of a 50 dollar gift certificate to a high-end restaurant, or a 50 dollar grocery coupon, mostly chose the grocery coupon, even after rating the restaurant gift certificate as more attractive. This is claimed to be due to the justification process, whereby people feel the need to justify choice according to rational criteria. Despite the scholarly recognition of the importance of hedonic

properties within product design, consumers in general find it more difficult to rationalise the importance of these properties. So, while it is academically accepted that designs need to not just function and be operable, but to aesthetically appeal to a user in order to project its functionality, usability and social relevance (Hassenzahl and Monk 2010; van Schaik and Ling 2008, 2011), consumers still conceptualise hedonic qualities in relation to luxury, self-indulgence and even guilt (Diefenbach and Hassenzahl 2011; Kivetz and Simonson 2002; Prelec and Loewenstein 1998; Strahilevitz and Myers 1998).

**Psychological approaches to UX**

Experience is a psychological phenomenon, and many scholars have approached UX from this perspective (Forlizzi and Battarbee 2004; Jordan 2000; Hassenzahl 2003; Lavie and Tractinsky 2004; McCarthy and Wright 2004). In particular, crucial to our understanding of UX is the mental experiential event. This occurs as the result of numerous interacting factors which include: sensorial input (the five senses), cognition (thinking and acting), affect (emotions and feelings), temporality (time), spatiality (inhabited space), relationality (social relationships) and corporeality (the body and physicality) (Coxon 2007; Hassenzahl and Tractinsky 2006; Wang, Young, Love and Coxon 2013).

Some psychological approaches to UX can be noted as: 1) the role of emotions in forming memorable experiences and affective relationships between product and brand; 2) the role of positive emotion in enhancing usability, or perceived usability; 3) identification and articulation through design and brand consumption; and 4) usage intention and facilitation of design in achieving (social) ends (Diefenbach and Hassenzahl 2011). For instance, using Facebook is not usually about using the application. Rather, it is a medium for communication and self-expression between individuals. Thus, it is acknowledged, that UX design is not all about the design itself, rather what the design should be doing to assist its user in everyday situations and social interactions.

As mentioned in the holistic UX section, emotions are considered in all accounts of UX. Emotions are one of the key factors which define a UX study, from that of general usability. Hassenzahl (2006) notes that there are two ways of approaching the factor of emotions in UX, these include: 1) emphasising the role of emotions as a result of product use (Kim and Moon 1998; Desmet and Hekkert 2002; Hassenzahl 2003; Tractinsky and Zmiri 2006); and 2) observing the role of emotion as antecedents of engaging in product use and evaluating design (Norman 2004; Singh and Dalal 1999). Thus, of importance here is not simply the emotion that is instilled in the potential user by the design, but rather, the mood that a person is in before encountering the design (Hochschild 1990).

In a special issue editorial on design and emotion, Desmet and Hekkert (2009), list publications which have served as crucial contributions not just to the understanding of the role of emotions in design interaction, but to the experiential design and consumption paradigm in general. These seminal

works have included: *The Experience Economy* (Pine and Gilmore 1999); *The Dream Society* (Jensen 1999); *Affective Computing* (Picard 1997); the previously mentioned *Designing Pleasurable Products* (Jordan 2000); and of particular interest regarding the psychological effects resulting from the lack of consideration for the user and broader interaction factors is *The Inmates are Running the Asylum* (Cooper 1999). This last publication discusses the negative psychological effects caused by badly designed user interfaces. It highlights the fact that most of the technological products available on the market at the time of publication generated feelings of inadequacy and frustration within the user due to usability difficulties. Thus, emotional experiential content is triggered not solely by hedonic qualities, but also by the quality of pragmatic factors.

One major topic regarding the psychology of UX is the link between aesthetics, perceived usability and actual usability. Norman (2002) stated that "attractive things work better," in reference to product performance. To expand upon this notion, significant studies have also been undertaken in regards to perceived usefulness and usability by scholars such as Adams, Nelson and Todd (1992), Davis (1989), Tractinsky et al. (2000), as well as Hassenzahl and Sandweg (2004). Davis (1989) defines the notions of perceived usefulness and perceived ease-of-use. Perceived usefulness is described as the way in which a person believes that a device (design) will assist them in performing tasks and enhancing performance. Perceived ease-of-use describes the way in which a person believes a system will be utilised with minimal effort and learning. By definition, the word "ease" means without difficulty or exertion. Davis (1989) suggests that devices which are perceived as being easier to use, are more likely to be favoured than devices which appear complicated.

It is research such as Tractinsky (1997) and Tractinsky et al. (2000), Norman and Ortony (2006), and Hassenzahl and Sandweg (2004) which combine these two notions of beauty, or aesthetics, and perceived usability. These studies show that not only are people more inclined to use products they are aesthetically attracted to, but, firstly they are attracted to devices which aesthetically project ease-of-use (free from clutter and excess functions etc.). Then secondly, these scholars note that devices which are experienced as more attractive *are* easier to use. This reinforces the idea, both for design as well as for the investigation of psychological factors influencing UX, that hedonic and pragmatic factors need careful attention (Hassenzahl 2007). In addition to enhancing people's perceptions of ease-of-use, willingness to use, and strengthening the emotional bond between user (community) and product (company and brand), emphasis on experience also has greater outcomes. Experiential outcomes of design engagement can be seen to have a positive effect on personal well-being (van Boven and Gilovich 2003; Hassenzahl 2007). Thus, in addition to usefulness, products may be designed to enhance affective quality (even life quality) and assist in the regulation of affective states (for instance, see discussions on life-based design in Leikas 2009).

**Social approaches to UX**

Although it has been repeated in this dissertation that experience is psychological, it must be articulated that UX does not simply exist in a vacuum within the individual. Rather, it is generated and manifested in social interaction. The social nature of UX has been discussed and examined by numerous scholars including: Battarbee (2003); Battarbee and Koskinen (2005); Forlizzi and Battarbee (2004); Gentile, Spiller and Noci (2007); and Jakobs, Fischer and Manstead (1997). There are three main streams of approaching UX from a social perspective. Firstly, there is the notion of "co-experience" (Battarbee and Koskinen 2005), a social quality of UX which enhances interaction, not just between user and product, but rather, between users via the product. Secondly, there is the approach of observing UX as a social manifestation – that is, product (design) meaning, and thus experience (and pre-experience), is generated through social interaction (creative and otherwise) and word-of-mouth (Duan, Gu and Whinston 2008; McCarthy and Wright 2004; Mäkelä, Giller, Tscheligi and Sefelin 2000). Thirdly, there are design strategies which strive to design for experience via designer engagement in social interaction with users (Kankainen 2002). This social method is used as a tool to gain deeper understanding of and empathy for the user perspective.

Wright et al. (2008) discuss a relational or dialogical approach which can be likened to these social ways of treating UX. Here, they mention that experiences are generated through a multitude of value systems, or reference points, as well as through perspectives involving the self, the object and the setting in which the interaction takes place. The experience is generated through numerous voices and perspectives. In this instance, it is claimed that the design can never be finalised. In other words, designs will always remain incomplete in themselves, as they require people and their interactions to give them meaning and define their experiential qualities. This seems to relate quite strongly to what has been studied in relation to multi-media mobile phones (Battarbee 2003; Battarbee and Koskinen 2005; Koskinen 2003; Kurvinen 2003) and social media. Arguably, and particularly from a semiotic perspective, an object in itself does not possess meaning as it is the mental interpretation of the person perceiving the object who creates this meaning (Peirce 1998, 497). Further, some designs such as those facilitating social exchange and content sharing (e.g. Facebook and Youtube etc.) are not even complete products without the users' input. Furthermore, experience happens in relation to not what the design in itself represents, but what is represented inter-relationally through social interaction afforded by the design.

Battarbee and Koskinen (2005) define three social types of UX, these are: lifting up experiences; reciprocating experiences; plus rejecting and ignoring experiences. In lifting up experiences, people are defining experiences, or turning "subconscious[8]" (unconscious) experiences into "an experience," or

8 The use of the term "subconscious" has largely been avoided in this dissertation due to the criticism it attracts in fields such as psychoanalysis (see e.g. Freud 1978). For

what are recognised as conscious experiences. This is discussed below in the section on consciousness, whereby unintentional or non-representational experiences, become intentional or representational as a result of social interaction. Social interaction not only shapes the way we experience design or phenomena in general, but it also makes us aware of the experience. In this respect, Battarbee and Koskinen (2005) mean that specific things and events are lifted from streams of experiences when they are discussed between people. Therefore, through social interaction, encounters, things and events are made meaningful. In the case of reciprocating experiences, once an event or encounter has been isolated from the stream of experiences, people respond to and evaluate the experience. That is, in a course of social interaction, once one person has mentioned a specific thing or event and shared their experience, others engaged in the social interaction reciprocate by sharing their own experiences and perspectives on whatever is being discussed. They share views and experiences, or possibly, without direct experience, share sympathy (Battarbee and Koskinen 2005; Koskinen, Kurvinen and Lehtonen 2002; Mauss 1972; Licoppe and Heurtin 2001; Taylor and Harper 2002).

In cases where experiences are rejected or ignored, those who are recipients of the experiential re-collections downgrade or reject the claims of those who are sharing their experiences (Battarbee and Koskinen 2005). In these instances, experiential information which is shared may be perceived as too familiar, offensive or simply uninteresting. But in these interpersonal interactions UX falls short of becoming socially manifested. Perhaps, the manifestation has already occurred in previous social interactions, and will be continued in others. However, in the case of rejection and ignoring, the experience as a social manifestation arrives at a 'dead end' so to speak.

No doubt numerous other perspectives exist, but in general social approaches aim at demonstrating the social nature of experience through discursive meaning-making. In fact, it was Dewey (1934) who highlighted that thinking of experience in terms of subjectivity is a modern way of conceptualisation. He states that:

> "To the Greeks, experience was the outcome of accumulation of practical acts, sufferings and perception gradually built up into… skill… There was nothing merely personal or subjective about it." (Dewey 1934, 198)

In this research, UX is considered psychologically and cognitively as a composition of mental contents, based on interactive encounters and resulting from the interplay of a numerous factors (namely mentioned in the holistic approaches section). However, experience and significance particularly of design phenomena and specific events is highlighted (lifted), shaped, and manifested socially.

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this reason, "unconscious" has been preferred and used to describe unrepresented mental states and contents (see Searle 1983; Chalmers 2004).

### 2.2.2 Cross-cultural issues in UX

Based on what has so far been discussed, the relevance of considering UX from a cross-cultural perspective should already be apparent. Design is cultural – it is culturally situated, culturally practiced and through the lenses and senses of culture, culturally perceived, interpreted, experienced and recalled. Language and symbols that we use to identify, classify, operate, evaluate and once again, recall the design products are for the most part culturally bound[9]. Culture is social, historical, geographical, psychological and embodied. It affects the entirety of our aesthetic experience. To not consider culture (national, religious, linguistic and communal/societal cultures, i.e. the Roma community in Finland) and deeply embodied issues such as race, disabilities, age and gender[10] at any stage is to dismiss a crucial component of our mind-body experience.

Culture is complex, and as with any other term mentioned in this dissertation, cannot be represented by one unified definition. The AskOxford dictionary (2013b) provides three noun definitions of "culture," and one verb. These include: 1) culture as the arts and collectively regarded manifestations of human intellectual achievement (e.g. design); 2) customs, ideas and behaviour demonstrated by people from particular societies or communities; and 3) the cultivation of bacteria or tissue cells in biology. The verb definition refers to cultivating plants. Traditionally the word 'culture' in French, or more directly 'cultura' in Latin, referred to growing or cultivation. Likewise, in late Middle English (early 16th century) culture also meant the cultivation of soil. It was not until the early 19th century that culture began to imply the cultivation of the mind – faculties and manners.

A cross-disciplinary definition of culture has been provided by Kroeber and Parsons (1958) who state that culture exists as transmitted and generated content in addition to patterns of value, thought and ideas, and further symbolically meaningful systems. These factors shape people's behaviour, in addition to shaping the artefacts that are created through this behaviour. Thus, when referring to culture we are not purely referring to national culture (as quite often understood in cross-cultural UX studies). Instead, what is referred are the ways in which people are psychologically, socially and behaviourally cultivated. Extensive work has been undertaken in the fields of social and cultural psychology, which investigate matters such as the way in which culture shapes people's world view (way of positioning and mentally representing phenomena), sense of self and means of expression and behaviour

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9 The non-cultural or mental component of sign systems is explained in the sub-chapters on semiotics, as well as user psychology and cognitive science.

10 Compelling arguments regarding the embodiment of race in everyday social engagement and experience can be seen in the works of authors such as George Yancy (2008, 2012) and Clevis Headley (2008) who discusses racial experience from an ontological perspective. Discussions are also taking place in relation to embodiment and UX in relation to people with disabilities (MacLachlan, Mháille, Gallagher and Desmond 2012; Hussain and Keitsch 2005, 2007, 2010). These studies use semiotics as a means of explaining user interpretation and experiential design qualities, in addition to embodied UX.

(Lonner 2000; Matsumoto 2000; Smith, Bond and Kağitçibaşi 2006). Of relevance to this research and included in articles not attached to this dissertation, have also been theories by Lev Vygotski (2012), Benjamin Whorf (1941, 1956) as well as Brent Berlin and Paul Kay (1969), who have investigated the relationship between culture, language and thought. It is important to remember that these aspects contribute to shifts and differences in matters which shape lived experience.

Increasingly more scholarship is taking place regarding the cross-cultural comparison of design preferences and UX (Cyr 2008; Cyr and Trevor-Smith 2004; Marcus 2006; Marcus and Gould 2000; Tractinsky 1997). Many UX studies have directly applied theoretical models comprising cultural dimensions to their own cross-cultural evaluative framework (see e.g. Marcus 2006; Marcus and Gould 2000; Cyr and Trevor-Smith 2004). The dimensions can be useful, but need to be used with caution. The range of dimensions on offer should properly be considered in relation to how appropriately they fit to the field of study in question (what is relevant for organisational contexts is not necessarily relevant for personal HDI). Studies which paved the way for establishing cultural dimensions (i.e. Hall 1980; Hofstede 1991, 1993, 2001; Kluckhohn and Strodtbeck 1961; Parsons and Shils 1951; Schwartz 1994; Trompenaars 1993) are also spatio-temporally, geographically and culturally located. This means that they too exhibit interpretative bias based on the researcher and those who are represented (mostly in organisations). Additionally, these pose fixed notions of cultures and cultural characteristics which do not and cannot hold, in that cultures constantly change over time (Harvey 1990; Inglehart 1997; Inglehart and Baker 2000; Stewart 1955).

One important matter is that the identification of cultural characteristics is problematic in that there is no accurate tool for measuring a culture's implicit levels (Straub, Aristo, Karahanna and Strite 2002). This is why theories on cultural dimensions have been developed. However, Lee et al. (2008) recognise the fallibility in directly applying just one set of pre-established cultural dimensions to UX research. They extensively outline the existing cultural dimensions, in order to assess the applicability of a new set of cultural dimensions specifically aimed at studying cross-cultural UX. In all, Lee et al. (2008) identify 36 cultural dimensions, which are presented in Table 1. In order to determine which cultural dimensions would be most relevant for studies of UX, Lee et al. (2008) conducted expert interviews in four different countries (US, Germany, Russia and Korea). Ten cultural dimensions were extracted from the list and emphasised as playing critical roles in UX (and HCI in general). These dimensions are: 1) uncertainty avoidance; 2) individualism vs. collectivism; 3) masculinity vs. femininity; 4) contextuality; 5) time perception; 6) time orientation; 7) power distance; 8) ascription and achievement; 9) affective vs. neutral; and 10) controllability. A subsequent survey study featuring these ten dimensions showed that the dimensions were effective in isolating cultural characteristics specific to certain countries in relation to particular products. They also showed that some of the cultural dimensions

were more influential than others in regards to particular aspects of UX. For instance, the dimension of contextuality proved to be more relevant in relation to looking at differences between countries, and the dimension of individualism was more influential when analysing differences between devices. This study demonstrates not just the need to be critical and inquisitive in terms of understanding existing cultural theories and models that can be applied to cross-cultural studies, but also how in UX research factors such as cultural dimensions can be adopted with flexibility. In other words, one set of cultural dimensions cannot be adopted as a 'one size fits all' approach to observing UX as a whole. Rather, various understandings of the dimensions on offer can be utilised when examining different components of UX.

TABLE 1 Lee et al.'s (2008) comprehensive list of 36 cultural dimensions

| **Dimensions** | **Reference** | **Dimensions** | **Reference** |
|---|---|---|---|
| Uncertainty avoidance | Marcus & Baumgartner (2004) | Meaning of life | Condon & Yousef (1981) |
| Universalism vs. particularism | Parsons & Shils (1951); Trompenaars (1993) | Nonverbal communication | Victor (1997) |
| Achievement vs. ascription | Parsons & Shils (1951); Trompenaars (1993) | Political decentralisation | Wright (1955) |
| Activity orientation | Condon & Yousef (1981) | Power distance | Hofstede (2001) |
| Affective (emotional) vs. neutral cultures | Parsons & Shils (1951); Trompenaars (1993) | Authority conception | Condon & Yousef (1981) |
| Human nature orientation | Kluckhohn & Strodtbeck (1961) | Property | Condon & Yousef (1981) |
| Context | Hall (1976); Victor (1997) | Space | Hall (1976) |
| Time perception | Hall (1976); Trompenaars (1993); Victor (1997) | Degree of power | Wright (1955) |
| Time orientation | Condon & Yousef (1981); Kluckhohn & Strodtbeck (1961) | Resources | Wright (1955) |
| Environment and technology | Victor (1997) | Economic progress | Wright (1955) |
| International trade and communication | Wright (1955) | Technological development | Wright (1955) |

(continues)

TABLE 1 (continues)

| | | | |
|---|---|---|---|
| Face-saving | Victor (1997) | Conservation | Schwartz (1994) |
| Masculinity vs. femininity | Hofstede (2001); Kluckhohn & Strodtbeck (1961) | Affective autonomy | Schwartz (1994) |
| Individualism vs. collectivism | Condon & Yousef (1981); Hofstede (2001); Kluckhohn & Strodtbeck (1961); Parsons & Shils (1951); Trompenaars (1993); | Intellectual autonomy | Schwartz (1994) |
| Instrumental vs. expressive orientation | Parsons & Shils (1951) | Mastery | Schwartz (1994) |
| Specific vs. diffuse cultures | Parsons & Shils (1951); Trompenaars (1993); | Hierarchy | Schwartz (1994) |
| Relationship to nature | Kluckhohn & Strodtbeck (1961); Parsons & Shils (1951) | Harmony | Schwartz (1994) |
| Long-term vs. short-term orientation | Hofstede (2001) | Egalitarian commitment | Schwartz (1994) |

Overall, in order to understand what UX is we need to understand the people that the studies and designs affect – or are intended to affect. The operation of UX cannot be properly understood if the mechanisms of culture are also not understood. It is these mechanisms that affect the way people perceive (theories on embodiment in particular emphasise the role of socio-physical relationships in perception), interpret, understand and relate their experiences. Even Peirce stressed the fact that all comparisons need to consider the grounding and correlates, i.e. the factors that mediate representation or in other words, compose the interpretant (Peirce 1998, 2009). The interpretants – emotional, energetic, logical, immediate, dynamical and final – are mental interpreters which seek components that correlate with the mind's own understanding of phenomena. That is, the way in which the mind understands phenomena, can be said to be to a great extent programmed by culture (Hofstede's (1993) "mental programming"). This subsequently influences how an individual formulates their experiences with design and other interactive systems. Hofstede's (1991) terming of the "software of the mind" can be seen to quite colourfully describe culture's psychological nature. This is why measures such as semiotics are useful in gaining an understanding of the types of factors

people think of (representations of mental contents) in response to specific designs and design elements (symbolic meanings triggered by the designs), and how these thoughts are represented via language and associated symbolism.

### 2.2.3 Experience, pragmatism and emotional aesthetic meaning-making

From a psychological perspective, experience can be viewed as a mental meaning-making process, in which people make sense of phenomena internal and external to themselves (Battarbee 2003; Forlizzi and Battarbee 2004; Wright and McCarthy 2008). Wright, Wallace and McCarthy (2003) describe this sense-making process as comprising: anticipation, connection, interpretation, reflection, appropriation and recollection. McCarthy and Wright (2004) go on to elaborate these factors of the sense-making process. Anticipation is described in terms of the fact that people are never 'empty slates' or unprejudiced units approaching artefacts, people and situations without bias. Instead, we always have some kind of pre-mental impression which is accompanied by expectations, predictions and means of sense-making which are established from prior experiences or social interactions. We make connections between the phenomena we encounter in the external world with knowledge obtained through previous experiences and interactions. At the heart of what McCarthy and Wright (2004) are stating rests the sense-making process of connectivity. Often meaning is generated immediately through the pre-conceptual and pre-linguistic cognition of situations.

During interpretation, a person deciphers and translates the situation, interaction or encounter according to their own knowledge resources (mental contents) and schema. It is during this phase that a picture or narrative - mental representation – of the interaction is constructed, and apperception takes place (explained in the mental representation section below). Based on the picture or narrative that is established, we evaluate design and its interaction by and through the attribution of emotional contents. For example, when a 1996 Nissan Primera will not start, we identify possible agents (immobiliser button on the keyring) and the possible actions (forgetting to press the button before turning the key in the ignition), attached to which we have feelings – frustration and impatience. Reflection entails examination and evaluation of an interaction. In reference to the above example we reflect on why the car will not start immediately, what could have and should have been done to ensure that the car would have started immediately – i.e. pressing the button before inserting the key into the ignition, or pressing it just before attempting to turn the key to allow smooth flow of action and operation. We may even reflect on the emotions that such interaction requirements incur. This can occur during or after the interaction.

The way in which McCarthy and Wright (2004) present appropriation, is related to how people understand new experiences in terms of the ways that they fit with previous experiences and a person's general sense of self. Thus, sense is made of experience according to how it relates to our sense of self, how it can be related to personal history, and what is anticipated in terms of the

future (dreams and aspirations, or desired usage/experiential outcomes). Through doing this, experiences are internalised and personalised. This form of sense-making also determines how people behave as users or consumers. Recollection (or recounting) occurs both mentally and rhetorically in social interactions. Through storytelling for example, people actively make sense of, or find a descriptive narrative structure, for the purpose of defining experience. By nature, recollection is dialogical. In the act of recollection meanings can, and over time and according to the situation of the re-collector or receiver, ultimately do change. Recollection and meaning alteration enable for new experiences to arise. This very much relates to the social approaches of UX that are described above.

Wright et al. (2008) talk of continuous engagement and sense-making. They describe the way that people are constantly experiencing and deriving understandings out of everything they are involved in and encounter. In particular, factors such as personal history, culturally understood meanings and anticipated futures constantly influence the ways in which sense is extracted from experiences. Here, they define experience in etymological terms as "an orientation toward life as lived and felt in all its particulars" (Wright et al. 2008, 18:3). Aesthetic qualities are described as the potential of all experience. These aesthetic qualities comprise what is known as felt life. They are characterised by Dewey (1958, 10-11) in a holistic way, in terms of what we do, what is being strived for (hopes and desires), passion, belief, endurance, how we behave and how other people behave towards us. This is what has already been mentioned above as the "unanalysed totality," whereby there is a mergence between behaviour and the physical, subject and object.

Pragmatic approaches attach action to meaning (Battarbee and Koskinen 2005, 7). Important to these approaches is consideration for felt life, or emotions. It is through sensation (bodily) and its connection to emotion that experiences are concretised (Dewey 1934). These aesthetic sensations and associated emotions exist in relation to needs, desires, fears, aspirations and anticipations. Further, these factors allow for possibilities in terms of surprise, provocation and transformation (Wright et al. 2008). Much attention has been placed on factors such as surprise and the 'wow factor' in UX. Substantial empirical research investigating the connection between sensory perception, or sensory incongruity, and its abilities to evoke emotions such as surprise can be seen in work of e.g. Jones and O'Neil (1985), Ludden (2008), Ludden and Schifferstein (2009), Ludden, Schifferstein and Hekkert (2006, 2007, 2008) Ludden, Kudrowitz, Schifferstein and Hekkert (2012), Marks (1978), and Martino and Marks (2000).

Petersen, Iversen, Krogh and Ludvigsen (2004) indicate an increasing interest in aesthetics in the design of interactive systems. Through focusing on aesthetics scholars and designers are afforded diverse opportunities towards understanding how people relate to and interact with technologies. Here a distinction is made between analytic and pragmatic aesthetics. Analytic aesthetics concentrates on an artefact and its value in light of perceivable

attributes, independent of its socio-historical context and irrespective the user or perceiver (Wright et al. 2008). This is a common approach amongst designers and design researchers (Monö 1997; Petersen et al. 2004), and emphasis is placed on appearance as well as tactile qualities of the designs. While it is claimed to be analytic with certain delineated principles and practices, the omission of broader contextual and user/consumer concerns, means that judgment is also quite intuitively based. That is, the designer designs for what they (in reflection of their analytical methods and guidelines) feel looks good – seductive, alluring and enticing.

