EMOTIONAL DESIGN: AN INVESTIGATION INTO DESIGNERS’
PERCEPTIONS OF INCORPORATING EMOTIONS IN SOFTWARE

by

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Abstract

In my teaching and software development practice, I realized that most applications with human-computer interaction do not respond to users' emotional needs. The dualism of reason and emotion as two fairly opposite entities that dominated Western philosophy was also reflected in software design. Computing was originally intended to provide applications for military and industrial activities and was primarily associated with cognition and rationality. Today, more and more computer applications interact with users in very complex and sophisticated ways. In Human-Computer Interaction, attention is given to issues of usability and user modeling, but techniques to emotionally engage users or respond to their emotional needs have not been fully developed, even as specialists like Klein, Norman and Picard argued that machines that recognize and express emotions respond better and more appropriately to user interaction (Picard, 1997; Picard & Klein, 2002; Norman, 2004). This study investigated emotion from designers' perspectives and tentatively concludes that there is little awareness and involvement in emotional design in the IT community. By contrast, participants in this study (36 IT specialists from various fields) strongly supported the idea of emotional design and confirmed the need for methodologies and theoretical models to research emotional design. Based on a review of theory, surveys and interviews, I identified a set of themes for heuristics of emotional design and recommended future research directions. Attention was given to consequences; participants in this study raised issues of manipulation, ethical responsibilities of designers, and the need for regulations, and recommended that emotional design should carry standard ethical guidelines for games and any other applications. The research design utilized a mixed QUAN-qual methodological model proposed by Creswell (2003) and Gay, Mills, and Airasian (2006), which was modified to equally emphasize both quantitative and qualitative stages. An instrument in the form of a questionnaire was designed, tested and piloted in this study and will be improved and used in future research.
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Chapter One: Introduction

1.1 Background

Computing is typically associated with science and rationality and understood to downplay emotions. Originally, computers were used in military and industrial activities for processing data collected by various devices, and for interpreting, evaluating and reporting data. However, more and more software applications were developed to interact directly with humans for business, learning, entertainment, and therapeutic use in medicine. A more human face of computing was developed starting with Graphical User Interfaces (GUIs) that are user friendly and inviting to the advanced use of psychology and cognitive science for designing robots. Industry experts and researchers are more and more interested in human interfaces for optimal and effective communication with machines.

My expertise in computer science and technology is technical, theoretical and practical, with an emphasis in design of software applications. I participated and managed development of software applications in industry and at the British Columbia Institute of Technology (BCIT). However, all my projects were very technical; affective aspects were not taken into consideration. I realized in my practice that designing software applications that sense the users’ emotional needs and respond to them is an area in computer science that does not yet have an accepted methodology and theoretical model.

There are two situations of emotional design: 1) when applications are intended to generate emotions in users, and 2) when applications recognize the user's emotional state and respond to it. In literature I found these two situations identified as "affective computing" and "emotional design", or "emotion engineering" and "emotioneering" (the last two being from
Affective computing is a new interdisciplinary research area concerned with design of systems that can register, model and influence human emotional states. One approach focuses on creating intelligent devices and robots which can sense, interpret, and respond to emotions (Picard, 1997; Norman, 2004). According to Rosalind Picard, computers should have the ability to recognize, understand, process and express emotions in order to respond intelligently to user interaction (Picard, 1997). Emotional design is a concept introduced by Norman and refers to the ability to design objects that are pleasing and responsive and therefore, become more effective because users connect with them emotionally (Norman, 2004). "Emotioneering" is a set of rules for emotionally engaging a game player presented by Freeman (2004) in his book *Creating Emotion in Games*.

### 1.2 Rationale

Today, our lives are interdependent with technology and computers are involved in all aspects of human life: controlling industrial processes, business transactions, communication, learning, medical treatment and entertainment. We use various technologies frequently and they are designed to perform different tasks, but how effective do they respond to our needs? Let's take for example educational software. Walker and White (2002) argued that technology should be introduced to children through “meaningful, creative, challenging, inquiry-based, and active applications” (p. 63). They mentioned an interview with Bill Gates, who equated technology with tools: “Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important” (Walker & White, 2002, p. 63). Are computer applications just tools? Technology as a tool suggests a simplistic view of technology as solely related to rationality. As Woodward (1997) observed,
computers are generally associated with “the task of exchanging information efficiently and with extending the capability of humans to think rationally, while humans are assigned the work of emotions” (p. 95). By contrast, even if computers were perceived as related to reason, science fiction literature and visual arts were populated with machines that reassemble emotional humans (Woodward, 1997). Petrina (2007) suggested that there is a strong relationship between technology and emotion and contended that even if technology elicits emotions in users, it is perceived as “devoid of feelings, emotion and values” (p. 67). He stated that computer technology evolved to allow for emotional interaction between machines and humans combining rationality and emotion (Petrina, 2007).

I argue that in order to create efficient applications we should expand the notion of ‘technology as a tool’ to a different level taking into consideration the users’ emotional needs. For example, educational software for language learning can be effective and complement teachers’ work. In their study of chatbots, Fryer and Carpenter (2006) stated that language students face many challenges: cultural differences, pronunciation problems, lack of motivation, and lack of effective feedback. Technology opened many opportunities in language learning and one of them is the use of chatbots, applications that imitate human behavior and offer a learning experience based on intelligent conversation. Fryer and Carpenter (2006) identified a lack of confidence, shyness and feedback as main reasons that hinder language learning. Learners need to spend more time practicing and in this respect, chatbots are a better solution because offer a learning environment that eliminates issues related to shyness and lack of confidence. I believe that chatbots will be more effective if, besides intelligence, they would have a human interface that emulates human behavior and affect (see Wang, 2008).
I argue that in today’s computing the original antagonistic relationship between technology and humanism should be replaced with a symbiotic one where emotions are incorporated in software applications and machine responses and behavior. Important research projects focus on creating intelligent devices and robots which sense, interpret and respond to emotions. In the technological context of robotics and interactive computing, emotion and intelligence (reason) become very interrelated and cannot be separated (Picard, 1997; Norman, 2004). However, incorporating emotion in computer applications, devices, machines and robots is a process that is socially and culturally sensitive and involves significant ethical issues.

1.3 Purpose

Emotions are an important part of human behaviour and have a major role in human-to-human interaction. However, in today’s world, humans interact with machines on a regular basis; human-computer interaction is replacing human-to-human interaction in several situations: filling tax forms, learning, playing games or shopping. Humans interacting with machines have emotional needs that are not yet addressed by current systems (Picard & Klein, 2002).

This study focused on issues related to emotional design observed from the perspective of specialists from the IT industry. There is interest in research communities in creating machines and software applications that have a rich interface serving users’ needs in both terms of usability and emotional responses. However, I wanted to know if there is the same interest in the IT community: Is there awareness of emotional design? To what extent are specialists from industry involved in this process and what attitude do IT specialists have
towards the development of machines and applications that respond to users’ emotional need? The focus of this study was to research the heuristics of software design and development and to analyze to what extent are different participants in the process (analysts, designers, managers, programmers and testers) responsible for creating the affective component of a software application. Incorporating emotion in computer applications, devices, machines and robots is a process that is socially and culturally sensitive, and involves significant ethical issues. Therefore, this study observed the designing process equally from a technical and from a socially responsible perspective.

Four themes were explored and evaluated:

- Attitudes, awareness and involvement of computer specialist in a design process that takes into consideration the user's emotional state and responds to the user's emotional needs.
- Heuristics of emotional design.
- Strategies and techniques used to incorporate emotions into a computer application and to respond to the user’s emotional needs.
- Consequences of creating machines that recognize and respond to the user’s emotional state.

1.4 Statement of Problem

Computers can solve different tasks, but their basic structure and functionality are very similar with the first computer model: John von Neumann’s machine. Von Neumann’s machine consists of a central processing unit (CPU) needed for execution of instructions, a memory for storage and input/output devices for communication with the user. This is known
as von Neumann’s computer architecture. An important principle is the generality. It doesn’t matter if a program performs computations or displays an image on a monitor, the program is executed in the same manner: it follows a sequence of instructions. Considering this technical context and the principle of generality, the question that surfaces is to what extent is it possible to associate emotions with computers? There are two aspects that should be taken into consideration here: emotions felt by the user and associated with the execution of programs (applications) that run on the computer, and emotions that can be expressed, and recognized by the computer itself.

The proposed study focused on software design that senses users’ emotional needs and responds to them and influences human emotional states and addressed the following questions:

To what extent is there awareness of emotional design in the IT community? What are the strategies and techniques applied by different participants in the process of software design and development aimed to incorporate emotions in a software application and respond to users’ emotional needs?

The proposed study also evaluated the effectiveness of these strategies and identified some of the heuristics of emotional design. Therefore, the following sub question was answered:

What are the heuristics of emotional design?

The process of responding to the users’ emotional needs was observed from a critical perspective with respect to social and moral implications.
To what extent are these strategies effective and what are the ethical consequences of development of software applications that are designed to trigger affective responses from users?

Last, but not least, this study piloted a questionnaire designed to survey the IT community and provide data to answer the above research questions. The instrument was effective for the current study. However, this study offered opportunities to the participants to critique the questionnaire and to critically reflect on issues of relevance and validity. The findings of this study will help me design a better instrument that I intend to use for a longitudinal panel study.

1.5 Organization of Thesis

To achieve the goals stated above, this thesis is organized into six chapters. Chapter One introduces the reader to the background of this study, presenting the rationale, the purpose and the research questions. Chapter Two is a critical review of literature related to epistemological aspects of emotion, philosophical perspectives of emotion and cognition, emotion and technology, artificial intelligence, affective computing and emotional design, designing applications that respond to emotional needs in the context of human-computer interaction, and issues of virtual communities and identity formation. Chapter Three presents the research design and methodology employed in this study. The study used mixed research methods and was organized in two stages: a quantitative stage and a qualitative stage. Therefore, data analysis and findings are presented in two separate chapters: Chapter Four dedicated to the quantitative stage and Chapter Five to qualitative stage. Chapter Six presents
methodological aspects related to the study design and instrument, conclusions based on the results from Chapters Four and Five, practical implications, and directions for future research.
Chapter Two: Literature Review

2.1 Introduction: Definition and Etymology

There are several definitions for emotion. According to the on-line Merriam-Webster Dictionary emotion is defined as “a: the affective aspect of consciousness b: a state of feeling c: a conscious mental reaction (as anger or fear) subjectively experienced as strong feeling usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body” (Definition of Emotion, 2007).

The Latin etymology of the world “emotion” is composed from two words “e(x)”/out and “movere”/movement, action, gesture. Its English usage was originally inherited from the French emouvoir. It is interesting to observe that, originally, the meaning of the word was not associated with a mental state, but with a physical one. In the sixteenth century, the word “emotion” described physical agitation, tumult. Emotion was later associated with a physical or a mental disturbance and “strong feelings”, and only in the nineteenth century with “any feelings” (Online Etymology Dictionary, 2007, Oxford Dictionary of Etymology, 2001).

This chapter provides a review of literature related to the history of research into emotions, contemporary theories and philosophical influences, emotion and technology, affective computing and emotional design. A discussion related to how emotion is observed from the HCI perspective is also included. The chapter concludes with a presentation of consequences felt by users of computing technology and ethical issues that correlate to emotion.
2.2 Emotion: Epistemologies and Areas of Research in the Historical Perspective

In the modern world, emotion is generally associated with feelings, perceptions and beliefs and addressed by several disciplines: biology, education, neurosciences, pathology, philosophy, and psychology. Because emotion is connected to human behavior, it is strongly bound to the social sciences and especially to education (Boler, 1997; Scherer, 2001). Scherer observed a current broad preoccupation of the general population with emotion (Scherer, 2001). He also noted that the human behavior is currently considered to be governed by passion (emotion) as opposed to reason.

However, the question about which is primordial, emotion or reason, belongs to a very old, unresolved argument. The dualism of reason and emotion as two complete opposite entities dominates Western philosophy (Boler, 1997; LaRock and Kafetsios, 2004; Norman, 2004; Woodward, 1997). Nicholson also observed an epistemological separation of reason and emotion in Western Europe and North American cultures from the period of the nineteenth century up until the early twentieth century (Nicholson, 1997). At that time, reason was considered the bonding element of public life, missing an essential observation that a society is first built on cultural and religious affinities and traditions which are in fact representations of emotions shared by its members. I can see similarities between the dualist relationship emotion/reason and the dualist relationship body/mind as formulated by Descartes. Descartes stated the separation body/mind and argued that the body follows the laws of physics, opposed to the mind which is non-material. He asserted that there should be a relation between the body and the mind that acts in both directions: the body controls the
mind and, also, the mind can influence the body, opposed to earlier philosophers who believed that the body influences the mind (Baker & Morris, 2002).

The modern world during the nineteenth century and early twentieth century brought substantial social, political, and moral changes. Research and innovation in several disciplines were substantial in the Western European and North American societies. This was the era of the industrial revolution, the 1848 European social revolutions, Marx and Engels’ “Communist Manifesto”, and the American Civil War. This was the time of Baudelaire, Brahms, Chopin, Gaugain, Goethe, Schopenhauer, Turner and Van Gogh. Arts, literature and philosophy flourished. In this context, emotions became an object of study for scientists and philosophers, were associated with arts and aesthetics, and started to be considered important for the proper function of the society. In nineteenth-century western societies, expressing context-appropriate emotions was desirable and even required for social functions: compassion towards youngsters, affections between parents and children, romantic love between spouses (Nicholson, 1997). Nicholson observed that emotions were gender and class specific: strong emotions like anger and fear were associated with the male courage and behavior, motherly love with women, and members of a certain class were characterized by the way they expressed their emotions. For example, “middle-class Victorians not only viewed the lower classes with disdain for not controlling their emotions; they also viewed them negatively for not being able to experience certain emotions, such as love and grief, with intensity” (Nicholson, 1997, p. 4). Emotions were important for the proper function of society (i.e. the family life) and were promoted by art and literature.

LaRock and Kafetsios (2004) argued that the study of emotion evolved considerably since the end of the nineteenth century when scientists and philosophers embarked on formal
analysis. At the end of the nineteenth century, emotions were considered generated solely by physical changes in the body. William James was an important proponent of the idea that emotion is physical and occurs as a result of physiological changes such as a change in the heart rate or perspiration of hands (Picard, 1997).

In the late nineteenth and early twentieth century in studies by James (1887), McDougall (1908), and Cannon (1927), emotions were identified with instincts, and neurophysiological and perceptual processes (LaRock & Kafetsios, 2004). After a period when emotions were disregarded in light of behaviorist theorists who reduced all that organisms do (actions, feelings, activities, thoughts) to behavior, emotions again became an object of study and research. Nicholson observed that in distinction to the period before the twentieth century, when reason was associated with public life and emotion with private life, modern society reconfigured this association giving emotion a role in public spaces in terms of political decision-making (Nicholson, 1997). An important movement was introduced by Freud who analyzed human emotions in perspective of human sexuality. According to Nicholson, the consumer culture that governs today’s world is based on Freudian and other therapeutic theories that promoted a healthy psyche by avoiding suppression of sensual gratification (Nicholson, 1997).

In the second part of the twentieth century, another important movement in social sciences shifted to a “cognitive paradigm”, which considered cognitive process as a prerequisite of emotional experience. The focus on cognition-first aspects of emotion started with early theories developed by Walter Cannon in 1927 who, influenced by Darwinian theory, identified emotions with neurophysiologic processes (Picard, 1997; LaRock & Kafetsios, 2004). Cannon challenged the physical-first theory developed by James and
argued that emotion can be generated by the brain without any other external stimuli (Picard, 1997). The cognition-first approach became the dominant perspective and was represented by several models: neo-associationist, appraisal theories, propositional theories and multi-level cognitive models combining associationist and propositional models (LaRock & Kafetsios, 2004).

Two theories, physical-first and cognition-first, are merged today into a new theory that recognizes that emotions are both generated by the brain and the body (Picard, 1997). Contemporary discourses also recognize the importance of emotion for human behavior in social, political and cultural context, and propose interactionist, multidisciplinary, and technology-based approaches to research (Scherer, 2001, Woodward, 1997).

An evolution in computing and robotics that marked previous decades generated a new philosophical and theoretical framework that I refer to as a “technological paradigm”. Today’s discussions related to emotion do not stop with humans but extend to other forms of life (plants and animals) and to machines. Advanced machines need emotions for the same reason humans need them: for survival in a context when operating without human intervention, in decision making (Norman, 2004), and for intelligent responses (Picard, 1997). Associating emotions with computers and machines is not without negative consequences. Woodward observed that attributing emotions to computers is necessary to facilitate our accommodation to this new form of technology and argued that this is just a subset of a larger process part of “consumer culture”. She cautioned about the social danger of a person psychologically investing more in material objects than in relationships (Woodward, 1997).
2.3 Emotion: Contemporary Discourses and Philosophical Influences

According to Boler (1997), there are four primary discourses of emotion: rational, pathological, romantic and political. Rational discourse is found in Western philosophical traditions based on science and rationality. For example, emotions are used in rational discourse to emphasize a political or scientific debate. Pathological discourse is characteristic of biology, psychology, neurosciences and social sciences and treats emotions as part of the physiology of the mind or body. Romantic discourse derives from religion, art and aesthetics. Arising from the Civil Rights movement, political discourse is the most recent. Political discourses of emotion are concerned with class, gender, oppression and race (Boler, 1997).

Boler identified the following disciplines associated with the four discourses:

Rational: philosophy, sciences, technology, legal theory
Pathological: psychology, social sciences, medicine
Romantic: arts, literature
Political: feminist, post-structuralism

I find Boler’s classification incomplete. I argue that social sciences are not restricted to the pathological discourse, but also include the political and rational discourses. Also, a political discourse can be both political and rational. According to Boler, three philosophical movements influenced contemporary theories of emotion: Aristotelian, conceptual and phenomenological (Boler, 1997).
Aristotelian philosophy is built around the scientific knowledge that the nature of things is their form. Aristotle’s philosophy is known to be functionalist, logical and rational. Aristotle argued that emotions are strongly connected with judgments and beliefs and can be disciplined. His theory is still popular in the contemporary world (Boler, 1997).