Pragmatist philosophy has formed the foundations of the pragmatist approach, namely through reference to the work of e.g. Peirce (1998, 226-241), Dewey (1934) and Morris (1970). A pragmatist approach considers aesthetics to be a specific type of experience which is formed through the interaction of not simply user with design, but rather, contextualised user-design interaction situated in relation to historical and socio-cultural values. As will be discussed in the section on embodiment, experience is the product of relationships which influence perception and interpretation. The design always exists in some form of relationship to the user. This ultimately inspires or discourages usage, usage approach and evaluation of the interaction. Aesthetic experience has quite often been connected to cultural products such as art, theatre and even design philosophy, but as Dewey (1934) stresses, aesthetic experience is continuous within our everyday lives. This is why it is important to consider it in terms of HTI, as it not only operates as a source of pleasure, but is an instrumental part of our mind-brain evaluative system. We firstly perceive and *feel* what is right and what is not right for us based on a complex network of information – biological, cultural and social – and then take appropriate action based on these feelings, in accordance with our end goals (anticipated future). Aesthetic experience represents a complete whole comprising the means and the ends in conjunction with meaning and movement (Wright and McCarthy 2005; Wright et al. 2008). Everything an individual does is meaningfully connected to a total act, which gives the experiencer a sense of entirety.

In terms of human-system interaction, aesthetic interaction can also be understood as comprising two main characteristics: 1) the primary goal of aesthetic interaction is to generate involvement, surprise, serendipity and thus experience; and 2) aesthetic interaction entails bodily experiences through sensory perception, in addition to multifaceted symbolic representations during interaction (Bødker and Kammersgaard 1984; Iversen, Krogh and Petersen 2003; Petersen et al. 2004; Wright et al. 2008). This last matter regarding symbolic representations in interaction highlights the pertinence of understanding HTI and UX in general from a semiotic perspective. It is through these symbols that we not only make sense of our interactional experiences, but also recall and re-present these experiences to ourselves and others.

## 2.3 User psychology and cognitive science

User psychology is an evolving field, still in relative infancy. It has its roots in cognitive science, and draws on traditional psychological theories to explain HTI. In addition to using psychological theories to explain the mental processes which occur during HTI, user psychology also has interest in examining psychological preconditions of use (Juutinen and Saariluoma 2007; Leikas and Saariluoma 2008; Moran 1981; Oulasvirta and Saariluoma 2006; Saariluoma 2004). Further, psychological concepts and methods are used to explore problems of usability and UX. In particular, one of the main goals of user psychology is to develop scientifically justifiable methods for analysing human experiences and usability issues.

While the field of user psychology is still developing, the appropriation of psychological theories and their application in HTI research has been occurring for quite some time (Saariluoma and Oulasvirta 2010). Early examples can be seen in the work of scholars such as Alan Turing (1948, 1950), Douglas Engelbart (1962) and Marvin Minsky (1967) in relation to intelligence and symbol processing – of high relevance for this research and featured in the last article of this dissertation. Other scholars whose work incorporates psychological theories include J.R Licklider (1960) in regards to problem-solving and Vannevar Bush (1945) regarding memory (or memex[11]). In fact, a psychological orientation dominated early human factors research (Saariluoma and Oulasvirta 2010; Welford 1968). Interest in human cognition during computer use gained momentum throughout the seventies and early eighties. At this time much attention was placed on examining users' skills and expertise during end-use as well as programming (Chase and Simon 1973; Martin 1973; Sackman 1970; Shackel 1959; Shneiderman 1976; Weinberg 1971). During this time instrumental concepts such as memory "chunking" emerged (McKeithen, Reitman, Rueter and Hirtle 1981).

Moran (1981) can be seen as a key figure in relation to the user psychology field, as he was the first scholar to suggest that HTI research should cover a broader scope than simply behaviour and cognition in human factors and ergonomics (Saariluoma and Oulasvirta 2010). It was in fact Moran (1981) who coined the term "user psychology" when introducing a special issue of *ACM Computing Surveys* (*The Psychology of the Computer User*). Moran's main argument was that design should be based on firm psychological principles, thus calling for the need to establish systematic scientific approaches to studying the psychology of HCI. The realisation of Moran's vision has been somewhat slow and modified, as subsequent works such as *The Psychology of Human Computer Interaction* (Card, Moran and Newell 1983) were narrower in

11 Memex is a hypothetical proto-hypertext system described by Bush (1945) which would be able to store books, as well as records and communications. According to Bush this system would be fast and flexible in terms of accessing the stored information.

scope (Clemmensen 2006; Saariluoma and Oulasvirta 2010). Since then numerous researchers have distinguished their work as separate from a pure "cognitivist" orientation (Bødker 1989; Carroll and Campbell 1986; Carroll 1991; Ellis and Nutt 1980; Grudin 1990; Heath and Luff 2000; Helander, Landauer and Prabhu 1997; Kuutti 1996; McCarthy and Wright 2004; Picard 1997) in order to accommodate for other influential factors affecting human computer usage.¨

During the 1990s in particular, concepts such as user-centred design (Norman and Draper 1986), cognitive task analysis (Draper and Stanton 2004; Kirwan and Ainsworth 1992; Schraagen, Chipman and Shalin 2000), human factors ethnography (Blomberg and Burrell 2009) and methods including scenario-based design (Carroll 2000; Rosson and Carroll 2001) came into focus as ideal tools for designers to understand the psychological needs of users (Saariluoma and Oulasvirta 2010). More attention was placed on developing testing methods (Nielsen 1993), but practitioners such as designers and information technology engineers were less capable of properly exploiting psychological principles than their cognitive science counterparts (Saariluoma and Oulasvirta 2010). In recent decades there has been considerable theoretical fragmentation which has accompanied the "psychologically loaded" (ibid. 318; Olson and Olson 2003) areas of affective computing and technology (Picard 1997; Umemuro 2009), ubiquitous computing (Weiser 1991), ambient displays and embodied interaction (Antle, Corness and Droumeva 2009; Ishii and Ullmer 1997; Wellner, Mackay and Gold 1993), as well as augmented reality (Haller, Billinghurst and Thomas 2007; Silva et al. 2003) etc.

Saariluoma and Oulasvirta (2010) propose three objectives for user psychology, these are: 1) to expand on HTI research from merely direct interaction – or the interaction loop – towards studying the user "as an intentional actor" (p. 318); 2) to articulate a problem-solving epistemology that emphasises problems and possible solutions rather than setting the goal at truth finding; and 3) to develop a coherent picture of psychological approaches which have been taken in HTI research. The problem with many of the psychological approaches, particularly the earlier cognitivist approaches, was the absence of consideration for the role of emotions in HTI. Furthermore, other important factors which influence not just the way in which a person uses technology, but the way in which they approach, adopt and represent it such as personality, past experience, motivation, meaning, and most notably socio-cultural factors were not comprehensively considered.

When explaining the very nature of UX, user psychology cannot be ignored. Experience is psychological, and there are already hundreds of years of psychological and philosophical traditions which have sought to explain the mental processes that occur when humans interact with man-made (cultural) artefacts and phenomena. The disciplines of social, environmental and architectural psychology are already well established. When considering architecture for example, there are numerous ways to explain the psychological impact of structures in terms of proportions and design principles (Green 1999; Gardner 1996) e.g. the Golden Ratio, Defensible Space (Newman 1973; 1996),

Cathedral Effect (Meyers-Levy and Zhu 2007), and accessibility (Mace, Hardie, G. and Place 1990). Likewise, in design there are theories such as contour bias (Bar and Neta 2006, 2007) and arguably the baby-face bias (Lorenz 1971; Lidwell et al. 2010). In relation to UX there is also the mere exposure effect (Zajonc 1968; Bornstein 1989), cognitive dissonance[12] (Festinger 1957; Harmon-Jones and Mills 1999), and the aesthetic-usability effect (Kurosu & Kashimura 1995; Norman 2002; Tractinsky et al. 2000) to name some.

All of these theories have sought to explain the complex psychological processes that occur when human beings encounter design products. While user psychology strives to engender new psychological interpretations and explanations of HTI, it would be ignorant to dismiss these already well-founded disciplines. Of paramount interest to recent user psychology in cognitive science, has been the investigation of design ontologies and mental contents (Saariluoma 1997, 2000, 2003; Saariluoma et al. 2013). Where for example, cognitive semantics is designed to examine how thought structures are represented in linguistic representations (Talmy 2000), ontologies are designed to reveal how UX is mentally structured. In particular, ontologies are content theories which explain objects, their specific properties and the connections that exist between these properties and specific knowledge domains triggered in interaction (Saariluoma, Jokinen, Kuuva and Leikas 2013; Chandrasekaran, Josephson and Benjamins 1999; Rousi, Saariluoma and Leikas 2010). Ontologies assist both researchers and designers in understanding the connections between specific material or physical qualities and corresponding knowledge structures. This is in essence similar to the process demonstrated in the semiotic model of UX above. The idea is that, if designers understand what types of knowledge or mental representational contents (Saariluoma 2003) are generated in relation to particular physical design elements, they can more effectively design for intended interactive experiences. This represents a major practical goal in the cognitive scientific approach to studying UX.

All designers approach design and particular usage problems with a conceptual model of human behaviour (and or thought) in mind, whether they explicitly recognise this or not (Froehlich, Findlater and Landay 2010). Froehlich et al. (2010) note that all of these models are wrong, however some may be more helpful than others. For this reason methods such as ontologies and others e.g. the Design with Intent (DwI) toolkit (Lockton 2011) have been developed. Ontologies are established as the result of content derived from empirical research investigating people's responses to design interactions, based on uni- or multi-modal sensory perception. The DwI toolkit operates in a scenario based format, giving designers alternate possibilities for how users may respond to and experience products in varied usage situations.

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12 Cognitive dissonance describes the state of mental discomfort that occurs when a person's attitudes, thoughts, or beliefs conflict. Consonance is used to describe the effect of when two cognitions agree, dissonance when two cognitions disagree (Festinger 1957; Harmon-Jones and Mills 1999).

Lockton's (2011) user psychological model recognises the importance of intention in defining the interactional outcomes of design encounters. This corresponds with literature on the cognitive approach of appraisal and the law of *concern* which has been described as the instant evaluation of a situation in relation to one's own well-being (Frijda 1988; Lazarus 1991). This definition is particularly applicable when considering the UX of elevator usage featured in some of the dissertation's articles. Here, appraisal is seen as the causal relationship between how someone evaluates a situation and its components, including the design product's relevance to their own concerns (needs and/or desires), and the emotional outcome of this evaluation. Thus, intended goals and motivations which vary according to the usage situation, impact the way in which someone experiences a product (Demir, Desmet and Hekkert 2009). In this respect, Peirce (2009, 13) illustrates the nature of concern in reference to attention by inferring the connection between experience as the result of preparation based on concern. He uses the example of a mother, who in a crowded room filled with conversation is able to detect a child's cry. He notes that she is able to do so, due to the fact that she is already prepared to hear the child cry. She has concern for the well-being of the child. This is similar to any design user who has their own concerns and subsequently experience the designs in accordance with what they are prepared to recognise as benefitting their circumstances and idea of the future (2009, 15).

Lockton, Harrison, Cain, Stanton and Jennings (2013) emphasise the role of understanding user behaviour in context, and how this enables for the examination of mental models possessed in relation to interactive systems. Thus, in order to design for meaningful experiences, designers must conceptualise the world of the user and design interactions (Krippendorff 2007, 1386). Meaning and meaning making rest at the core of the cognitive scientific approach to UX. Thus, semiotics and its focus on understanding how meanings exist and are generated in relation to signifying elements, makes it an ideal tool for the cognitive analysis of UX. This can be seen in Lockton's (2012) demonstration of user psychology as process of connecting semiotic relationships to user behaviour. This is what Lockton describes within the scope of behavioural heuristics. In other words, he notes a semiotic, semantic, connection between phenomena, relationships and codes or rules of behaviour. Lockton exemplifies this in the following points:

- *If someone I respect read this article, I should read it too*
- *If this email claiming to be from my bank uses language which makes me suspicious, I should ignore it*
- *If I've read something that makes me look intelligent, I should tell others*
- *If the base of my coffee cup might be wet, I should put it on something rather than directly on the polished wooden table*
- *If, when asked which of two cities has a bigger population, I have only heard of one of them, I should choose that one*
- *If my friend posts that she has a new job, I should congratulate her etc.*

These are just some of the points that Lockton (2012) mentions. These examples however, only illustrate the way in which people behaviourally respond to specific symbolic cues. Of significance within this research is: 1) how people mentally represent these cues – thus calling for the need to consider the mind, its contents and mental representations within the semiotic model of UX in relation to qualitatively articulated responses of the user; and 2) how people emotionally experience these cues, or more precisely, how they attribute emotional contents to the experience of design elements and characteristics of design interaction. Therefore: is a user's response to a suspicious looking email claiming to be their bank simply ignored and not consciously or representationally experienced before it enters the trash bin? Or, are emotional and mental representational contents attached to these messages - i.e. mental images of the suspicious offenders or what they could do if the user offered them sensitive information, and how the recipient feels about people trying to deceive them? These issues will be explained in the next section on emotions and aesthetics in UX.

Other psychological concepts which will be discussed in this sub-chapter in addition to emotions and aesthetics include: consciousness, embodiment and mental representation. Consciousness is explained in order to characterise the psychological nature of experience. It relates strongly to notions of "an experience" and "experience" as described earlier in the dissertation. The section on embodiment articulates the situatedness and relatedness of conscious experience. Likewise, this is closely connected the theoretical models of UX expressed by Hassenzahl and Tractinsky (2006) and McCarthy and Wright (2004). However here, not just UX, but an individual's entire mental existence is hinged upon physical and socio-psychological relationships between an individual and their environment. The section on mental representations draws on matters of key concern to the field of user psychology. In this section cognition is explicitly connected to the semiotics of UX. It is here that the process of apperceiving experiences is explained.

### 2.3.1 Emotions and aesthetics in UX

Despite the lack of attention in earlier human factors studies, emotions are recognised as playing a critical role in determining human decision-making and behaviour. Contrary to popular connotations associated with emotions such as 'soft,' 'irrational,' and 'fuzzy,' emotions play a vital role in human reasoning. That is, we can view emotions as existing at the heart of rational thinking. In fact, Peirce explicitly states that human logic is based on feelings (Peirce 1998, 79). He emphasises that the pros and cons in decision-making processes are weighted not purely on facts, but more on intuition of what seems to be a more appealing outcome, and what *feels* right. This is notably one characteristic that researchers in AI have also realised and subsequently responded to with investigations into artificial emotions (Suzuki, Camurri, Ferrentino and Hashimoto 1998; Wilson 2000). Smith and Lazarus (1990) state that emotions notate every significant event of a person's life: the anger at crimes and

injustices committed against us; the joy of the birth of family members; sorrow and grief at the death of loved ones. Here, it is argued that emotions are constantly present, whether conscious and explicitly represented, or unconscious in unrepresented states (Bierman and Radin 1998; Chalmers 1996; Searle 1989; Berridge and Winkielman 2003; Winkielman and Berridge 2004). Emotions can be seen as a constant regulation system between the external world and the body. It is the third element that Peirce sought to explain in his triadic models of logic, semiotics and the mind. Emotions frame thought and alert the body (brain) regarding detected benefits or harm. Generally the states that are referred to as 'neutral' are in fact positive. That is, no threat is sensed, thus, there is no need to consciously represent the experience or its accompanied emotion.

As is mentioned in relation to human factors, the subject of emotions has been relatively neglected in the field of psychology (Smith and Lazarus 1990). Rather than recognising emotion as a core function behind psychological reasoning, psychologists such as behaviourist Burrhus Skinner (1953) had relegated emotions to that of an irrelevant epiphenomenon. Other scholars had recognised emotions as playing somewhat of a role in cognition, yet had never fully developed the concept beyond random chapters mentioning aspects which have not been addressed by other authors (Bolles 1974; Lazarus 1966; Tomkins 1962). Over recent decades this problem has been addressed however, and scholarship in emotions has developed (Ekman 1999; Izard and Ackerman 2000; Frijda 1988; Plutchik and Kellerman 1980; Scherer & Ekman 1984; Smith and Lazarus 1990). This late uptake on matters of emotion is quite surprising in light of theorists such as Baumgarten (1936), who already back in the eighteen century had noted that feelings (emotion) contribute to knowledge equally as much as cognition.

Furthermore, the foundations of Peirce's philosophy of logic, thought and Law of Mind are based on feelings, and how, as also exemplified in discussions on apperception, ideas or elements of thought are always intermingled with feelings (Peirce 2009, 14). In fact, Peirce criticised the overenthusiasm of positivist psychologists in seeking to explain the mind based on laws of behaviour and physics. Instead, he emphasised that the only law that can be applied to the mind is that of the act of welding (Peirce 2009, 13). This means the welding of ideas (thoughts based on memories of prior experiences) with present encounters and their associated feelings. Further, he mentions that feelings continue in thought to overlay new feelings. Therefore, Peirce (2009, 95) presents the complexity of emotions and their framing of ideas, as there are feelings that are connected to specific ideas based on memories, then feelings that are generated in the mind at an earlier point in time (e.g. one hour ago, or two days ago etc.) that continue in consciousness. Both of these feelings overlay the current experiences and intermingle with the feelings generated by these experiences. Subsequently, it is the combination of all of these that pursues these ideas to the future.

In regards to defining emotions (or feelings), difficulty can be seen in relation to the level of agreement and differences among scholarly understandings. Some points of consensus pertain to what should be recognised as emotions, e.g. joy, fear, anger and what should not, e.g. tiredness, hunger etc. Then, there are mental states that scholars dispute over whether or not they should be classified as emotions such as interest, guilt, panic etc. (Ekman 1984; 1985; Ortony 1987). There are neurological explanations which serve to address issues such as emotional responses generated as the result of higher order processing. Higher order processing has been discussed in relation to design and cultural product appreciation. The more immediate (primitive) emotional responses caused through high arousal (e.g. fright and panic), have been considered the result of lower level cognitive processing (Brave and Nass 2007). The formerly mentioned debates as well as cognitive neurological reasoning are all reflected in discussions on HCI and HTI (e.g. see Brave and Nass 2007; Desmet 2002; Desmet and Hekkert 2002; Hekkert 2006; Norman 2002, 2004). Table 2, adopted from Ortony and Turner (1990, 316) and combined with Plutchik (1980), provides an overview of what have been considered to be the basic emotions by the scholars in question. This is furthered by mentioning their role in relation to psychophysiological functions and the corresponding analytical approach.

Table 2 represents what the respective scholars have considered as basic emotions. In particular, the scholars who consider basic emotions as critical to understanding psychological reasoning and behavioural relationships are Izard (1977), Panksepp (1982), Plutchik (1980), Tomkins (1984) and Ekman (1999; Ekman, Friesen and Ellsworth 1982). Strikingly, in the above mentioned theories negative emotions such as anger, disgust and fear seem to be the most consistent. In the research presented in the appended articles of this dissertation, emphasis was placed on negative emotions and experiences in all of the case studies. Positive emotions and valence were more often indirectly expressed via the use of metaphors and analogies. Thus, in the context of this research throughout all of the studies (ranging from the smartphone icons to elevator design) users are generally more consciously aware of negative emotions and their attached experiences. This follows suit with what was mentioned above, whereby particularly threats are represented consciously and emotionally to the user, whereas in general positive experiences – or experience of things which are working the way they should be (without threat) – remain unrepresented. When asking a user to elaborate on positive responses towards design, corresponding mental contents is largely unrepresented, or in a tacit state (Smith 2001), requiring the employment of metaphors to explain sentiments which cannot be explicitly expressed (Hekkert 2006).

The inclusion of emotions within the scope of human factors has brought with it invested interest into the aesthetic qualities of design (technological and otherwise) and how these impact interactional experience. Significant theoretical contributions such as those by John Dewey (1934), Battarbee and Koskinen (2005) and McCarthy and Wright (2004) to name a few, serve to

accentuate the character of experience as being that which is generated through actions and their associated emotions. Furthermore, action such as digging a hole (in Dewey's case) comprises aesthetic qualities which exist not just in the hole that is taking shape (the product), but the narrative that is unfolding mentally and linguistically when the actor recollects the story for themselves and to others. There is a holistic picture which is composed of multi-sensory input – optical (sight of the hole, tools, one's own body, environment), olfactory (smell of soil, sweat, textiles and cleaning agents, weather), audio (shovel in the earth, birds, cars, voices), tactile (weight of the shovel, sensation of the grip, force needed to drive into the soil) and gustation (the taste of dirt, bugs, thirst).

TABLE 2 Adaptation of Ortony & Turner's (1990) Selection of Lists of "Basic Emotions"

| | **Basic Emotions** | **Psychophysiological role** |
|---|---|---|
| Plutchik (1980) | Acceptance, anger, anticipation, disgust, joy, fear, sadness, surprise | Relation to adaptive biological processes |
| Arnold (1960) | Anger, aversion, courage, dejection, desire, despair, fear, hate, hope, love, sadness | Relation to action tendencies |
| Ekman et al. (1982) | Anger, disgust, fear, joy, sadness, surprise | Universal facial expressions |
| Frijda (1988) | Desire, happiness, interest, surprise, wonder, sorrow | Forms of action readiness |
| Gray (1982) | Rage and terror, anxiety, joy | Hardwired |
| Izard (1980) | Anger, contempt, disgust, distress, fear, guilt, interest, joy, shame, surprise | Hardwired |
| James (1884) | Fear, grief, love, rage | Bodily involvement |
| McDougall (1926) | Anger, disgust, elation, fear, subjection, tender-emotion, wonder | Relation to instincts |
| Mowrer (1960) | Pain, pleasure | Unlearned emotional states |
| Oatley and Johnson-Laird (1987) | Anger, disgust, anxiety, happiness, sadness | Do not require propositional content |
| Panksepp (1982) | Expectancy, fear, rage, panic | Hardwired |
| Tomkins (1984) | Anger, interest, contempt, disgust, distress, fear, joy, shame, surprise | Density of neural firing |
| Watson (1930) | Fear, love, rage | Hardwired |
| Weiner and Graham (1984) | Happiness, sadness | Attribution independent |

While emotions have often been described in terms of soft qualities, soft politics and as being irrational, they serve an incredibly important role in our existence. To turn the discursive tables, emotions can be considered the decisive factor in human rationality. They serve as a radar system for our personal well-being, intentions, motivation and interests. Emotions provide the key to our thoughts and actions. They shape the way in which we contextualise and frame our own personal narratives and experiences (mental representations) in addition to affecting the way we behave. In light of experience and its semiotic function of interpretation, emotions can be seen as providing meaning content to

information (Frijda 1988). In this respect, contextualisation plays a major role in the activation of emotions, as emotions are directed by meaning structures implicated in events, encounters and interactions (Frijda 1988).Thus, emotions can be seen as the frame of experience, adjusting their form in relation to context. When approaching UX from a semiotic perspective emotions possess a twofold function: firstly, they narrate the communicative fit between design, purpose, knowledge and context; secondly, they shape the qualitative output provided by the user. If matters such as consciousness and emotional representation and intentionality (Chalmers 1990; Nelkin 1993b; Saariluoma 2012; Searle 1989) are understood, the researcher's or designer's ability to appropriately interpret qualitative data increases.

### 2.3.2 Consciousness

In order to discuss experience in relation to UX or otherwise it is necessary to establish an understanding of consciousness. Consciousness is described as the quality or mental state in which one is aware of phenomena either external or internal to oneself (van Gulick 2004). Arguably, consciousness rests at the core of theorisation of the human mind. While remaining under heavy contest and debate, definitions attributed to consciousness have included: awareness, wakefulness, sentience, subjectivity and sense of self, executive mind control, ability to experience and to feel (Farthing 1992). Consciousness and conscious experience are formed by anything and everything that we are aware of at any given moment (Schneider and Velmans 2008). The intrigue with consciousness holds in that on the one hand it (and qualia, which are discussed below) is the most familiar thing known to human beings. Consciousness along with emotions, essentially define our mental existence. However, consciousness remains the greatest mystery of the scientific world (Revonsuo 2010). The field of consciousness research is broad, and advances have steadily occurred in relation to locating relationships between the neuro-system and conscious states. However, no one can still prove the entire dependence of consciousness on physiology, and whether or not consciousness, and thus the mind exist beyond the body.

Consciousness is described as being systematically ambiguous (Nelkin 1993a, 419). It is referred to as one of two distinctive phenomena which pertain to the philosophy of the human mind (Chalmers 2004, 1) - the other attribute being intentionality. Humans are both conscious and intentional. That is, humans are conscious in that "there is something it is like to be us" (Chalmers 2004, 1) and intentional, due to the fact that we represent (to ourselves and to others) what is happening in the world around us according to our own available knowledge (mental contents). Conscious experiences can be seen as the connection between these two elements. It is conscious experiences that alert us to what is happening.

Compared to David Chalmers, Norton Nelkin (1993a; 1996) differs slightly in his approach, through articulating that consciousness comprises three features which can be noted as playing various roles in the same process; or

likewise instigating separate simultaneous processes. Nelkin mentions these three features as being: phenomenality or how experiences feel; intentionality or how experiences are of something; and introspectibility, which describes the awareness we have of experiential phenomenality and intentionality (Nelkin 1993b). Interestingly, Nelkin's theory of consciousness can be overlaid with semiotic theories (Morris 1971a, 1971b; Peirce 2009 [13]; de Saussure 1983). By this one may observe that phenomenality represents the emotional syntactic dimension of semiosis. Intentionality corresponds with a combination of syntax (signifying element) and semantics (meaning), or in de Saussure's theory, the *signifier*. Finally, introspectibility can be likened to the interpretant, or interpretation of the sign demarcated by the syntactic–semantic relationship of the phenomenal and intentional dimensions, the *signified* (de Saussure 1983). This semiotic-consciousness relationship can be seen in Figure 12.

In Nelkin's argument it is seen that everyday conscious experience comprises the three above mentioned features, which manifest at any given moment. Nelkin exemplifies his argument through the everyday phenomenon of someone asking what the time is. In response, the person who has been asked firstly looks at their watch, which is different to looking at something such as the Big Ben, and just as varied in qualitative experience as the comparison of looking at an analogue watch or looking at the time on a mobile phone. This first feature, phenomenality, is described as the experience "feeling." This differs to pure perception, as the action and associated thought are accompanied by a feeling (emotion), quite similarly to what has been described by Peirce as the "welding" of feelings (Peirce 2009, xxx). Often times this is tacit, that is, the feeling and subsequently the *thought-feeling* cannot be comprehensively expressed to another individual (Smith 2001). Rather, it frames the event.