Conceptual theory was developed in the 1940s and was represented by philosophers as A. J. Ayer, who, contrary to the Aristotelian philosophy, believed that emotions are not generated by judgments and beliefs, but by religion, ethics, and aesthetics. A strong movement was represented by the behaviorist psychology and by Freudian psychoanalysis which viewed emotion as non-cognitive. Later philosophers such as Anthony Kenny, Robert Solomon, Robert Gordon, William Lyons, Ronald de Sousa and Michael Stocker critiqued behaviorist interpretations of emotions and argued that emotions are strongly connected to cognition. Another important contribution of the conceptualist movement was the inclusion of the social context in defining and interpreting emotions (Boler, 1997).

Phenomenological philosophy is based on the need of exploring phenomena with the purpose of identifying the essence of individual experiences. Boler cautioned that conceptual and phenomenological traditions are not too far apart being both interested in “intensionality” and “intentionality”. The phenomenological approach is found in educational studies by Freire and Dewey, and in Marxist philosophy (Boler, 1997).

I argue that Boler omitted a very influential philosophical movement which shaped contemporary emotion theory: post-structuralist philosophy. Post-structuralism offered a theoretical framework for modern theories of emotion recognizing culture as a context for expressing ourselves. Developed as a critical reaction to structuralism, post-structuralism started in France in the 1960s. Originally a structuralist, Roland Barthes became attracted to
the post-structuralism movement. He used the metaphor “the death of the author” to indicate that a text has several meanings and was not only defined by what the author intended to say. This liberated the reader from the barriers of a single interpretation. Similarly, Terada argued that poststructuralist theory introduced the metaphor “the death of the subject” as liberation from subject-centered approaches and as a necessary condition for having emotions. Terada believed that emotions should be non-subjective: “Yet if emotional effects are so terribly pervasive in poststructuralist theory ... it is time to consider the possibility that post-structuralism is directly concerned with emotion. In order for this to be so, emotion would have to be nonsubjective” (Terada, 2001, p. 3).

Controversy exists: “the death of the subject” can be interpreted as a lack of feelings and thinking, and many scholars considered post-structuralism to be inconsistent (Terada, 2001). The structuralist approach was based on a binary opposition of elements with opposite meanings (man/woman, civilized/savage, reson/emotion, etc.) By contrast, post-structuralism, which was developed as a critical response to structuralism, eroded the boundaries between these opposites to open doors to new frontiers of knowledge and interpretation. I argue that artificial intelligence has theoretical roots in the post-structuralist concept of the “death of the subject” through a non-subjective, not-only-human, interpretation of emotion.

Contemporary discourses in emotion theory, place emotion on an important position in education. An important contributor to this field is Megan Boler a pedagogue and feminist, who analyzed emotions and power relationships in educational and cultural contexts. Boler (1999) argued that educational systems are built on models that are designed “to discipline young people’s social and moral values and behaviors. This moral conduct is inextricably tied to emotional control” (p. 30). Social sciences started to analyze and measure emotions
in education by the end of the World War II. However, before educational reforms of the 1960s, emotions were perceived mainly as barriers to education: The *Emotions and the Educative Process* report developed and published ten times between 1938 and 1961 by the American Council of Educators, concluded that emotional (“labile”) students are a “challenge to the modern educational system” (Boler, 1997). Boler identified how Marxism, civil rights, and women’s liberation movements influenced views of emotion in the educational process. Boler’s main critique was that despite the recent progress in mentality and practice, existing educational programs are still based on “a combination of cognitive and psychobiological science and behavioral psychology” and “are directed toward behavioral modification” and only rarely “address questions of social hierarchies or power relation in relation to emotion” (Boler, 1997, p. 227).

Paolo Freire in his book *Pedagogy of the Oppressed*, published in English and Spanish in 1970, offered one of the most important discourses about education as a liberation tool. According to Freire, the “banking” concept of education where the teacher is a “narrating subject” and the student a “listening object” is an instrument of oppression. The dialog teacher/student is essential to education as the “practice of freedom” (Freire, 1970/2000). However, Freire offered a conflicting view of emotions observed by Sherman and Boler (Boler, 1997; Sherman, 1980). In his discourses, Freire identified on one hand emotions as necessary for dialog and education and on the other hand, he associated them with a “naïve and irrational consciousness” (Sherman, 1980).

I applaud Boler’s critique of the missing discourse of power in education. Present in the feminist and Marxist movements, the power discourse in schools is mainly liberal: “the
role of schools is not to alter social inequities but to adapt the individuals to the existing model” (Boler, 1997, p. 221).

2.4 Emotion and Technology

In her chapter “Prosthetic Emotions”, Woodward (1990) introduced the term “artificial emotions”. Humans projected their emotions to objects and artifacts in today’s consumer culture to an extent that life and emotional states shifted from humans to their objects: “humans are empty, void of emotions, the very emotions that been projected into the technoscape, animating it with an emotional quotient, if not life itself” (Woodward, 1997, p. 104).

The role of emotion in advanced intelligence is the main theme of science fiction. A non-human, and to a lesser extent a computer (machine or robot), that can sense and respond intelligently and affectively is a cultural development that started long ago. I find it interesting to observe that, when discussing emotion and technology, theorists and scientists selected and analysed examples of situations from narratives, movies and TV series that belong more to popular culture and less to the scientific or scholarly world. Giving an example from Star Trek, Norman asserted that authors of science fiction provided psychologists (for example Robert Sekuler and Randolph Blake) with illustrative social interactions and characters that portray “the role of emotion in decision making” (Norman, 2004, p. 165).

science fiction movie *2001: A Space Odyssey* directed by Stanley Kubic was mentioned and discussed by both Woodward and Norman (Woodward, 1997; Norman, 2004). Woodward observed that for non-humans, emotions are considered strength and not weakness. More than that, machines display an affective life that has an emotional impact on others: HAL, the computer in *2001: A Space Odyssey* has a deep affective influence on Dr. Chandra. The emotional growth experienced by the character Bowman from the same movie exemplifies that humans are enriched by their contact with other forms of life and intelligence (Woodward, 1997).

Definitely, the user feels emotions when running an application on a computer. These emotions are not accidental: they are embedded in the application’s execution by its designers. Interactive applications and games are implemented to interact with the user and trigger emotional responses. This is not something new: novels, paintings and movies generate emotions in readers and viewers by creating a series of circumstances that occur to the characters. If this is possible and desirable in visual arts and literature, why not in computer applications like educational programs, software used for therapeutic purposes, and entertainment?

### 2.4.1 Embedding Emotion in Computer Applications

Let me begin by turning to the world of visual media and gaming. David Freeman, a media teacher for games and film, published in 2004 a book named *Creating Emotion in Games* where he introduced a new word: “emotioneering” (emotion + engineering) defined as “a vast body of techniques that can create, for a player or participant, a breadth and depth of emotions in a game or other interactive experience, or that can immerse a game player or
interactive participant in a world or a role” (Freeman, 2004, p. 7). He offered advice in his book on how to hire a screenwriter who can produce engaging stories, and presented his “emotioneering” techniques: developing emotionally informed decisions, complex moments and situations, enhancing emotional depth through symbols, gamers group bounding and promoting motivation. Freeman teaches screenwriting workshops in Los Angeles to film and television producers, but has no formal education and training. The main critique I have for his book is related to the way he answered the question “Why put emotion into games?” His immediate answer was for “art and money”, but he later elaborated offering nine reasons that are all but one related to money: expanding demographics, better “buzz”, better press, competitive advantage, so you don’t burn millions of dollars of potential profit, etc. More research is needed to find out to what extent his techniques are recognized and used in the gaming industry and in the scientific world.

Not only media and film specialists but also theoreticians, designers, engineers and scientists are interested in how emotion is embedded in interactive applications and games. This is not a new development: according to Woodward (1997), machines that communicate to humans with friendly voices are part of a development that has a long history in western culture. Bates (1994) acknowledged that animators use specific techniques to properly portray animated characters, and to make them believable. These techniques are not identical, but similar to methodologies developed by researchers and theorists in artificial intelligence.

A fairly new area of research is the field of educational games. Educational games designed for children intend to expose players to pedagogical experiences that improve motivation and levels of engagement in the learning process. In order to measure these characteristics, Conati and Zhou (2002) from the University of British Columbia designed
"pedagogical agents", which they incorporated into games. Pedagogical agents are based on a probabilistic model of a Dynamic Decision Network and used to measure students’ emotions during the game. The goal was to assess “affect by predicting how student goals, personality and knowledge influence student appraisal of the interaction with the game” (Conati & Zhou, 2002, p. 954).

2.4.2 Affective Computing and Emotional Design

Another important development of emotion in technology is related to emotional machines: machines that can recognize, feel and express emotions. Woodward (1990) named these emotions “artificial emotions” in the same way that intelligence attributed to machines is called “artificial intelligence”.

In the world of humans, intelligence, as the capability to adapt to change, was associated with emotion by Charles Darwin in 1872. Artificial Intelligence (AI), first used by John McCarty in 1956, is the science and engineering of making intelligent machines. What an intelligent machine is changed over the time. Originally, artificial intelligence was developed to solve difficult problems and was not associated with emotion: Arthur Samuel wrote, between 1956 and 1962, the first game-playing program for checkers, and James Slagle further developed in Lisp (the computer language developed by McCarty for artificial intelligence) the first symbolic integration program that solved college-level calculus problems. The hardware development of the technology allowed better performance and storage capabilities and therefore, more complex programs can be executed and more “intelligence” embedded into machines: case-based reasoning, multi-agent planning, data mining, natural language understanding and virtual reality. However, this field is very new.
In the late 1990s emotional agents were developed at MIT and in 2000 the first pet robots become commercially available.

Currently, when discussing emotions expressed or recognized by machines, theoreticians and scientists associated them with cognition to a point that artificial intelligence and emotion are interchangeable.

Donald Norman, professor emeritus of cognitive science at University of California and professor of computer science and psychology at Northwestern University, dedicated his research to cognitive science, cognitive psychology in the domain of usability engineering and emotional robots. In his book *Emotional Design*, Norman underlined the intellectual tradition that separated reason from emotion and argued that reason and emotion should be treated together:

Visceral, behavioural, and reflective: These three very different dimensions are interwoven through any design. It is impossible to have design without all three. But more important, note how these three components interweave both emotions and cognition. This is so, despite the common tendency to pit cognition against emotion. Whereas emotion is said to be hot, animalistic, and irrational, cognition is cool, human, and logical. This contrast comes from a long intellectual tradition that prides itself on rational, logical reasoning … Nonsense! Emotions are inseparable from and a necessary part of cognition. (Norman, 2004, pp. 6-7)

Norman concluded that emotion is the best way to translate intelligence into action. Industrial robots and computers are already developed to include decision-making and safety features: protection from excessive heat, power outage, computer viruses and Trojan horses.
However, these machines react to a specific situation based on a computer program that executes a sequence of steps and not because of "emotional states" like fear or pain.

Norman (2004) asserted that the future will bring a dramatic cultural development in the field of emotional machines. He mentioned the impact that the automobile industry had on the modern lifestyle: houses now have garages and driveways, and an efficient highway system had been developed. In the future, houses will be built to accommodate household and cleaning robots (Norman, 2004).

The association between intelligence and emotion in computing led to the development of a new branch of artificial intelligence: affective computing. Affective computing is a multidisciplinary field involving computer science, psychology, and cognitive science that is concerned with the design of machines and computers that can process emotion. A very important researcher and theorist in the affective computing field is Rosalind Picard, founder and director of the Affective Computing Research Group at the Massachusetts Institute of Technology (MIT) Media Laboratory and co-director of the Things That Think Consortium, the largest industrial sponsorship organization at the lab. In her book, Affective Computing, Picard (1997) argued that the only way to create intelligent machines is to make them sense and respond to emotion. She asserted that emotion is both physical and cognitive and can be expressed through facial movements, body language and muscular and physiological responses. In order to express and recognize emotions, the computer should have implemented two kinds of systems: systems that analyze and synthesize patterns and systems for decision-making. These systems should be built on different levels of abstraction from low level signals that represent the heart beat to complex interpretations of statements describing emotions (Picard, 1997). However, the process used
by machines to express and recognize emotions does not have to utilize the same mechanisms as humans.

The problem of emotion recognition is not simple: Norman (2004) and Picard (1997) are both concerned with the fact that emotions are internal states and therefore can be recognized only by the person who experiences them. Outsiders can only observe the affective state. Picard (1997) suggested that "recognizing emotions" should be interpreted as "inferring an emotional state from observations of emotional expressions and behavior, and through reasoning about an emotion-generating situation" (p. 176).

Therefore, an important question is to what extent are computers capable to recognize the users' emotional state and respond to it in a sensible manner. Picard and Klein (2002) identified two kinds of emotional needs that a user might experience: emotional skill needs in the form of emotional self-awareness, managing emotions, self-motivation, affect perception and empathy, and experiential emotional needs like loneliness or frustration. Experiential emotional needs are met with help of others and therefore, computers can assist users with this kind of needs, such as frustration. Picard and Klein (2002) reported that prototypes of interactive computer systems have been designed and evaluated to sense human emotional expression and respond with emotionally supportive interaction to the users' needs when frustration and other negative emotions were detected. Klein, Moon and Picard (2002) conducted a study that demonstrated that it is possible to build intelligent agents with social capabilities that provide the user with emotional support to overcome frustration and computers are capable of alleviating negative emotions even when they are the source of these negative emotions. In their study, the users did not know about the existence of intelligent agents. They suggested that research should be conducted to see if users will
welcome such an agent when they become aware of its existence (Klein, Moon & Picard, 2002).

Several scientists and researchers argued that machines that recognize and express emotions are more suitable for situations like help-desks, child-care, interrogation of patients in hospitals, and providing information or leisure activities because they make user-interaction more credible and satisfying (Bates, 1994; Picard, 1997; Picard & Klein, 2002; Norman, 2004).

In a case of hospital interrogation, Picard and Klein (2002) asserted that all users who were interrogated by a computer program reported that their emotional needs were addressed and agreed that the computer seemed to be paying attention to their questions. On the same issue, Brave, Nass and Hutchinson (2005) investigated how users responded to intelligent agents that cared about them, comparing two situations: when agents exhibited (1) self-oriented emotions and (2) empathy. They confirmed the interest of the research community in the topic of emotional design and emotionally-responsive agents, but cautioned that there were no studies that explored the users’ responses to emotional expressions generated by these agents: “Although the evidence shows that people can recognize and correctly identify emotional expressions by embodied agents, there are essentially no studies investigating how people respond to an agent’s emotional expression” (Brave, Nass & Hutchinson, 2005, p. 163). The study concluded that agents that “cared” and exhibited empathetic emotions were better rated by users in terms of likeability and trustworthiness.

However, not all members of the research community agree that emotional responses to computer applications and machines are desirable. In the same study, Brave, Nass and Hutchinson (2005) addressed the issue of “whether emotional expressivity by computers is or
is not beneficial in human–computer interaction" (p. 172). They agreed with Bates (1994), Klein, Moon and Picard (2002), Norman (2002), and Picard and Klein (2002) and concluded that embedding emotional responses in computer applications leads to positive outcomes. Their study offered a persuasive demonstration that users’ experience was enhanced by the existence of an agent that exhibited empathic emotions (Brave, Nass & Hutchinson, 2005).

2.4.3 Human-Computer Interaction (HCI) and Emotional Design

Human-Computer Interaction (HCI) emerged as an important discipline that combines computer science and behavioral sciences and is concerned with the design, evaluation and implementation of computer systems that interact with humans. The core goal of HCI is to improve the interaction between humans and technologies and identify design strategies that can be used in practice for the implementation of computer applications that optimally assist the users. Norman asserted that in order to create machines (systems) that assist humans in solving practical tasks, we have to build design strategies that take into consideration the complexity of the tasks, the challenge derived from the discontinuity between psychological variables (users’ goals) and physical variables, and existing technological limitations. In his chapter “Cognitive Engineering” he observed the lack of theorization and methodology with respect to design of systems that are used by humans for a scientific field that is “neither Cognitive Psychology, nor Cognitive Science, nor Human Factors,” which he named cognitive engineering (Norman, 1986, p. 31). He offered some prescriptions and started with the recommendation of creating “a science of user-centered design” (Norman, 1986, p. 59). This science will later emerge as HCI. When prescribing
“user-centered system design” Norman identified one of the core principles of HCI: inferring the user’s goals and needs (Norman, 1986, p. 61).

Based on the review of literature, I identified three important aspects of HCI: aesthetic design, universal usability, and user modeling.

Aesthetics is a principle that was underestimated in the beginnings of computing. Norman told a personal story related to the transition from black and white screens to colored ones. He did not appreciate the popularity of the color computer screens until he decided to understand this phenomenon and borrowed one to use with his computer. From a cognitive point of view, it was unimportant to have color; however, emotionally Norman felt better when used the color computer screen. Norman concluded that design should be tailored to situation (task and context), match the users’ needs, and create a balance between usability and aesthetics. Cognition and emotions cannot be treated separately and both have implications for design (Norman, 2002).

Another important issue of HCI is universal usability. Ben Shneiderman, professor at University of Maryland, pioneer and important contributor of HCI identified three universal usability challenges: technology variety, user diversity, and gaps in user knowledge. Shneiderman (2000) identified goals associated with the three challenges and analyzed the multitude of problems associated with each goal.

Usability is influenced by aesthetics: the way users feel about the technology they are working or interfering with was reported to be related to usability issues. Cyr, Head and Ivanov (2006) described a study by Kurosu and Kashima (1995) related to how customers of ATM machines responded to different interface layouts in respect to the relationship beauty – ease of use. An interface that was perceived by customers as aesthetically pleasing affected
how they assessed other characteristics of ATM systems like the ease of use. Cyr, Head and Ivanov (2006) also studied this relationship in the context of mobile devices and concluded that a design that included aesthetic considerations influenced the users’ perception of usefulness and ease of use.

User modeling, a field of HCI and AI, is concerned with the creation of “interface agents” or “intelligent agents” that can predict the user’s future actions based on the current state of the system, the user’s profile, and previous actions and prior beliefs (Horvitz, 1999). User modeling is used to identify users’ needs based on a decision model that takes into consideration users’ beliefs, intentions and goals. Uncertainty is a key aspect of user modeling because the same situation can induce a variety of different outputs depending on several factors, such as the users’ emotional or mental states (Coneti & Zhou, 2002; Horvitz et al., 1998; Horvitz, 1999). Another important issue in user modeling is related to complexity. Horvitz et al. (1998) were concerned with the complexity associated with temporal reasoning and, Albrecht and Zukerman (2007) observed concerns that were raised in their research by Lekakos and Giaglis related to time complexity, and by Domshlak and Joachims regarding tractability during model construction. Bayesian models are used in user modeling as probabilistic models for computing the likelihood of a certain event to happen. Horvitz et al. (1998) identified several areas of research that used Bayesian models for user modeling: multi-attribute utility models employed in the Pathfinder pathology diagnostic system, models used for interpreting patterns of evidence by flight engineers at the NASA Mission Control Centre, models of pilots’ goals for commercial aircrafts, and models for inferring drivers’ goals when navigating in traffic. The dynamic nature of user modeling data
was also observed as a challenge by Albrecht and Zukerman (2007), Conati and Zhou (2002), and Horvitz et al. (1998).

As part of the user modeling solution during the past decade, attention has been given to adaptive and adaptable interface design. Adaptive interfaces are intelligent interfaces that adjust automatically to what is supposed to be the best outcome for users by keeping a user profile and predicting what the users’ goals and needs might be. McGrenere, Baecker and Booth (2002) described adaptive interfaces as intelligent agents that adapt in a “way that is expected to better suit the needs of each individual user” and cautioned that often users perceive them as “a loss of control” (p. 164). I argue that adaptive interfaces are a promising solution to complex human-computer interaction but have drawbacks related to complexity and uncertainty as no mathematical model was yet developed to fully predict future events. Adaptable interfaces do not adjust automatically, have features that allow users to set up the layout of the interface to their desires, and are not constrained by issues of complexity and uncertainty. McGrenere, Baecker and Booth (2002) evaluated both adaptive and adaptable interfaces and concluded that “results favour the adaptable design but the adaptive interface definitely had support” and recommended multiple interface design that combines the benefits of both adaptive and adaptable models (p. 170). According to findings from the literature review, adaptive and adaptable interfaces referred more to needs in terms of intelligent behavior and did not attempt to address emotional needs.

Emotional awareness is a new area of HCI research, more precisely of Computer Supported Collaborative Work (CSSW). Neyem et al. (2007) researched and designed an interface that supported “public-emotion based dialog” by allowing users to communicate
their emotions and be aware of other participants’ emotional state in dialog. They critiqued HCI as being focused on usability only:

By enabling direct control and feedback on a number of levels, providing aesthetic pleasure and supporting intrigue for the unexpected, physical user interfaces can help designers take the step beyond usability (p. 234).

Neyem et al. built the Emoti-Picture Frame, a device that allows users to develop “a form of emotional language” (p. 232) and can be used to actively communicate one’s emotional state or passively be aware of other participants’ states.

2.5 Virtual Communities and Identity Formation

The rise of the Internet created opportunities for the development of cyberspace: a new “world” governed by new rules. The word cyberspace was introduced by the science fiction writer William Gibson in the early 1980s, first in his story “Burning Chrome” and later in his popular novel Neuromancer. Turkle (2004) observed that we witness today the development of relational artifacts that employ emotional behavior, and predicted for the future the development of “relational artifacts that have feelings, life cycles, moods” (p. 25). Turkle (2004) remarked the contradiction between the different views perceived by computer designers and users. Even if designers of computational objects focused on the cognitive powers of the machines, users developed a different relationship with them. According to Turkle (2004): “Technologies are never “just tools”. They are evocative objects. They cause us to see ourselves and our world differently” (p. 18).

The virtual world has rules and protocols that are non-existent in the real world. Several theorists observed that virtual space offers possibilities for identity play (Silver,
Stone (1992) reiterates a story of “computer crossdressing” in which a middle-aged male psychiatrist developed and used an old, disabled female virtual persona (p. 83). Several theorists observed the rise of a new culture, generally described with the term cyberculture (Hayles, 2006; Petrina, 2007; Stone, 1992; Turkle, 2004).

How are emotions recognized and expressed by members of virtual communities? Current avatars have immobile faces, which give small clues about the emotional state of the persons they represent. Therefore, a different type of literacy was developed between members of virtual communities: special words and symbols are used in communication for expressing emotions. Messengers, e-mail applications, and games offer a collection of symbols named emoticons: animals, cartoons, cloths, computers, games, smiles, and unhappy faces. Applications like MSN, Yahoo and AOL Messenger provide the user with sets of emoticons (see http://www.sachgup.com/msn_emoticons/happy_emoticons.php).

Who is emoting: the computer, the user, or the avatar? Are these emotions real or virtual?

Identity issues are strongly related to emotion. The boundaries between humans and machines, between virtual and real persona are blurred. Silver and Stone told stories of embodiment, “going meatless” (Silver, 2004, p. 60), computer “crossdressing” (Stone, 1992, p 84), “quasi people”, and “quasi agents” that represent “intelligent machines”, “cluster of people, or both” (Stone, 1992, p 112). In Stone’s story of a middle-aged male psychiatrist posting messages as a handicapped woman, what emotions were expressed? Is the male psychiatrist or the old disabled virtual woman expressing compassion, care, fear, or happiness? How do we define the emotional state of a cluster of humans and machines?
Starting from the new social realities, in her *Cyborg Manifesto*, Haraway (1991) intended to “build an ironic political myth faithful to feminism, socialism, and materialism” (p. 149). Haraway’s cyborg is a post-modernist, post-human creature that exists because of the blurring boundaries between humans and animals, animal-human and machines, and physical and non-physical. Haraway observed the cyborg’s world from two perspectives. On one hand Haraway warned: “a cyborg world is about the final imposition of a grid of control on the planet, about the final abstraction embodied in a Star Wars apocalypse waged in the name of defence” and on the other hand, she had reasons for optimism: “a cyborg world might be about lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines, not afraid of permanently partial identities and contradictory standpoints” (Haraway, 1991, p. 154).

We are in danger of developing feelings for devices and making virtual friends that might be just computer-generated, but we can also escape from our “real” identity and embark on new intellectual experiences. In cyberspace, on one hand, we respond to a call to consume new devices, depend on them for work, school, or leisure, and use their volatile power to store our memories and narratives. On the other hand, we enter a new world without limitations and boundaries for our virtual creations and lives.

There are no simple answers to the questions raised. However, when answering them, we do not have to forget our physical, human condition: “Cyberspace developers foresee a time when they will be able to forget about the body. But it is important to remember that virtual community originates in, and must return to, the physical. No refigured virtual body, no matter how beautiful, will slow the death of a cyberpunk with AIDS” (Stone, 1994, p. 112)
I argue that the way emotions are understood, interpreted, and expressed is culturally dependent, and cyberculture offers a new cultural context where prosthetic and natural emotions are combined and interleaved to an extent that virtual reality and “real” reality are difficult to separate. Cyberculture emerged as mass culture, offering a new social and cultural context that is not yet well analyzed or understood. In a context where the boundaries between humans and machines, between virtual and real persona are blurred, a new duality emerged: the virtual world as a political and economical agenda about power, money and control, and virtual reality as a context that offers opportunities for progress and liberation.

2.6 Conclusion

Building machines that respond appropriately is a very complex task. The response to emotion and the way emotions are interpreted or felt depend on the situation. Humans sometimes hide their emotions making it difficult to understand and interpret them. Norman observed that people are not always good at responding to others’ emotions (Norman, 2004).

Human emotions are very complex: trying to imitate them can lead to non-believable robots. Science fiction addressed this problem: Norman observed that the computer character HAL from 2001: A Space Odyssey and the robot Dave from the movie AI do not yet have the emotional complexity of a human. HAL did not react naturally when his friend wanted to kill him. Dave displayed affection to his mother that was too “perfect”: Dave had an unconditional love for his parent which is very different from a real child who has a mix of feelings: love, anger, dislike, indifference, etc. (Norman, 2004).
Response to emotion is not only context specific, but culturally sensitive. Each culture has a different way to interpret emotions and to respond to them. In some cultures, children are educated that it is polite to hide certain emotions and express others.

The natural aggressivity of humans helps them survive difficult situations like disasters, accidents, animal attacks or predators. However, some individuals use their aggression not only in critical situations, but to commit anti-social acts. Should negative emotions and violence be incorporated into a machine’s behaviour to make it believable or more “human”? This is a very important ethical question that needs to be carefully and responsibly answered. Creating machines that express emotions and respond to them is not only a technological challenge, but also a very complex and sensitive ethical and social issue.
Chapter Three: Methodology

3.1 Introduction

There are two situations related to software design of computer applications with emotional content: first when applications are intended to generate emotions in users, and second when applications recognize the user's emotional state and respond to it. In literature the two situations are observed as: affective computing, emotional design, or emotioneering (Freeman, 2004; Norman, 2004; Picard 1997). After an extensive literature review, I found that this topic was not explored extensively, and the literature offered only partial support. Based on my experience as a computer scientist, software engineer and educator in the IT field, and based on my research for this study, I concluded that there is no adequate methodology for studying the emotional design of software applications. I also did not find any instruments for data collection to satisfy my needs and therefore, under the supervision and with help from Dr. Petrina, my supervisor, I developed an adequate instrument for data collection.

The following chapter has two parts. The first part includes the research design and the implemented procedures, a description of the participants, and the data collection instruments designed and used in this study. The second part is dedicated to data collection and analysis in an attempt to communicate how data were collected for this study and to describe the quantitative (descriptive) and qualitative methods applied to analyze data.

3.2 Methods

This study was organized in two stages and used mixed research methods. Due to the complexity and lack of standard instruments, it started as a case study involving a limited
number of participants, and it will be later extended to a larger context. Besides addressing the research questions, I also intended to use this opportunity for designing, piloting and testing an instrument on a small sample population. The future goal is to improve the instrument and use it for a longitudinal panel study.

In this research, a modified explanatory mixed design method based on a QUAN-qual model was used (Creswell, 2003; Gay, Mills & Airasian, 2006). The QUAN-qual model implies two sequential stages: a quantitative stage followed by a qualitative stage. Characteristic for this model is the fact that quantitative data are collected first and are more heavily weighted than qualitative data. The data collected in the second (qualitative) stage is determined by the findings of the quantitative study. The qualitative information is used to better interpret the quantitative information, to give a deeper understanding, and to elaborate on the quantitative results.

According to Creswell (2003), there are particular situations in social and human sciences where mixed methods better serve the research goals. The nature of this study and the specifics of data intended to be collected during the study lead me to the idea of exploring mixed research methods. The central premise of this study was that there is little awareness of emotional design of software application in the IT field, but the literature did not help me validate this assumption. I also did not know if emotional design is considered desirable in the IT community, who is responsible for emotional design, and what strategies and techniques are used for embedding emotions in computer applications. In this respect the literature offered some support but I found the need for further empirical validation. Therefore, a quantitative study that looked at relationships between different variables (participants in the software lifecycle and responsibilities for emotional design, participants
in the software lifecycle and awareness of emotional design, emotional awareness and success of a software application, etc.) was an appropriate method. Methodologically, the choice of quantitative research was justified by the fact that one of the key factors of quantitative research is that hypotheses predict the results of the research before the study begin, which was the case with my study (Gay, Mills & Airasian, 2006).

However, statistical relationships only do not offer a deep understanding of the phenomena. The macro-level analysis that resulted from the quantitative stage was followed by a micro analysis which was focused on particular aspects of emotional design, consequences, and implications for participants and users.

Figure 3.1 presents the diagram that describes the QUAN-qual methodology and the respective stages. This model was modified during this study to a QUAN-QUAL model with triangulation. Section 6.1.1 describes these modifications (see Figure 6.1).

![Figure 3.1: The QUAN-qual Mixed Research Model (Adapted from Gay, Mills & Airasian, 2006)](image-url)
3.2.1 Study Design: Mixed Research Method Approach

The first stage of this research started in mid October 2007 and finished at the beginning of April 2008. In the first stage, a quantitative purposely self-reported research (Gay, Mills & Airasian, 2006) was implemented to identify the participants’ attitudes towards affective computing and emotional design, to what extent the participants are involved in embedding emotions into the final software product, and what strategies and techniques are used in industry to incorporate emotion into computer applications.

The second stage started in April 2008 and ended at the end of May 2008. This stage was employed as an interpretative qualitative research and was focused on exploration of issues raised in the survey (Gay, Mills & Airasian, 2006).

During the quantitative stage, quantifiable information was collected from the sample of population using a questionnaire. For the qualitative stage interviews were conducted. The questionnaire was implemented using Share Point technology as an on-line survey and installed on a stable and secure server at British Columbia Institute of Technology. The participants were identified from companies’ directories and websites, and I was introduced to some of them by colleagues from British Columbia Institute of Technology and former students. The questionnaire was available to participants for four weeks. Each week, I resent a kind reminder to the participants who did not respond. Data were recorded automatically and some statistics were automatically performed by the system.

In the second stage, seven participants in the surveys were invited to take part in interviews. The criteria used for selecting participants in interviews were decided pending the results of quantitative data analysis. For data collection, I developed interview strategies in a
semi-structured format (Gay, Mills & Airasian, 2006) to allow for the free flow of ideas. The starting points for each interview were results from the quantitative stage of this study.

3.2.2 Procedure

Quantitative research methods are different from qualitative research methods in many respects: qualitative research methods are characterized by deduction when qualitative research methods are characterized by induction; quantitative methods are focused on cause-effect relationships and qualitative methods are focused on understanding of phenomena; participants are randomly selected in quantitative studies, opposed to qualitative studies when participants are selected based on emergent or pre-determined criteria (Gay, Mills & Airasian, 2006). The research methodology employed in this study reflects the differences between the two stages.

The following section provides a summary of steps and activities required to be performed in order to carry out the study and reach the research goals. Each component mentioned in the procedure section will be clearly identified and described in details in the next sections. The procedural steps are presented in the order in which they occurred. The study was organized in three stages: preparation, quantitative stage, and qualitative stage according to the following steps:

**Preparation**
- Literature review
- Preparation of recruitment and ethics forms

**Quantitative stage**
- Design of the questionnaire questions and design and implementation of the on-line instrument
• Networking for recruitment of participants

• Testing of the on-line survey:
  o Technical
  o Methodological

• Design of the interview guide (first draft).

• Recruitment of the participants for study:
  o Post recruitment advertisements
  o Contact participants
    • Direct contact (i.e. at Career Fairs)
    • Telephone conversation
    • E-mail
  o Send invitations

• Data collection using the on-line survey
  o Send “Thank you” notes to the participants who responded the survey
  o Send reminders to the participants who did not respond to the survey

• Quantitative data analysis (macro analysis)

• Conclusions based on survey data

**Qualitative Stage (based on the findings from survey data)**

• Design of the interview guide (final)

• Recruitment of participants

• Interviews

• Data collection

• Qualitative data analysis (micro analysis)
3.3 Site of Research and Participants

This study took place in Vancouver, British Columbia. The sample is represented by specialists in the IT field: analysts, designers, programmers, testers, managers, researchers and educators. Because the focus of my research is emotion and technology, I targeted specialists involved in design and development of applications with rich user interfaces from the fields of human-computer interaction, web development, and computers games. The participants were recruited from institutions and organizations specialized in the above areas. I started with the assumption that software applications involving user interfaces with emotional responses and intelligent agents that recognize the user’s emotional state use models that influence belief, act as an intrinsic reward or punishment, and motivate intentions to act. They presume the ability to understand human beliefs, desires and intentions. Specialists involved in the design and implementation of these applications are the best candidates for studying emotion in affective computing design. Vancouver has a vibrant IT industry; however I estimated that only a smaller number of specialists corresponded to the purpose of my study because not all software applications have rich user interfaces or intelligent agents and not all IT specialists are involved in the design, implementation or testing of the above.
As I mentioned in the previous section, this study was organized in two different stages (quantitative stage and qualitative stage). Participant recruitment and selection was employed differently for the two stages of the research.

### 3.3.1 Quantitative Stage

Due to the nature of this study, selective purposive snowball sampling was the most adequate method (Gay, Mills & Airasian., 2006). Participants were selected by purposive sampling from a population represented by IT specialists composed by analysts, designers, programmers, testers, managers, researchers and educators involved in development of applications with human interaction. My previous experience in the IT field led me to select participants whom I knew met the criteria. For example, I sent invitations only to instructors in a post-secondary institution who I knew that have been or currently are involved in applications involving human-computer interaction. In some cases, participants were invited by other participants in the study. The sampling model when participants identify additional participants is known in literature as snowball sampling (Gay, Mills & Airasian., 2006). Snowball sampling was appropriate for this study because it was difficult for me to directly find participants with the desired background.

The participants were recruited by advertising the recruitment document to human resources professionals and by direct invitation. Participants who were directly invited are former British Columbia Institute of Technology students, now working in industry, and former and actual colleagues of mine.

According to Gay, Mills and Airasian (2006), for quantitative research it is common to sample 10% to 20% of the research population. Given the time constraint of one month and the snowball effect, the sample exhausted at 35 participants. However, in this stage of
my research, the focus was on piloting the instrument. In the future I intend to accurately calculate the population, improve the instrument and use it for a longitudinal panel study.

3.3.2 Qualitative Stage

Gay, Mills and Airasian (2006) asserted that sampling in qualitative research is generally purposive. They identified different types of qualitative sampling: intensity sampling, homogenous sampling, criterion sampling, snowball sampling and random purposive sampling. For this study, I considered that the best method of selection is criterion sampling because I intended to invite to interviews the most experienced specialists in the human computer interaction area.