This feeling is also described by others such as Thomas Nagel (1974) as a quale (qualia being the plural). In this example, a watch (or mobile phone displaying the time) is being perceived, and we perceive this as a separate object to ourselves. There are also instances, such as in dreams, when we experience objects even if they are not physically present (see e.g. Descartes 2009, 19). This is what is defined as intentionality, or meaning (semantics). Thus, intentionality describes the establishment of meaning through representation. This use of the term "intentionality" refers to first-order or linguistic-like representation. Intentionality which is implicated in introspection can be referred to as second-order linguistic-like or even image-like (Cooper and Shepard 1984; Kosslyn 1980, 1987) representation. Yet, as already specified, and will be discussed in reference to mental contents, these specifications are not so straight forward as tacit content may not manifest in either of these ways.

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13 Peirce himself had written extensively about consciousness (see e.g. Peirce 2009, 80-97).

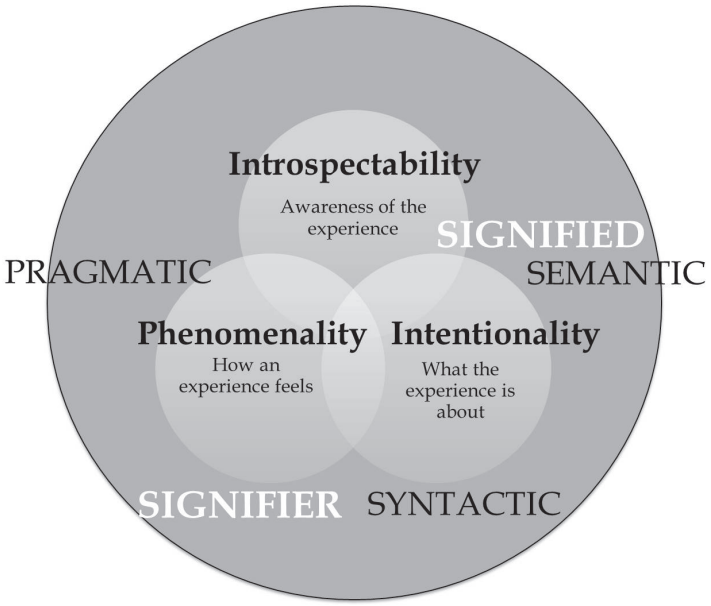


FIGURE 12 Semiotic-consciousness relationship based on models by Nelkin (1993a), Peirce (1931-66), Morris (1971a, 1971b) and de Saussure (1983)

Introspectibility can be seen where firstly, attention is drawn towards the watch or mobile phone in the sense that we think that we are seeing it and not hearing it etc. Here, we see the clock (or mobile phone) and our attention is focused towards the object itself, rather than the action of seeing it. Representation is an internal experience. If information about phenomena is perceived through representations (linguistic or image-like) we are subsequently aware that we are in turn representing the time piece. Everyday experience is said to comprise all three of these features (Nelkin 1993a, 421).

In another argument, Chalmers (2004) observes how traditionally, philosophers such as René Descartes (2009, 21), John Locke (1963, 1997), Franz Brentano (2004) and Edmund Husserl (1973) treated consciousness and intentionality simultaneously. A development occurred during the latter half of the 20th century in which philosophers separated the two and began working with only one of these two topics. For example, scholars such as David Rosenthal (1997) and Peter Carruthers (2000) look at higher order states that represent conscious states. Michael Tye (1996) and Fred Dretske (1995) examine first-order intentional content of conscious states. In this second approach representationalism is promoted, whereby conscious states are analysed in terms of particular kinds of first-order intentional states. In these examples consciousness is grounded in intentionality (Saariluoma 2012).

In cases where intentionality is grounded in consciousness, scholars advocate that phenomenology provides the basis of representational content. That is, scholars such as John Searle (1990) – who claims that all true intentional content is based on consciousness – and others such as Terence Horgan and

John Tienson (2002), Colin McGinn (1991) and Charles Siewert (1998), who claim that there is a form of content that amasses in connection with "the phenomenal character of mental states" (Chalmers 2004, 2), all approach the subject from the perspective that consciousness somewhat prioritises the constitution of intentionality. That is, intentionality, which is the element of many mental states that are directed towards or about, or about objects or circumstances serves as a basis for experience (Searle 1983). In other words, beliefs or personal schemas regarding appropriateness, consistency, truth and accuracy for example influence the way we experience phenomena. Moreover, addition intentional factors which affect how we think about things include hopes, desires and fears. Searle (1983) also notes that there are states which are not intentional such as nervousness, elation and non-directed anxiety. In other words, states which are not intentional are not directly *about* something, they are more general frames of mind.

Intentionality plays a role in how people experience technology, its design and interaction (or usage). For example, when encountering a set of smartphone icons, a user expects to be able to operate the device through not only semantically identifying functions within the icon images (and equally text labels), but also finding the functions/icons that best fit their expectations of smartphone usage (according to their own usage habits), with generally as much ease as possible – that is *without* much thought. Likewise, when a user enters an elevator they expect, believe, or at least hope that the elevator will safely transport them from floor A to floor B without any problems.

It is at this point that the separatist schools of intentionality and representationalism meet within this research, as based on the findings of the case studies, particularly in the embodied context of elevator usage, when intentionality is matched with performance or the *object* of the design (i.e. the elevator works in the way that it is expected), experience remains unrepresented. In other words, when an elevator works in the way that we would hope – transporting us safely from one floor to the other without any issues or alerts – often times we refer to 'neutral' experience. Neutral in the context of this research is perceived as positive, as the contents of the design interaction matches with the intentional contents of the user, thus there is no need for further thought, as there is no need for further action on behalf of the user. However, in cases where a user is alerted to physical qualities which pose somewhat of a threat to their physical well-being, such as the negative aesthetic experience of a swaying or floor-skipping elevator, or even the sound of wind in the elevator shaft alerting the user of the physical nature of the elevator (travelling to great heights), the experience becomes represented. That is, we become consciously aware of the experience in order to physiologically respond to the circumstances. Likewise, in the context of the smartphone icons, if a user either cannot identify functions, or cannot locate regularly used icons-functions, they too become alert to the experience. Inability to locate functions means the inability to undertake *intended* tasks, and when considering this in relation to

human behaviour we may observe that at that moment of frustration, they are preparing for action relating to alternate means of achieving these goals.

Correspondingly, among his discussions on consciousness, Peirce (2009, 280-97) characterises consciousness as that which is paid attention to and remembered. Most specifically he states that a conscious state *is* that of an excited state, which is typified as a condition of derangement, disturbance and disorder. In other words, Peirce portrays consciousness as a representational state which is generated through arousal caused by disturbance of what is considered the norm. Furthermore, in his work Peirce also recognises the unrepresented nature of emotions, or feelings, by stating that while all thoughts (ideas) are intermingled with feelings, feelings in themselves do not always "involve consciousness proper" (Peirce 2009, 95).

Representation is particularly discussed in article VII relating to elevator UX. In this article attention is drawn to the fact that while much UX research focuses on factors such as the 'wow factor,' surprise and positive aesthetic experience which especially emphasise conscious experience, this research acknowledges that not all design actually should be noticed. In particular elevators should be viewed as spatio-physical user interfaces for architectural structures facilitating *flow* in regards to other activities users are engaged in prior to, during and following the elevator usage. Thus, the ideal UX in this usage situation would be that of unconscious experience. Corresponding with the notion of unconscious emotions is also the concept of unconscious experience. In other words, we experience continuously, but we are not actively aware of everything that we do experience. That is, not all experience is conscious, or mentally represented, much of our experience remains unrepresented, or unconscious (Merikle and Daneman 2000; Schacter and Curran 2000; Searle 1989, 1990). Mathias Rauterberg (2008) describes this unconscious state as a "parallel background process" between the body and mind, that a person, although fully functional and awake, is not aware of (p.15)[14]. It is only during times when, for example, we would need to physiologically prepare for e.g. fight or flight (the elevator jams – what do I do?) that experiences (and related UX) become consciously represented[15].

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14 Although, a difference of interpretation can be seen in Rauterberg's definition of "unconscious", as he refers to the unconscious as that which cannot be accessed or made conscious. Whereas, he uses the term "subconscious" to describe the state of consciousness which lies in between consciousness and unconsciousness, which has the ability to become consciously represented. In other words, his definition uses "unconscious" to describe everything that is unknown to us, about us, which is subsequently the dimension of great interest in studies regarding the mind. In this dissertation it is argued that unconsciousness *is* the unrepresented state of information processing. It does exist as parallel background processes comprising its own agenda (or *concerns*) in accordance with appraisal theory (Frijda 1988), and in agreement with Rauterberg, its very nature is unrepresented. Yet, here it may be seen as a processor that detects and sorts information according to its main concerns, which correspondingly also determines as to whether or not the information should be consciously represented.

15 This conforms to Peirce's idea that consciousness is an excited state triggered by disorder and disturbance (Peirce 1998, 23 & 2009, 81).

With this said, findings of the smartphone icon study also suggested that people preferred icons which were 'clear,'[16] thought of as easy to use, were easy to read and were primarily composed of solid bright colours. Furthermore, there was a link between these characteristics and the smartphones of major players on the international markets, suggesting either: a) the influence of branding and perception of ease-of-use (mere exposure effect; Bornstein 1989; Zajonc 1968); or b) somewhat related to the first point, the familiarity with these smartphones through usage or otherwise means that people's expectations (intentionality) are based on the formats represented by these brands.

All in all, the studies reveal the need to also study experience outside remarkable encounters of surprise, fun and meaningful user-design relationships. Instead, UX should also be focused on understanding the role of unconscious experience in effective user-design interaction. This even seems logical in light of studies by for instance Battarbee and Koskinen (2005) who focus on not simply what the technology is, but what it can do in regards to human-human interactions and relationships. Not always is the design intended to drawn attention towards itself, but instead, to facilitate other experiences of thought or interaction.

### 2.3.3 Embodiment

With the above said, consciousness is situated. We are situated within our physical bodies and whether the mind and body are in fact inseparable or not, the mind operates for the benefit of the body. The mind can be likened to the body's control tower, and consciousness can be seen similarly to a navigation screen in which emotions act as the alerting radar system for possible benefits or threats. Traditionally, mind-body dualists such as Coulter (1979), Turner (1984, 1992), Hirst and Woolley (1982), and most notably Descartes and Plato with his 'Forms' - said to be true substances separate from the physical body (Robinson 2011) - treat the mind and body as two separate entities. On the other hand, resonating with the traditional lack of interest in emotions in psychology, behavioural psychologists viewed the conscious mind as an 'epiphenomenon,' or a physiological by-product bearing no effect on physical reality (Robinson 2011).

However, dualism and its associated mechanistic view of the body were challenged by the likes of theorists such as Maurice Merleau-Ponty (1962, 1968). Merleau-Ponty in particular drew our attention to the synchrony of mind and body, and the existence of consciousness according to relationships between the body and external phenomena, physical and otherwise – i.e. historical and social (Crossley 1995). Merleau-Ponty dismissed the mechanistic view that

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16 It was the application of this term 'clear' in both national samples of the study that sparked interest in delving deeper into semiotics and semantics as the researcher wondered whether or not there was a common understanding of the term, or if perhaps people applied the same term to mean different things – i.e. clear=free from clutter; or clear=intuitive, and corresponding with expectations of how the icon should be formatted.

bodily sensory systems perceive everything as raw data, and instead highlighted the fact that we perceive in terms of relationships. That is, the information that is perceived already possesses some kind of significance to us. We do not simply absorb everything. Thus, according to embodiment, our experience is shaped and emotionally framed by our bodily relationship to our surroundings – contextual, environmental, historical and social.

When thinking of this research, and the argument put forward in terms of representation, non-representation, and in particular unconscious experience, we cannot posit that *only* relevant data is perceived through the senses. Or, perhaps to rephrase, it could be stated that *all* data is relevant on some level. What is argued in terms of unconscious experience and unconscious emotions, is that we are constantly experiencing based on the data physiologically obtained through the senses. However, representation or lack of representation, and subsequently conscious or unconscious experience does rely on the mind-body relationship with the external world. That is, rather than stating that we perceive in relationships, embodiment in the context of this research refers to the fact that we *experience* according to relationships. These relationships exist between the body and the external world also for the reasons mentioned in Merleau-Ponty's argumentation.

Thus, where we observe in the case of elevator UX that only negative narratives were recalled when elevator users were asked to comment on their usage experiences, it may be assumed that these experiences became conscious, or represented, in response to the mind's sensory awareness that the body's well-being was under threat. Likewise, somewhat similarly to Merleau-Ponty's view, the body is located and acted upon in terms of physical, social and cultural qualities. So, the information we perceive through the senses to a large extent is already moulded according to these relationships – i.e. the ship piston mentioned in my earlier semiotic example appeared large, because I was shorter. People are also physically and socially acted upon by others due to their physical traits (i.e. race, disabilities etc.). Thus, social dynamics imposed by cultural infrastructure or codes of behaviour can also affect a person's experience of technological interactions. Therefore, a semiotic relationship also exists between the user as a signifying element (in relation to others), and symbolic interpreter in response to the behaviour of others, as well as technological coding – language, materials, colours and physical dimensions (also decided upon by other people – the designers).

HCI and cognitive science scholars have already been aware of this issue for quite some time. Varela, Thompson and Rosch (1991) specifically use Merleau-Ponty's theory of embodiment as a basis for situating the human user in the context of the everyday. That is, they acknowledge that HCIs are situated within the everyday. The everyday may be seen as often repetitive and mundane, but even in repetition comes variations in relations and situatedness. No two moments or contexts are identical as our mental contents, or thought, emotions and moods, as well as external actors i.e. environment, tasks and people change from one moment to the next. The bodies of human users can be

seen as physical and experiential structures, or outer (biological) and inner (phenomenological) structures. Raymond Gibbs Jr (2001) highlights the symbol grounding problem, commonly referred to in semiotic AI studies, whereby meaning is generated from ordinary or everyday experience (Harnad 1990; Searle 1980). In his argument which refers to the relationship between embodied experience and linguistic meaning, Gibbs states that kinaesthetic experience also plays a major role in how they derive meaning.

On this note, Dourish (2001) drew attention to what he termed as "embodied interaction," whereby technology interaction always encompasses simultaneous physical and social qualities. Petersen et al. (2004) furthered this concept of embodied interaction to examine pragmatist aesthetics in the playful contexts of gestural and tangible interfaces and emotional expressions. The physical and social nature of interaction is epitomised in research on co-experience (Battarbee and Koskinen 2005), which demonstrates the relationship between the physical involvement of utilising technologies and its corresponding social interactions. Thus, meaningful experiences emerge through physical kinaesthetic aesthetic experience (remembering Dewey's (1934) arguments on the aesthetics of action), social interaction (narrative and emotional expressions) and phenomenological meaning making processes.

Due to the embodied character of human beings, HCI or HTI has at no point, not been embodied. Yet, with increasing research and development in interactions which go beyond the screen such as gesture and tangible user interfaces, ubiquitous computing, and augmented reality to name some, the need to understand the way in which a user's physical being impacts there experience becomes ever more pressing. In order to consider the embodied nature of UX, scholars and designers should remain aware of the physical dimensions of HTI - the physical user-technology relationship and physical user-user relationships (the body as a symbolic site); as well as the social – meaning which is generated through social interaction in response to physically engaging with the design. One final note relates to how the body itself impacts our experience of sensory data. Again, the ship piston example highlights the relativity of height (short body in comparison to tall ship piston), but also the senses can modify and impinge access to particular information. For example, people who suffer from Anosmia, a condition in which someone loses their sense of smell, do not have the ability to perceive and thus experience odour. Thus, if the object of an event or product is based on odour, people with anosmia will be excluded from the physical dimension of the experience. They may be enlightened through social discussion of the product, but they cannot participate on the physical sensory level. Lack of ability to participate can be seen in terms of designs which exclude for example, people in wheelchairs, people with vision or hearing impairment, and even learning disabilities etc. This embodied nature of experience based on the body's sensory ability to perceive is discussed in the next section in relation to qualia.

### 2.3.4 Mental representations

The user component of the UX semiotic model can be viewed in terms of mental representations. These are signs or symbols and formulations of experiences which exist only within the mind. Mental representations are cognitive scientific theoretical constructs belonging to concepts such as the Computational Theory of the Mind (CTM), and the Representational Theory of the Mind (RTM, Pitt 2012). Pitt (2012) likens mental representations to information bearing structures which occur, transform and are stored in the mind. Yet, discussions on RTM can be traced back to antiquities (Aristotles), whereby commonsense mental states were explained in terms of perceptions, imaginings, desires, thoughts and beliefs. Quite often intentionality is discussed in relation to mental representations (Farkas 2008; Horgan and Tienson 2002; Kriegel 2003; Loar 2003; Pitt 2004; Saariluoma 2012; Siewert 1998; Strawson 1994). In these instances, mental representational content is described in terms of its phenomenal character (Mendelovici 2010, 80). That is, intentionality describes how mental representations refer to or are about phenomena (Pitt 2012). Intentions and intentionality are in themselves mental content which determine the objective of particular actions and behaviour (Miller, Galanter and Pribram 1960; Saariluoma 2012). Here, they can be seen to possess semantic properties which are connected to the external world in terms of content, truth-value, truth-conditions etc., and can be analysed in terms of their consistency with tangible or observable phenomena.

While mental representations have been described as hypothetical symbols that represent both mental processes and the external world (Marr 2010) within the scope of this research they are not seen as fixed. Nor are mental representations direct personal duplicates of the external world. Rather, these representations are comprehended as complex, dynamic and fluid compositions that are generated via cognitive processes or states and comprise units of information conceptualised as mental contents. They are generated both in response to external stimuli as well as implicitly within thought states (Fodor 1978). Mental contents are the building blocks or information components of mental representations (Saariluoma 1997, 2000, 2003, 2012; Saariluoma et al. 2013). Mental contents are characterised as both explicit and implicit information units. In other words, some information components are explicit or phenomenal as they contain intentionality. Thus, there is a relationship between what is mentally represented and what can be found in the external world. In these instances, mental contents mimic information that exists in the physical and cultural environment, for instance in forms, images, colours, music and language. Other mental contents, such as tacit or implicit information components, exist only within the mind (Smith 2001). They cannot be related to or experienced by another person.

Tacit and explicit representations have been discussed and characterised by scholars such as Daniel Dennett (1983) and Jerry Fodor (1975). According to Dennett (1983), there are two ways of distinguishing tacit representation from

explicit representation. Firstly, tacit representation can be categorised as 'know-how,' internal knowledge and schemas of systems that are difficult if not impossible to explain, yet can be directly applied to explicit situations. Secondly, tacit knowledge can exist in connection to the real world, corresponding with variations that occur in the real world, and even be expressed in explicit representations. Yet, these explicit representations and their tacit roots are conceptual or imaginary in nature. Examples can be seen in terms of mythical creatures (e.g. unicorns and trolls; see Saariluoma 2012) and even theoretical conceptualisations about the way things work (e.g. the theory of the mind).

Jerry Fodor (1975) expressly characterises the mentally bound nature of thought through relating to Mentalese, the Language of Thought (LOT). According to the Language of Thought Hypothesis (LOTH), thought takes place via a mental language. That is, through the facilitation of physiological brain processes, thought is actualised in a symbolic system that is relevant to and recognised by the brain in relation to mental states (Aydede 2010). LOTH poses propositional attitudes which change the nature of meaning in thought. For example, the terms "believe," "hope," and "desire," can be seen as propositional attitudes (*A*) in that they alter the contextual meaning of a sentence: e.g. *S* (subject) believes (*A*) that *P* (proposition), *S* hopes (*A*) that *P*, *S* desires (*A*) that *P* etc. In LOTH these attitudinal propositions or *A*s are converted in the mind and replaced by *R*s (psychological relations). Likewise, the subjects (*S*) and propositions (*P*) are translated in the mind to their corresponding representations. According to LOTH, mental representations that are seen as constituting direct objects, or holding truth-value, are understood as adhering to a symbolic system in which representations feature structurally complex molecular combinations of syntax and semantic *re*-presentations composed of atomic units.

In this account of LOTH, the language of thought exists and is bound by brain function. A person experiences and mentally represents their world based on the symbolic system provided by the brain. Interestingly, although this is a physically or bodily based account of mental representation and experience, it coincides in part with dualist views such as those by Descartes (2009, 17-24) in which an individual or human mind does not have direct access to the real world. Descartes' argument poses that the mind as the instrument of experience exists on a metaphysical level, rendering these accounts in opposition to one another. According to Descartes sense-data in itself is seen as a mental (the mind pertaining to the spiritual realm) reconstruction of what might be in the physical world. Fodor (1975) on the other hand sees this mental representational system as being reliant on physiology, and the physical. Fodor's argument is that while the LOT cannot be expressed via explicit representations, making it seem highly personalised and mysterious, it is in fact shared amongst thinking organisms. Yet, we can see that both theories claim that what we experience is purely constructed within the symbolic systems of the mind. In these accounts, the world is experienced through mentally

constructed interpretations and images that only the individual can *mentally* know.

These two views branch into questions of consciousness outlined in the section above. The following sub-sections on qualia as well as mental contents and apperception represent two differing discussions on the subjectivity of sense-data processing and representation. Although the concepts present the uniqueness of mental representations in decidedly different ways, it is important to describe them within the format of this research as: 1) research on the mind and its contents is conceptual, and we cannot experience someone else's experiences – qualia and/or differing qualities, types and possible quantities of mental contents (afforded by past experiences); and 2) compositions created via the assemblage of the afore mentioned information are framed by emotions, moods and sentiments which are largely characterised by their tacit nature. The way in which not only the mental representations are constituted, but what types of information are available (their semantic connections and positive-negative valence) varies from person to person in terms of mental contents and the way they are apperceived. Both of these components can be said to define our conscious experience.

**Qualia**

Work referring to the subjective nature of mental representations can be seen in relation to discussions on consciousness and corresponding theories on qualia (Dennett 1988, 1991; Gregory 1994; Jackson 1982; Nagel 1974), apperception (Gerard 2010; Ott 2004; Saariluoma, Kuuva, Laitinen, Parkkisenniemi and Rimppi 2009) and the role of mental contents in mental representations (Saariluoma 1997, 2000, 2003; Saariluoma et al. 2013). These concepts discuss the subjectivity of mental representations based on the highly individualised cognition of sense-data (Russell 1910; Prichard 1950). Yet, theories on qualia are conceptually separated from apperception and mental content theory. This is due to the fact that qualia are related to theories of consciousness and the inability to understand how not simply phenomena, but sense-data are experienced from one individual to the next. That is, if one person says, "This ice cream tastes like cow poo," we know that according to the person stating the claim, the ice cream *tastes* like cow manure (or what they suppose it tastes like). But, we do not know *how* they imagine cow manure would taste. Unless tasting the ice cream ourselves, there is no way of knowing how the ice cream tastes to us, and whether this corresponds with our own imaginings of what cow manure would taste like. Thus, theories on qualia specifically focus on the subjective qualities of sense-data (taste, smell, touch, sight, sound). Whereas, apperception or the reconstruction of sense-data via mental contents, is reliant on multiple factors such as memories, experiences, emotions (previously or currently attached to the contents), moods and other influential factors (Saariluoma 1997, 2000, 2003, 2012). In order to understand the mental component of the UX semiotic model, there is the need to elaborate on both qualia and apperception, particularly in light of the notion of conscious experience.

Any effort to describe experience, even UX, without acknowledging or discussing qualia would be redundant. Qualia (plural), or quale (singular), is the term used to explain "the way things seem to us" (Dennett 1991). This is the way in which we are aware of phenomena. Or in other words, qualia as conceptual constructs describe subjective and thus irreproducible conscious experience of what is perceived through the senses. For example, if you look at a glass of wine on a candle lit table, you will see the glass in the way it appears to you. The visual quality of this glass of wine is a (your) quale of visual experience. If you hold the glass of wine to your ear and ping the glass with your finger, the sound you experience is how it sounds *to you*. This is an auditory quale. Finally, the way the wine tastes – perhaps a Cabernet Shiraz from South Eastern Australia – is how it tastes *to you*. This refers to your gustatory quale. Consciousness theorists (Gregory 1994; Jackson 1982; Nagel 1974) argue that it is through qualia that we experience the world. This corresponds to a great extent with René Descartes' theorisation that what is experienced in the mind is never directly of material phenomena, rather it is of the way we imagine it to be. Qualia, it is argued, provide a sense of self by locating us, or our minds, as agents between physical and metaphysical qualities (Dennett 1991).

Discussions on qualia can date back to antiquities. It was the philosopher Rene Descartes, a mind-body dualist[17] who believed that true knowledge is only accessible through introspection (Descartes 2009, 20). Thus, physical information gained through the senses is not stable (Descartes 2009, 18). It was Descartes who claimed that the mind and physical matter differed in three ways: 1) sensations are experienced within the mind that are impossible to explain technically; 2) unlike the brain, the mind cannot be reduced to physical space; and 3) the mind cannot be divided as it exists in its entirety, and it cannot be reproduced as physical matter can (Descartes 2005, 32). Descartes also defined four problems of qualia. The first problem relates to how to explain qualia. Descartes uses the example of colour, in that it relies on light for its perception (Descartes 1998, 33; Hatfield 2008). However, we all perceive through varied wavelengths of light, meaning that the shades and qualities of colours would vary from person to person. Ironically, this explanation poses a contradiction in terms in that the perception of wavelengths of light in itself is dependent on physiological characteristics of the perceiver. Yet, postulations regarding qualia refer specifically to these *qualities* in the perceived sense-data. To illustrate this, Descarte's theory can be contextualised in the semiotic model of UX shown in Figure 13.