The participants in the qualitative stage of my study were selected from the participants in the survey with one exception: one participant (Participant B) who intended to participate in the survey but did not find the time. However, Participant B is a very experienced IT specialist with many years of experience in industry and education. The other participants were selected based on their answers using criteria that were determined after the quantitative data were collected and analyzed. The criteria used for selection included: experience in the IT field, participation in design of applications that involved user interaction and/or emotion recognition, participation in applications that were unsuccessful because of the lack of consideration for the user's emotional state, involvement in the gaming industry, and the richness of the answers from the open-ended questionnaire questions (questions 23, 24, and 25). Participant interest in research and availability were other factors used in determining participation in interviews. For example, Participant E met the criteria and also was very enthusiastic regarding this study. He indicated in the survey that he would like to elaborate more on this topic: “If you'd like further elaboration on any of the above
points, feel free to contact me at the email address above, or at XXX.XXX.XXXX. This is a fun topic!” (Participant E)

According to Gay, Mills and Airasian (2006) for criterion sampling a group of “five or so” participants is adequate (p. 115). After discussing this issue with my supervisor, I set up a target of six participants for interviews.

3.3.3 Recruitment

I prepared a visually attractive recruitment document that was printed and offered to prospective participants, and sent via e-mail.

I invited participation by direct invitation from the following organizations:

Companies:

• Business Objects (Web Development)
• Habanero Consulting Group (Web Development and Share Point)
• IBM (User Interfaces)
• Incadesign (Research for Human Computer Interaction)
• Electronic Arts (Computer Gaming)
• Relic Entertainment (Computer Gaming)
• ThreeWave Software (Computer Gaming)

Institutions:

• British Columbia Institute of Technology
• University of British Columbia
• Simon Fraser University
Each prospective participant (or human resources professional) received the recruitment document, an introduction letter and an invitation. Please see the appended documents (Appendix 1: Recruitment). Note: the documents do not include real names.

I contacted directly around eighty individuals, and some of them distributed my invitation in their organization. I estimate that over 110 specialists were invited to participate.

For the qualitative component of the study, recruitment was employed by direct invitation. After I identified the most suitable participants for interviews, I contacted them by e-mail, phone, or direct conversation. Eight participants were identified as the best participants who met the pre-determined criteria. From the eight participants, seven were interviewed (one participant declined the invitation).

3.4 Instrument and Interview Guide

The next section describes the instrument and the interview guide used to collect data. The instrument designed and implemented for this study and the interview guide were intended to respond to the following questions:

- To what extent are specialists aware of affective computing and emotional design?
- Who is responsible with affective aspects of software design and development?
- What strategies and techniques are used for embedding emotions in computer applications with user interaction?
- What are possible consequences of embedding emotions in computer applications?
The questionnaire was intended to answer mainly the first three questions. Based on quantitative data analysis, the interview questions were further designed to elaborate on the quantitative results and obtain a deeper understanding of the problem and finally, answer all four questions.

3.4.1 Questionnaire

Before designing the instruments for this study, I researched the literature to identify instruments already developed and used by other researchers. The literature I reviewed in preparation for this study did not offer instruments for data collection. Therefore, I proceeded to an extensive search using the keywords “awareness of emotional design”, literacy of emotional design”, “programming literacy” AND “test” OR “scale” OR “survey” on Google scholar and on the DAI (Dissertation Abstracts International) database. I did not find any study on this topic implementing quantitative research, or any instrument developed for this purpose. Guided by my supervisor, I started the process of developing my own instrument in the form of a questionnaire. I designed the questionnaire over a time period of three months evolving through eight iterations (see Appendix 2: Questionnaire).

Technical Implementation

An important decision was related to the method used for data collection. According to Gay, Mills and Airasian (2006), there are five approaches for survey administration: mail, e-mail, telephone, personal administration, and interview. My aim was to create an instrument that serves the purpose of my study the best, and also is attractive, simple to respond, and easy to access. Therefore, I opted for an on-line survey, a more modern and convenient method than e-mail. Considering the target participants and their involvement
with technology, an on-line questionnaire was, in terms of effectiveness, the best choice. It is also faster to respond to an on-line survey than to a document attached to an e-mail. On-line tools are easier to access because they eliminate any issues related to compatibility in terms of document type and are independent of operating systems.

The questionnaire was implemented using Share Point technology and posted on a secure server at British Columbia Institute of Technology at the address:


![Survey's Site](image-url)
There were some initial issues related to SharePoint and to the fact that I was new to this technology, but with the help of the server’s administrator, I overcame difficulties. There was more time spent with the development of the on-line questionnaire compared with other methods of data collection. However, the time was well invested because SharePoint offers several advantages: administration of responses, time stamps, simple statistics, and easy export to Excel for further complex statistical analysis.

The questionnaire was posted on the server on February 26, 2008 at 11:59am. For the first five days I tested the questionnaire in several situations and I asked my supervisor and fellow graduate students to respond and offer feedback. The feedback I received was very helpful and assisted me in solving several technical and content-related issues. For example, all three fellow graduate students who tested my questionnaire found the method of administration very effective, but the content too technical and in some respects confusing. Their comments helped me to observe the situation from a different perspective and as a result, I re-worded some questions into a format that was less technical and less confusing.

**Questionnaire Blueprint**

The questionnaire was based on the following theory: affective domain (Krathwohl, Bloom, & Masia, 1964; Petrina, 2007), Norman’s (2004) emotional design, post-structuralism, and principles of HCI. However, some questions were not based on theory, but designed to extract information based on the experience of the participants. The variables taken into consideration are: awareness of emotional design, heuristics, techniques and strategies, and consequences and values. I developed a blueprint for the questionnaire in the
form of a matrix that had on the horizontal rows variables and on the vertical columns the theoretical elements on which was the questionnaire designed (see Table 3.1).

Table 3.1: Questionnaire Blueprint

<table>
<thead>
<tr>
<th></th>
<th>Affective Domain</th>
<th>Emotional Design</th>
<th>Experience and Exploration</th>
<th>HCI</th>
<th>Post Structuralism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness</td>
<td>13</td>
<td>12a, 12b,</td>
<td>8, 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12c</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heuristics</td>
<td></td>
<td>21a, 21b</td>
<td>14, 15</td>
<td>16, 17, 18, 19</td>
<td></td>
</tr>
<tr>
<td>Strategies and</td>
<td>20a, 20b</td>
<td>23, 24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Techniques</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consequences and</td>
<td>20c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Questions 2-7 and 10 and 11 are demographic and informative and are not based on theory. Question 1 represents the consent form and question 25 allows the participants to comment before submitting the survey.

The final version of the questionnaire had twenty eight items from which seven are demographic and the rest are relevant to affective computing (please see Appendix 2: Questionnaire). The majority of items are structured (closed-ended items). There are also four unstructured items that offer opportunities for further elaboration and comments. However, even structured checklist items allowed for free responses. The reason underlining my decision to include free answers was based on the fact that this questionnaire explored a
topic that did not have a strong base in literature and I wanted to leave the door open to discovery of new and interesting aspects, not taken into consideration during my design.

When designing the questionnaire, I decided for the Likert-scale items how many scale points to implement. Is the validity affected by the number of scale points? How is reliability related to Likert-type items? Reporting results, Mattel and Jacoby (1971) argued that: “The evidence from this study led us to conclude that both reliability and validity are independent of the number of scale points used for Likert-type items” (p.666).

According to their research, finer-rating scales did not yield an increase in reliability and did not affect the validity over a coarse scale. Therefore, a dichotomous 2-point scale is enough in many situations and offers convenience in administrating and scoring. However, a 6-point scale can reflect direction and also measure the intensity of response (Mattel & Jacoby, 1971). In conclusion, the items designed for my survey are dichotomous (Yes/No), or employ a Likert-scale of four or five points for observing direction and intensity of response.

3.4.2 Interview Guide

The advantage offered by an interview study was the opportunity for obtaining in-depth data not possible with the questionnaire (Gay, Mills & Airasian, 2006). The questions asked in interviews required long answers and elaboration that was not possible to obtain from structured questions (i.e. multiple choice questions).

The interviews for this study were semi-structured for allowing for free discussion. The interview guide was developed in three weeks, between March 31 and April 21, 2008, in three iterations and was validated by my supervisor.
The interview guide was developed after quantitative data analysis. After analyzing the survey data, I identified areas that needed more clarification and questions needed to engage the specialists selected for interviews in discussions to help answer my research questions. I prepared a set of thirteen questions. I used a blueprint similar to the questionnaire’s blueprint with the same variables: awareness of emotional design, heuristics, techniques and strategies, and consequences and values. Because awareness of emotional design was central to the survey, the interview guide contained only one question related to awareness aimed to clarify the survey’s results. The remaining twelve questions were divided between the other four variables with more emphasis in consequences and values. This was purposely done to create an adequate balance. Consequences and values were only superficially explored in the survey in two Likert-scale items and one structured checklist item. The final interview guide included thirteen questions. Table 3.2 presents the interview guide blueprint:

<table>
<thead>
<tr>
<th>Affective Domain</th>
<th>Emotional Design</th>
<th>Experience and Exploration</th>
<th>HCI</th>
<th>Post Structuralism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heuristics</td>
<td>3, 4, 5 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategies and Techniques</td>
<td>6, 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consequences and Values</td>
<td>2, 13</td>
<td></td>
<td></td>
<td>9, 10, 11, 12</td>
</tr>
</tbody>
</table>
The interview guide was not used in the same way for all seven participants. For example, Participant J already addressed question 3 in the Comments section (item 25) of the survey. As Participant B did not answer the survey, a question regarding participation in software design that recognizes the user’s emotional state was added. Also, two questions (questions 6 and 7) referred to particular responses from survey:

• You indicated that you were involved in the life cycle of a software application that involved emotion recognition. Can you explain what techniques and strategies have been used to recognize the user’s emotional state or response? (This question will apply only to participants who indicated involvement in emotion recognition.)

• You indicated that you participated in the design or implementation of a computer application that was unsuccessful because of lack of consideration to the user’s emotions. Can you elaborate on this topic? (This question will apply only to participants who indicated involvement in design or implementation of computer applications that were unsuccessful because of lack of consideration to the user’s emotions.)

Therefore, the two questions were included in the interview guide only in the situation when the participant indicated involvement in these particular software applications. For a detailed description of the interview guides see the appended document (Appendix 3: Interview Guide). For interviews I used the following procedure:

• After agreeing to be interviewed, each participant was invited to indicate where and when the interview would take place. Because of busy schedules, three of the seven participants indicated that they preferred an e-mail interview.
• I prepared an interview guide for each participant based on the survey’s responses.

• For interviews that were scheduled in person, I made sure that I was on time, I had a professional attitude, and I created an inviting and pleasant atmosphere.

• I followed up interviews with thank you notes.

3.5 **Participant Ethics**

This study met the requirements of Behavioral Research Ethics Board (BREB) at University of British Columbia and was graded as “minimal risk”. However, there are some important ethical issues that had to be taken into consideration. Maintaining the confidentiality of the participants and protecting the data were the two main concerns.

The participants were required to sign a consent form that ensured confidentiality and prevented the author of this study to use the real name and identity of the participants. Because the study started with the on-line questionnaire, the consent form was added as the first item of the survey. All thirty five participants who responded to this survey electronically signed the consent by confirming that they agreed to participate in this study. The only participant, who did not participate in the survey but was interviewed, signed a paper consent form.

3.5.1 **Quantitative Stage**

Maintaining confidentiality, protecting the integrity of data, and assuring the correct identity of the participants were very important issues in the context of an on-line questionnaire. The technology used for designing and implementing the on-line questionnaire offered the hardware and software support needed in this respect.

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The following steps were employed to assure confidentiality, preserve data, and allow correct identification of participants:

- The questionnaire was installed on a server at British Columbia Institute of Technology with limited access via Internet. The server was set up at British Columbia Institute of Technology for learning purposes and was not advertised in any way.

- Only the questionnaire was available to users. Data recorded by other participants were protected by user ID and password. Only two persons who knew the user ID and password were able to see data (system administrator of the server and myself).

- The questionnaire included items requiring responses to identify the participants: name and e-mail address. This was especially useful when I did not personally know a participant: it helped me identify the participant and provided opportunities for following up with clarifications, invitations to participate in interviews, and thank you letters.

- For backup, data were downloaded on my British Columbia Institute of Technology desktop computer and my laptop which also are secured with user ID and password.

3.5.2 Qualitative Stage

With the exception of one, participants in interviews already signed the consent when responding the on-line questionnaire. I made sure that the participant, who did not respond to the questionnaire, signed the consent form before starting the interview.
The closeness between participants and researcher provides rich data, but raises some additional ethical issues. Therefore, I was careful to not influence the participant in any way, I employed a professional attitude, I followed the same interview strategy, and I did not disclose information that I obtained from other participants. The interviews took place in contexts that were comfortable for participants (offices or cafeteria), using a friendly and professional manner to prevent influences that might alter the results.

3.6 Data Collection and Analysis

3.6.1 Data Collection

Overall data collection (quantitative and qualitative) lasted two and a half months starting on February 26, 2008 and ending on May 12, 2008.

The questionnaire was posted on the server on February 26, 2008. The first participant responded on March 6, 11:00am, and the last participant responded on April 7, 2007 at 10:53am. The interviews took place between April 30, 2008 and May 12, 2008. A special case was the interview with Participant E: the interview was employed as an e-mail conversation which started on March 31, 2008 and ended on May 1, 2008.

Questionnaire data were collected from the SharePoint server in digital format. Interview data from e-mails were also collected in digital format, and interview in-person data were recorded with an audio device and transcribed into text.

3.6.2 Data Analysis

Three stages of data analysis were employed in the process of my research: quantitative data analysis using descriptive statistics, qualitative data analysis and validation.
The qualitative data analysis included categorization, pattern coding, content analysis, and matrix analysis.

**First Stage**

The data analysis started with a multi-site sampling of data collected from survey questionnaires. Data extracted from questions were statistically analyzed, graphed and displayed. The following methods of descriptive statistics have been used: graphing data using pie charts and frequency polygons, measures of central tendency, and measures of relationship.

**Second Stage**

After data collected from interviews were recorded, data were categorized using an inferential and explanatory coding system. The coding system was developed after data collection. The categorized data was meta-coded by employing a pattern coding framework. During this stage, codes were compared for finding consistencies, differences and recurrences, and identifying themes. A separate document was created in a checklist matrix format for recording and describing the results. The matrix was analyzed with a quasi-statistic method for estimating the frequency of each theme, and with logical analysis for outlining causation and identifying the logical process. Written descriptions and tables were used to represent the results. Taking into consideration the fact that the participants in this study are from different backgrounds (analysts, designers, managers, programmers and testers), I believe that a conceptually clustered matrix offered the best representation of data (Miles & Huberman, 1984).
Third Stage

The results form the first and second stages were combined into a casual network (Miles & Huberman, 1984). The casual network employing cross-site procedures was used for the final data analysis, and provided interpretative and explanatory results.

Drawing Conclusions

Conclusions were drawn by counting, noting patterns and themes, clustering data into relevant groupings, and identifying relations between variables. For internal validation, triangulation between data collected from questionnaires and interviews was used.

3.7 Conclusion

The data collected in this study referred to emotional design of software applications: awareness, heuristics, techniques and strategies, and consequences and values. Participants in this study were IT professionals involved in software design and development of applications with rich user interfaces including games. In this study, explanatory mixed design methods were used (Creswell, 2003; Gay, Mills & Airasian, 2006). The method employed two stages: a quantitative stage with data collected from a questionnaire, followed up by a qualitative stage with deep and rich data obtained from detailed interviews. The qualitative data collected and the nature of the qualitative data were based on the results of the quantitative stage. The analysis of data is reported in the next two chapters.
Chapter Four: Data Analysis - Quantitative Stage

4.1 Introduction

The last chapter described the data collected and focused on the research methodology employed for this study. This chapter and the following one are dedicated to data analysis and interpretation. Because this study used explanatory mixed design methods based on a QUAN-qual model, data analysis and interpretation were processed differently for the two research stages (Creswell, 2003; Gay, Mills & Airasian, 2006).

Three stages of data analysis were employed in the data analysis process of this study: quantitative data analysis, qualitative data analysis, and validation. Data analysis included descriptive statistics (for the quantitative stage), categorization, pattern coding, content analysis, and matrix analysis.

Quantitative data analysis was employed based on data collected from survey. Some interesting conclusions were drawn during this stage. However, in many situations, quantitative data were used to identify areas that needed further evaluation and analysis. Based on the quantitative data analysis, I developed an interview guide and decided what will be the focus of qualitative analysis. For example, involvement, awareness and attitude were well explored in the questionnaire to allow for conclusions. On the other hand, consequences and values needed the further investigation. I was very pleased with the participant’s response and the rich data that emerged form survey. Generally, all items were answered by all 35 participants. In very few situations, one or two participants declined to answer an item. These situations will be documented in the following sections.
4.2 Demographics

Gender Distribution

All participants responded to the demographic items. Ten females and twenty five males participated in the survey. The gender difference in my study is consistent with the female/male distribution in the IT field. However, this study is not focused on gender issues and differences in respect to emotional design.

The following chart presents the gender distribution among the participants in this study:

![Gender Distribution Chart]

Figure 4.1: Gender Distribution

Work Experience

My intention was to include in my survey a variety of specialists from the IT field. Figure 4.2 indicates participants' work experience based on current positions in industry, education, or research, and their current work. In the Current Position chart, a large group of participants (25%) is represented by educators. However, educators have previous experience in the IT field and some educators also indicated that they currently occupy other positions.
Several participants (21%) indicated more than one position (i.e. one participant indicated that he is an analyst and programmer, and another designer and writer, etc.).

The Current Work chart reflects a similar trend: a large number of participants (29%) indicated that their current work in more than one field (i.e. gaming and web-development; education, web development, and business; gaming and web-development; etc.).

![Figure 4.2: Current Position and Current Work of Participants](image)

Figure 4.2 presents the years of experience in the computing field of the participants in this study. The results indicate that a large number of participants have a long experience in the IT field: 51% of the participants have over 16 years of experience in computing.

![Figure 4.3: Number of Years of Experience](image)
4.3 Awareness, Involvement, and Attitude towards Emotional Design

A total of six questions were employed for this topic. Three items (8, 9 and 13) were designated to observe the awareness and involvement in emotional design and three items (12a, 12b and 12c) referred to attitude.

- (Q8) Have you been involved in any of the software lifecycle stages of a computer application that involved user interaction?
- (Q9) Have you been involved in any of the software lifecycle stages of a computer application that recognized the user’s emotions and responded to them?
- (Q13) Have you been involved in any of the software lifecycle stages of a computer application that was unsuccessful because of lack of consideration for the user’s emotional state?

Questions 8, 9 and 13 were answered by all 35 participants. The quantitative data indicated that a vast majority of participants (89%) have been involved in the software lifecycle of an application with user interaction. However, only a small minority (6%) have been involved in a situation when the user’s emotional state was recognized and responded to (see Figures 4.4 and 4.5).

A slightly larger number of participants (17%) indicated the participation in an application that was unsuccessful because of lack of consideration of the user’s emotional state (see Figure 4.6). For the rest of participants who participated in applications with user interaction, it is possible that the application was successful, or the user’s emotional state was not taken into consideration. Based on results from the qualitative stage of this study, I concluded that emotional states were generally not taken into consideration in applications even if other aspects (usability, general accessibility, etc.) were included in design.
Figure 4.4: Involvement in Applications with User Interaction

Figure 4.5: Involvement in Applications that Recognized and Responded to User's Emotions

Figure 4.6: Involvement in Applications that were Unsuccessful because of lack of Consideration to User's Emotions

Items 12a, 12b and 12c were designed to reveal the participants' attitude towards emotional design:
• (Q12a) To what extent do you agree that emotion should be embedded in software applications involving user interaction?

• (Q12b) To what extent do you agree that embedding emotions is (or could be) successful in applications involving user interaction?

• (Q12c) To what extent do you agree that computers are capable of alleviating negative emotions (i.e. fear, confusion, anxiety), even when computers are the source of these negative emotions?

Items 12a, 12b and 12c were answered by all 35 participants. The answers to these items were surprising to me. For an easier understanding of the results besides the 5-point scale analysis, I will analyze data at a coarse granularity observing only three items: agree, neither agree nor disagree, and disagree. For 12a, barely a majority (52%) agreed or strongly agreed that emotions should be embedded in software applications, a small number of participants (11%) disagreed, and a large number was in the middle (see Figure 4.7).

![Figure 4.7](image)

Figure 4.7. To what extent do you agree that embedding emotions is (or could be) successful in applications involving user interaction?

A similar pattern was employed for item 12b with the difference that more participants (64%) agreed or strongly agreed that embedding emotions is (or could be) successful in applications involving user interaction (Figure 4.8).

![Figure 4.8](image)
Figure 4.8: To what extent do you agree that embedding emotions is (or could be) successful in applications involving user interaction?

Question 12c referred to the role of the computer in alleviating negative emotions (i.e. fear, confusion, anxiety), even when computers are the source of these negative emotions. Less than half participants agreed (48%) and an equal percentage of 26% disagreed, or neither agreed nor disagreed. See Figure 4.9:

Figure 4.9: To what extent do you agree that computers are capable of alleviating negative emotions (i.e. fear, confusion, anxiety), even when computers are the source of these negative emotions?

A similarity observed analyzing the above items is the fact that for all three a large number of the sample population is in the middle. I concluded that a possible reason is the fact that the field of affective computing is new, unexplored or unexplained. However, a later
question (Q21a) that referred to the user experience revealed that a vast majority (94%) considered that emotion influences the user's experience and only a small number (6%) neither agreed nor disagreed, and nobody disagreed (see Figure 4.16, page 74). However, when asked if emotion should be embedded in software applications, only 52% agreed and 37% neither agreed nor disagreed.

In conclusion, I believe that there is not enough awareness and involvement in emotional design in the IT community. However, it was recognized that emotion consideration is an important aspect of software design. The issues arising from these items needed a micro analysis that was employed in the qualitative stage. Question 1 from the interview guide was based on the above results.

4.4 **Heuristics**

Eight items were included in this questionnaire to identify heuristics of emotional design. The eight items were focus around three themes: responsibilities of design, differences between general applications with human interaction and games, and principles of emotional design.
4.4.1 Who Should Be Responsible with Emotional Design?

Two items were intended to explore the participants’ expertise and identify who is (or who should be) responsible for emotional design between analysts, designers, programmers, and psychologists.

- (Q14) In your opinion, who is responsible for the emotional aspect of a computer application?
- (Q15) Are you aware of situations where testers were responsible for testing the function of the application as well as the emotional content?

Item 14 was answered by 34 participants and item 15 was answered by all participants. Several participants responded by indicating that the responsibility is distributed between two or more professionals. There were also indicated end-users, change managers, and the client’s own communication department as responsible participants in emotional design. 14% of respondents indicated that all of the above are responsible. One participant elaborated that “all of the above have separate considerations/ responsibilities in realizing an affective computing solution”.

However, only a small number of participants (14%) indicated that testers were responsible for the emotional content. Figures 4.10 and 4.11 present the results:
In conclusion, the participants in this study indicated that designers, analysts, and psychologists should be mostly responsible for emotional design, and there should also be a distributed responsibility among all participants in the software lifecycle. These aspects needed more in-depth exploration; therefore I developed two questions (question 4 and 5) in the interview guide.
**4.4.2 Are Games Different from General Applications?**

In my study I intended to explore to what extent are games different from other types of software applications in terms of emotional design.

According to Federoff, computer games have different design considerations than other types of computer applications. Federoff observed that T. W. Malone identified in 1980 and 1982 specific heuristics that apply to game design (Federoff, 2002). However, games changed since the 1980s and are a rapidly evolving field. Therefore, Federoff revised the topic and identified a set of heuristics for game design. However, her study touches the topic of emotional design only very superficially, even if the title of her thesis is: *HEURISTICS AND USABILITY GUIDELINES FOR THE CREATION AND EVALUATION OF FUN IN VIDEO GAMES*. In fact, her thesis uses only once the word “emotion” and seven times the word “affect” (Federoff, 2002).

I included the following item in my survey:

- (Q19) In your opinion, to what extent is the emotional design of computer games different from other computer applications?

The question used a Likert scale of four points: very different, different, similar, and very similar. As you can see, this item is more like a dichotomous Yes/No question that also measures the intensity of the response. Figure 4.12 presents the results:
Thirty four participants answered this item, and one participant declined to answer. When asked how different computer games are from other applications in terms of emotional design, 82% respondents considered it very different or different and only 18% similar or very similar. It is interesting to observe that a large majority of the participants who indicated that games are similar to other applications in terms of emotional design chose “very similar”. Four participants are specialists from the gaming industry. I assumed they had similar responses. To my surprise, two of them responded “very different”, one “similar” and one “very similar”.

In conclusion, I believe that there are differences between computer games and other applications in terms of emotional design. However, I wanted to know why participants in general, and in special participants from the gaming industry, chose one of the four answers. Therefore, I included question 3 in the interview guide to clarify this issue.
4.4.3 Principles of Emotional Design

Based on Clanton’s (1998) model and on the ten usability heuristics identified by Nielsen, Federoff assessed usability issues of games and classified game heuristics into three categories: game interface, game mechanics, and game play (Federoff, 2002). However, Federoff’s perspective is limited to usability issues:

Game interface is the device through which the player interacts with the game. Game mechanics are the physics of the game, which are developed through a combination of animation and programming. Game play is the process by which a player reaches the goal of the game. All three relate to the game being both functional and satisfying and require design and evaluation. (Federoff, 2002, p. 11)

Without offering a precise model, Freeman identified 32 categories of emotioneering techniques that helped me identify when emotions should be taken into consideration in terms of emotional design (Freeman, 2004).

Based on Federoff’s model and on Freeman’s techniques I identified three areas where emotions can be incorporated in game design: interface, mechanics (or execution), and intelligence. The first two terms (interface and mechanics) have the same meaning as in Federoff’s study. Game intelligence refers to the artificial intelligence techniques used in game design.

A total of five items (16, 17, 18, 21a and 21b) were employed to identify principles of emotional design. Three items were directly designed to identify what heuristics should be defined for emotional design and two items explored the participants’ attitude towards the user’s experience. All participants responded to all five items.
• (Q16) In what component of a computer application do you believe emotions are or should be incorporated?
  a. The interface
  b. The mechanics of the application (the execution)
  c. The intelligence
  d. Specify your own value:

Several participants selected more than one of the three options. I counted how many times each term was selected by participants. The interface was checked by 32 participants (91%), followed by intelligence checked by 25 participants (71%), and mechanics – 13 participants (37%). Definitely, all components of game design are important for incorporating emotions; however, a vast majority identified the interface as very important.

![Principles of Emotional Design 1](image)

**Figure 4.13: In what component of a computer application emotions are or should be incorporated?**

Item 16 referred to “where” and item 17 referred to “when”: in what stage of the software lifecycle should be strategies for emotional design employed?

• (Q17) For the emotional content, in what stage of the software lifecycle should an expert on emotion be involved? (you may choose more than one answer)
  a. Analysis
  b. Design
  c. Implementation
  d. Testing
  e. Specify your own value:
In this case, 29 participants (83%) indicated more than one stage. Counting how many times each item was mentioned, design was first with 25 occurrences, followed by testing (22) and analysis (21). According to my participants, implementation is the least important stage in software development in terms of emotional content. This conclusion is consistent with the heuristics of the software development process which identified implementation with a technical stage of translating the design document into a code product.

![Principles of Emotional Design 2](image)

**Figure 4.14:** For the emotional content, in what stage of the software lifecycle should an expert on emotion be involved?

Item 18 was based on HCI principles. HCI is a mature field with an already defined methodology which is concerned with user interaction and directly related to emotional design. I argue that HCI principles should be evaluated to confirm that they fulfill the needs of emotional design and to identify new aspects. Federoff also concluded in her study that having an HCI specialist in the game development team could result in a better overall design (Federoff, 2002).
(Q18) What are the most important issues for the emotional content of a computer application? (you may choose more than one answer)

a. Aesthetics
b. Creating a user profile
c. Inferring the goals and needs of users
d. Universal usability
e. Specify your own value:

Again, participants in my study responded that more than one issue should be important for emotional design. No new items were identified by my participants. One single participant added “don’t neglect power users while catering new users”. I did not find that a new category would emerge from his comment and I included his response with “Creating a user profile”. I counted the number of occurrences of each item and I concluded that aesthetics, creating user’s profile, and universal usability are almost equally important. However, inferring the goals and needs of users was mentioned by a large majority of participants (25 participants or 71%).

![Graph](https://via.placeholder.com/150)

Figure 4.15: What are the most important issues for the emotional content of a computer application?
Two five-point Likert scale items (question 21a and 21b) were included in this questionnaire to identify to what extent participants believe that embedding emotion in software applications influences the user’s experience:

- (Q21a) To what extent do you agree emotions can influence the user’s experience of a computer application?
- (Q21b) To what extent do you agree that responding to the users’ emotions is important for computer applications?

A very large majority (94%) agreed or strongly agreed that emotions influence the user’s experience of a computer application, and nobody disagreed or strongly disagreed.

![Principles of Emotional Design 4a](image)

**Figure 4.16: To what extent do you agree emotions can influence the user’s experience of a computer application?**

However, only 63% of participants agreed or strongly agreed that responding to the user’s emotions is important for computer applications. For this item, 31% of participants neither agreed nor disagreed.
In conclusion, I identified four important principles of emotional design from quantitative analysis:

- The interface design is the most important aspect of emotional design.
- The most important stages of software lifecycle with respect to embedding emotions in a software application are design, analysis and testing.
- Inferring the goals and needs of users is the most important HCI principle that applies to emotional design.
- The user’s experience is strongly influenced by emotion. Responding to the user’s emotions is important for computer applications.

For further analysis, two interview-guide items were employed to explore in more depth the topic of principles of emotional design: items 1 and 8. Item 1 was also mentioned in Section 4.3. One interview goal is to understand why a large majority of participants agreed that emotions can influence the user’s experience, but not as many considered that responding to the user’s emotions is important for computer applications.
Important conclusions came from quantitative analysis. However, I realized that this topic needs more macro and micro analysis that is behind the scope of this study. More research is needed to identify and classify a methodology for emotional design.

4.5 Strategies and Techniques

Several items were designed to identify what strategies and techniques are used and are effective in design of applications with user interaction with respect to the user’s emotional state or response.

When I asked about techniques and strategies I was thinking at strategies as planned methods and at techniques as technical solutions for implementation of methods. For example a strategy is to have a game with fast responses and techniques are the use the assembly language and a dedicated hardware. Two participants indicated that they did not understand the difference between strategies and techniques. In a future instrument, I will be more explicit in defining the terms.

Four items (20a, 20b, 23, and 24) were designed for this purpose: questions 20a and 20b were designed as Likert five-point scale items and referred to the affective domain. Items 23 and 24 were designed as open-ended questions and left to participants for detailed elaboration.

4.5.1 Affective Domain: Receiving and Responding

The questions related to the affective domain were based on Krathwohl, Bloom, and Masia’s (1964) model recommended by Petrina (2007). Krathwohl, Bloom, and Masia’s (1964) model is generally used in learning theory and describes the manner in which participants in the learning process deal with things emotionally, such as feelings, values,
appreciation, enthusiasm, motivations, and attitudes. The five major categories of Krathwohl, Bloom, and Masia’s (1964) model are (from the simplest behavior to the most complex): receiving, responding, valuing, organizing, and characterizing. For the purpose of this study, I referred only to receiving, responding and valuing.

Two items were employed for assessing strategies and techniques from the affective domain: first item referred to receiving and the second item referred to responding. An item referring to valuing will be discussed in the next section.

- (Q20a) To what extent do you agree that creating visual and sound stimuli to attract the user’s attention and awareness is important in a computer application?
- (Q20b) To what extent do you agree that collecting data that can identify the user’s emotional reactions is important in a computer application?

A large majority of participants (77%) agreed or strongly agreed that creating visual and sound stimuli and collecting data that can identify user’s emotional reactions are important in emotional design. The same percentage (77%) of participants agreed or strongly agreed that collecting data that allow the computer program to respond to the user’s emotions is important. Figures 4.18 and 4.19 present the results:
4.5.2 Responses to Open-Ended Items

Two open-ended items were included in the questionnaire:

- (Q23) What techniques do you consider that are effective for embedding emotions in a computer application?
• (Q24) List any strategies that you find effective for engaging the user emotionally:

The two open-ended items offered very rich data and interesting conclusions. The differentiation that I expected between strategies and techniques did not occur, participants referring more to global strategies than to technical solutions. Therefore I combined the answers from the two items and treated them as a single item referring to “strategies and techniques”.

Several themes emerged from the participants’ responses. The themes were identified using a coding model recommended by Miles and Huberman (1984). The coding system was created after data collection and was based on the data resulted from the open-ended items. Miles and Huberman (1984) asserted that this method is superior to models that assume pre-coding prior to data collection, and is effective because data are well molded and the “analyst is more open-minded and more context sensitive” (p. 57).

Table 4.1 presents the coding system that emerged from the open-ended items. The right column indicates the wording occurrences that lead to that particular classification. The left column is the coding column which translates into themes:
<table>
<thead>
<tr>
<th>Code</th>
<th>Occurrence in responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usability issues</td>
<td>Usability</td>
</tr>
<tr>
<td></td>
<td>Usability testing</td>
</tr>
<tr>
<td></td>
<td>Step-by-step instructions</td>
</tr>
<tr>
<td></td>
<td>Friendly messages / Friendly interface</td>
</tr>
<tr>
<td></td>
<td>Error messages / Respond to mistakes</td>
</tr>
<tr>
<td></td>
<td>Adjusting the feedback</td>
</tr>
<tr>
<td>Visual aspects</td>
<td>Visual effects</td>
</tr>
<tr>
<td></td>
<td>3D</td>
</tr>
<tr>
<td></td>
<td>Animation</td>
</tr>
<tr>
<td></td>
<td>Aesthetics</td>
</tr>
<tr>
<td></td>
<td>Color / color scheme</td>
</tr>
<tr>
<td></td>
<td>Images</td>
</tr>
<tr>
<td>Audio aspects</td>
<td>Sound effects</td>
</tr>
<tr>
<td></td>
<td>Music</td>
</tr>
<tr>
<td></td>
<td>Voice recognition / Voice input</td>
</tr>
<tr>
<td>Capturing user’s activity</td>
<td>Capturing user’s speed / user’s reactions / user’s activity</td>
</tr>
<tr>
<td></td>
<td>Keeping track how users react</td>
</tr>
<tr>
<td></td>
<td>Detecting user’s heart beat / lung movement</td>
</tr>
<tr>
<td></td>
<td>Collecting user’s data with sensors</td>
</tr>
<tr>
<td></td>
<td>Creating a user’s profile</td>
</tr>
<tr>
<td></td>
<td>Tracking personal information</td>
</tr>
<tr>
<td>Artificial intelligence (AI) issues</td>
<td>Intelligence</td>
</tr>
<tr>
<td></td>
<td>Non-invasive intelligence</td>
</tr>
<tr>
<td></td>
<td>Intelligent behavior</td>
</tr>
<tr>
<td></td>
<td>Narrative framework</td>
</tr>
<tr>
<td></td>
<td>Offering help when needed</td>
</tr>
<tr>
<td>Identity immersion</td>
<td>Identity immersion</td>
</tr>
<tr>
<td></td>
<td>Adopting a person that matches the user’s self-image</td>
</tr>
<tr>
<td>Recognizing the user’s values</td>
<td>Recognizing user’s values</td>
</tr>
<tr>
<td></td>
<td>Cultural sensitivity</td>
</tr>
<tr>
<td>Engage the user in design</td>
<td>Engaging the user in design</td>
</tr>
<tr>
<td>Differential design</td>
<td>Different nature of applications</td>
</tr>
<tr>
<td></td>
<td>Differentiate between computer applications</td>
</tr>
<tr>
<td></td>
<td>Hardware / software</td>
</tr>
</tbody>
</table>
The following chart presents the number of occurrences for each code / theme. For example, 14 participants identified visual techniques as effective for embedding emotion in computer applications. It is important to observe that three themes: audio, visual, and recognizing the user’s values were already captured in questionnaire under the umbrella of affective domain and discussed in sections 4.5.1 and 4.6.

In conclusion, important themes emerged from quantitative data analysis of open-ended items. An important observation is the consistency with the affective domain as defined by Krathwohl, Bloom and Masia (1964) and recommended by Petrina (2007): a large majority of participants in both structured and open-ended items indicated that using audio and visual stimuli are effective techniques for engaging the user emotionally.