17 Mind-body dualists view the mind and body as separate entities. Thus, the mind may exist without a body (Revonsuo 2010).

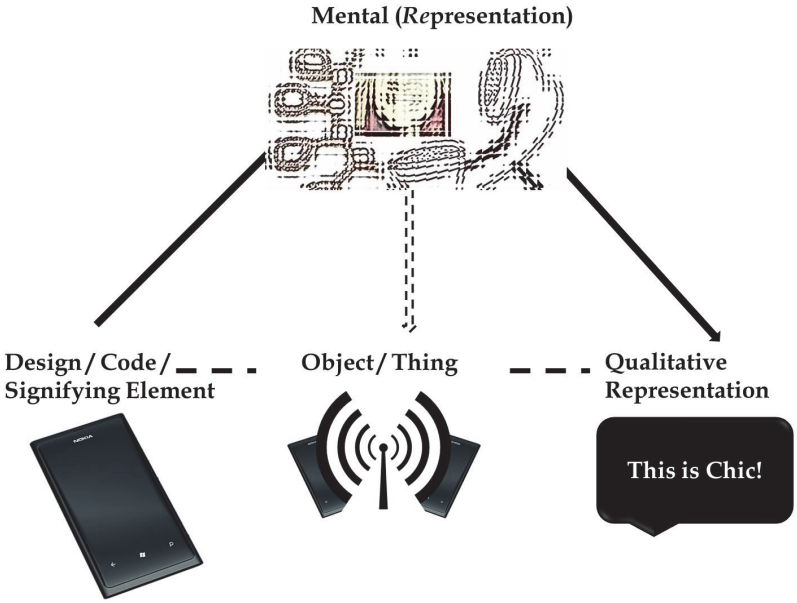


FIGURE 13 Semiotic model of mental representation according to qualia – no direct link between mental representation and the real world (dualist perspective).

During Descartes' time, there were no explanations in physics to substantiate why encounters with light would generate experiences of colour[18] and how these change from person to person. This describes the physical influence on visual quale. However, Descartes' argument was that one individual cannot adequately communicate to another individual what is experienced through the senses. While sensory stimulation operates via physical nervous systems, the information perceived through this stimulation cannot be tangibly related. The second qualia problem related to the location of the mind. Descartes (2009, 19) explained that it is the mind which possesses the capacity to think, and the body cannot[19]. The third problem Descartes cites is that of consciousness as a united whole (Descartes 2009, 12). He posits that there is no way of dividing the mind (Descartes 2005, 32). Even if our body is halved and even if thoughts are incoherent (such as in cases of insanity), we do not experience things in halves. In other words, even something that is only partly perceived constitutes a whole experience. This is interesting to note in relation to HTI as even faulty – partial encounters or erroneous usage – generate experiences (and perhaps, especially due to these). The fourth problem is subjectivity. Qualia cannot be compared between individuals meaning that there is no way of knowing how

18 Later on Benjamin Whorf (1941, 1956) introduced linguistic relativity to explain different mental perceptions and experiences of colour. Whorf claimed that language and how the terms used to describe and structure the world influences how individuals experience it.

19 This point is later contested in the works of scholars such as Frank Jackson (1995, 1998) who indicate that there is no way of knowing that the mind can exist outside a physical body.

similarly or differently people experience and mentally represent the same phenomena. This argument actuates the mind-body duality problem in that physiological nervous responses to specific stimuli and thought processes can be neurologically studied via instruments such as functional magnetic resonance imaging (fMRI) and electroencephalography **(**EEG). Yet, thought content cannot. The interpretation of even neurological studies in relation to explaining the representational experiential content of these thought processes cannot be objectively analysed.

While not advocating a mind-body dualism, Frank Jackson (1982, 129) highlights the inability for us to conceive what another person experiences, particularly if our physiology or processing abilities differ from one another. Jackson uses a fictional character called Fred to illustrate this. Fred is a man who sorts red tomatoes into two separate piles. Fred terms these as red$^1$ and red$^2$. With ease he sorts the same tomatoes consistently into the same groups according to what he says are red$^1$ and red$^2$ tomatoes. According to Fred these colours are as different from each other as yellow and blue, but for the purposes of others understanding he uses the term 'red.' His brain and optical system are studied and it is observed that his cones react in a different way to most people when perceiving particular light waves in the red spectrum. This means that scientists can observe the physical reasons for the difference in Fred's experience, yet for us who cannot perceive the differences between red$^1$ and red$^2$, there is no way of knowing what Fred is experiencing. We do not know what he is seeing, even if he describes it because we do not have the capacity to experience it for ourselves. This argument corresponds with that of Thomas Nagel's (1974) who claims that no matter how much information we have about a bat, we still cannot understand what it is like to be a bat.

Jackson (1982) terms this as the Knowledge argument. No amount of knowledge about someone can enlighten us on how things are experienced from the inside. Thus, what we gain from research informs us from an external perspective on the properties of what contribute to Fred's (or the bat's) experiences. Even if we had the same processing capabilities as Fred, or a bat, there is no way of knowing that the way in which we experience our sensory information is the same as Fred and/or the bat. Jackson's (1982, 132) point, in which he contests purely physicalist views, is that just because one cannot physically measure how a person experiences, does not mean that experience is not a fact. Indeed, human experience is real. It is this specialist quality which cannot be explained about experience that describes the nature of experience.

Dennett (1991) points out that everything real has properties. This means that even conscious experience has properties. Dennett acknowledges that conscious experiences vary from one person to another, but rather than this being solely due to the mind existing as a metaphysical entity unable to be adequately described, it is more due to the properties of things which are occurring within a person at a particular moment in which the experience takes place. Dennett's approach comes close to what is discussed shortly in relation to mental contents and apperception. Thus, his argument is not that of long-

sought qualia, a traditional theory which attached qualia to particular objects (Gregory 1994), but rather to demystify qualia from being something existing on its own in its own special way. He claims that conscious experience has no special qualities of its own, and that the qualia known in terms of "subjective and intrinsic properties," "qualitative character," "raw feels" and "phenomenal properties" is not a given. To interpret his reasoning, he argues that conscious experience comprises properties which can distinctly be connected to other functions and phenomena. Therefore, when we experience, information is drawn from other sources (such as memories, socio-cultural conditioning, moods and emotions) at the particular moment in time that an experience takes place. This is what shapes *how* we experience the encounter.

Qualia are gradually being discussed in the field of HCI (and HTI). Examples can be seen in relation to artificial intelligence (AI) development (see Linson, Dobbyn and Laney 2012) alongside symbol processing (Harnad 1990, 1994, 2000), evaluating design experience (Huang, Houng and Lin 2011), and the UX of instrumental HCI (Kerkow 2007; Springett 2008, 2009). Somewhat similarly to Dennett's (1988, 1991) stance (although he denies qualia as special separate knowledge entities particular to conscious experience) qualia are considered in terms of their connection to causality. Qualia and individual quale are of interest when designing for experience is concerned (Springett 2008). By treating qualia in relation to causality, particularly viewing experience as the interaction of multiple dimensions of information in a specific space, at a specific moment in time (Hassenzahl and Tractinsky 2006), we can at least begin to understand the relationship between types of experiences, corresponding design elements and various encounters. This is where the concept of apperception is useful.

**Mental contents and apperception**

As seen in the section above, Dennett's argument highlights the fact that anything in the real world possesses qualities. These can be interpreted in terms of physical and metaphysical properties. This refers to the *object* component of the semiotic model of UX. Likewise, as seen in the discussion outlining contemporary HCI and HTI research which engages qualia, what is important from the design perspective is the investigation of knowledge, or knowledge contents which are attached to the sensory perception of real world phenomena. In terms of examinations into mental contents, what is important to consider is the way in which the mental contents correspond with real world phenomena. That is, one view towards mental contents is that in order for someone to experience something, or establish some kind of meaning from a thing (artefact or symbol) or event, a person needs to possess mental contents which semantically matches or connects with whatever is being presented (Saariluoma 2012). In other words, in order to process information and experience phenomena, people need to already possess knowledge which corresponds with the perceived phenomena. This is in order to recognise and attach meaning to phenomena encountered.

Thus, mental contents are information, or knowledge bits. Mental contents consist of anything, any piece of knowledge or information that a person possesses in relation to the world. They can be hypothesised as small mosaic tiles which are cognitively pieced together when a person makes sense of a situation, artefact or encounter. Both attached to these units of information, as well as overlaid onto the entire mental representation as a whole, are emotional contents and sentiments (i.e. the positive-negative valence or mood of the transaction). The point of the mental contents discussion is that while no one can exactly know what another person experiences, we can gain an understanding in regards to the type of knowledge content triggered in a person's mind in response to certain phenomena.

Similarly to mental contents, Peirce (2009, 127) refers to ideas as the basis of thought or mental signification. As with mental contents, ideas cannot be directly defined in terms of finite boundaries and characteristics. Further, through what Peirce refers to as "continuous affectibility" ideas have the tendency to spread through connectivity (2009, 126). That is, rather than accumulating countless new ideas, the human mind has a tendency to build on what it already has. Thus, ideas become more intensely connected with time. Moreover, the significance of Peirce's "Law of Mind" in connection with this research and its views on apperception is that the underlying factor of what is known as subjectivity, or consciousness, is defined by ideas' connectivity to emotions (or feelings as Peirce terms it).

In relation to semiotics and the symbolic systems used within product design, the inability to use or interpret technologies has been related to the semantic absence of corresponding mental contents which would assist in the recognition of symbols (Saariluoma 2012). It was Peirce (Peirce 1931-66, 172) who stated that anything is a sign as long as it is recognised as a sign. Morris (1971a) takes this further by explaining that even devices that are specifically intended to act as signs (street signs etc.) are simply artefacts if they are not recognised for their semantic or communicative content. That is, if a sign or symbol is present – take the navigation search symbol on a smartphone maps application for example – but the user does not have corresponding mental contents (knowledge) relating to this symbol, the symbol does not have any communicative or functional value. Thus, there is the inability to conduct a search of the map due to the user's inability to appropriately mentally conceptualise or represent the icon and its operation.

During learning processes people gain information or knowledge, which exist in the form of mental symbols that are connected to and correspond with external phenomena. Once an individual has learnt something – a procedure or a concept for example – they are able to mentally represent this via the contents acquired and the related components. The related components which include emotion contents, can also be seen as intrinsically connected to learning. For example, an emotional self-explanation such as "this procedure is boringly repetitive" (see for example Juutinen and Saariluoma 2007) can and does frame future experiences with the particular procedure in question, and how this is

recalled for others. This is also what distinguishes experts from novices, as experts have a comprehensive mental model (not simply representation) of a system in which tacit and explicit knowledge is complexly intertwined (Saariluoma 1995; Saariluoma and Laine 2001a, 2001b).

Similarly to the later expressed notions of qualia, apperception is recognised for its explanation of the causal relationship between real world phenomena and composition of mental contents. That is, where emphasis is placed on the unknowingness or mystery of *how* other people experience sense data in qualia discussions, apperception focuses on the compositional nature of mental representations by emphasising the role of mental contents (Saariluoma 2012). It is consciousness and in particular its relationship to the physical world (time as much as environment), that cause the fluidity of mental representations. If we consider mental contents as information units of beliefs, propositions, concepts, observations, memories, scripts, ideas thoughts, which are connected to emotional content and re-contextualised in terms of current moods and experiences, no two mental representations can be the same. Memories and experiences accumulate, and associated emotional content constantly changes in an individual at any two moments in time, because we are learning and adapting beings.

Mental contents and their associated components also dramatically change according to the current life situation of the experiencer. This issue is addressed in research on life-based design (Leikas 2009; Saariluoma and Leikas 2010). Life-based design concentrates on the concrete design research and practice of life situations and technological experiences. But, the idea is to accommodate for the changes that occur in the mental representations of users according to physical and psychological circumstances that result from the ever increasing, ever changing influences of new information and challenges – mental contents.

Apperception is described in psychology as a process in which new experiences are assimilated to and transformed by past experiences in order to establish a new *whole*, representation or mental symbol (Runes 1972). Apperception can be seen as a constructivist approach (Schindler and Case 1996; Stoof et al. 2002) towards examining mental representation. Due to the complex nature of mental contents and their composition in mental representations, this research considers apperception as extending beyond the mere assimilation and influence of past experiences. Instead, it sees past experiences and earlier acquired information contents as being juxtaposed against one another, and then further re-evaluated and transformed by the current experience, and its related intentions and motivations. Apperception is established through the interaction and assemblage of portions of earlier representations, and more accurately, contents, rather than accurate recollections of entire scenarios. This is due to the fact that when remembering an event, we do not remember everything about an event. Rather, what are remembered are just the elements that were relevant to us during the encounter, and moreover, the elements that are relevant to us now. Two individuals remember and recollect the same event differently, according to the

characteristics that were relevant to them personally then, and are of interest to them, and relate to the way they currently experience the event now. Figure 14 below illustrates apperception according to the semiotic model of UX.

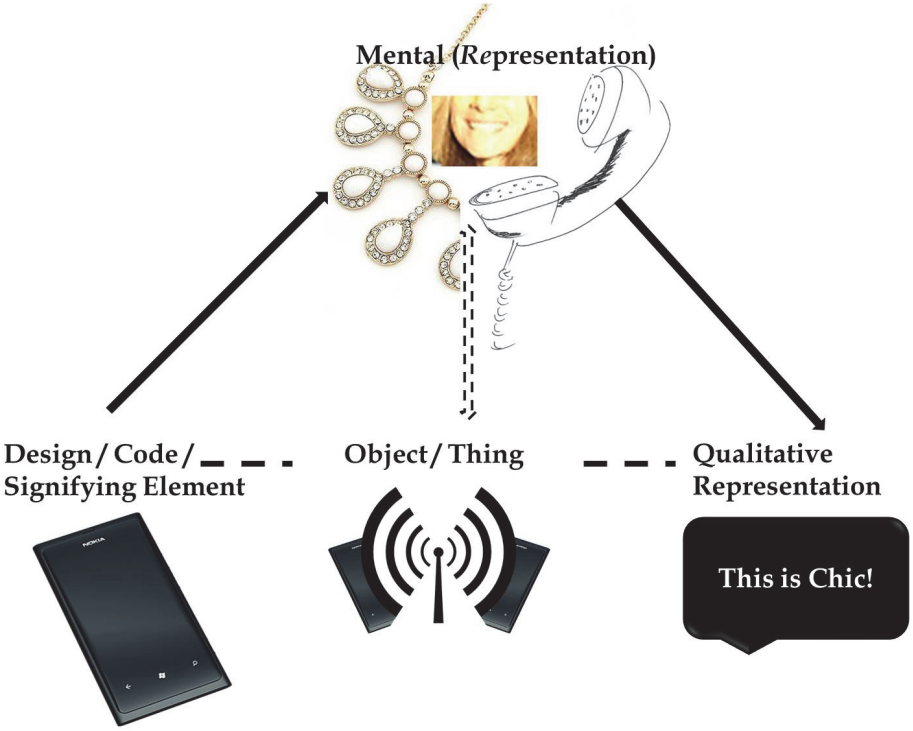


FIGURE 14 Semiotic model of mental representation according to apperception

In Figure 14 mental contents is semantically connected in some causal way to the real world. The artefact being perceived is the Nokia Lumia design, but what is represented in the mind of the perceiver is in relation to all the information contents that the individual attaches to that design. The perceiver semantically recognises that it is a telephone, thus, the link between the signifying element-design and the object is established. The landline telephone receiver is used as a symbol, as it is the basic image or design form that the user associates with telephones due to the era in which she formed her mental semantic content (1970s to 90s). It possesses positive valence and emotional content due to: a) its facilitation of efficient social communication and perceived ease of use; and b) because its sleek black shell carries connotations of luxury and quality, which are connected to the non-instrumental qualities of the design (e.g. the jewellery). Here, while the mental representation is not of one clear united image directly reflecting a real life situation or artefact, there are connections to explicit knowledge and properties, which contrasts the Cartesian, or dualist, views on qualia.

An interesting point about the earlier understandings of apperception is that they viewed it as the passing of information into consciousness (Spencer 1897, 1899, 1900; Lotze 1888; Wundt 1897, 1904). That is apperception was seen as perceived sense-data entering into consciousness, or being consciously represented. This is where the later understanding takes ground, as perceived information does not maintain a direct relationship to the external world, rather it is influenced and transformed by content already existing in the mind. Thus, information that has been obtained through the senses is not perceived within the mind, it is instead *ap*perceived.

Herbart (1891) saw apperception as the way in which the apperceptions-system, or mass of representations already featured in the mind are systematised by the new information and sense-making taking place in response to either extrinsic or intrinsic stimulation. Thus, the self or how our conscious experience is for us, is formed as the result of previous experience. In line with studies on life-based design (Leikas 2009; Saariluoma and Leikas 2010), Herbert Spencer (1897, 1899, 1900) is noted as characterising the evolving nature of apperception and mental representations. Here, he is stated as recognising that the mind (and its experiences) is what it is due to its ability to deal with varying types of environments (Murphy 1928; Carneiro 2012, 519). Thus, apperception explains the human mind's ability to adapt to different situations and changing circumstances. It represents and enables learning by assimilating and transforming our concepts and notions of the outside world and our relationship to it.

## 2.4 Related theoretical disciplines

Up to now, this chapter has gone into detail describing key theoretical concepts and disciplines which have informed and are connected to the subject of examining UX from a semiotic perspective. While this research is making progress towards providing a more detailed cognitive understanding of the experiential mechanisms in design interaction based on a semiotic theoretical framework, it does not stand alone in terms of: a) exploring the semantic relationships between experience and physical properties, or syntax; and b) using qualitative articulations (linguistic, pictorial, formal etc.) to understand cognitive contents. In fact, researchers in the field of design semantics have been concentrating on the former – particularly in relation to the more recently emerging area of design experience; and cognitive semanticists have undertaken substantial work in relation to the latter. The empirical approach of this PhD research has been to examine qualitative user representations to understand what mental content is triggered in response to interactions and evaluations of design products, in order to establish conceptual relationships between semantic content and particular types of design interactions.

### 2.4.1 Design semantics

Design is the signifying element of the semiotic model of UX in this research. Design products operate as signifying vehicles, or manifestations which refer to objects: an object being e.g. physical action, operation and/or function, and metaphysical values (cultural, societal, ethical etc.), quality, beliefs, status and other references. The AskOxford dictionary (2013c) defines "design" as both a noun and a verb. The first noun definition of design refers to a drawing or plan of an object or product, the act of planning or conceiving something, and the arrangement of an artefact's properties according to a plan. The second noun definition describes design as a decorative pattern, and the third as the intention behind action. Design as a verb refers to the way in which decisions are made and plans are established to accommodate for particular purposes and goals (intentions). Design has also been described as the field of human experience, ability and knowledge enabling people to shape their environment in order to match their material and spiritual needs (Archer 1973).

To categorise the nature of design within human semiotic experience we can refer to Émile Durkheim (1953, 87) who stated that "things around us have a deeper meaning because they are the bearers of collective values" (Janssen and Verheggen 1997). Meanings that are associated with the phenomena, or design, cannot however be reduced to the bearer itself. Rather, designs are the physical manifestations or explicit representations of designer and/or corporate (or political) ideas, ideologies, values, beliefs, intentions. Within the design semantics understanding of designs, they are communicative devices or coded messages which are intended to appeal to the consumer through their identifiable reference to concepts such as function, operation, quality, values etc. (Krippendorff and Butter 1984). With this said, Krippendorff and Butter (1984) also acknowledge that meaning is not inherent within the object or event. Rather, meaning is established by the human receiver in relation to a semiotic or symbolic environment. It is an on-going circular process which relies on human interaction and interpretation, socio-cultural histories, in addition to physical as well as socio-cultural environments to establish meaning. The design as a signifying element should: 1) say something about the object and its intended nature; 2) say something about the wider context (usage, social, cultural etc.). Further, as specified in relation to the above discussion on mental contents, designs and their syntax must correspond with the receiver's mental contents. That is, it is necessary that the potential user possesses mental contents, or knowledge, which match the expressions and intentions of the design (Saariluoma 2012).

With the experiential focus of today's global market (Pine and Gilmore 1999) identification of what design is, and what it is about is no longer enough to help products and designers compete among masses of companies offering identical products. Rather, designers are under pressure to design *for* experiences. Given this, they not only need to understand the semantic connections between design syntax and corresponding mental representations

(thoughts, ideas and understandings) of the consumer, but also e.g. emotional connections. Work undertaken by design experience researchers such as Susann Vihma (1995, 2003), Anders Warell (2001, 2004, 2008), Toni-Matti Karjalainen (2004), and Rune Monö (1997) to name some, is of extreme relevance for the empirical development of this research. These scholars have approached the issue of experience from concrete design perspectives, including design processes, material property selection and evaluation, and user-product experience evaluations within their scopes.

Vihma (1995) and Warell (2001, 2008) in particular have used Peirce's semiotic model of presentation and representation to develop theoretical models, and practical empirical frameworks for investigating the experiential (emotional-semantic) connections users make with specific design elements and compositions. Presentation and representation are used as a basis for understanding the design experience transaction. Presentation refers to the pleasure component of user-design transaction. But similarly it can be likened to the initiation of the transaction as this is the point of contact that incites the semiotic-experiential process. This can be seen in cases where the user encounters the design or signifying element (or representamen) characterised in the semiotic model of UX. The presentation does not necessarily refer to an original, or a tangible object in and of itself. In fact, in accordance with Peirce and what has been discussed in terms of mental contents (apperception) and their role in semiotic systems, the presentation has to correspond in some way with the user's mental representation (understanding) in order to be presented as a design. For, as we know of Peirce's semiotic theories anything is a sign if it is viewed as a sign. Yet, nothing is a sign unless it is recognised as a sign (Eco 1979; Morris 1971a; Peirce, 172). That is, the presentation will always also inevitably refer to something, and thus simultaneously exist as a *re*-presentation. In other words, the presented component will always exist on other levels and in different contexts as a representation. For this reason experiential research into design properties is important.

Representation refers to the way in which the presentation is *re*-presented. This can be interpreted as the interpretant of Peirce and Morris' models and the mental component of the semiotic model of UX. Representations exist as both mental representations as well as explicit symbolic and linguistic expressions. This is the site in which the design is recognised for its signifying qualities and symbolic connections are generated. It is at this point that sense-making and experience occurs. Warell (2001, 2004, 2008; Warell and Young 2011) provides a model of visual product experience (VPE) or perceived product experience (PPE) that organises design experience according to sense-data, cognitive and emotion processing. Figure 15 below once again illustrates Warell's PPE (and VPE) theory which emphasises the two dimensions of experience: presentation and representation. Experience, in addition to the accompanying two dimensions, comprises three sub-modes: experience – sensorial, cognitive and affective; presentation - presentation – impression, appreciation and emotion; and representation – recognition, comprehension and association.

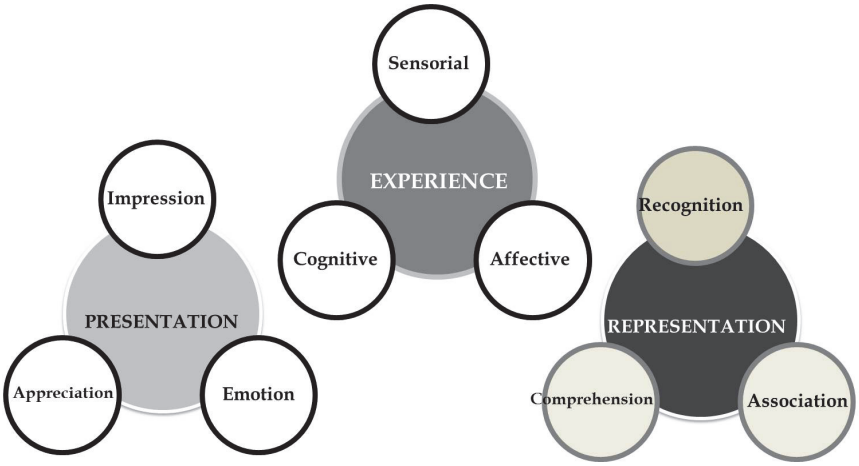


FIGURE 15 Theoretical model of PPE (Warell 2008; Warell and Young 2011)

According to PPE theory (Warell 2008; Warell and Young 2011), *presentation* is interpreted as the pleasurable dimension of the product. That is, this dimension refers to the "pure" sensory stimuli of the experience (Warell and Young 2011, 282). This is where the impression is made. In other words, the first thoughts that come to mind are based on sensory stimulation (sense-data) which occurs during this phase. The appreciation sub-mode explains the recognition of aesthetic values, or the way in which aesthetic devices establish an impression within the user. This sub-mode refers to cognitive processing of the holistic compositional choices made regarding the product (Warell 2001). Emotion refers to the affective reaction that is evinced by the design in light of e.g. appraisal (Desmet 2002; Frijda 1988). Representation on the other hand is the meaningful dimension (Warell and Young 2011, 282) in which sense is made of the design and its encounter – the apperception of the design. Emphasis is placed on the changing of meaning depending on socio-cultural and purpose contexts, which corresponds with theories on UX characterising the dynamic and ephemeral nature of the experience (Hassenzahl and Tractinsky 2006; Battarbee and Koskinen 2005).