There are other important aspects that emerged from the open-ended items. I believe that the idea of differentiating between applications in terms of emotional design is very important even if it was mentioned by only two participants. Therefore, two items (6 and 7)
were included in the interview guide to allow for a more detailed discussion and
interpretation.

4.6 Consequences and Values

Three items (20c, 21c, and 22) were included in the questionnaire to identify the
participant’s opinion related to consequences of emotional design and how these
consequences affect the user’s system of values. The first two items use a Likert’s five-point
scale, and the third item is structured.

• (Q20c) To what extent do you agree that a user interface should be consistent with
  the user’s value system?

• (Q21c) To what extent do you agree that affect-recognition applications pose
  potential concerns that outweigh the benefits?

The first item is based on Krathwohl, Bloom and Masia’s (1964) model also
recommended by Petrina (2007) that employs five categories (receiving, responding, valuing,
organizing, and characterizing) and refers to valuing. 63% participants in this study agreed
or strongly agreed that a user interface should be consistent with the user’s value system.
However, 31% neither agreed nor disagreed. Figure 4.21 presents the distribution:
I was surprised with so many undecided responses and I decided to try to ask for clarification in interviews. Question 11 was added to the interview guide to allow for further elaboration.

Responses to item 21c were also surprising to me. 31% of the participants in my study identified that affect-recognition applications pose potential concerns that outweigh the benefits, 14% disagreed, and a large number (55%) neither agreed nor disagreed.
I believe that this response needs further micro-analysis and I generated question 12 in the interview guide.

Item 22 was based on post-structuralist views and philosophy:

- Do you believe that embedding emotion in computer applications can have the following as consequence: (you may choose more than one answer)
  a. Reinforcing power
  b. Creating a status difference
  c. Eroding the boundaries between machines and humans
  d. Identity formation
  e. Developing relationships with machines
  f. Specify your own value:

Many participants indicated more than one possible consequence and three participants referred to additional issues like removing frustration, stress, fear and anger.

Two participants misunderstood the item and viewed the possible choices as concerns.

However, they indicated that the above choices are of no concern.

Eroding the boundaries between machines and humans was the main consequence of embedding emotion in computer applications observed by the participants in this study.

According to the literature, a consequence of embedding emotion in computer applications is identity formation (Norman, 2004; Stone, 1992; Woodward, 1997). However, only 17% of the participants of my study identified this aspect as a possible consequence.
Again, the answer to this item was surprising to me and I proceeded to include two questions (question 9 and 10) in the interview guide.

I found that with respect to consequences and values, I could not draw rich conclusions from the quantitative analysis. Therefore, the interview guide had more weight towards this topic. Four questions (9, 10, 11, and 12) were added to the interview guide for in-depth exploration.

I also included in the interview guide an item intended to open discussions related to the main reasons for responding to the users’ emotions (question 2). I expected responses that relate to consequences and values, and possibly to heuristics of emotional design. Question 13 in the interview guide was intended to allow participants to add to this topic something that was not addressed in survey or in interview.
4.7 Conclusion

The following paragraph summarizes the themes emerging from the quantitative stage:

THEME 1: Awareness, Involvement, and Attitude towards Emotional Design

- Specialists from the IT industry recognized the importance of emotions in software design of computer applications.
- Only 52% of participants agreed or strongly agreed that embedding emotions in computer applications is desirable, 64% that it can be successful and only 48% participants believed that computers are capable of alleviating negative emotions.
- The large number of respondents that neither agreed nor disagreed was an indication of lack of awareness of emotional design and the very small percentage of participants (6%) involved in the life-cycle of a software that recognized and responded to users' emotions pointed out that there is no involvement in emotional design.

THEME 2: Heuristics of Emotional Design

The following directions emerged, which should be developed into heuristics for emotional design:

- Designers, analysts, and psychologists should be mostly responsible for emotional design and the responsibility should be distributed among all participants in the software lifecycle.
- There are differences between computer games and other applications in terms of emotional design.
- The interface design is the most important aspect of emotional design.
• The most important stages of software lifecycle with respect to embedding emotions in a software application are design, analysis and testing.

• Inferring the goals and needs of users is the most important HCI principle that applies to emotional design.

• The user’s experience is strongly influenced by emotion. Responding to the user’s emotions is important for computer applications.

THEME 3: Strategies and Techniques

The following directions emerged, which should be developed into strategies and techniques for emotional design:

• Solving usability issues translates into solving some emotional issues.

• Audio and visual techniques can be employed to elicit emotional responses and enhance the user’s experience.

• Capturing users’ activity (using external devices like headsets) and profile is effective for responding to the user’s emotional reactions.

• Artificial intelligence techniques allow for intelligent responses.

• In video games, identity immersion (an avatar that matches the player’s personality) is a technique that emotionally enhances the player’s experience.

• Recognizing the users’ values and culture is important for emotional design.

• Engaging users in the design process can help designers understand users’ emotional needs.

• Differential design should apply to different types of computer applications.
THEME 4: Consequences and Values

- Eroding the boundaries between machines and humans was the main consequence of embedding emotion in computer applications.
- Identity formation might not be a possible consequence of emotional design.
Chapter Five: Data Analysis - Qualitative Stage

The qualitative data collection followed the quantitative data analysis. The interviews were aimed to gather an in-depth understanding of this phenomenon and helped clarify issues that came out in the quantitative stage.

5.1 Participants

The seven participants in the qualitative stage of my research were not randomly selected; they were selected based on their questionnaire responses, work experience, and expertise. For example, participants who confirmed participation in a design process that took into consideration the users’ emotional state, or gave rich answers to the open-ended questions and comments were invited to participate in interviews. I also targeted participants from different perspectives to allow for a multi-angle analysis. Participant B is the only participant who did not participate in the survey, but offered to participate in interviews. He was invited because of his rich experience in industry and education. Six participants are males and one participant (Participant J) is a female.

My participants were professionals with a long working experience in the IT field (three participants have over 25 years of experience) and expertise in more than one field. From the seven participants, Participants E, K and R were directly involved in emotional design: Participant E and R in game development and participant K in research. Participants B and J, I would say were indirectly involved in emotional design in their professional life by considering the user’s needs in terms of aesthetics and user’s satisfaction. Table 5.1 presents the expertise of the seven participants.
Table 5.1: Participants Experience and Expertise

<table>
<thead>
<tr>
<th>Participant</th>
<th>Number of years in the computing industry</th>
<th>Expertise</th>
<th>Experience in emotional design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant B</td>
<td>Over 25</td>
<td>Industry Web Development Education</td>
<td>Yes, indirectly Web Design Designing pleasing user interfaces</td>
</tr>
<tr>
<td>Participant E</td>
<td>21 - 25</td>
<td>Gaming Writing</td>
<td>Yes, directly Computer games</td>
</tr>
<tr>
<td>Participant J</td>
<td>16 - 20</td>
<td>HCI Industry Education</td>
<td>Yes, indirectly HCI applications Facilitating a specific audience Designing pleasing user interfaces</td>
</tr>
<tr>
<td>Participant M</td>
<td>16 - 20</td>
<td>Industry Web Development Education</td>
<td>No</td>
</tr>
<tr>
<td>Participant K</td>
<td>Over 25</td>
<td>HCI Education</td>
<td>Yes, directly Research Haptic systems</td>
</tr>
<tr>
<td>Participant R</td>
<td>6 - 10</td>
<td>Gaming Web Development</td>
<td>Yes, directly Computer games</td>
</tr>
<tr>
<td>Participant T</td>
<td>Over 25</td>
<td>Management Industry Education</td>
<td>No</td>
</tr>
</tbody>
</table>

I intended to observe the phenomenon of emotional design from different professional perspectives and I concluded that four perspectives will satisfy the requirements of this study. The perspectives were based on the participants’ work experience, expertise, and involvement in design of games or applications with human-computer interaction. The four perspectives that I considered are: gaming industry, HCI, industry and Web-development, and management. In the analysis I intended to observe the four themes: awareness, heuristics, strategies and techniques, and consequences and values. I also wanted
to differentiate between the responses that I received from participants from the four perspectives. As I mentioned before, the participants have expertise in more than one field. The association with one of the four perspectives was based on the nature of the data that I collected during interviews. For example Participant J worked in industry and education, and her expertise is HCI. The fact that she was associated with the HCI perspective is because her responses were more oriented towards HCI issues. Table 5.2 presents the distribution of the seven participants between the four perspectives.

<table>
<thead>
<tr>
<th></th>
<th>Gaming Industry</th>
<th>HCI</th>
<th>Industry and Web-Development</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant M</td>
<td></td>
<td></td>
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<td>Participant E</td>
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<tr>
<td>Participant R</td>
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<td>✔</td>
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<td>Participant J</td>
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<tr>
<td>Participant K</td>
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<td>✔</td>
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<td>Participant T</td>
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<td>✔</td>
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**5.2 Meta-Matrix for Qualitative Data Analysis**

In preparation for the qualitative stage and to facilitate data analysis, I prepared a meta-matrix that assembled descriptive data from the descriptive statistics employed in the
quantitative stage (see Section 4.7) and the issues that needed to be addressed in the qualitative stage. The model was recommended by Miles and Huberman (1984) for a better management of data. The meta-matrix is presented in Table 5.3:

<table>
<thead>
<tr>
<th>Table 5.3: Meta-Matrix Preparatory to Qualitative Research</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantitative Stage</strong></td>
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<tr>
<td><strong>Conclusion</strong></td>
</tr>
<tr>
<td>Awareness, Attitude and Involvement</td>
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<tr>
<td>Lack of awareness/involvement</td>
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<tr>
<td>Heuristics</td>
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5.3 Awareness, Involvement, and Attitude towards Emotional Design

Discussions regarding awareness, involvement and attitude towards emotional design were generated in relationship with question 1 from the interview guide:

- **(Q1)** There are two situations: one when applications are intended to generate emotions in users and the second one when applications recognize the user's emotional state and respond to it. In literature I found these two situations observed as: "affective computing", "emotional design", or "emotion engineering" (the last one was from the gaming field). In my view "embedding emotion into applications" refers to both these two situations. From my survey, I found that many participants (94%) considered that emotion influences the user's experience and only a small number (6%) neither agreed nor disagreed (nobody disagreed).

However, when asked if emotion should be embedded in software applications, only 52% agreed and 37% neither agreed nor disagreed. In your opinion, what would be a reason for this response? What would be the main reason why emotional design would not be desired?

An explanation why a large number of participants in this survey did not consider emotional design desirable is the novelty of the field that translates to lack of experience, knowledge and understanding. This explanation is consistent with the results from the literature review. Indeed, I found that the field of emotional design has very little theoretical support. Besides the novelty of the field, other issues were raised in interviews: the cognition/emotion paradigm, differences between applications, ethical issues, negative
feelings related to computers, technological limitations, and users’ fear of technology. Table 5.4 presents the participants’ perspectives:

Table 5.4: Why Emotional Design is not Desirable?

<table>
<thead>
<tr>
<th>Participant</th>
<th>Reasons</th>
</tr>
</thead>
</table>
| Participant B | Cognition/emotion paradigm  
Ethical issues: manipulation |
| Participant E | Frustration associated with computer programs  
Differences between applications |
| Participant J | Frustration associated with computer programs  
Ethical issues: manipulation |
| Participant M | Technical difficulties |
| Participant K | Cognition/emotion paradigm  
Differences between applications  
Ethical issues: manipulation  
Novelty of the field |
| Participant R | Technical difficulties  
Response to the fear of technology |
| Participant T | Novelty of the field |

It is easy to observe that each reason (except for “response to the fear of technology”) appears at least twice in my participants’ discourses.

Referring to why not all participants in the survey agreed that embedding emotions in software applications is desirable, Participant B stated that “A lot of computer applications I would say fall into the cognitive domain, so emotions will be of secondary consideration” and “the whole affective domain is tangential to what most software is trying to convey”. His observation is related to the important philosophical issue of a dualism of reason and emotion.
viewed as two complete opposites (Boler, 1997; Woodward, 1997; LaRock and Kafetsios, 2004; Norman, 2004) critiqued by Picard and Norman (Picard, 1997; Norman, 2004).

Participant B also observed that embedding emotions can have manipulation as a negative consequence: “I guess that one of the things I can see is the question of being manipulative”. The idea of ethical responsibilities and manipulation was also entertained by Participant J and Participant K. Because this aspect is closely connected with other issues (i.e. responsibilities of emotional design) and appeared repeatedly in interviews, it is discussed separately in Section 5.6 (Consequences and Values).

Participant E referred to the lack of emotional design and the negative impact that people feel when using computers: “I suspect that a fair measure of the emotion attached to computer programs is accidental, and probably clusters around the “frustrating” emotional node”. On a similar note, Participant J stated “often when I think about emotions in software or from the software or coming from software is a negative emotion”.

Technological limitations were also taken into consideration: Participant M argued that “I do not think that machines have the ability to correctly read the state of a human’s emotions”. Participant R raised an interesting point stating that a “fear of technology” expressed by users of computer systems could be a drawback for software developers:

My last comment has to do with the way people interact with technology. It's like people have a bit of a fear. I'm not sure the best way to describe it, but I think a good example is the automated phone systems: When you call the 1 800 number at your local bank you end up at a computer system and you press 1 to go here, press 2 to go here etc. When these systems started integrating voice recognition, end users didn’t take it so well. It's the difference between pressing a button on your phone or
verbally telling the computer what you're calling about, in plain English! Clearly the latter seems like the most efficient solution, but for some reason using the system 'just doesn't feel right.

Consistent with Norman (2004), Participant R observed that in historical perspective humans are not used communicating with machines: “People don't make the association between a computer and something you can communicate with. Historically, people have always commanded computers, not communicated with them”. Participant R concluded on a positive note: “Perhaps it's just a matter of time before we get over this?”

Participant T made a strong point when stating that there is no knowledge or understanding of the field:

Well, I can think of one obvious reason it is that the idea that emotions are part of computer applications is new to people and so, and I don't think anybody really understands what that means even and so not understanding the principles and the concepts of that is a new idea so they don't think about it and its hard to think about it, and secondly, I'll bet that a lot of people neither agree or disagree because they have no idea what the tools are. We are dealing with those things. So I think that it comes from lack of knowledge or lack of understanding. I think that there is - I think - that they feel that it is important because whenever you use pieces of software you always have emotional reaction to, so they know that but not getting beyond, is the reason.

Participant K also highlighted the novelty of the field. He expressed the hope that emotional design will be soon a better explored and established field:
It is also like any other kind of technology. I don’t think we know how to do it very well yet, but we will and it is only a matter of time I think before we’re extremely good at it ... So I think this moves us into an area were we have almost no experience in this software.

In conclusion, the participants in interviews observed that besides the gaming industry and research, emotional design is not currently employed in software applications. Interesting issues related to the cognition/emotion paradigm, differences between applications, ethical issues, negative feelings related to computers, technological limitations, and users’ fear of technology were raised in discussions.

5.4 **Heuristics**

5.4.1 **Differences between Games and other Applications**

When asked how different computer games are from other applications in terms of emotional design (Q19: “In your opinion, to what extent is the emotional design of computer games different from other computer applications?”), 82% participants considered it very different or different and only 18% similar or very similar. Four participants are specialists from the gaming industry. I assumed that their answers will give me a clue. To my surprise, for two of them it is very different, for one similar and for one is very similar.

However, according to the interviewed participants, there are significant differences between computer games and other applications. The differences refer to the scope and motivation. Table 5.5 presents comments from the seven participants in this respect:
Table 5.5: Differences between Computer Games and other Applications

<table>
<thead>
<tr>
<th>Participant</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>&quot;They [games] are different in many situations. OK. They are sort of more similar to advertising than accounting&quot;</td>
</tr>
<tr>
<td>E</td>
<td>&quot;Games, on the other hand, can strive to pull the user through any conceivable gamut of emotional ranges, from hope and desire and bliss and ecstasy through fear and grief and despair. Anything that can be accomplished in a movie or a book (which is almost anything, in an emotional context, I'd offer) should be possible in a game.&quot;</td>
</tr>
<tr>
<td>J</td>
<td>For games “the purpose of the application IS the interaction” opposed to regular applications where “Application should facilitate the user task - The user interface should be completely non-obtrusive”</td>
</tr>
<tr>
<td>M</td>
<td>“The world of computer games is virtual. Victories and/or failures when playing a computer game does not really affect us in the real world.”</td>
</tr>
<tr>
<td>K</td>
<td>“…the whole point of the gaming experience is to provide an emotional experience” opposed to “a very different motivation in other applications for example where you do want people to sort of enjoy using Excel”</td>
</tr>
<tr>
<td>R</td>
<td>“Video games are purely for pleasure. This is not the case for most applications.”</td>
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<tr>
<td></td>
<td>“Video games contain a non-interactive cinematic element similar to movies. For the most part, other applications do not have this.”</td>
</tr>
<tr>
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<td>“Video games contain a theme, a setting and, in some cases, even a background story to set the mood. Again, for the most part, other applications do not have this.”</td>
</tr>
<tr>
<td>T</td>
<td>“…gaming application is often an application for its own use or its own pleasure whereas you use Microsoft word or Excel its really to produce something else so it’s a step whereas the gaming application is an application for its own just for its own self your not producing something else.”</td>
</tr>
</tbody>
</table>

Games are associated with advertising, visual arts, books, movies and their motivation is the same as the motivation of an exciting book that stirs the reader’s imagination. In terms of motivation, the main difference it that games are designed to elicit emotions in users, whereas other applications are tools that perform specific tasks or help the user perform tasks, therefore
their human interface should help the user reach the goals. The interface of an accounting
application should be "completely non-obtrusive" as asserted by Participant J and should prevent
user frustration. Participant E argued that "mitigating extreme frustration has to be the best that tax
software can hope for" and later referring to games and general computer programs as applications
that should be treated differently concluded: "Emotions in computer games = awesome. Emotions
in Excel = useless." I agree that the interface that allows the user to interact with Excel functions
doesn't need to exhibit emotions but sensing the user's emotional state and helping the user to
perform his tasks more efficiently fits also under the umbrella of emotional design and can be
assigned as a design goal. An example of research in user modeling for improving the user's
assistance and help was the Lumière Project, designed and implemented at the Microsoft usability
laboratory between 1993 and 1997. The Lumière project used probability distributions over users'
goals to provide automated services for help. The purpose was to create an intelligent prototype
that determined the users' needs, goals and intentions from user profiles, context, events in the
interface, and words from the users' queries. A Bayesian model was used to infer the likelihood
that a user needed help and the type of help that was needed (Horvitz et al., 1998). Participant K
shared this idea but had a different point of view than Participant E when referring to Excel and to
the potential benefits in productivity and usability that could be employed in this type of
application by responding to the user's emotional state:

I think it is acceptable to accept that [in] a piece of software like Excel, which we
happen to use a lot, I think we are able to detect frustration for example, or anxiety
especially when anxiety is related to the user trying to meet a deadline... but the point
is responding to the capabilities of the user where the goal would be between the
human and the computer; you are trying to be more productive or more correct, or
more whatever the goal of the software is - so you know – that is a kind of noble and
very hard to achieve goal, but that would certainly be - I think - what is behind a lot
of the research on emotion interface that is not directly related to gaming or other
kinds of emotional experiences for the sake of emotional experience.