Representation entails the recognition of design elements – i.e. the match between what is perceived and corresponding mental contents, requiring antecedent experience of similar symbolic material and devices (Simon 1992, 132; Solso 1999, 78; Warell and Young 2011, 283). Comprehension takes place in this dimension, whereby understandings of the designs are established. Further, the communication component of a representation relates to associations that are made in regarding properties such as values, heritage and origins etc. which relates to the metaphysical component of an object in the semiotic model of UX. In Warell's model, experience itself is composed of a

sensorial sub-mode, which relates to sense-data or the information obtained through the senses (sight, taste, smell, touch and sound). It also comprises the cognitive sub-mode, explaining the cognitive processing of this information. And finally, an affective sub-mode illustrating the affective or emotional response and connection attached to the experience.

Thus, it can be seen that work undertaken in relation to design semantics and experience come close to what has been undertaken in this current PhD research. Variance is observed in relation to this research's hesitation to divide the cognitive and emotional components between the modes of presentation, experience and representation. Rather, apperception and its nature of constructing or composing experiential mental representations from mental information contents, is understood as a less problematic way of explaining the mental component of UX semiotics. Moreover, of paramount to understanding the approach of this PhD dissertation is the fact of *not* being able to directly observe and comprehend the mental component. Instead, what Krippendorff and Butter (2007) refer to as ex-pressions and ex-planations of ex-periences are of prime concern. That is, via the examination of discourse and verbal-written recollections of user experiences, the aim of this research has been to coordinate an understanding of the types of mental content incited by designs and their usage, and how this qualitative content is shared from one user to the next.

### 2.4.2 Cognitive semantics

Cognitive semantics focuses on the way in which language reveals cognitive semantic processes, contents and their structures. Cognitive semantics treats language production and expression as the cognitive act of meaning making. In particular, language is interpreted as a system of mental functioning which enables scientists to gain greater insight into the mind and its functions in general (Talmy 2000). Cognitive semantics views linguistic expression as useful in the following three ways: 1) that it reflects how a person conceptualises the world and its phenomena; 2) that linguistic knowledge is learned and exists contextually; and 3) that linguistic production is a cognitive process existing in relation to other cognitive functions, rather than operating as the result of a stand-alone language module (Croft and Cruse 2004). Through language, people convey their conceptual mindscape in terms of aspects such as notions of time, and other relative phenomena (scale and distance), opinion, emotion and expectations – i.e. how the world and its phenomena should be according to their mental schema and norms (social-cultural). Through words, people offer a window to their mind (Evans forthcoming), which is why if a research goal is to understand *how* a person thinks and experiences, qualitative data should always be included on some level.

In order to comprehend the fashion in which the mind works, it is necessary to gain insight into its principles of organisation. That is, the key to understanding how the mind works, is by understanding how information is categorised, and how its various systems are organised overall. Through the comprehension of one cognitive system – language – invaluable insight may be

gained regarding all cognitive systems. This may be achieved via either the generalisation of similarities, or the contrasting of differences (Talmy 2000). It is for this reason that the empirical development of this research has focused on establishing an empirical framework designed to collect larger quantities of qualitative material. Qualitative data, or linguistic contents, is seen as invaluable in terms of its explanatory power, semantic connections and references.

Meaning and language as a cognitive phenomenon do not simply exist in pairs or chains, rather they exist in webs or networks (Evans forthcoming). Semantics between words (and other linguistic devices) and phenomena vary according to context. Thus, words and other mental symbolic material (mental contents) are tentatively attached or waiting to be connected and re-composed in response to, and in the apperception of any prospective interaction or encounter. As seen in regards to theories on mental representations and Evans' (forthcoming) subtle reference to the semantic web, computers and their analogies are frequently used in reference to human cognitive processing. Research in the field of artificial intelligence (AI) for example, utilises Chomsky's (1986) theory of Universal Grammar, which posits that the human mind has an inbuilt ability to distinguish whether or not a sentence is correctly formed. This is used as a basis of symbol processing logic in the development of AI. Theorists speculate that language has evolved from being "a mind-internal computational system" (Waser 2010, 3), used to structure thought and planning, to a means of communication. This is further reinforced by scholars who stress that through studying constants in cross-cultural language, we are afforded insight into internal representation systems – or mental-linguistic universalities (Pinker 2007). It also has been argued that language affects individuals' moral perceptions (Rawls 1971). This leads to theorisation which proposing that both morality and language share the same mental computation system.

In light of these various approaches to understanding the connection between thought and language production, this PhD research focuses on the ability of qualitative content to reveal shared and varying mental information contents and constructs across user samples. Unlike cognitive semantics, this work does not go into detail analysing the grammatical mechanisms featured in the structures of qualitative content – i.e. sentence formulations, punctuation and their ability to reveal structures of space and time etc. Rather, based on the same principle of recognising qualitative data's ability to reveal thought, this research focuses on content in terms of metaphors, emotions and design properties that are presented in study participants' descriptions. There are two main ideas behind this approach. The first idea is to gain insight into the relationships between qualitative content and specific design elements (in regards to factors such as context etc.), which is similar to the intentions of design semantics. The second is to generate an easily implemented and efficient empirical framework which can be implemented in industry and academia alike to collect larger qualitative data samples, yielding results which can be

immediately considered within the design process – preferably during pre-production phases.

The next chapter on methodology outlines the development and implementation of approaches designed for this very purpose. The chapter begins with a brief description on personal construct psychology, or theory (PCP or PCT) which has provided a theoretical methodological basis from which the methods were sought and reasoned. This is followed by descriptions of two techniques specifically stemming from PCP – picture sorts and repertory grid. Field observations were also used in one study described in articles VI and VII, which revealed the ability to combine the user's mental contents with the researcher's in terms of connections made to observed and experienced features regarding the designs and their contexts. Then the succinct qualitative analysis technique (SQAT) is introduced as the result of combining logics from picture sorts and the repertory grid, then further simplifying the empirical implementation.

# 3 METHODOLOGY

This PhD research has emerged through undertaking project studies which varied in nature regarding the types of design examined (smartphone icons, fry pans, elevators, home decor etc.). Yet, each study carried a similar focus which involved examining user/participant qualitative representations (data) for its potential to reveal present mental contents in design experience. Thus, from the outset one fixed method and procedure for investigating users' experiences could not be established and applied to such a range of products. Instead, empirical emphasis was placed on the theoretical principles behind the methodologies presented according to Personal Construct Theory/Psychology (Kelly 1955). These correspond with AI scientist, Stevan Harnad's (2005) view which proposes that to cognise is to categorise.

PCT (or PCP) was the basic empirical theoretical assumption behind all of the case studies. This theory stipulates that people organise the world and its phenomena in terms of categories. These categories are defined by specific criteria, i.e. "theirs and mine", "culture and nature", and within these categories are constructs. Constructs refer to the way we construct and represent phenomena in order to understand it in light of these categories (Kelly 1955, 1969; Bannister and Fransella 1986). In other words, through establishing constructs and organising them in terms of categories we are able to make sense of phenomena. Therefore, within PCT approaches qualitative data is crucial for gaining an understanding of how people cognitively and symbolically construct their experiences. This theoretical approach also comes close to theories in cognitive semantics which stipulate that linguistic communication and the way in which it is constructed allows us to gain insight into how thoughts are structured.

The noted pioneer of Personal Construct Theory (PCT) or Personal Construct Psychology (PCP) was George Kelly. Kelly's work is influential in this research not just on the semiotic level of providing tools for viewing and interpreting qualitative data semantically as constructs, but also on the level of psychological scientific philosophy. Kelly (1970, 1-2) uses the term *constructive alternativism* to describe how theories are implementations of philosophical

assumptions. According to Kelly, no matter what nature or reality may be, we are always subject to perceiving and reconstructing phenomena though our own personal categorisations. Anything we read or learn is adjusted and re-categorised within our minds. This information is subsequently re-formulated in our communicative accounts when relating this knowledge to other people. PCP was proposed by Kelly not as a means of contradicting other psychologies (or sciences) which maintain that a truth may be revealed when perceiving and analysing phenomena in a certain way, rather it was proposed as an alternative psychology. Thus, PCP does not deny the existence of truth or reality, instead it provides an alternative that maintains that the truth is always subject to our mental re-construction and interpretation. Here, truth is seen as being continuous mental and social re-constructions of that which is perceived. This approach allows for more interesting and elaborate understandings of how the world and its phenomena exist within the mind of an individual (Bannister and Fransella 1986, 7).

On a practical level, PCP or PCT views knowledge as existing in relation to categories. In other words, we organise and identify information in categorical terms, which also establish means of similarities and differences between information (Rugg and McGeorge 2005, 94). People use *constructs* to describe objects and phenomena (Kelly 1955; Bannister and Fransella 1986; Rugg and McGeorge 2005). Categories have been described as groups of things which are classified in terms of the same criterion. A criterion is the characteristic or attribute upon which phenomena (or for example picture cards) are sort and categorised. A criterion may be seen in terms of e.g. country of origin, cost, utility etc. The categories are represented according to the criterion. If the criterion were utility, then the category could be: cooking, time management, entertainment etc.

Facets pertain to the perspective in which phenomena is being investigated and categorised. User interfaces for instance, may be categorised according to criteria referring to the icon designs (aesthetics, usability, metaphors and semiotic relevance etc.) or overall usability in general (Vickery 1960; Rugg and McGeorge 1995, 2005). Constructs can be seen in terms such as "expensive", "cheap", "beautiful", and "funny" for instance. These are means of describing and framing phenomena in terms of specific characteristics. They can more widely be applied than either categories or criterion. Finally, a range of convenience refers to the expanse of settings according to which a construct can be meaningfully used (Kelly 1955; Bannister and Fransella 1989; Rugg and McGeorge 2005, 95).

In this research, methods which have been developed to instrumentalise PCT include the picture sorts and repertory grid techniques (RGT). The picture sorts technique was implemented in the smartphone icons study, and RGT was implemented in a handheld moisture meter study which for confidentiality reasons is not included in the attached articles. In contrast to other methods such as semantic differential (SD - Darnell 1970; Osgood et al. 1957), which have been implemented to examine UX and its associated emotions, picture sorts and

RGT ask participants to generate qualitative constructs against which they quantitatively evaluate semantic connections. In the case of picture sorts, participants are asked to place picture cards (in this instance smartphone icon interfaces) into three groups ranging from unattractive (1), neutral (2) to most attractive (3). The groups are then treated as quantities expressed in the corresponding numbers mentioned, and qualitative content provided to describe each group is matched to the quantitative opinion ratings. RGT also aims at quantitatively analysing user-generated qualitative constructs. However, in this case, the experiment takes shape quite similarly to SD. Where in SD participants are asked to quantitatively rate their opinion in light of bi-polar researcher/designer/marketer given constructs (such as adjectives), in RGT participants are asked to provide the bi-polar constructs (preferably adjectives) such as heavy-light, beautiful-ugly etc. themselves. Then based on these bi-polar constructs, participants rate the design objects numerically (i.e. from one to five, one to seven and so forth) according to the semantic connections they feel the designs share to the qualitative constructs.

The main reason for choosing the methods featured here is due to their emphasis on qualitative data, and in particular verbal/written expression. Field observations combined with interviews can be argued as standing out from the two above mentioned techniques. But here I argue that this ethnographically influenced approach in itself is a semiotic endeavour. The researcher is mostly dealing with their own observations and interpretations of symbolic systems of people, interaction, the surrounding context and environment, in light of data supplied by participants. Therefore, all of the results of a field observation and interview study are based on the way that a researcher contrasts their own interpretations. Finally this chapter outlines the Succinct Qualitative Analysis Technique (SQAT). SQAT is a method that was designed specifically in the context of this research. It has been influenced by all of the above mentioned methods and is intended to be implemented by researchers and design practitioners alike, in all types of UX studies and contexts. SQAT is a compact technique for gathering brief descriptive constructs which represent the first representations that come to mind when experiencing design. The idea behind the method is to gain insight into more direct connections between factors such as designs, design elements, sensory mode, context and the way in which these are represented mentally, and how they are externally represented to others.

## 3.1 Picture Sorts

The picture sorts technique (PST) was implemented in the smartphone icon study discussed in several of the articles. The basic premise of PST is that people's knowledge is represented in the categories they use (Rugg and McGeorge 2005, 94). Or more concisely, based on PCT (Kelly 1955) and the constructivist approach in general, people are assumed to make sense of the world through categories. In order to understand, interpret and make sense of

things and phenomena people place what is perceived into mental categories. Experts are distinguished from non-experts in that an expert has more extensive and sophisticated categorisations in their field of expertise than a non-expert would have (Chi, Glaser and Farr 1988; Ellis 1989; Rugg and McGeorge 2005, 94). These categories can be likened to mental contents, in that both represent knowledge and experts subsequently have greater repertoires of knowledge acquired through learning and undertaking (Saariluoma 2000; 2003). Knowledge in this case is represented in vocabulary and categories for articulating this vocabulary. It is for this reason that this PhD research has been built upon investigating how users explain their experiences, rather than how they match their perception of the design with expert vocabulary (i.e. seen in semantic differential and other semantic Likert-scale type measures).

In sorting techniques such as PST, participants are asked to sort things, or in this case picture cards, into groups. These groups vary from pre-established groups specified by the researcher, groups which are chosen and defined by the participant, and groups formed in collaboration with both parties (Rugg and McGeorge 2005, 95). These are useful techniques for opinion ranking, elicitation and agreement/disagreement examination. In particular, sorting techniques such as PST are convenient for investigating categorisations, commonalities and differences between participants. Participant samples can comprise, for example technology design users from similar backgrounds, users from varied backgrounds, or even expert (designer or engineer) and non-expert (users or consumers) participants for category comparisons. Another advantage of using PST is that it is efficient, easy to use and systematic (Rugg, Corbridge, Major, Burton and Shadbolt 1992; Rugg and McGeorge 2005, 95).

There are a few different types of sorting techniques which exist. The main types include: Q sorts (Stephenson 1953), hierarchical sorts, all-in-one sorts, and repeated single-criterion sorts. The Q sorts technique generally involves a large pack of cards which feature various statements and phrases on each card. In experimental situations, participants are asked to allocate the cards to predefined categories specified by the researcher. In this instance, cards may feature descriptions of for example personality attributes and participants may be asked to arrange the cards in terms of whether or not they “strongly agree” or “strongly disagree”. Analysis is performed statistically, similarly to the analysis of opinion based rating scales. The technique may be performed multiple times (at different intervals) with the same participants in order to establish results relating to e.g. higher-order clustering (Rugg and McGeorge 2005, 96). This is similar to questionnaire methods such as SD in that semantic closeness and distance is measured between researcher constructs and participant perception. This is not a time efficient method and demands great lengths of preparation on the researcher’s behalf in order to ensure suitable contents to be featured on the cards.

Hierarchical sorts can be performed using cards which represent various semantic levels (i.e. automotive parts, car types, models, brands), or by using cards which represent the same semantic level (i.e. just automotive parts or car

types etc.). In the case of the former, the participant is asked to organise the cards according to one hierarchy (such as seen in the Linnean taxonomy, see e.g. Cain 1959). But, once again this requires a lot of preparation and knowledge acquisition (KA) on behalf of the researcher, as deficiencies in the range entities represented generate deficits and distortions in terms of the responses provided by participants. In instances where cards representing the same semantic level are involved, participants are asked to sort the cards according to factors such as mechanics, chasse, interior etc. So, the cards could be once sorted in terms of mechanics, then next in terms of chasse, then interior, and so forth. But, once again, Rugg and McGeorge (2005, 96) highlights problems with this method in that complete branches of the hierarchies might be ignored.

In the case of all-in-one sorts, the participant is asked to perform only one sort. One type of sort is a matrix layout. Here, the participant is required to sort the cards or objects into a matrix. One attribute is represented by one axis and a second attribute is represented by the other axis. For example, a participant may be asked to position the objects or cards in relation to the perceived quality of glassware along one axis, and popularity of the glassware along the other axis. Or, participants may be asked to arrange the objects or cards into groups according to similarity. For example, a participant may sort glassware in terms of same purpose design items, brands, types, colours and perceived quality. The main weakness articulated in relation to this framework is that individual attributes are not elicited systematically and statistical analysis is generally used to investigate underlying elements (Rugg and McGeorge 2005, 97). This means that knowledge and their cognitive structures are not revealed as accurately as they could be via this approach. The repeated single-criterion sorts method is seen as a more effect sorting technique as it is flexible and easier for researchers from a variety of backgrounds to implement. In this approach, participants are asked to repeatedly sort the same objects/cards, each time by a different single criterion (attribute).

The technique used in the smartphone icon study represented in this dissertation was adapted from the single-criterion sorting technique (Rugg et al. 1992; Rugg and McGeorge 1999, 2005). The idea of using picture sort cards to represent the icon interfaces, in addition to the procedural structure of the experiment was based on Shieh, Yan and Chen's (2008) study into soliciting customer requirements for product redesign. In this current study's version of PST, participants were given a pack of 22 picture cards featuring icon displays of competing smartphone models. There were multiple models from the same brand, and even later and earlier versions of the same models. The single criterion was 'attractiveness'.

Due to goal of the study which was to test several methods (which included the icon identification experiment and icon rating) for eliciting consumer information about preferences in 'attractiveness', the single-criterion procedure was only performed once against this attractiveness criterion. Participants were asked to sort the cards into three piles: the most attractive; attractive (good but still not quite there); and the least attractive. Participants

could take as much time as they wanted. Some people did this in a matter of a few minutes, while others spent 30-45 minutes carefully looking at the icons and evaluating their attributes. Once the sorting was completed participants were asked to give the piles descriptive titles to characterise the nature of the cards in the piles. They were then asked to elaborate on their title decisions and summarise their opinions about the cards featured in the piles. Participants first wrote their responses on a questionnaire form and then vocalised these responses. The main intention of asking people to both write and speak was to obtain as much detail regarding their thought content as possible. Some people are inclined to write more and some to speak more (Fleming 1995).

Based on the format of the experiment and questionnaire (pile titles and space for summarising information), the qualitative material provided was semi-structured. Further, quantitative data was provided in relation to the sorting piles (most attractive = 3/3; attractive 2/3; least attractive 1/3). Thus, both elicitation and quantification on behalf of the participant were easy to perform, and analysis was clear on behalf of the researcher. As there was concise qualitative data, transcription of the audio interviews and content analysis were efficient to perform. The aspect which demanded substantial thought, and provided a point of interest for further investigation was the semantic interpretation of the qualitative data. Subsequently, the complexity of qualitative analysis reflects the main problem of this research: if a person states that they like a set of icons because they are "clear", are they referring to the clarity of the formal designs themselves, or the iconic relationship between the images and what they are representing (a direct relationship between the representamen and the object)? Then, if they refer to "clarity" of the designs, what constitutes this clarity? If a participant refers to the clear relationship between image and function, what is it about the image that represents the function? If the researcher wants to gain more information to elaborate on the participant given definitions they will need to probe deeper. This would form the basis of further PST methodological development, whereby single criterion used for the sorting may be based on the participant's own constructs.

The ultimate conclusions of performing this method are that: 1) qualitative analysis is always subject to the researcher's interpretation, further probing may be useful in providing more detail, but understandings are always formed, not by what the participant experiences, but by how the researcher or reader interprets data according to their own understanding of the constructs; 2) the same qualitative expressions (e.g. words) have multiple meanings, not only varying from participant to participant, but varying within explanations supplied by the same participant. For example, "functional" was mostly used to describe the "middle pile" (attractive) in terms of the icons which were perceived as "usable", yet not so enticing. On the other hand, the term "functional" was also used more positively to describe ease-of-use relating to the most attractive pile; and 3) due to the known impact of mental state (moods, emotions and sentiments) on user preference and experience, a method such as

this should be performed on several separate occasions with the same participants to measure constants in icon preference and descriptive constructs.

## 3.2 Repertory Grid

The repertory grid technique (RGT) is not described in any of the articles featured in this dissertation. However, it is important to discuss here as it provides a basis for further methodological development seen in the case of the succinct qualitative analysis technique (SQAT). Like the sorting techniques, RGT also stems from Kelly's (1955) PCT/PCP. RGT can be located between PST and SD for example, whereby participants are asked to provide their own bi-polar adjective constructs to describe particular design features. They are then asked to quantitatively evaluate a set of designs based on these constructs. RGT operates according an object-attribute grid or matrix (Rugg and McGeorge 2005). It was chosen for a case to examine the UX of handheld moisture meters, in order to address short-comings in the SD method. In the RGT situation, participants are first asked to supply a set of bi-polar qualitative (usually adjective) pairs against which to evaluate a group of artefacts (Beail 1985; Feixas 1995; Feixas, del Acebo, Bekaert and Sbert 1999). The artefacts are then evaluated via numerals written in the matrix, e.g. one to five, one to seven, or one to ten, comparable to the points on a Likert-scale yet appropriate for the grid. This technique has been noted as favourable in HCI studies which focus on gaining cross-cultural samples (see Fallman and Waterworth 2010; Tomico, Karapanos, Lévy, Mizutani and Yamanaka 2009; Tan and Tung 2003).

In the case of the handheld moisture meters, six designs were studied and participants were chosen as they represented actual users of the devices. In order to create 10 bi-polar adjective pairs, participants were shown the six meters in differing combinations. Participants were asked to select one moisture meter which stood out from the other two meters for either positive or negative reasons. They were then asked to verbally reflect upon why they chose the object they did, and then to state an adjective to describe the reason for choosing the object they had. This adjective was then written in the 'similarity' column presented at the left of the grid (see an example in Table 3). Participants were then told to generate an adjective which they felt described the opposite of the similarity adjective. This opposite adjective was then written in the contrast column of the grid.

Once the 10 bi-polar adjective pairs had been written into the grid, participants were required to once again view the moisture meters, however, this time one-by-one. Here, participants were asked to rate the items on a scale of one to seven in terms of their semantic relationship towards either the similarity construct (complete similarity = 7) or the contrast construct (completely contrasting = 1) against all 10 bi-polar pairs. This method was useful for several reasons. Firstly, it not only revealed the way in which the participant qualitatively experienced and represented the products

individually, but also revealed relationships between certain designs and design elements. Secondly, this method shows the first impressions of design objects, and factors that stand out when people encounter groups of products. Thirdly, although participants are not asked directly to indicate whether or not an adjective describes a negative or positive quality, negative or positive valence is apparent when analysing the constructs in light of the designs and their desired usage purpose. Thus, a contextualised negative and positive weighting can be attached to the adjectives in direct relationship to particular design features. For example, when reflecting on results gained from picture sorts in the smartphone icon study, constructs such as "trendy" and "brand" projected positive connotations, whereas in the context of the moisture meters, these constructs were connected to "impractical" qualities.

TABLE 3 Example of Repertory Grid

| **Similarity** | **Object 1** | **Object 2** | **Object 3** | **Object 4** | **Contrast** |
|---|---|---|---|---|---|
| Light (*example*) | 4 | 2 | 1 | 7 | Heavy (*example*) |
| Durable (*example*) | 3 | 2 | 5 | 6 | Fragile (*example*) |

This method allows for statistical analysis of one participant sample per time. But, when analysing the bi-polar pair sets and corresponding quantitative data as a whole problems arise. These problems start from the massive size of the data due to every participant providing their own set of 10 pairs. Thus, constructs increase by 20 every time an extra participant is included in the study. Secondly, as there is no set positive-negative scale, constructs may be used positively to describe one type of design element in one participant's constructs, and negatively to describe another design element in another's (York 1983; Rugg and Shadbolt 1991). There are numerous RGT analysis software applications, and several available freely online (such as OpenWebGrid, WebGrid and the software used for analysis in this case sci:vesco), all of which are relatively easy to use and interpret. However, there are still the problems of presenting the vast data samples concisely and cohesively when reporting, as well as the questions of varying semantic application of specific constructs from one participant to the next.

One way of dealing with these issues is by using the software to analyse the results of the participants independently. Then, content analysis can be performed to group the constructs according to similar themes and criteria and quantitative results can be connected to the objects across participants. If performed manually by the researcher, there is the allowance to observe the various bi-polar combinations and valence attributed to constructs. This would be time-taking yet fruitful. The point of implementing RGT in UX research is to gain insight into the personal meaning of objects in a structured manner (Väänänen-Vainio-Mattila, Roto and Hassenzahl 2008). Data obtained in this

fashion provides insight into concerns (see Desmet 2002; Desmet and Herkkert 2002 for the role of emotions in relation to concerns and appraisal), themes and topics that people perceive and evaluate particular design groups by. The analytical complexity however, seemed to be a major drawback in terms of promoting this technique to designers for instance, who work in industry, have tight deadlines and quite often not too much experience in dealing with statistical analysis. This is why the Succinct Qualitative Analysis Technique (SQAT soon to be discussed) was developed. But, before SQAT another approach was implemented to examine the UX of elevators. This was the ethnographically inspired field observations and short interviews approach.

## 3.3 Ethnography, field observations and short interviews

Ethnography inspired the approach of studying the UX of elevator design. This elevator study provided interesting material in regards to exploring the various impacts of context, usage purpose and embodied experiential dynamics in UX. For this reason some articles discussing this study have been included in this dissertation. Ethnography no doubt stands out against the content construct, or PCT, oriented methods described above. Ethnography, from the Greek words "ethnos" meaning people, and "grapho" meaning to write, is a qualitative research method used to examine cultural phenomena in particular (Geertz 1973). Ethnography can also be described as an approach to studying cultural interaction. It does not prescribe one unified method (O'Reilly 2012) rather its intents and purposes are to gain insight into a cultural system from the perspective of an insider. In the study of elevator UX, and more specifically HCI in general, we can view the technologies, contexts, environments and human actors as types of cultural systems which reflect "certain values, practices, relationships and identifications" (Massey 1998). These dimensions are present on all levels of HCI (Burke and Kirk 2001). Thus, in order to gain information regarding perceptions of technology users, we need to gain an understanding of the types of viewpoints and issues operating in relation to these dimensions.

Ethnography as an approach to studying UX can be seen as a way of observing and examining human interactions when in action within social contexts (Burke and Kirk 2001). By acquiring information from the perspective of the user, technological developers and designers are able to generate designs which suit the needs and preferences of particular user groups. Of high priority in UX studies is the role of emotions and how they affect technology acceptance, technology use, and overall experience or sentiments left from technological interactions (Brave and Nass 2007).

Further, rather than purely relying on what is provided in interviews or questionnaires, ethnographic methods literally place the researcher in the position of the user and spectator. The researcher is both afforded first hand experiences of the technology and its accompanying physical, social and cultural dynamics etc. as well as the opportunity to observe nuances that

perhaps users are unaware of themselves, or simply forget to mention in their responses. These methods enable researchers to experience the technology for themselves in terms of flow and inconsistencies in the interactions. Through experiencing first hand, not only are there possibilities to uncover specific details which are not featured in the users' recollections, but also, this experience enables the researcher to engage in e.g. experience prototyping – from the perspective of the user (Burke and Kirk 2001). Furthermore, through the open-ended character of ethnography, there are increased possibilities for gaining unexpected findings in relation to not only how systems are used, but also interactions and relationships that take place because of, in the context of or around the technology, in addition to how these systems are perceived. This is the advantage of combining observations with tools such as interviews or questionnaires.

Types of ethnographic data include: documents; field notes containing observational information, spoken discussions, remarks and diagrams; as well as audio-visual material, photographs, interview transcripts and quantitative data (Massey 1998). A common understanding in ethnography is that in order to gain a deeper understanding of how phenomena and interactions are experienced by people (users), there is the need to obtain a multi-dimensional comprehension of the user setting (Woods 1994, 311). In order to accomplish this, data needs to include multiple data types as mentioned above. Thus, to undertake a comprehensive ethnographic type study, there is the need to combine multiple methods such as interviews, quantitative questionnaires, observations and possible collection of cultural artefacts. In this case, the nature of elevators does not permit this last activity, but photographs of the designs, usage and factors which would affect the design's perception such as the surrounding architectural setting and external items such as signs (wet floor) or renovation work, would be useful for developing this understanding. Therefore, an inquiry which utilises only one method cannot be considered ethnography (Massey 1998; Woods 1994).

Ideally, ethnographic studies take place over a longer duration of time in order for the people under study (users) to feel at ease with the researcher's presence, drop the performance and act/interact the way they normally would on a day-to-day basis. Further, longer term involvement also means that more detail is experienced first-hand by the researcher (Woods 1994, 310). Thus, first-hand usage and simply being present in the usage context, in relation to the interactions under study, enables the researcher to discover subtleties and nuances from the setting, that would not otherwise be re-collected or noticed (Spindler and Spindler 1992, 63 & 66). These pieces of information discovered first-hand may be more revealing than any of the data produced from other sources. In this methodological approach, the researcher can act as their own main informant (Denscombe 1995; Woods 1994, 313). This approach is justified in that interactions, whether technological or inter-personal are always experienced subjectively (Massey 1998). Furthermore, research itself, no matter how comprehensive and structured, is always the product of subjective

interpretation – firstly on behalf of the researcher, then on behalf of the reader. And as is considered in relation to the problems of any research requiring participant interpretation (semantic interpretations of questionnaire wording and instructions in quantitative and qualitative inquiries alike), research is also hinged upon the specific interpretations of the user. The point here is that while every measure needs to be taken to address the research problem as thoroughly and systematically as possible (Wilcox 1982, 459), the researcher and subsequently reader of the research must be aware of the subjective interpretative limitations that each actor faces in relation to the subject, associated interactions, and more importantly, experiences.

In the elevator study described in the articles, two days or 18 hours in total, were spent observing elevator usage behaviour, human interactions (with the design and other users), the surrounding architectural environment and experiencing the elevator usage first hand. Eighteen hours does not constitute a longitudinal study, but in this instance, as the primary focus was on the elevator usage itself, rather than a defined group of people, this seemed long enough to gain insight into experiences and interactions. Through being there in person I was able to gain an understanding regarding issues such as: perceived waiting time, versus actual waiting time (one of the main points of discontent related to the length of time spent waiting for the elevators, when observations showed that 50% of hall calls were responded to in under one second); aesthetic experience of mechanical design and non-intentional aesthetics induced by sound and movement (the sound of wind in the elevator shafts and swaying sensation as the elevator reached greater heights); as well as social organisation and design interaction in the elevator cabin spaces (hierarchies were revealed in terms of gender and professional-age superiority in standing arrangements and interactions with features such as mirrors).

From a mental contents perspective, I was able to analyse participant given data in light of my own observations and experiences of the elevators and aesthetic context as a whole. For instance, when performing statistical analysis of quantitative opinion scale questions relating to specific design elements, we noticed a positive correlation between feelings of security (interpersonal interactions and well-being) and safety (relating to the elevator operations) and the control buttons. When people gave a higher rating for the control button design, they were also likely to report a high sense of security and safety. In reflection of this, it is claimed that questionnaires revealed subconscious layers of mental contents (Saariluoma et al. 2013). One interpretation of these results may be, e.g. that when people feel more in control (of the elevators), they also feel safer and more secure. However, what questionnaires do not reveal are the ways in which the surrounding environment, its designs and specific features also impact on mental contents existing in the subconscious.

Through being there, analysing the ground floor aesthetics, in addition to travelling in the elevators, I noticed that while both buildings featured in the study had been recently refurbished, and the elevators had been upgraded around the same time – meaning that the architectural environments were

equally as new and updated – and the same elevator brand had been used, there were still two particular features which contrasted one building from the other. These features were: 1) the ceiling height – one building (Westpac House) had extremely high ceilings in the foyer and the other (Grenfell Centre) featured notably low ceilings for a commercial property; and 2) a security desk was present in the foyer of Westpac House and was absent in the foyer of Grenfell Centre. In Westpac House less people were willing to participate in the study. Yet at the same time, the ones who did, did not recall any negative experiences. In Grenfell Centre, as an outsider I experienced more of an openness and equality created by the design symmetry and lower ceilings. Further, more people were willing to participate in the study. However, many of the people participating also recalled negative experiences, mostly relating to the former elevators housed at the building and interpersonal experiences with people who should not have been in the building.

Thus, two contributors may be observed that cannot be extracted from the questionnaire: 1) the feeling of openness and welcoming to the researcher as an outsider due to the lack of security desk, induces the opposite feelings to those who occupy the building (usually for work purposes) – thus, there is no consideration of defensible space (Lidwell, Holden and Butler 2010; MacDonald and Gifford 1989; Newman 1973, 1996), meaning that people feel conscious of possible threats to their personal security; and 2) the lower ceilings, while to me also as an outsider felt intimate and inviting, might be seen to contribute to what is known as the Cathedral Effect (Meyers-Levy and Zhu 2007) – the Cathedral Effect attributes noticeably lower ceilings to feelings of confinement and reduced cognitive ability to problem solve, while noticeably higher ceilings (experienced in Westpac House) are attributed to freer, creative thinking which assists people in tasks such as problem-solving. So, in the case of an ethnographic approach, the types of valence (positive or negative) reflected in experiential recollections can be connected, not simply to content constructs represented in qualitative data, but the constructs through which the researcher defines their own experience. This type of detail regarding mental contents in UX cannot be gained from the use of e.g. quantitative opinion questionnaires alone.

## 3.4 Succinct Qualitative Analysis Technique (SQAT)

When implementing the above mentioned methods a number of problems arose. Firstly, while the PST is easy to implement and relatively straightforward to analyse – i.e. the quantitative scale is one to three, and only one qualitative construct was given to name each group – the explanations of the titles and group contents were largely unstructured and are fairly time consuming to analyse. RGT provides more structure in regards to participants rating designs according to sets of constructs. As there are bi-polar word constructs rather than purely full interview material (though usually this is also collected), the

qualitative constructs are simple to analyse one participant per time. However, problems arise when combining the participants' responses. Even when utilising RGT analysis software such as sci:vesco and OpenRepGrid, there are large amounts of results to report, as every participant has their own set of bi-polar constructs. Even when the constructs are categorised via content analysis, there are still numerous questions remaining regarding the inevitable differences in bi-polar constructs. This characteristic has previously been noted by scholars whereby many words do not have one single antonym but several, causing difficulties in terms of meaning interpretation (Wikström 2002; Schütte 2005; Warell 2008).

Thus, rather than moving into more complex waters, this research has recognised the benefits of simplifying the examination of UX both in terms of data collection and analysis. By simplifying the process we not only reduce the complexity of an already complicated, multi-layered dynamic phenomenon, but make the analytical model and methodology accessible to designers and industry alike. It is hoped that the methodological developments mapped out in this dissertation will be adopted and applied by practitioners and companies as a convenient and insightful way of examining users' qualitative contents.

Of the above mentioned methods, the PST applied as the single-criterion sort, is the most user friendly in terms of ease-of-use and analysis for professionals whose focus is something other than research (such as designers). However, time still needs to be spent reading through the open form explanatory summaries of the titles, extracting relevant constructs which categorise the way that a user is mentally perceiving the design and its interactions. The sorting in itself (while it should be repeated on several occasions with the same participants in order to observe constants) does not pose too many problems *if* the sort is performed repeatedly for different categories of single-criteria. In this way, designs which do not necessarily perform well according to user expectations of one category, or which project complexity in their semantic interpretation can be explored in terms of diversity of meanings and strengths-weaknesses across attributes.

Concerns which arose during the research pertained to: how can we obtain direct access to the mental content of people's design experiences? As well as, how can we access quantitative material without the user or participant needing to think in terms of numbers – thus, allowing them to focus solely on qualitative constructs? To somehow access mental content through qualitative constructs, and also consider ways of quantitatively measuring this in order to make general observations of cognitive processing in UX, became further goals of this method development. As mentioned above, in the context of this research relying solely on quantitative material obtained through opinion rating questionnaires is seen as problematic. To collect material which simultaneously allows for greater qualitative insight and understanding, and is able to be analysed efficiently on a surface level by practitioners whose profession is something other than scientific research, as well as on a deeper semantic level revealing the interchange and relationships between cognitive categories and

deeper thought structures by e.g. cognitive scientists, seemed enticing. Then, to structure both the data collection and analysis in such a way that larger sample sizes could be dealt with, qualitative constructs could be quantified and as a consequence generalisations could be made, seemed like an ideal way to proceed with method development examining PCT, mental contents and even design semantics in general.

The idea with the quantification of qualitative constructs is not to reduce words to numbers, but to observe patterns and frequencies in qualitative mental content triggered in users as the result of particular designs, elements and associated interactional attributes. Thus, factors under consideration also include use context, use purpose, environment etc. and as is discussed in the article (IV) relating to multi-sensory UX, the different facets of mental contents and experiential qualities generated through multi-modal stimulation. Therefore, within the SQAT framework qualitative data is analysed for its semantic qualities (content analysis and close reading of the meanings and associations generated in the qualitative material) and cognitive content (generalisable observations of content trends across larger samples of users in relation to specific designs and interactions), which connect cognitive categories to specific design and interaction factors.

With this complexity comes the need for simplicity. RGT was useful as it not only featured user-generated qualitative constructs, but also quantitatively ranked semantic relationships between the constructs and the designs. For reasons mentioned above, including masses of data (one set of bi-polar pairs per participant) and the complexity in analysis and presentation, it did not seem like a viable direction for non-scientific specialists to take when designing for UX. However, the plotting of independent constructs based on (multi-sensory) design experience, and hidden quantitative mechanisms which would not intimidate either the participant or practitioner, seemed the way to go.

Thus, in SQAT participants are asked to write the first five things (constructs) that come to mind when perceiving a design – of whatever nature - via one or more of the five senses. Preferably studies are undertaken examining more than one sensory mode, and the modes can be studied separately or together (ideally control and experimental groups would be useful in SQAT studies). The five constructs participants are asked to write (or verbally report) are not restricted to adjectives, but are simply *anything* that comes to mind when encountering the design. Therefore, adjectives and their distinct types are content categories in their own right when analysing the results. The constructs are labelled one to five. The participant does not have to think of quantitatively evaluating the designs or expressing semantic distance, but these numbers are significant to the researcher/designer who uses them to measure the meaning of the construct in relation to the experience of the design. Thus, constructs written in label "1" represent the very first information the participant drew on, or recognised in relation to the design. While all five constructs are of high relevance, we can observe the order in which the qualitative impressions take place in the interaction.

Data is analysed in terms of frequencies of qualitative constructs, synonyms and categories, and how these are distributed in relation to the order in which the constructs are given. A logical way of approaching the data is by performing content analysis first, then coding or numbering the subsequent content categories. An example of this method can be seen in Figure 16.

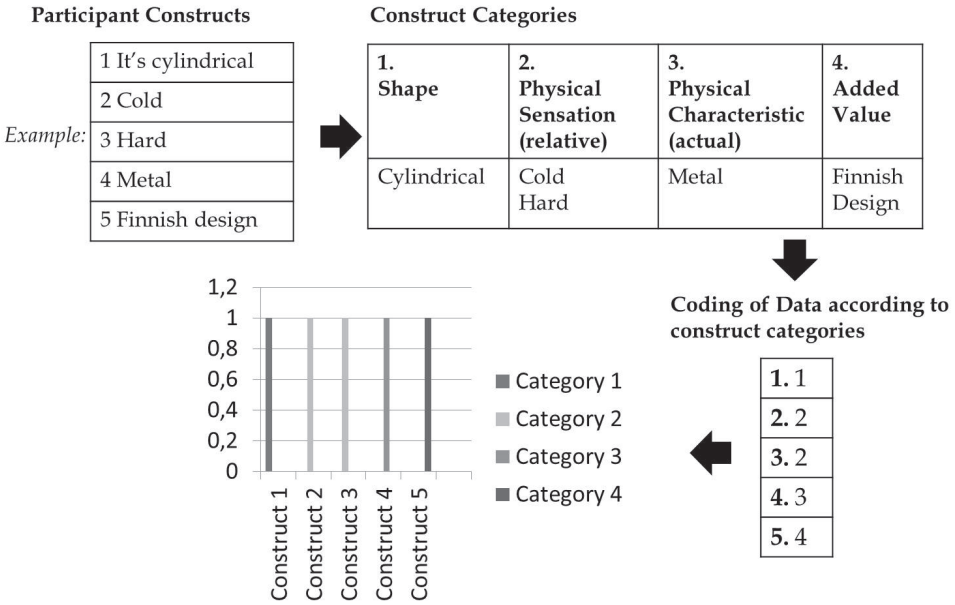


FIGURE 16 Example of SQAT analysis

Above shows a basic example of the analysis process of SQAT. It shows the constructs provided directly by participants. In an actual empirical situation there are sets of five text fields (as seen in the top left-hand side of Figure 16) for each sensory perception of each design under examination. Thus, if in the empirical study participants are asked to perceive stimuli via three sensory modes, e.g. touch, sound and sight, there will be a set of five text fields for each of the senses (fifteen altogether) per design. If five designs are under investigation, this means that 75 qualitative constructs will be provided per participant. The constructs are then analysed via content analysis. There is a range of qualitative content analysis software available for this type of purpose, these include: Nvivo, Nudist, Ask Sam, Info Select, EZ Text, Atlas T1 and Kwalitan. Further, there are some open source qualitative content analysis applications available such as Weft QDA and the Coding Analysis Toolkit (CAT). The software varies in terms of ease-of-use and pricing (if not open source). For a professional who does not have much time to read through material carefully, categorise the constructs and summarise the results as a whole, this type of software is a viable option.

Content analysis in this research was performed via manual close-reading, categorisation and analysis. This contributed to the thought process behind the research, as well as the theoretical and methodological development that is described in the attached articles. In other words, the hands on approach provided a cognitive research process of observing relationships between the participants, the qualitative material they were supplying and the designs they were responding to. Further, due to the programmed nature of software, content analysis applications cannot readily detect subtleties in semantic differentiation in relation to the same word in the same document. These nuances are easier to detect by the researcher who observes the valence attributed to the constructs when they are articulated in relation to certain design elements within the usage/evaluation context.

SQAT is not just seen as a method, but rather a part of a larger project designed to establish a typography connecting qualitative mental contents, or more accurately qualitative representational contents of design experiences, to specific design elements (materials, forms, scale etc.) in relation to context and usage purpose. It is designed to give an overview of the types of things people think about when encountering particular designs and their properties. Designers can match the frequencies of certain types of content provided by the participants to their own design goals and intentions. SQAT presents a simple yet easily replicable method for collecting data from cross-cultural samples. It may also be used to contrast and compare user mental content with designer mental content relating to the same designs and interactions.

# 4 SUMMARY OF ARTICLES

This next chapter presents the summary of articles, the structure of which can be seen in Figure 17.

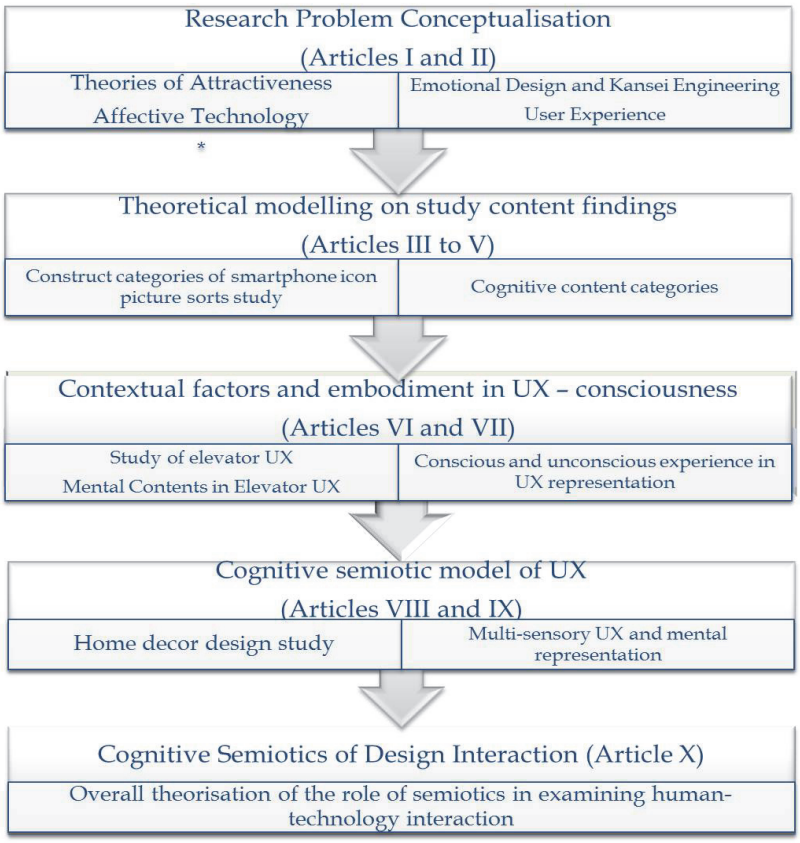


FIGURE 17 Structure of the Articles

The articles progress from the initial explorations and considerations made in regards to design attractiveness and experience, to the categorisation and role of mental contents in the UX discussed. The articles outlining the elevator study emphasise the role of context when exploring the experience of design, particularly in relation to mental representation. Then the home decor related articles introduce the C-model and its application in interpreting the multi-sensory experiences of the design objects. Finally, the last article operates as an umbrella, characterising the central role of semiotics in any kind of technology interaction. All of these articles and their related studies can be attributed to the development and understanding of the semiotic model of UX illustrated and discussed in the theoretical chapter of this dissertation.

**Article I:** "Cute" displays: Developing an emotional bond with your mobile interface

Rousi, R. 2009. "Cute" displays: Developing an emotional bond with your mobile interface. After mobile media. In S. Penny (Ed.), Proceedings of Digital Arts and Culture Conference, 2009. Irvine: University of California. Available at http://escholarship.org/uc/item/9xz0m8mn.

This article conceptualises the problem of investigating user perceptions of attractiveness in smartphone icon design. In this initial phase of research, basic psychological principles of attractiveness and attraction were explored. These principles included the evolutionary psychological theory of universal traits (e.g. paedomorphosis and baby-faced bias), explaining a simultaneous reaction of attraction to both reproduce – youthful features signifying fertility to others of the same species – and to nurture. These principles are then discussed in relation to notions of attraction in technology, which includes aspects which define attraction according to the combination of cultural and political context (i.e. the transference of "cute" or baby-face principles in Japanese product design to contrast a regimental and stringent societal context), as well as semiotic utilitarian properties (i.e. metaphor, familiarity and coherence).

This philosophical paper takes a semiotic approach to investigating the relationship between positive affect and usability of graphical user interface (GUI) icons. It begins by explaining the concept of "cute" and psychological theories of "cuteness" in reference to scholars such as Konrad Lorenz and Paul Leyhausen (1973) and Stephen Jay Gould (1980). Based on this, the user-centered design fields of Kansei (Feeling or Emotion) Engineering with its gimmicky sub-category Kawaii (Cute) Engineering are also described. The paper goes on to discuss the development of computer GUI icons. It offers a brief history of desktop metaphors and examines the conversion of the icon to mobile communication technology. Here, attempts to establish positive affective (emotional response) through icon and animation design are also cited. The pivotal point of the paper is when speculation is made towards the role that "cute" may play when designing GUI icons for affective design interactions.

This is achieved by discussing the psychological implications of adjusting physical proportional and functional characteristics within mobile phone and icon design.

The concept of cute is not un-problematic, as the paper cites differences that occur when it is interpreted from one culture to the next. These differences are also noted elsewhere in this dissertation regarding semantic interpretation of design properties. However, evolutionary psychology is used to exemplify some of the universal physical qualities that appeal not just to humans, but animals as well. Paedomorphosis, or the appeal of infant-like characteristics, is said to be an evolutionary emotional response to things or people in – i.e. the recognition of healthy, young and fertile partners, as well as beings that need to be nurtured[20]. Nurturing and the protective response induced by paedomorphosis (infant-like characteristics) are explained in light of affective user-product relationships.

The history of GUI development is outlined through reference to Ivan Sutherland's (1963) Sketchpad and its use of simulated microworlds. This is tied into Jerome Bruner's (1966) observations on child learning. Bruner's three stage theoretical model of child learning is applied to the discussion of increasing usability in GUI icons. Bruner's stages of learning are: 1) the *enactive* stage - learning through action; 2) the *iconic* stage - learning through the organisation of visual and other sensory material into summarising images (impressions); and 3) the *symbolic* stage - learning through representation in language (textual and otherwise).

The philosophies of "cute" are combined with theoretical models of GUI icons and learning in the virtual environment. This is where the semiotic dimension of icons is discussed. The adoption of desktop imagery, first from real-life to personal computing, then from personal computing to mobile phones is explained in light of discussions on the microworld – or creating a whole which comprises elements that are already familiar to user in order to aid system learning. Based on discussions of the alienating effects of technological engineering (Cheok, Fernando, Merritt and Zhang 2008) and the impersonalised nature of desktop imagery cute principles are reflected on for both the generation of user-device affective interactions, as well as overall usability. It is noted that positive affect broadens a user's thoughts and actions repertoire (Norman 2004; Hazlett and Benedek 2007).

**Article II:** Research with affection – User psychology research from an artistic perspective.

Rousi, R. 2009. Research with affection - user psychology research from an artistic perspective. In M. Mäkelä (Ed.), Proceedings of the Art of Research

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20 Hekkert (2006) and Frijda (1988) describe a similar psychological phenomenon in that, objects and phenomena which we identify as aesthetically appealing are usually good for us – i.e. aesthetics acting as a warning system to inform us regarding the correction cognitive and emotional response.

Conference. Helsinki University of Art and Design, Finland. Available at: http://tm.uiah.fi/tutpor/AOR2009/Rousi_paper.pdf.

This paper supplies the conceptual and professional background behind this PhD research and case study approaches. By citing earlier professional experience as a visual artist and within the arts field, the paper contextualises the research approach of investigating affect and affectiveness (later on UX) from a content-based semiotic perspective. The paper discusses the common interests of an artist, or arts worker and an HCI researcher (or designer) in discovering what makes users and consumers respond in the way they do, to particular product qualities.

The paper draws on previous work by arts historian Sari Kuuva (2007), who took a content-based approach to examining the experience of visual art. The content-based approach is adapted from scholars such as Pertti Saariluoma (2000, 2003), who investigate and explicate the connection between what is represented by technology users and what they mentally experience – their mental representations. Interestingly, Kuuva's (2007) research revealed that non-perceivable (emotional) mental content played a greater role in how participants mentally constructed (apperceived) art works, than the perceivable (cognitive) content. This importance of emotional content in the way we mentally re-construct things and phenomena has led to the study of affect (emotional interaction) as being a primary concern of this PhD dissertation.

Affect is discussed here in connection to usability and perceived usability. Norman (2002) and Umemuro (2009) are drawn on to exemplify the connection between positive emotion and a user's ability to think creatively and problem-solve. It is argued that while positive emotion broadens a person's capacity to use a product through their willingness to explore options, negative emotions or affect, causes a person to narrow their focus – their focus is usually on escaping from the situation. This negative affect has negative repercussions on technology use.