I argue that the Cartesian separation in terms of emotional design games – other
applications is too simplistic. Many applications with human interaction will benefit from
emotional design just by making the application more pleasing. There is no already-defined
methodology for emotional design, but two participants in my study indicated that in their
professional experience as designers they considered aspects of technicality and usability in
user interfaces. Participant B participated in the design of applications that responded to the
user's needs by “designing user interfaces or providing information in a way that is pleasing,
so that people would respond positively towards it and would be interested in using the
application”. Participant J reported that she did not directly design applications that embed
emotions but had taken into consideration the users’ emotional state in mind: “I can’t
remember any time that I have specifically thought about embedding emotion into a user
interface. The closest that I would say I have ever come is, embedding things into the user
interface that might facilitate a specific audience” and using “colors, and making it
esthetically pleasing”.

There are also applications that are different from games that have a practical task, but the
users’ participation and response in terms of emotional aspects is very important as these issues are
from games: educational software. Participant K argued in the end of his interview:

I think there is a big area of software you didn’t mention which is educational
software… educators and psychologists know a reasonable amount about learning
and emotion and I can certainly imagine [that] if you are monitoring the emotional state of a student especially a younger student, you might be able to present material to them in a much better way, so when they are in an emotional state where they are not likely able to deal with challenging material and they won't be able to learn, than you don't push them, you do something else including perhaps discontinuing the session which is what a good teacher does.”

Participant J also stipulated that besides computer games there are also other applications that will benefit from emotional design:

I think that there are perhaps applications more suited to this kind of thing than others. Games, children’s applications, maybe some types of teaching, learning applications could possibly benefit. In the gaming situation the intent is to create emotions in the user so it is not just like this is a good user interface or a bad user interface. We are trying to generate excitement … [in] learning application there is an intent, possibly, to generate emotions which will be maybe, you know, an emotion of feeling pride or self confidence … you’re trying to build into the application some kind of generation of emotions which you believe will then help the person to learn, you know, if they’re feeling better about themselves.

In conclusion, computer applications should be treated differently in terms of emotional design and the design goals will vary from reducing frustration to complicated techniques aimed to secure the user’s emotional investment and response.
5.4.2 Inferring the Goals and Needs of Users

In Participant E’s opinion “most emotional content arises from human-computer interaction is unintentional, and largely regrettable”. He refers to the frustration that is generated by a computer program in users:

More often, however, if I have an emotional reaction to a program, it’s frustration based on unexpected, confusing, or misrepresented program behavior.

He is not the only participant who identified frustration as the major emotional issue related to the user’s emotional state and emotional response. All other participants identified frustration as an important example of how emotions can influence the user’s experience of a computer application, and considered that reducing or eliminating frustration will improve user’s satisfaction.

However, other participants indicated that emotion is not un-intended and positive emotions could be employed intentionally in the design resulting in positive outcomes. In this respect, Participant J compared well-designed user interfaces with poorly-designed ones: “one is a good user interface thereby creating positive emotions just because it is so good and nice and so easy to use and looks good or is it a lousy interface thereby creating frustration and negative emotions”. On the same note, Participant R commented:

I would think that emotions could make or break the user’s experience. For the most part, a user’s interaction with a computer application is simply a process. If execution of the process invokes emotions of frustration on the user, the user is going to deem the process a negative experience. Likewise, if the user experiences joyful emotions, they will find the process to be a positive experience.
Unfortunately, current efforts in improving user satisfaction and reducing frustration were not always successful or not perceived by users as useful. An example that came from interviews was the Microsoft paper clip. The paper clip is a simplified solution of user modeling derived from the Lumière project (Horvitz et al., 1998). Several participants mentioned the paper clip as an example of a bad solution: Participant E mentioned it as a negative example and, Participant B and Participant J found it “annoying”. By contrast, Participant R was optimistic when regarding the paper clip as an example of intelligent emotional agents:

I think the Microsoft paper clip that was around in earlier versions of MS Office is a great example. Incorporate a level of intelligence into your program that tries to detect the user’s emotion and respond with an optional outcome.

I believe that reducing frustration in computer application is a matter of interface design and I agree with Participant J that “application isn’t trying to generate negative emotion; it is simply a matter of not having a very good job in defining the user interface”.

An important point was raised by Participant B who cautioned that inferring the goals and needs of users should not be treated like one size fits all:

the goals and the needs of the users umm… yea… most of the things that I’ve seen, they seem to make the assumption that everybody is the same so they have the same goals and needs so therefore you don’t need to find out what they are. My personal idea would be that this is nonsense.

Participant B also observed that he is not aware of commercial applications that have the flexibility of inferring the goals and needs of a large variety of users:
I could see some use in paying attention to the needs and desires of a particular user but I haven’t really seen anything out there that does that in general. I think that that’s a good idea I am not aware of anything.

In conclusion, inferring the user’s goals and needs is an important aspect observed also in the literature review. Some solutions can be found in user modeling, which is an important field of research in the academic world and industry with several statistical, probabilistic, and mixed methods being studied and proposed (Albrecht & Zukerman, 2007, Coneti & Zhou, 2002; Horvitz et al., 1998; Horvitz, 1999). Members of the HCI community are optimistic that human-computer interaction can be improved by user modeling, but issues like complexity and performance did not allow implementations in commercial software (Albrecht & Zukerman, 2007; Horvitz, 2007).

5.4.3 Responding to the User’s Emotions

According to my participants, responding to the user’s emotions is very important. Again, issues of differential design for games and other kinds of applications emerged as important for future guidelines. However, the four perspectives (gaming industry, HCI, industry and Web-development, and management) presented differences. Participant E evoked the game programmer’s perspective:

The main reasons for responding to a user’s emotions? For storytelling purposes.
Although it’s conceivable that there are scenarios where a user’s performance is affected positively by, say, fear, I’d offer that emotion is generally only useful in providing an immersive narrative experience for the user.

The HCI industry and Web-development perspectives were similar and were illustrated the best by Participant B who indicated that finally, even if emotional design is not
directly employed, designing a computer program is an issue of responding to an emotional state:

Responding this is sort of an issue because what I think most people do is in terms of designing a program to elicit positive emotions. That is going down to design.

Designing a program is responding to an emotional state.

I consider that Participant T who is in a managerial position, observed the phenomenon from a very general perspective which is specific to a professional that is in charge with people with very different points of view:

I think probably just at a very basic level, it doesn’t matter what people do. Anything that people do creates emotions in people. At the very least it is not that they like it or they don’t like it, they are feeling grumpy when they are using it, or they are feeling happy; so people’s emotional states are very important and affects anything that they do and then, certain things that they do - I think - evoke emotional responses.

However, all participants argued that responding to the user’s emotions is a challenging task for various reasons: difficulties in understanding and interpreting emotions, ethical issues, lack of expertise, and technical limitations.

Referring to the challenges of emotional design, both Participant M and Participant R expressed concerns and recognized that current technologies have limitations and do not provide a good solution:

Emotional design is not always desired because I do not think that machines have the ability to correctly read the state of a human’s emotions. This approach may be OK with games but cannot be relied on for mission critical applications. (Participant M)
I could see developers shying away from embedding emotion into applications because it's extremely difficult to get right and it adds risk to an already risky development process. (Participant R)

Participant T wearing his "manager's hat" observed the lack of expertise of the personnel from industry and recommended that "designers, analysts and programmers and so on, have to add another skill set which is something to do with how to deal with emotional reactions". When discussing this topic, my participants referred repeatedly and engaged in interesting arguments in connection to ethical issues. Due to the importance of this topic, I will address ethical issues separately in Section 5.6 (Consequences and Values).

5.4.4 Responsibilities of Emotional Design

According to the quantitative results, designers, analysts, and psychologists should be mostly responsible for emotional design, and there should also be a distributed responsibility among all participants in the software lifecycle. Question 4 from the interview guide was designed to facilitate in-depth analysis of this issue:

- (Q4) Designers, analysts and psychologists are responsible for the emotional aspect of a computer application. From your experience, can you explain to me what responsibilities are employed in this context? What does responsibility mean in this context?

In terms of responsibilities, my participants confirmed the results from the quantitative stage (see Section 4.4.1.) and agreed that designers should have the most important role in embedding emotions in applications and recommended a diversified participation in design including testers and psychologists. From the gaming perspective,
Participant E offered an interesting point-of-view stating that my selection of choices (analysts, designers, developer, psychologists and testers) was only semantically correct. In his opinion, responsibilities of embedding emotions in games are always carried on by designers, who could be psychologists, or other categories:

When considering who is responsible for the generation of emotional context in software applications, your selection choices seem to me to be only semantically useful. In games, at least, if you're not drawing the pictures and you're not implementing the code, you're designing. That means that emotional content is always configured by designers, be they psychologists or ludologists or whatever.

When asked what responsibility means in this context, participants referred to technical issues: who is responsible with what, or what new set of skills are required. However, three participants strongly voiced ethical responsibilities. A detailed discussion about ethic means is included in Section 5.6 (Consequences and Values). Table 5.6 presents the distribution of responses:

<table>
<thead>
<tr>
<th>Responsibilities of Emotional Design</th>
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<tbody>
<tr>
<td>Participant B</td>
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<td>Participant E</td>
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<td>Participant J</td>
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<tr>
<td>Participant M</td>
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<tr>
<td>Participant K</td>
</tr>
<tr>
<td>Participant R</td>
</tr>
<tr>
<td>Participant T</td>
</tr>
</tbody>
</table>
5.4.5 To what Extent are Testers Responsible with Testing Emotional Content?

From the quantitative stage, only a small number of participants (14%) indicated that testers were responsible for emotional content (see Section 4.4.1.).

In this respect the gaming perspective was very different from all other perspectives. The conversation I had with Participant B is very relevant: in industry testers are not used to test for emotional content per se confirming the results from the quantitative stage.

Mirela: “But are you aware of applications that have used testers and testing for emotional content?”

B: “No. Only in terms of usability”

Mirela: “Usability, yes…but not emotional…”

B: “If they like it or so on…Is there a positive response? Yes. But not [for emotional content]…”

In the gaming industry, the situation is very different. Participants E and R clarified the fact that yes, gaming industry testers test games for emotional content and special companies are hired to fulfill this requirement. Participant E provided links to Websites of the companies that perform testing:

This is a link to an article on how THQ (MyCompany’s parent company) has tested emotions in games: http://www.gamespot.com/news/6177080.html and here’s a link to the company that actually did the testing: http://www.emsense.com/.

Participant R offered a detailed description of a testing process based on Romero (2008). Appendix 4: Testing Process contains the full description of the testing process used
in Participant R’s organization. However, he cautioned that not all gaming companies can
afford this kind of testing because it is expensive in terms of time and resources:

As you can see, the process appears time consuming and expensive. Because of this,
I think very few game companies give their games this type of treatment, but when
they do, it’s usually done right. One thing is for sure, the people at Microsoft Games
User Research take their work very seriously.

In conclusion, the quantitative results that testing for emotional content is not
employed in industry were confirmed. However, in the gaming industry there is a
methodology and a process already in place.

5.5 Strategies and Techniques

The quantitative stage offered valuable findings related to strategies and techniques
that could be used to employ emotional design in a software application. Two questions were
added in the interview guide for further elaboration.

• (Q6) You indicated that you were involved in the life cycle of a software
  application that involved emotion recognition. Can you explain what techniques
  and strategies have been used to recognize the user’s emotional state or response?

• (Q7) You indicated that you participated in the design or implementation of a
  computer application that was unsuccessful because of lack of consideration to
  the user’s emotions. Can you elaborate on this topic?

The two questions were addressed to the participants who reported involvement in
emotional design in the quantitative stage (Participants E, K, R, and T). Since he did not
participate in the survey, Participant B was also asked about strategies and techniques.
The interviews offered opportunities for discussing strategies and techniques outside the two questions. I also asked the two participants from the gaming industry to describe the practice employed in their companies.

Generally, participants reinforced aspects related to the affective domain, receiving, responding and valuing especially referring to aesthetics, colors and sounds. The valuing aspect was well debated, but I will discuss it in more detail in Section 5.6 (Consequences and Values).

When asked about the process used for emotional design in his organization Participant R indicated that even in the gaming industry, in small companies, a rigorous process is not implemented because of economical reasons:

...we don't really have the time or resources to spend too much time on this area of development. Basically, our Game Designers make all the decisions relating to any story or game play moments that may invoke user emotion. There is definitely no specific process. Designers just use their instinct to determine what will (or will not) invoke a reaction from the user. And yes, if you're wondering, quite often they make incorrect assumptions and the game does not achieve the intended result. So yea, no psychologists or other professionals here, just Game Designers.

According to Federoff there are three important elements in game design: the interface, the mechanics of the application (the execution), and the intelligence (Federoff, 2002). Question 16 from the survey referred to these three aspects and the participants’ response was that that the interface is important, followed by intelligence and mechanics (see Section 4.4.3).
Participant E’s response was very interesting and related to Federoff’s model. Without using exact the same terminology, he identified all three aspects as identified by Federoff: the intelligence (the story, the narration), the interface (following conventions from the film industry) and the mechanics or the execution of the game.

**The Intelligence:**

Participant E’s organization doesn’t have a formalized process or methodology, however, more attention is given to emotional design. The company hired writers who are responsible with the emotional component of the game. In fact, Participant E is one of the writers:

[My organization] doesn’t follow a specific or formalized process to include emotional context in our games; we don’t involve psychologists or other emotion-related specialists …But we do retain writers on staff (like me) whose primary responsibility is to ensure the dramatic nature of the game, and you could certainly construe that goal as being very emotionally-oriented.

**The Interface:**

Participants B and K observed that the gaming industry has many aspects in common with advertising and the film industry: “all the software is doing is delivering the images in the same way a movie does so I think, its not that these aren’t issues these are very important issues, but they’re the same issues that when applied if you were talking about a TV show or a movie or anything else that has portrayed certain things” (Participant K). “Look at how music is used in film. OK. Because that is known in research [and] it is not random. People
who design the sound for films are doing things very intentionally. And in games as well, they will put you in various stressful situations which require response and things going on in the same time which is partially trying to elicit emotional response” (Participant B)

Participant E confirmed that in his organization many techniques are borrowed from the movie industry:

In production, we follow a lot of the same conventions employed by film. For instance, writers tend to follow Hollywood: place narrative contentions (such as those exposed by Robert McKee: http://www.mckeestory.com/), and the art director and cinematics artists obey standard filmic visual conventions (such as those advocated by Bruce Block: http://www.bruceblock.com/). Although these two references are very different in their approach, they’re both trying to infuse their medium with emotional content that will resonate with their audiences. And I think both succeed in their own way...it’s up to game developers, then, to effective migrate these principles to the small (and interactive) screen.

The Mechanics:

The mechanics (execution) of the game is an element that connects the intelligence and interface. According to Participant E, this is the component that is not established yet:

The tricky part is then to tie the story and visuals with the game play. This is a topic which has received intense scrutiny in the past few years, and there’s a wealth of material on the topic. ...In this respect game development is in its infancy, and we’re still a long ways from achieving what I hope is possible with interactive entertainment.
In conclusion, I found that in gaming industry attention is given to the intelligence and interface and techniques for these two aspects were learned from other fields, especially from the movie industry. However, there are unsolved aspects related to the mechanics of the gameplay. In the other areas of the IT industry there are no strategies and techniques employed in design.

5.6 **Consequences and Values**

Four questions were included in the interview guide to allow an in-depth discussion related to possible consequences of embedding emotions in computer applications:

- (Q9) According to the literature, a consequence of embedding emotion in computer applications is identity formation. However, only 25% of the participants of my study identified this aspect as a possible consequence. Do you see a reason why?

- (Q10) Eroding the boundaries between machines and humans was the main consequence of embedding emotion in computer applications observed by the participants in this study. Can you elaborate more on this subject?

- (Q11) Only 63% of the participants in my survey agreed and 31% of the participants in my survey neither agreed nor disagreed with the statement “To what extent do you agree that a user interface should be consistent with the user’s value system?” What would be a reason for this answer?

- (Q12) 31% of the participants in my study identified that affect-recognition applications pose potential concerns that outweigh the benefits, 14% disagreed,
and a large number (54%) neither agreed nor disagreed. What is your opinion in this respect?

The quantitative stage did not offer sufficient data for drawing conclusions with respect to issues related to identity formation, eroding the boundaries between machines, to what extent an application should be consistent with the user’s system of values, and the risk of potential benefits that outweigh benefits.

5.6.1 Identity Formation

The identity formation issue was controversial for the survey participants. According to the literature, identity formation is a possible consequence of embedding emotions in machines (Norman, 2004; Stone, 1992; Woodward, 1997). However, only 17% of my survey participants identified identity formation as a possible consequence. For clarification, I included question 9 in the interview guide.