In the paper the picture sorts experiment is described. Experiments were undertaken in Finland and Australia ($N$=35) – 21 participants in Finland and 14 in Australia. Quantitative data was collected through the sorting of 22 picture cards representing smartphone icon interfaces into three groups (one= least attractive; two=neutral; three = most attractive). Additionally, qualitative data was collected in the form of descriptive titles for the groups in addition to explanations of the titles (verbal and written). The results revealed that in the context of smartphone icons attractiveness does not necessarily mean gimmicky, novel or "cute". Instead, similarities between the national groups suggested that in the context of smartphone icons people prefer clarity (free from excess clutter) and intuitiveness (identifiable semantic connection between the user's mental representation of the function and the function itself). There was also a connection between brand familiarity, preference and ability to use the icons. Further, content analysis revealed nine main content construct categories through which participants described their experiences. These were:

aesthetic appeal; clarity; icons, colours and layout; intuitiveness; amounts of icons, arrangement; understandability; labels; shapes; and size. The article compares the construct category distribution between the countries.

**Article III:** A cultural approach to human-centered design – Measuring user perceptions of attractiveness in smartphone icons.

Rousi, R. 2010. A cultural approach to human-centered design - Measuring user perceptions of attractiveness in smartphone icons. In W.S. Yeo (Ed.), Proceedings of the Young Investigators' Forum on Culture Technology - engaging culture and technology, Daejeon: KAIST, 23-33.

This paper also concentrates on explaining the picture sorts methodology in the study of smartphone icons. It begins by contextualising the study in relation to the third HCI paradigm which is attuned to meeting the needs of users not just usability-wise and ergonomically, but also psychologically. The aim of the study was to: a) discover whether particular design elements and compositions can be attributed to contributing to a user's perception of attractiveness; and b) observe whether attractive things do work better. Two underpinning questions of the study were: What is attractiveness? What is attractiveness in the context of smartphone icons? For this, a Personal Construct Psychology (Kelly 1955) approach was adopted.

The development of the experiment methodology is described as an alternative solution to implementing the semantic differential (SD) method. The reason for preferring picture sorts over SD is due to the fact that SD asks participants to act on, or evaluate, designs in accordance with designer/marketer/researcher derived adjectives (constructs). In other words, participants are guided in their impressions to evaluate the designs according to criteria set by those other than themselves. The picture sorts technique was seen to address the bottleneck of data in relation to analysing user-derived information (i.e. listening to the user's voice) and analysing qualitative material in light of quantitative information. That is, given that words and phrases do not always possess innate positive or negative connotations, what types of user descriptions of experiences can be associated with either positive or negative valence? This could be seen when attaching the qualitative descriptions to the numeric weighting of the groups the cards were sorted into.

When analysing the quantitative material no significant differences were noted between groups and no significant differences were noted via cross-tabs between gender, nation or age. This meant that overall statistically participants had quite similar opinions regarding what was attractive regarding the icons and what was not. The paper speculates as to whether or not the two national participant groups were either: a) too similar culturally to notice any differences; or b) that similar market infiltration of the favoured brands and models could be observed in relation to each group.

The content construct categories which were derived through content analysis of the qualitative material are again introduced in this paper. These are: aesthetic appeal; clarity; icons, colours and layout; intuitiveness; amounts of icons, arrangement; understandibility; labels; shapes; and size. These results show, in regards to positive criteria of greatest importance to the Australian participants was clarity. However, of greatest importance to Finnish participants was aesthetic appeal. When describing the icon designs negatively, both Australian and Finnish participants used the category of aesthetic appeal to support their opinions. Statements regarding aesthetic judgment can be noted for their ability to convey emotion in the context of affective studies. Thus, it can be seen that negative perception (valence) more often induces emotional responses (or implicit content) than positive perception.

**Article IV:** Unpacking the contents – A conceptual model for understanding user experience in user psychology.

Rousi, R., Saariluoma, P. & Leikas, J. 2011. Unpacking the contents - A conceptual model for understanding user experience in user psychology. In L. Miller & S. Roncagliolo (Eds.), Proceedings of the 4th International Conference on Advances in Computer-Human Interactions ACHI2011. Gosier, Guadeloupe: IARIA, 28-34.

This paper develops discussion regarding the content analysis findings outlined in the previous papers (the nine content construct categories). The paper suggests that the content categories derived from the qualitative data can be organised into four main dimensions. These dimensions are: cognitive, emotional, practical and aesthetic. In human technology interaction (HTI), the cognitive and emotional dimensions are seen as pertaining to the user, and the practical and aesthetic dimensions are seen as belonging to the product design. Attributes of the dimensions are not easy to allocate, as there are no clear boundaries between them. In other words, cognitive attributes can easily be interpreted in terms of practical qualities, and aesthetic content can be seen as emotional.

This is the first of the featured papers to explicitly discuss user experience (UX). Here UX is described in relation to the importance of understanding the psychological pre-conditions of human design interaction. The discipline is also situated in light of other fields with similar aims: Kansei (Feeling) Engineering (Nagamachi 2008) and Emotional Usability (Norman 2004). Various perspectives of UX are highlighted including McCarthy and Wright's (2004) emphasis on UX as a meaning making process and Battarbee's (2003) interpretation of UX as existing through social interaction. Finally, UX is described overall as encompassing: interactional flow; pleasurable and hedonic aspects of product usage; and multisensory interaction (Väänänen-Vainio-Mattila et al. 2009).

The picture sort study described in the previous two papers is also described here in the methodology section. As in the former paper, the content construct categories are illustrated and compared. However, this time there is no national comparison instead all the results are combined. The categorical dimensions of UX are then introduced. Attributes were allocated to the dimensions in the following way: cognitive (user) – logical, abstraction level; emotional (user) – personalisation, comfort, attention; practical (design/product) – usability, functionality, format, information; and aesthetic (design/product) – values, quality, timeliness and physicality. As mentioned above, these are not unproblematic as attributes can be seen to apply to more than one dimension. Further, the aspect of motivation or willingness to use is positioned on the diagram (included in the paper) in between cognitive and emotional.

The main purpose of the paper was to open discussion regarding the way in which users encode (express) their experiences of technical designs and devices. In turn, it also proposes a way for examining this encoding process. By allowing participants to give reasoning behind their preferences and choices, a possibility is generated to gain insight into the mental contents involved in the way users emotionally appraise products. In the paper, the empirical findings have been treated via a content-based psychological approach (Saariluoma 2000, 2003; Kelly 1955; Green 2004). Verbal output reflects conscious experience, beneath which rests layers of subconscious mental contents.

**Article V:** Mental contents in user experience.

Rousi, R., Saariluoma, P. & Leikas, J. 2010. Mental Contents in User Experience. In Q. Luo (Ed.), Proceedings of MSE2010 V.II 2010 International Conference on Management and Engineering. Hong Kong: ETP Engineering Press, 204-06.

In this paper, a user psychology approach is taken towards examining the role of mental contents in UX. UX is once again briefly described in terms of its traditions and position alongside other related fields such as Kansei Engineering (Nagamachi 2008) and Emotional Usability (Norman 2004). UX is outlined as a paradigm shift in HCI research which has departed from pure usability-function related issues, towards greater concerns affecting HCI. It is noted that there are multiple disciplines and interpretive models of UX, with the main points being: user perceptions of HCI, cultural and symbolic human-to-human interaction producing UX, and studies of emotions and aesthetics. Given this last point, the nature of UX is described as a psychological phenomenon, meaning that it should be addressed by user psychology research.

The research question at the heart of this paper is: how can we gain an understanding of *how* participants mentally reconstruct (apperceive) design products? Then, how can we gain insight into specific elements and dimensions that users have deemed as important within their experiences of the designs?

For this, George Kelly's (1955) Personal Construct Psychology theory provided the basis of analysis, in that content analysis was used to code qualitative information, and quantitative responses were utilised to determine positive-negative valence.

Based on the content analysis results, the paper provides a condensed account of the categorical dimensions of UX. The paper highlights the similarities discovered when comparing the categorical dimensions with the technology acceptance model (TAM – Davis 1986). The paper emphasises the fact that when users perceived the smartphone icons positively, the information content they provided in their qualitative feedback related to clarity. Clarity, as seen in responses from both Australian and Finnish participants, can be interpreted as the ability to easily see and interpret the function that the icon represents. Yet, when participants negatively experienced icon designs, their explanations were dominated by content related to aesthetic appeal (or lack thereof).

The paper emphasises the role of emotional and aesthetic content in evaluating icon designs negatively, and the role of cognitive and practical content in clearly articulating reasons for positive evaluation. While many descriptions provided by the participants were rationalised both in terms of the positive and negative, the reasoning featuring emotional and aesthetic content were less rationally explained. The results show difficulty in giving reasons behind aesthetic judgments such as beautiful, ugly, funky (positive), dull and dreary. The paper further reinforces the prominence of emotions when experiencing designs negatively. Results also emphasise the important role aesthetics play in negative perception of design. Likewise, findings show the importance of not only appealing aesthetics and brand association in positive experience, but also the usability of the icons.

**Article VI:** Investigating mental contents of elevator design user experience through ethnographic inquiry

Rousi, R. & Saariluoma, P. 2011. Investigating mental contents of elevator design user experience through ethnographic inquiry. Presented at the 18th international product development management conference - innovate through design, EIASM, June 5th-7th, 2011, Delft, Netherlands.

This paper describes the process of examining the UX of elevator design based on ethnographic inquiry. This paper is written from a product management perspective and proposes a conceptual cause-effect model of product development from a user-centred perspective. The paper starts by describing UX and the importance of considering it already in the early stages of product development. Norman (2002; 2004) is drawn on to describe how product developers need to consider how potential users think and feel. Feelings or emotional experiences are described as the key experiential factor explained in relation to the empirical findings. Here, it is stated that mental representations

are the basis of conscious experience. Mental representations are described as internal mental states, and mental contents are outlined as being the information contents in mental representations.

Another core point mentioned is that of Mike Kuniavsky's (2003) observations on positive and negative valence in experiences. He states that positive experiences do not always lead to the success of a product, but negative experiences always lead to failure. This is paramount to understanding how UX operates in relation to elevators. While elevator users do not usually purchase the vehicles, their negative experiences of them are long lasting and are easily transferred through word-of-mouth. Here the specific nature of elevator UX is described, as seldom do the qualities of playfulness or decoration feature in what is expected of elevator design interaction (with the exception of e.g. KONE Marimekko elevator cabs etc.).

Among a list of things, elevator UX is particular in that the users are usually not the purchasers. For this reason a diagram of the cause-effect relationship in product management was developed. The diagram illustrates the relationship between the elevator company (its designers, directors and manufacturers), the purchase decision-makers (propriety managers, owners, boards etc.) and their interests (low-cost, income generation, customer appeal in property). At the right-hand side of the diagram are other stakeholders (tenants – business owners, organisations) and their interests (time efficiency, productivity). At the centre of the diagram are the users (staff and customers) and their interests (safety, time-efficiency, comfort, reduction of negative emotions). The diagram suggests that somehow, despite decision-maker interests in low-costs etc. if user interests are not met, this impedes on other stakeholder interests. Subsequently, decision-makers will receive negative feedback either in the form of verbal feedback, or non-renewal of tenancy.

The diagram was drawn as the result of findings from the study which employed ethnographic style field observation and mini-interview (questionnaire) methods of data collection. In this paper, the results emphasised pertain to the field observations. The points of observation were: waiting and operating habits; interaction with the design; interpersonal interaction; and movement flow. The observations were compared with responses given via mini-interviews ($N$=44 participants). The question categories were: background information (gender, generation, culture); mental factors (thinker type, emotional state); design evaluation (aesthetics, function, usability); design suggestions (projected constructions of ideal elevator design); preference (users' attitudes towards elevators); security and safety (psychological factors influencing perception of elevator experience); and habits (self-awareness of elevator behaviour).

The results showed that 25% of the 44 interviewees were concerned about the length of waiting times and duration of the elevator travel. A one hour observation of 62 people showed that 50% of the elevator users stepped into an elevator in less than a second of pressing the hall call button. Twenty-six percent stepped in between two to five second, 10% six to ten seconds, 6% 11 to

15 seconds and 8% over fifteen seconds. In other words, it was seen that people perceptions of waiting duration may be longer than they actually are.

Further, positions of hierarchy and gender order were observed in the way people positioned themselves in the cabs. For example, generally men stood at the back and women stood at the front. Men would interact with design features such as mirrors and women would not unless there were only a few other women elevator users present. Some were consciously aware of these dynamics and stated in the interviews that sometimes for fun they would either stare at other users or face the 'wrong' direction (i.e. towards the back of the cabin rather than the doors). Finally, while interviewees responded to the categories of aesthetic features such as colours, music and sound, a key discursive theme was safety and security. Experience of the elevator sounds contributed to a sense of (or lack thereof) security and safety. It was important that users were not too aware of the heights and mechanics of the elevators. Sounds such as wind in the elevator shafts and irregular operational noise caused anxiety.

**Article VII:** The experience of no experience - Elevator UX and the role of unconscious experience.

Rousi, R. In press. The experience of no experience – Elevator UX and the role of unconscious experience. In A. Lugmayr (Ed.), Proceedings of Academic MindTrek 2013, Tampere: ACM.

This paper is a theoretical paper written in reflection of findings obtained during the elevator study explained in the article above. This paper ponders the act of studying the UX of design interaction that generally, if the design is working well, should not be consciously experienced. The paper likens elevators to spatio-physical user interfaces, and explains their function in transferring users smoothly from one user, purpose and social context into the next. The study is contextualised in relation to the finding that study participants only recalled negative elevator usage experiences. No positive experiences were specifically recollected.

It discusses how efficient elevator design and operation should allow the user to continue uninterrupted in actions and interactions that are established before the user's elevator usage transaction is commenced. Thus, flow in the context of elevator usage is seen as smooth flow of movement and thought of factors other than the elevator itself. Here, desired elevator UX is recognised as unconscious experience. To do this, the paper first describes experience and its representational nature of conscious experience. It then goes on to describe unconscious experience, or unrepresented experiential contents. It is understood that while people are not consciously aware of everything they experience, they are never the less constantly experiencing as a result of the mind body relationship and continuous sensual perception. The body constantly perceives physical information about its surroundings (smell, sight,

sounds, taste, touch) and the mind is constantly processing this information. If everything is perceived as it should be, posing no threat to the individual's well-being, the experience of particularly elevator usage, remains relatively unconscious. Yet, when something occurs during usage that is perceived as posing a threat to the user's well-being, suddenly the unrepresentational experience becomes representational – that is, it becomes conscious. This matter is explained in connection to embodiment, and how information is perceived and experienced as a result of the relationship between the body and its contextual environment.

While much attention has been concentrated on examining conscious experience in UX, this paper highlights the significance of studying unconscious experience, particularly in relation to designs which are intended to support and promote other interactions.

**Article VIII:** It feels brown – A cognitive semiotic model (C-model) of user experience

Rousi, R. In press. It feels brown - a cognitive semiotic model (C-model) of user experience. International Journal of Designed Objects. CG Publisher. http://ijgo.cgpublisher.com.

This article describes semiotics in relation to design semantics and UX, and introduces the cognitive semiotic model of UX, or C-model. The article draws on traditional views of semiotic components, such as those provided by Charles Peirce (sign classification of icon, index and symbol) – utilized in the work on design semantic and aesthetic interaction by Susann Vihma (1995, 2003) – and Charles Ogden and Ivor Richards' (1969) triangle of meaning (featuring the object/thing, its symbol (sign) and the referent (thought or interpretation). These semiotic views are discussed in relation to previous design semantics and experience studies which challenge the idea that within design research, the design is seen as an object. Krippendorff and Butter (1984), explain that design objects are rich in their symbolic value, possess strings of reference and associations to previous design traditions, formal-material choices and social-cultural values. Furthermore, they state that the experience or meaning of the designs is not innate to the designs themselves, rather they are formed and housed within the minds of the users and consumers. Thus, an important point in this article is that experience, is a mental phenomenon. Further, experience is the meaning derived from encounters with designs which are framed by contextual factors.

Anders Warell's (2004, 2008) visual product experience (VPE) model is referred to, both in terms of its theoretical underpinnings and interpretation of the modes of experience, as well as its practical empirical application. The VPE model comprises three experiential modes: presentation, experience and representation. These non-linear modes feature sub-modes: presentation – impression, appreciation, emotion; experience – sensory, affective, cognitive;

representation – recognition, association, comprehension. In contrast the C-model, concentrates on the symbol, or representation and mental information processing of the user. The reason for this is based on the fact that UX describes the experiential process of human design (or computer) interaction. Designs, being the material realization of designer (and corporate) ideas are also constructed representations, drawing on traditions and cultural values etc. (see studies on design semantics). Thus, here the 'object' in question is not seen as a presentation, as in the case of VPE, but it is rather a representation. Therefore, the model focuses on the *re*-presentational process of UX.

The empirical study outlined in this article asked participants to represent their experiences of three design objects based first on touch and then sight. The objects were encountered one-by-one in both parts, and in both parts participants were asked to write the first five things (words/phrases) that came to mind based on what was perceived through either touch or sight. After recording these qualitative constructs (words/phrases), participants were asked to rate the objects on a Likert-scale of one to five (one meaning the least value, five meaning the most) according to attractiveness and willingness to own. The quantitative results were not discussed in this paper, but were mentioned in terms of their capacity to indicate weighting of positive-negative valence in connection with construct-design element relationships in future papers.

What was emphasized that the findings revealed nine main construct categories as the result of content analysis (based on Personal Construct Theory – Green 2004; Kelly 1955). These construct categories are: 1) physical characteristics (actual), 2) shape, 3) metaphor, 4) colour, 5) emotional and aesthetic response, 6) physical sensations (relative subjective), 7) formal and stylistic judgment, 8) utility, and 9) added value. The categories are proposed as an analytic framework which may be utilized in future studies aimed at collecting succinct qualitative data – such as cross-cultural UX studies. While there is no hierarchy of constructs, the numbers seen above act as a coding system for further analysis of the construct categories and their frequencies in programs such as IBM SPSS. The model and method can be used to both obtain quick results from qualitative data, and may also reveal deeper mental content structures with further analysis of the precise constructs themselves.

**Article IX:** Formidable bracelet, beautiful lantern - Studying multi-sensory user experience from a semiotic perspective

Rousi, R. 2013. Formidable bracelet, beautiful lantern - Studying multi-sensory user experience from a semiotic perspective. In J. vom Brocke, R. Hekkala, M. Rossi & S. Ram (Eds.), Proceedings of the 8th International Conference of Design Science at the Intersection of Physical and Virtual Design (DESRIST). Lecture Notes in Computer Science 7939. Heidelberg Dordrecht London New York: Springer, 181-196.

This paper uses an empirical study to examine multi-sensory user experience from a semiotic perspective. This paper follows on from the previous article "It Feels Brown" in its attempt to further explicate the relationship between input of varying senses, and qualitative representational accounts of user experiences. The paper draws on design aesthetic and semantic theories to discuss UX as a mental process occurring in response to information received through the senses (sight, sound, touch, taste, olfactory). It discusses how, no matter whether intentional or unintentional all of the senses continuously provide input. This multi-sensory input (whether controlled or not) is mentally processed by the user to form an impression, or experience, of the design interaction. In the paper it is specified that the time frame focus is on momentary UX. This is noted in response to the UX White Paper (Roto et al. 2011) which states that researchers and practitioners should note the type of UX concentrated on. These types are based on temporality in the interaction which ultimately alters the experience processed by users. The types of UX mentioned by the White Paper are: anticipated (before interaction); momentary (during interaction); episodic (after interaction); and cumulative (over time). Thus, emphasis within this empirical study was on experiences generated while encountering designs and their formal elements.

To explain the study from a multi-sensory perspective, discussions on evolutionary psychology were drawn on. Hekkert's (2006) explanation of the relationship between the aesthetic, emotional and cognitive components of experience was used as a basis to understand the function of aesthetics as a system used to inform the mind of appropriate emotional and cognitive responses – i.e. aesthetically pleasing things are good for us (Frijda 1988). These observations were based on evolutionary psychological theories.

In this paper, the C-model was once again described. The C-model, while appearing basic, illustrates a complex process of re-presentation – seen in the design and as the material manifestation of the designer's (and corporate) ideas – the cyclical process of information processing and experiencing within the user, then their re-presentation of the experience. It should be noted that the elements of 'idea' and 'impression' were added to the pictorial model. The idea stands for re-presentation of a design idea or intention, and the impression refers to the re-presentation of the impression which is mentally experienced by the user.

The empirical study is also referred to in the previous article, whereby in two parts, participants were asked to encounter three design objects one-by-one through touch. Then the same objects were encountered one-by-one through sight. In each of the parts participants were asked to write the first five things (words/phrases) which came to mind based on what was felt or seen. Then they were asked to evaluate the designs based on what was either felt or seen according to a Likert-scale of one to five (one meaning least value, five meaning most) in terms of attractiveness and willingness to own. While there were quantitative questions present, the point of interest was on the qualitative representations (information constructs – words/phrases) that participants

provided. Rather than acting as a measure for cross-product comparison, the quantitative questions served to indicate positive-negative valence of experience based on sensory input experienced.

The results section briefly presents the quantitative findings of the opinion-based questions inquiring about willingness to own, and experience of attractiveness, regarding touch and then sight. The reason for including this is to demonstrate the dominance and preference of the senses when experiencing designs – and the relationship between different types of sensations of the materials (i.e. whether feeling rough, or appearing soft) and positive/negative valence. The qualitative results are presented according to information content construct frequencies. Interesting findings include the attribution of colour to particular tactile qualities. For example, when feeling the objects people mentioned that the plastic *felt* black or red. They mentioned that the cool smooth ceramics of a Barn Owl sculpture felt blue, and that the rough porous nature of the *Fire* candle lantern felt beige, orange or brown.

Furthermore, metaphors were the most used information constructs represented by the participants in the study. Metaphors are noted for their ability to communicate feelings and thoughts that cannot be easily transferred into words (Hekkert 2006). Likewise, something that was not really mentioned in the paper, but will be observed in the discussion is the connection between expressions of aesthetics – i.e. formal judgment such as beautiful and ugly – and emotional content.

**Article X:** Semiotic thinking: towards a content-based semiotic approach to analyzing human-technology interaction.

Saariluoma, P. & Rousi, R. Submitted. Semiotic thinking: towards a content-based semiotic approach to analyzing human-technology interaction.

This is a philosophical article explaining the significance of examining and developing semiotics in relation to human technology interaction. It asserts that human life, behaviour and thought is semiotic in nature, and that technology and its interaction should be seen in relation to and an extension to human cultural practice. The article particularly emphasises the role of mental representations and their corresponding mental contents in providing meaning within the semiotic process. That is, the article demonstrates that without the mind, and mental contents which matches or somehow relates to symbolic material – whether that be the product design as a whole, or coded information such as programming language – the designs are meaningless. In particular, designs which heavily rely on symbol input and interpretation do not possess any power to signify if the perceiver does not have corresponding mental contents to access and interpret the meanings of the symbols.

Symbols are discussed in terms of their connection to physical sign vehicles or bearers. A connection is made between conceptual content and its existence and reliance on the physical nervous system. Moreover, in addition to

outlining and exemplifying Peirce's (1998, 273-275) accounts of the three different types of signs - iconic, indexical and lexiconic – the article demonstrates the brain's own ability to signify via electric impulses or signals. This is achieved through discussing brain computer interfaces.

Yet, at the heart of the article's discussion lies the matter of meaning. Meaning cannot be derived through electro magnet imagery of neural functions. Semiotics provides the tools for understanding the relationships between particular signifying elements or symbols and how they are interpreted in the mind. Other disciplines (besides linguistics) that employ semiotics to examine how people mentally experience phenomena include film studies and music. Some studies in HCI were cited in terms of their use of semiotics to analyse elements such as user interfaces and icon metaphors. Overall, the cognitive concern with understanding how users perceive, interpret and make sense of is articulated as being semiotic in nature. Semiotics and semiosis, are also highly reliant on culture. All design and technological products are cultural products, thus the cognitive key to comprehending the mechanisms of interaction and experience is intimately connected to understanding the mechanisms of culture and symbolic practice.

As a co-author of this article I have actively discussed ideas, reviewed literature and participated throughout the writing process. The contents of the article build on earlier work by Pertti Saariluoma, the supervisor of my thesis, and subsequently relates to the main concerns discussed and developed throughout this research.

# 5 CONCLUDING MODELS, DISCUSSION AND CONCLUSION

This final chapter documents the resulting content category frameworks, the discussion and the conclusion. The idea is to: 1) summarise and elaborate upon the models that are discussed in the articles; 2) contextualise the research – its background and importance in future interactions research; and 3) conclude by summarising the contents of the dissertation.

## 5.1 Resulting content category frameworks

As a result of implementing the above methods, in addition to the findings offered by the data, several theoretical frameworks emerged. Two frameworks in particular are seen to influence the nature of the subsequent studies undertaken in this research. These frameworks are: cognitive content categories and the cognitive semiotic model of user experience, or the C-model. The cognitive content categories model is a model categorising the types of content user participants offered during experience evaluations of smartphone icons. The C-model on the other hand can be viewed as a more general experiential communication model of design. The C-model illustrates the cognitive semiotic process of design, in which signification is a continuous cycle of ideas (thoughts of experiences), their explicit manifestation and once again their interpretation. These models also provided insight for the development of the resulting semiotic model of UX mentioned in the above chapters.

### 5.1.1 Cognitive Content Categories

The cognitive content categories emerged in the content analysis of the results obtained in the picture sort smartphone icon study. Initially the results revealed eight and nine common categories for describing the experiences of attractiveness regarding the icons evaluated. The study had been undertaken

cross-nationally in Australia and Finland. Eight common construct categories were derived from the Australian sample and nine were derived from the Finnish sample. These categories were: aesthetic appeal; clarity; icons, colours and layout; intuitiveness (the need to think or informative); amounts of icons on screen (arrangement); understandability; labels; size; and shapes (only observed in the Finnish results).

Constructs expressing aesthetic appeal referred to judgments such as "funky", "trendy", "harmonious", "beautiful", "ugly" etc. Aesthetic appeal was one of the main content categories used to describe experiences of attractiveness in the icons, but interestingly it was more often expressed among the Finnish responses (both in positive and negative explanations), and among the Australian responses it was the main category for describing negative opinions of the designs. Clarity was the other main construct category represented by both national samples. Clarity was the main construct category for representing positive experiences with the designs among Australian participants. In all other explanations both negative and positive among both Australian and Finnish responses, clarity was the second most popular construct category participants represented. Icons, colours and layout was the next most referred to category. This pertained to the technical realisation of the designs in terms of explicit design choices that were either appreciated or criticised by the participants. Intuitiveness was referred to in terms of the need to think. This category can be connected to the clarity and understandability categories, but it contains the notion of cultural and user specific appropriateness – thus, awareness of the user in informative design choices. Amounts of icons on screen, was a straight forward technical category, and understandability follows on from intuitiveness. Yet, in this instance it refers to the ability to understand the icon in general, regardless of cultural and contextual dependence for semantic interpretation. The labels, size and in the Finnish case, shapes were also technical categories.

Thus, in after thought following the submission of several papers citing these eight (and nine) construct categories, it was realised that the categories could be grouped again into fewer, yet more cognitively descriptive content categories. These content categories are described in articles IV and V. The categories which arose in this subsequent analysis were: cognitive, emotional, practical (technical) and aesthetic (Figure 18). The cognitive and emotional content categories referred to constructs which related to user inherent properties: i.e. intuitive, understandable, dreary, joyful etc. The practical or technical and aesthetic categories referred to design inherent properties: i.e. layout, colours, shapes, quantities, beautiful, ugly etc.

Further thematic categorisation of the constructs provided in the icon study was undertaken in relation to the four cognitive content categories. Through this process of categorisation themes which emerged included: Cognitive (user inherent) – logic, attention (originally in the emotional category in the articles), abstraction level and motivation; Emotional (user inherent) – motivation, comfort and personalisation (originally personability in the

articles); Practical (design inherent) – usability, functionality, format, information; and Aesthetic (design inherent) – values, quality, time and physicality. Hekkert (2006) similarly identified components of aesthetic design experience as emotional, aesthetic and cognitive. Yet, this research takes the issue further, as relationships can also be observed between the cognitive and practical categories, as well as the emotional and aesthetic. Then, on a deeper level, the characteristics mentioned on the left-hand side of the diagram can be seen to represent explicit knowledge, or constructs that can be directly articulated or represented. The right-hand side of the diagram shows characteristics which are more implicit by nature. That is, they are more difficult to express or directly represent. Interestingly, often times in the icon study, positive opinions and experiences were represented via characteristics seen in the left-hand side of the diagram. Negative sentiments on the other hand were often represented via constructs characterised by the right-hand side of the diagram.

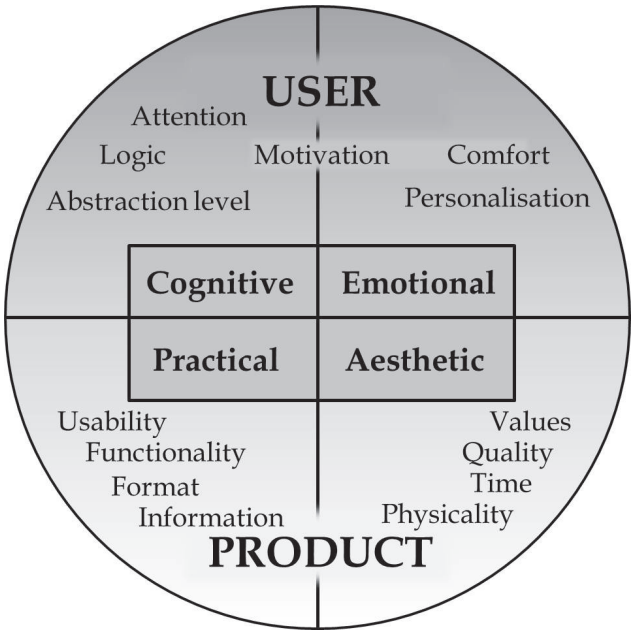


FIGURE 18 Cognitive Content Categories

It was when analysing the qualitative data and categorising the constructs that the problem of semantics arose. This can be observed in relation to the content categories seen above, i.e. motivation is a clear example of a factor which was difficult to place within the categories. On the one hand, from a psychological perspective motivation has been theorised as the drive or instinct for survival which can be connected to cognitive function and more specifically Instinct Theory (Heffner 2001). Abraham Maslow (1970) is often cited in terms of his hierarchy of needs. From the bottom up, these needs comprise: physiological

needs, safety needs, belonging and love needs, esteem needs and the need for self-actualisation or to reach one's fullest potential. The need to safety for example, can be seen as a prime factor determining conscious and unconscious experiential representation in the case of elevator usage. But, motivation is also connected, regulated and determined by emotions. Theorists such as Clark Hull (1943), observe how motivation is driven by biological needs, however the needs or drives are pronounced through internal states of arousal and tension. Arousal has been referred to in connection with its relationship to emotional, intellectual and physical activity (Hull 1943; Heffner 2001). However, here it would be argued that even the intellectual and physical activity are framed by emotional content or sentiments. This is what formulates the experience. Thus, the neat categorisation of a theme such as motivation cannot be undertaken as yes, from a cognitive scientific perspective motivation constitutes a cognitive function, yet on the other hand the way that it is experienced by the user can be seen as emotional.

This is where questions regarding semantics come into play, as there are no doubt differences between the way in which users and experiment participants not only experience design, but experience the constructs they express to describe their mental representations of the designs. And based on what is known of theories of mental representation and consciousness, there are further inconsistencies between understandings of qualitative constructs among participants. In this respect, one key construct category, "clarity," caused the most concern in terms of its application and subsequent understanding within the participant/user. Further problematisation can be seen in terms of scientific interpretation of this construct. Of concern was firstly the popularity of the construct – it was referred to often among both participant groups (Australian and Finnish), to describe various icons. Yet, as a researcher, this meaning seemed *unclear*. In terms of my own mental representation of the construct clarity can refer to transparency (i.e. a clear or transparent), it can refer to neatness or the absence of clutter. I wondered whether participants referred directly to the designs themselves, or the semantic connections they represent. That is, does clarity refer to a more direct connection that may be inferred between the icon and the object? These ponderings lead to the awareness of the need to seriously consider semantics in relation to several aspects. These aspects can be defined as: 1) how the qualitative constructs are understood between users or study participants; 2) how the researcher understands these constructs – i.e. can direct connections be made between the constructs and explicit design elements (such as materials, scale, weight, texture, form etc.)?; and 3) relating to the very foundations of the research, how the experiment task and research questions are understood by study participants.

It was through recognising these foundational problems of interpretation in arguably any scientific research in general, that lead this particular piece of work towards theorising and examining the operation of semiotics within UX. The next section outlines the cognitive semiotic model of UX, or the C-model. The C-model begins the process of addressing the need to specific the semiotic

cycle in UX, through visualising the continual circuit of signification and semantic associations.

### 5.1.2 C-Model

The labelling of design as a type of language has been criticised, yet the role of design as a vehicle of communication is widely accepted (Krippendorff and Butter 1984; Warell 2001; Karjalainen 2004). Traditional theories of communication comprising the sender and receiver at opposite ends of the signification process such as seen in e.g. Hall's (1980) encoding/decoding and De Souza's (1993) designer-user communication have also been criticised. Criticism derives from the fact that neither encoding nor decoding is fully reliant upon and consistent with either the designer or the user. Vihma (2003) draws our attention to the fact that design – designing products and experiencing or using products – is a continual interpretative process. The designer employs certain strategies and materials to explicitly realise and represent their ideas often in connection with corporate and societal goals and ideals addressing a problem/need (or *object* as it is related via the main semiotic model of UX mentioned in this dissertation). Then subsequently, the user interprets these strategies and materials by mentally and explicitly re-presenting the designs. They do de-code the products, yet at the same time, the products are reconstituted, or encoded once more, yet in another form. The user's input can be said to extend the product and ultimately influence its experience also in others, through e.g. social interaction and utilitarian appropriation (i.e. how a user implements the product). This model of thinking is additionally represented by De Souza (1993) as user-system communication.

Inspired by Krippendorff and Butter's (1984) circular process of design semantics and for the purposes of simplification, the C-model was generated (Figure 19). The C-model focuses specifically on the human dimension of the semiotic process as the user. The user refers to the user of signifying elements for the purpose of communicating, interpreting and re-presenting ideas and impressions. Thus, *user* refers to both the user in the design transaction as well as the designer, as both generate and process ideas which are subsequently represented as mental and subsequently explicit impressions and material products. In accordance with Vihma (2003), users and designers are not in fact at opposite ends of the communication process, rather they exist within their own symbolic representational and interpretative processes.

Both the designer and the user are users, or interpreters of symbols, and likewise both designer and user are designers of re-presenting those symbols. Each syntactic decision, whether that be through material or formal representation in a design product, or explicit qualitative representation of user experiences, carries with it not simply one understanding or interpretation, but infinite understandings and interpretations. Contextual factors such as time and place certainly provide frameworks of meaning, yet to further problematise the matter, based on mental representational theory, each individual attributes their own meanings and associations to the symbols. Thus, in signification there is no

beginning or end, and experience in itself as a constant flow of consciousness, can also be said to continuously evolve and change with each representation produced – either mentally or explicitly.

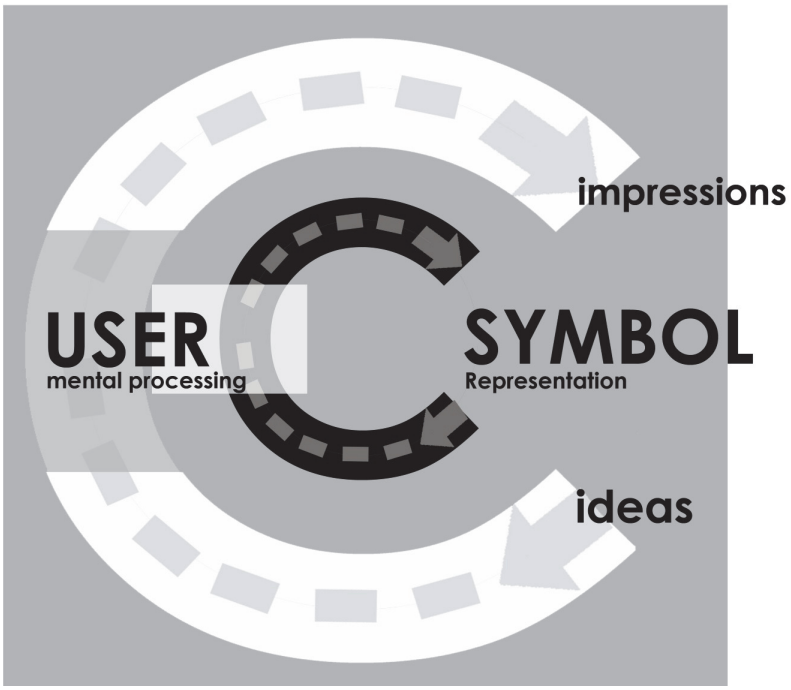


FIGURE 19 The C-model of UX

It was upon this idea that the study of home decor designs was based. The motivation behind the investigation was to observe as to whether or not specific experiential content could be anchored and attributed to particular design syntax (i.e. materials, textures, dimensions etc.). To gain a more holistic understanding of how these mental representations alter according to which sense is used to inform the experience, the senses of touch and sight were examined. While the study did not provide any concrete conclusions, it did shed insight into the types of associations that may be triggered by sensory information obtained in response to particular design elements. One example related to the attribution of colour to specific materials and textures. For instance, the sense-data obtained through touching an aesthetically unpleasant porous material was associated with warm earth colours (i.e. orange, brown and beige), and the touch of plastic material was associated with reds and blacks.

With this in mind, the study provided insight into characteristics pertaining to the relationship between emotional content, positive-negative valence and qualitative constructs used to express these mental representations. While the above highlighted the possibilities of tactile sense-data to draw associations related to visual sense-data, the results obtained during the study

showed a correspondence between positive emotional responses and qualitative representations which were dominated by metaphors and aesthetic qualities, and negative emotional responses, which were characterised by qualitative representations that focused on describing concrete material characteristics and physical sensations. In other words, negative responses to the perceived design elements were explicitly represented both mentally and in qualitative representations provided in participant feedback. Whereas, the positive responses, comprising affective emotional content were more difficult to represent, requiring the employment of metaphor to describe the sensations of the mental event. Hekkert (2006) notes that metaphors are often used to describe tacit knowledge, that is, information contents which are tacit (or mental) in character that are difficult to convey explicitly. This finding also confirms findings obtained in the elevator UX study which showed that positive experience often remains unrepresented (both mentally and in discourse), whereas negative emotions and sentiments are drawn to our attention through their representation, thus enabling ease of recollection and articulation.

The C-model demonstrates the circular, ever flowing and referring nature of signification. It not only illustrates the chain of signification, or infinite semiosis, also referred to in the earlier stages of Peirce's (Peirce 1931-66, 339-343) semiotic theorisations, but it also shows that experience is continuous and forever changing within the mind itself. In other words, along with the constant stream of conscious experience that defines 'who we are for us' (Chalmers 1996; Dennett 1988, 1991; Nelkin 1996), and how we experience the world through our notion of a conscious 'self', experiences that might be thought of as isolated events, or representations of interactions and encounters are also constantly changing through associations made to and influenced by other experiences. As seen in the semiotics sub-chapter of this dissertation, the C-model is not the final semiotic model of UX arrived at during this research, however it articulates that no experience is a complete and static package in and of itself.

## 5.2 Discussion

This PhD research emerged through the undertaking of several studies for projects in human-technology interaction and user-centred design (Theseus I and II as well as ITEA2 Easy Interactions). Due to a background in visual arts and creative industries, the research approach has largely been engaged in examining the semiotic relationship between the design products, qualitative data and mental representations. This can be said to have been a core interest even when working as a practicing artist and arts worker. Particularly when employed as a gallery assistant at Western Australia's leading contemporary arts space, Perth Institute of Contemporary Art, I was surprised by the fact that every piece of art had someone who adored it, and likewise every piece also had someone who despised it. Already then, I became intrigued by the motivational factors, and modes of perception (or in this case apperception) that contributed to viewers' resulting sentiments. This provided the inspirational basis for the first project study examining notions of attractiveness in smartphone icon design.

As many other studies were undertaken ranging from handheld moisture meters, fry pans, glassware and elevators to social media and security, theoretical awareness of related issues such as emotional usability, affective technology, Kansei Engineering and then UX (and experience design) also developed. UX was preferred and adopted within subsequent studies as it entails not simply isolated dimensions such as attainment of usability goals, functionality, or even notions of pleasure and taste in relation to technology design, but rather UX encompasses a holistic view towards interactions. UX involves consideration for all the factors that can be thought of as contributing to the overall experience (thought, interpretation or mental representation) obtained by a user when interacting with technology. As proven in numerous research articles (Adams et al. 1992; Davis 1989; Hassenzahl 2001; Hassenzahl and Sandweg 2004; Tractinsky et al. 2000) UX and focusing on experiential factors does not simply entail examining notions of pleasure, fun and other non-instrumental elements. Rather, by examining experiential factors and developing an understanding in regards to how they operate in relation to specific designs, design elements and in the context of particular temporal and spatial interactions, practitioners may also be able to make decisions which enhance usability, efficiency and overall user satisfaction.

All the studies, their findings and associated articles included in this dissertation lead to the observation that experience, and in particular UX are semiotic interactions. Design encounters: perception (apperception), usage and overall sentiments recalled from the experiences all rely on symbols, their presentation, interpretation and re-presentation, in order to operate. As acknowledged in semiotic and communication literature (Eco 1979; Krippendorff and Butter 1984; Peirce 1998, 478; Saussure 1983), signs are only signs when and if they have the ability to signify to the perceiver. In order for a sign, or signifying element to be able to signify, the perceiver must possess corresponding mental contents (Saariluoma 2012). These mental contents, as observed in the theoretical chapter, comprise information obtained through prior experience, which is overlaid

and attached to other contents such as emotions, which frames both the recalled experience in addition to subsequent experiences. To re-iterate, the C-model is significant in that it represents the way that even past experiences are representationally transformed by new experiences, which is also addressed in discussions on intentionality (Farkas 2008; Horgan and Tienson 2002; Kriegel 2003; Loar 2003; Pitt 2004; Saariluoma 2012; Siewert 1998; Strawson 1994), whereby when intentions change, so do mental representations (see e.g. Leikas 2009).

Discussions of a similar nature can be observed in relation to design aesthetics, emotions and HCI whereby *concerns* – i.e. the concern to stay safe; the concern to reproduce or find love; the concern to obtain better financial resources – also have an impact on how phenomena are experienced (Brave and Nass 2007; Desmet 2002; Frijda 1988). Moreover, concerns and their corresponding mental contents also impact the way in which people approach interactions, usage and evaluation. In other words, people evaluate, interpret and ultimately experience phenomena not only in accordance with previously acquired knowledge content, but also based on individual end goals.

Thus, problems which arise in discussions on mental representation, apperception, and associated observations on conscious/unconscious experience, or represented and unrepresented experience and information content, pose serious challenges in regards to not only designing for experience, but other design fields such as AI. One key concern for AI is known as the symbol grounding problem (Harnad 1990, 1994, 1995, 2000, 2003; Searle 1980). A substantial amount of AI research is semiotic, the reason being is that cognition is seen as taking place through symbols, or categorisation (Harnad 2005). In this respect, thinking is based on a being's ability to process and interpret symbols. The symbol grounding problem addresses the issue that there are no fixed mental representations or interpretations of specific phenomena between individuals. Or, if mental representations did exist in accordance with one universal mental language as suggested by Fodor (1975) and to some extent Chomsky (1986), there is no way of knowing. For even according to universal mental linguistic theories, due to the mentally bound nature of experience, or thought, there is no way of expressing this language explicitly between individuals.

This is the dilemma of AI, as the key is already known – once a scientist or designer can develop a machine that not only learns, develops, constantly updates and modifies their symbol processing according to factors such as moment, environment, context, which are framed by specific intentions (concerns), they will have an artificially intelligent machine. The trick is that cognition and not just (biological) intentions of survival, but self-motivated intentions such as desire, are intermingled with basic emotions (discussed in the theory chapter). Moreover, not only do these emotions frame overall mental representations, but added layers of emotions can be seen as connected to each mental content unit. Human beings are complex. Theories of embodiment and embodied experience observe consciousness as being shaped and affected by an individual's physical relationship to the outside world and its inhabitants. As an extension to this, an individual's psychological and social relationships to others, encounters which surround these relationships – i.e. connections made between specific events and even other factors such as family

members – also influence the types of mental contents that are drawn upon. This can be seen in relation to my example of the ship piston in the semiotic theory sub-chapter. Therefore, until we have reached a stage when not just the human operators, but the machines themselves can develop and house these relationships framed by emotional content, can we ever expect genuine AI. Thus, signs and their interpretation are dependent on emotional relationships. This is why attention has been placed on the development of artificial emotions (see for example Suzuki et al. 1998 and Wilson 2000). It would be interesting to observe how scientists deal with the fundamental and foundational relationships presented by parenting, family lineage and fore-parents, social positioning and other associated issues within artificial emotional development (Denham 2007; Konner 2010) and how this affects symbolic representation and interpretation.

## 5.3 Conclusion

The theoretical issues raised in this dissertation are expansive, yet are united through reference to classic texts of scientists such as Charles Sanders Peirce, Charles Morris and John Dewey. In order to address an issue such as UX, with particular consideration for the cognitive psychological nature of experience and its relationship to, and dependence on semiotic systems, it has been deemed necessary to articulate crucial factors such as emotions, consciousness, embodiment and mental representation. The field of UX alone is vast in its own right. In the theoretical chapter it is stated that there are at least three ways of categorising UX, and that is as a phenomenon, a field of study, and as a practice. UX is observed in terms of its role in the experiential consumption and design turn, which no longer simply focuses on quantity, functionality or usability, but instead meaning. In other words, what do designs and products actually mean to consumers?

It has been mentioned that the research emerged during the undertaking of project case studies. These case studies began by investigating notions of attractiveness in smartphone icons. Through careful analysis of the qualitative data provided in the smartphone icon study, observations were made and models derived in relation to experiential content present in the explanations. This led to consideration for UX and its influential factors in subsequent studies. Yet, the driving objective of the research has been to examine how qualitative data may reveal thought, or experiential content, and in particular how qualitative representations can be connected to specific design elements (with regard to influential factors – time, place etc.). The empirical approach has been concerned with developing methods that are efficient, simple and effective for designers and research practitioners alike to implement to develop insight into experiential reactions relating to any kind of design. PCP was used as a basic theoretical assumption behind the empirical approach in that cognition is categorisation (Harnad 2005). This led to the initial implementation of the picture sorts and repertory grid techniques, followed by the development of SQAT. The idea driving all the techniques in addition to efficiency (particularly for those whose practice

pertains to something other than science) was to directly observe constructs and their associated categories in order to gauge the types of mental content drawn upon to represent users' experiences.

The dissertation begins by initially stating basic concepts in the introduction regarding user design relationships. It progresses to explain the research scope in terms of its objectives, focuses and research questions. The theoretical framework chapter outlines the core theoretical concerns and implications of this research. Notably the significant theoretical contribution of this research is illustrated in the semiotics sub-chapter, in the form of the *semiotic model of UX*. This model is then demonstrated when explaining the related theoretical components pertaining to consciousness, embodiment and mental representation. UX is then described in relation to its three associated notions (phenomenon, field of study and design practice) in addition to its major models and issues linking UX specifically to culture (observed in the section on cross-cultural UX). It is in this sub-chapter that experience as a psychological phenomenon is introduced in relation to pragmatism and emotional-aesthetic meaning making. The user psychology and cognitive science sub-chapter outlines the fundamental theoretical factors involved in experiential investigation which entail: emotions and aesthetics in UX, consciousness, embodiment, and mental representation. Further, fields which are closely related to, and have informed this particular research are described as being design semantics and cognitive semantics. Both are concerned with meaning, yet design semantics focuses on the relationship between design syntax and meaning, and cognitive semantics examines the way that linguistic structures and contents can express cognitive structures, contents and understandings of phenomena not easily explicitly represented such as distance, time, space and movement.

The methods chapter explains the theoretical rationale of PCP and then describes the picture sorts and repertory grid techniques. Following this, ethnography, field observations and corresponding interviews are elaborated upon in relation to their application in the elevator UX study. Then the SQAT is introduced as a more user/designer friendly alternative to the picture sorts and repertory grid techniques. SQAT is noted for its ability to not only efficiently produce results, but also enlighten in terms of distinct relationships which may be observed between qualitative constructs, design elements and positive-negative valence. The article summaries demonstrate the progression of this research from theoretical conceptualisation of notions attractiveness, semiotics and experience, towards cognitive categorisations of contents observed in the qualitative data. Based upon these findings, the models outlined in this chapter – cognitive content categories and the C-model – have emerged.

The discussion serves to contextualise the research and its significance. The empirical research process has been devoted to examining means of measuring and evaluating UX based mostly on qualitative data. The empirical framework is applicable for application in relation to design of any nature. The reason being, is that the focus of the methods is on the user and their qualitative representations of their experiences, which are subsequently analysed in terms of content to observe semiotic relationships, i.e. symbol interpretation and re-presentation within the experiential process of design interactions.

The undertakings of this research provide a foundation for future studies and understandings regarding HDI issues pertaining to cognitive semiotics, the psychology of experience and embodied interaction (such as experience of augmented reality and human robot interactions), as well as other areas such as AI. While a few distinct products such as the semiotic model of UX and the relationship between positive emotional contents and unrepresented experience can be articulated as contributions of this research, this piece of work also serves to highlight existing problems associated with conducting any type of user interaction or evaluation research. Notably, there is the problem of interpretation. If every individual possesses a differing mental representation or experience of phenomena, then the way in which we interpret particularly symbols and their expression (through creative or technological products or language etc.) also varies. Thus, even when looking at the task of formulating questions intended for a user evaluation study, whether qualitative or quantitative, the researcher will always have a differing interpretation of the formulated constructs to the study participant. Likewise, each study participant's interpretation of the questions will vary from one another, and the researcher's interpretation of the representation provided by the participant – whether that be qualitative or numeric – will always vary from the original mental representation established within the participant. Upon establishing a means of deciphering exact relationships between design elements and corresponding mental representations (experiences), we will have also generated a solution to AI.

As observed throughout this dissertation, experience, thus thought and interpretation, are representational. Intentions (e.g. goals and desires) and concerns (e.g. physical and psychological well-being) work in tangent with emotions and subsequent notions of consciousness to either represent particular experiences – outstanding events, or potential threats – and not consciously represent others. Human beings constantly experience, this defines us as ourselves through thought, and can be seen as a constant processing mechanism of sensory information. This research has served to demonstrate that experience cannot be readily separated from 'an experience,' as even mental representations are constantly altered according to the continuous flow of thought and information. This view corresponds with Peirce's reference to continuous affectibility (Peirce 2009, 126) and thus, the nature of the mind as a welder of ideas (ibid, 128). He states that ideas seek uniformity and that people seek information that to some extent conforms with ideas obtained through past experiences. Thus, future ideas have a tendency to resemble those formed in the past. However, Peirce states that ideas (as with mental contents) cannot be described as discrete units with defined boundaries, rather they have the propensity to spread and connect with other ideas. Rather than accumulating more ideas, with time Peirce claimed that thoughts become increased interconnected, which in turn affects their representation within the mind. With this said, perhaps when considering UX in the future, the term experience design, or designing for experience, should be revised to that of designing for representation.

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