A possible reason for the survey’s results is that some participants in the study did not understand the concept of identity formation. Participant M reported: “No comment as I do not know what is meant by formation...” Other participants asked for clarification: “Yea, I am still not sure what that means so if I am the user and you’re either the human being or the computer you’re talking about the identity I form about you?” (Participant K). Participant E believed that the reason for the survey’s results is the fact that the term is ambiguous and needed more clarification:

I suspect that terminology might be a part of the reason why “identity formation” didn’t receive more attention in your surveys, because the term is ambiguous: are we discussing the formation of character traits that the user carries with him through the
rest of his life, or are we discussing a well-formed avatar that represents an idealized persona that the user assumes for the duration of a particular role-playing event?

Another reason was offered by Participant R who found an explanation in the field’s novelty and lack of awareness:

Possibly because embedding emotion is a niche field and the majority of the audience is not educated on the topic and is only speaking from personal experience? In other words, the topic is not widely discussed or studied in computer science.

However, after clarification, when the interview participants elaborated on the subject, very interesting aspects emerged. In my clarification I told Stone’s (1992) story of the psychologist who posted as an old handicapped lady in an online community. I also acknowledged that the issue of identity formation is not necessarily a negative consequence and gave the example from Silver (2004) who stated that the computer technology can help shy persons to perform better. This aspect is consistent with the theory around learning languages with intelligent and emotional chatbot agents. Chatbots are tools that imitate human behavior and offer a learning experience based on intelligent conversation. Fryer and Carpenter (2006) highlighted the fact that learning with chatbots is based on conversation and not on speech. Learning languages is a process that needs practice through conversation and studies have shown that learners may not practice enough because of lack of confidence, shyness and lack of feedback (Fryer & Carpenter, 2006).

Participant J observed: “Umm, you know that’s an interesting question because really - you know - in some ways the guy who poses as an old lady, and a computer who poses as a caring structure or something like that you know is possibly not a lot of difference between those two things.”
After inquiring about my opinion regarding negative aspects of identity formation, she concluded that in the case of a computer program with an intelligent and emotional agent, if the user knows there is an agent, there is no issue with identity formation. A similar opinion was expressed by Participant K who referred to Stone's example:

I guess what I have trouble with this... I am not sure for whose benefit is the identity formation, and who is forming the identity so as an example if it is just software and I just programmed in very clever stuff that is intended to project things, the software is the same no matter who's using it.

According to my participants from the HCI perspective, in terms of emotional design, there are no issues of identity formation because the identity formation is something exterior and not necessarily related to what the software does.

However, the gaming perspective was different. Participant E recognized identity formation as an aspect of the gameplay and asserted:

For me, identity formation is embedded in storytelling: a story needs three entities to exist: the storyteller, the hero, and the audience. Although the three can conflate in certain circumstances, they all need to exist in some form, and "identity formation" is a small part of defining each of these entities.

In conclusion, I agree with my participants that in terms of identity formation, factors like the lack of understanding of the concept and the novelty of the field are good reasons for the survey's results. I argue that the contradictory results are an indication that the identity formation can be interpreted differently from different perspectives. More research is needed for better understanding and interpretation.
5.6.2 Eroding the Boundaries between Machines and Humans

Nineteen participants in the survey suggested that eroding the boundaries between machines and humans is the main consequence of embedding emotion in computer applications. Different opinions emerged from interviews.

Two participants argued that the main difference between humans and machines is the lack of emotions on the machines' part. Therefore, embedding emotions into software will result in emotional machines and boundaries will erode:

"Humans are different from machines because we have emotions whereas machines don't. The line between machines and humans becomes thin once machines start having a semblance of emotions." (Participant M)

"The above statement makes sense to me only if the computer program is itself demonstrating emotion." (Participant E)

However, in his later discourse, Participant E cautioned that as long as the player knows that he or she is playing with a machine (computer), "the user [does not] attribute the emotional reaction to the computer itself, but rather to the story and the experience as presented by the computer." In this respect, similar to books, computers are just vehicles for emotional reactions in users:

When I read a book and am emotionally affected by the story told therein, I don't think that I'm confused by the erosion of the boundary between books and humans. I would be willing to consider the idea of the erosion of the boundary between fact and fiction, reality and story, but that's not at all the same thing ... People do not fall in love with their television sets. They fall in love with the narrative context portrayed on their television sets.
Participant K also agreed that adding emotional reactions to machines will erode boundaries and stated that it is common that people “developed a personality for their computer” and “they assumed it depending on their relationship.” There is a fine line between employing usability into applications and creating situations that go behind usability:

So, I think there is a whole continuum between what is classically thought of as good engineering design and usability doing over into the purposely designing these emotional things in, and anywhere you are in that spectrum you are certainly going to affect, you know, people’s experience.

Participant B disagreed that boundaries between humans and machines can be eroded. He highlighted difficulties based on physical limitations that “our current understanding of physics would not allow us to build a human being or even the cognitive part of the human being” and mentioned Penrose’s work in this respect. He presented an argument based on Gödel’s completeness theorem:

In terms of eroding the boundaries between machines and humans … I think that I am quite skeptical in that computers are inherently bound by Gödel’s completeness theorem. Basically it says that if you have a consistent set of logic that it cannot be complete there have to be things you cannot prove… things that are true but you cannot prove or disprove in the system and humans don’t seem to be bound by Gödel's completeness theorem … so there seem to be things that humans can do that computers can fundamentally not do the way they are currently constructed … I think that … artificial intelligence hasn’t progressed so much as we had thought from the
60's. I think that there is more of a boundary between machines and humans than there is obvious.

In conclusion, some participants were consistent with post-structuralist theory in agreeing that embedding emotions into computer applications will erode the boundaries between humans and machines. However, one participant strongly disagreed based on Gödel's completeness theorem.

5.6.3 Affective Domain - Valuing

Only 63% of the participants in my survey agreed and 31% of the participants in my survey neither agreed nor disagreed with the statement "To what extent do you agree that a user interface should be consistent with the user's value system?"

Two reasons for the survey's results emerged from interviews. As in case of the question related to identity formation, a possible reason was that lack of clarification of the term's meaning. According to Participants E and R, the term “value system” was ambiguous:

I'd need an explicit definition for “value system”. I want a user interface to obey the laws of affordances that I implicitly expect because of my cultural and intellectual upbringing, so as to minimize confusion and frustration, and maximize efficiency and intuitiveness. Does that count as a “value system” consideration? (Participant E)

I think the definition of “user’s value system” may be unclear to participants. I interpreted the user's value system to mean the user's standards and I think UIs should try to be consistent with any user's standards the user may have. For example,
the cancel button should always be on the right of the ok button, changing it at this stage is not a good idea. (Participant R)

Another reason had the roots in issues related to difficulties defining what a system of values should be for a particular application. Participant J agreed that cultural values should be taken into consideration but cautioned about difficulties that emerge from complying to a system of values:

I guess the answer to that is that you want your user interface to work within a certain culture or within a certain group of value systems, then yes it should be consistent … if you’re talking about specific values like I shall not steal or does your audience believe in you know in abortion or not-abortion if you start getting into that kind of value system then umm you know that would be pretty hard. I suppose if you know exactly if every one in your audience had the same value system you might try to go for that but I guess, see that’s were it gets a little bit difficult to answer and that’s why people were having a problem answering it.

Participant B agreed that user interfaces should be consistent with the user’s value system but disagreed that the system of values is related to emotions and augmented with arguments from the cognition/emotion paradigm:

See to me value system has nothing to do with emotion, value system is … a rational system; emotions are not rational they are sort of irrational like they sort of just are… they are things that sort of come out outside of rationality but value systems are rational so they are outside the emotions … ok I would agree that a user interface should be consistent with the user value system. I am not sure totally what that means in terms of like how it could be inconsistent and so on…
In his discourse he presented an opinion similar to Participants J by noting that defining a system of values if difficult. Participant K argued that user interfaces should be neutral to systems of values for ethical reasons. He gave an example that raises an obvious ethical concern:

I think that there is a little light saying that when I go to buy tickets at Ticket master if my values are that I don’t want to sit next to anyone who is homosexual it would allow me to do that? That’s a value and some people have it and you know it is depending on how strongly they express something like that it may or may not be legal.

In conclusion, more attention should be given to the terminology used in surveys. Complying with a user system of values is difficult because of the variety of users and systems of values and of ethical concerns.

5.6.4 Ethical Issues

Responsibilities and consequences in terms of ethical issues were strongly raised by the participants in my study even if there was no specific question directly asking about ethical issues. Participant B cautioned that embedding emotions can have negative impacts on users and advised that “If you try to elicit some emotional responses and so on, you must make sure you debrief them”. He told a story about an experiment from the 50s that had repercussions on a participant:

Just one thing on terms of question four in terms of responsibilities: there has been a big shift from the 50s in terms of ethical design and what you are allowed to do, and what your are allowed to test people on. So I guess a famous case was a subject they made afraid of rabbits, yes… a little kid… and they never debriefed him… so there
was this kid who grow up as an adult who had this fear of rabbits because of the psychological experiments done on him... when he was young...I see lots of responsibilities in terms of ethics. Most likely in psychology there will be generally an ethical committee that will approve before you’re allowed to do an experiment

He also cautioned about the risk of manipulating the user through emotions:

“Probably most people think that manipulation is a negative thing and if you are embedding emotional response that might be manipulative”. On a similar note, Participant J argued that manipulation poses an ethical dilemma:

Manipulating the emotion of a person whenever that be through a computer interface or you know how whatever, it might be a serious thing, it is not, you know, an insignificant thing so right there you are kind of on a borderline of some kind of, you know, ethical dilemma.

The ethical issues resulted from responding to the user’s emotions should be regulated. In fact there is already a form of regulation that applies to computer games because of their emotional content in terms of sexuality and violence. Participant K indicated:

I think we get much more into the realm of an area where needs to be some sort of ethical concerns and possibly even regulatory concerns and we see that for example in computer gaming, computer games are rated, it is the only software I am aware of that has a public rating system and it is precisely because of the emotional issues that go with that.

Participant E confirmed what Participant K stated in terms of ratings for sex and violence content. He reported that the gaming industry is regulated by the Entertainment
Software Rating Board (ESRB), see http://www.esrb.org/, and designers should consider ESRB standards when designing a game. However, according to participant E, there are no other ethical guidelines that apply to game design besides the ESRB rating, which is a voluntary system. In his opinion a lot of attention is given to sex, but not as much to violence, which is perceived less negatively. Therefore, some games are violent; an example is Grand Theft Auto (GTA). Unfortunately, a violent and an antisocial game like GTA became very popular despite an unfavorable ESRB rating:

The video games industry is regulated in the States by the ESRB...Like all American rating systems (for movies, etc.) the ESRB is pretty retarded, and seems to think violence is much healthier than sex. Most game developers in North America use the ESRB as their “ethical” guide, though of course there are strong connections between ESRB ratings and sales: I’m not able to cite specifics off the top of my head, though I know that certain retailers, like Wal-Mart, will decline to carry certain games based on ESRB ratings and reviews, which can all but destroy a game’s financial viability. On the other hand, some games (like the GTA series) can achieve significant notoriety because of their content, and perhaps increase sales *because* of an unfavorable ESRB rating.

There are no other ethical regulations when video games are designed. Participant E sees a correlation between the entertainment market requests and offers, arguing that the market dictates the ethical considerations:

Aside from the ESRB, I don’t know of any standard ethical guidelines for games. Games are getting bigger and bigger, more and more expensive, with larger development teams and greater capital consumption, so the marketplace drives ethics.
American automakers are moving into the “enviro-friendly” space not because of a consideration for the planet, but because that’s what consumers want. Gamer developers are just the same.

However, emotional manipulation is not necessarily a negative thing. Art produces “emotional manipulation” by creating in the consumer of that particular form of art an emotional response based on a story, images, or sounds. Referring to games as an artistic expression, Participant K argued:

People play games to get an emotional experience and so it is perfectly reasonable as long it is done sensibly to take that into account … (the) attempt to manipulate emotions because in the same way when you put a movie or you go to a concert or to anything that is artistic there is a public contract essentially that everyone agrees and knows that emotions are involved and there is a communication and an attempt to I’ll say manipulate.

5.7 Conclusion

The qualitative stage provided clarification and consolidated the findings and themes from the quantitative stage.

THEME 1: Awareness, Involvement, and Attitude towards Emotional Design

- The participants in interviews observed that in the IT community there is little to no awareness of emotional design.
- The novelty of the field is translated in lack of experience, knowledge and understanding.
• In the IT community, computer programs are associated with cognition and the affective domain is considered tangential to the cognitive domain.

• There are technical difficulties and ethical issues associated with emotion recognition.

• The field needs research and exploration.

THEME 2: Heuristics of Emotional Design

The following directions emerged, which should be developed into heuristics for emotional design:

• There are differences between computer games and other applications in terms of emotional design.

• Computer applications should be treated differently in terms of emotional design.

• Inferring the goals and needs of users is important. Reducing user frustration should be a mandate of emotional design.

• Responding to users emotions is an issue that raises important ethical issues.

• Designers and other participants in the software lifecycle should be responsible for emotional design. Besides technical responsibilities there are ethical responsibilities.

• Testing for emotional design has already a methodology developed and used in the gaming industry. Other industries don’t seem to employ emotional testing.
THEME 3: Strategies and Techniques

The following directions emerged, which should be developed into strategies and techniques for emotional design:

- Outside the gaming industry, there is no process that provides strategies and techniques for emotional design.
- Even in the gaming industry, in small companies, a rigorous process is not implemented.
- The process of emotional design in games involves: intelligence (AI), interface and mechanics (game play).
- Intelligence and interface issues have solutions but the mechanics (tying the story and visuals with the game play) is an unsolved issue.

THEME 4: Consequences and Values

- Identity formation is not perceived as a consequence of emotional design by participants with a HCI background. However, this issue is considered by game designers.
- Complying with a user system of values is difficult because of the variety of users and systems of values and of ethical concerns.
- More clarification should be given to terms like "identity formation" and "system of values" in future surveys.
- Eroding the boundaries between humans and machines is a consequence of emotional design. However, this is a debatable philosophical subject.
• There are important ethical issues associated with emotional design; regulations to be followed by designers should be established in the near future.

• Current ethical regulations for game design are restricted to ESRB ratings.

This study was organized in two stages: quantitative and qualitative. The quantitative stage was employed as a survey and the qualitative stage was based on interviews. The findings from the quantitative stage were used to determine the micro-analysis needs for interviews.

The study was based on four themes that were based on the literature review: awareness, involvement, and attitude towards emotional design, heuristics of emotional design, strategies and techniques, and consequences and values. Conclusions, implications and recommendations will be presented in Chapter 6.
Chapter Six:  
Conclusions, Implications & Recommendations

The purpose of this study was to investigate the practice of emotional design in the IT industry based on self-reported data collected with a pilot questionnaire, and on interviews conducted with experienced specialists from IT, including HCI and gaming. The main research question addressed awareness of, implications for, and attitudes toward emotional design. Before I began my study, I assumed that there was little awareness of emotional design of software applications in the IT field. Based on my professional experience, HCI principles, and literature review, I presumed that there was a need for emotional design to be included in the general process of software design and in other components of the software lifecycle, for example, analysis and testing.

This research identified an important undeveloped area in software design. Currently, attention is given to issues like aesthetics, inferring the goals and needs of users, and usability, but users’ emotional needs are not taken into consideration. I believe that this study offers a starting point for future research and for the development of a methodology. Given the findings and comments made by participants and colleagues, the instrument designed and used in this study should be improved and employed in future research.

This study addressed the following research questions: **To what extent is there awareness of emotional design in the IT community? What strategies and techniques are applied by different participants in the process of software design and development aimed to incorporate emotions in a software application and respond to users’ emotional needs?** The research also evaluated the effectiveness of these strategies and
identified directions for the heuristics of emotional design. The following sub question was also addressed: What are the heuristics of emotional design?

The process of responding to users' emotional needs was observed from a critical perspective with respect to social and ethical implications. The following research question was also addressed: To what extent are these strategies effective and what are the ethical consequences of development of software applications that are designed to trigger affective responses from users?

6.1 Reflections on the Thesis

6.1.1 Did the Methodology Serve the Purpose of this Study?

The research design utilized an explanatory mixed QUAN-qual methodological model proposed by Creswell (2003) and Gay, Mills, and Airasian (2006). The quantitative (QUAN) stage was designed to gather and analyze data, interpret data and draw conclusions, and focus of the qualitative (qual) stage. The findings shaped not only what data was to be collected in the second stage, but also the participants who were invited for interviews.

Two reasons were employed to choose an explanatory mixed design model: the recommendation given by Creswell that mixed methods better serve the research goals in particular situations in social and human sciences (Creswell, 2003), and the nature of my study. The quantitative stage was justified by the findings and results of the research and the qualitative stage was needed for an in-depth microanalysis not possible within the quantitative realm.

My intention was to use the QUAN-qual model exactly as proposed by Gay, Mills and Airasian (2006). However, the data collected from the qualitative stage was very rich and
meaningful and offered great opportunities beyond clarification of quantitative data. Therefore, my methodology was different from Gay, Mills, and Airasian’s (2006) QUAN-qual model because of the emphasis given to the qualitative stage. In the model proposed by Gay, Mills, and Airasian (2006) a qualitative stage follows the quantitative stage and quantitative data are more heavily weighted. In my study the qualitative data collection and analysis followed the quantitative stage, as in the original model, but the qualitative data were almost equally weighted, and were used not only for clarifying quantitative data, but also for interpretation of quantitative data. In Chapter 3, Figure 3.1 illustrates the QUAN-qual model proposed by Gay, Mills, and Airasian (2006). Figure 6.1 presents the QUAL-QUAL methodology employed in this study. The difference is the interpretation component and the emphasis (QUAL) given to the qualitative stage (in red).

![Figure 6.1: QUAL-QUAL Model: Variation of QUAN-qual Mixed Research Model Employed in this Study (Adapted from Gay, Mills & Airasian, 2006)](image)

The quantitative stage supported statistical findings that were discussed and micro-analyzed in the qualitative stage. It is important to highlight that the qualitative stage
provided opportunities not only for in-depth analysis, but also for triangulation, a more complete picture of the phenomena and data cross-checking. Each theme and sub-theme discussed in Chapter 5, were compared with the literature and the survey’s results. Based on the rich data that were collected, the participation in survey and interviews, and the trustworthiness of data collection and analysis, I believe that the methodology employed in this study served the research purpose.

6.1.2 The Instrument: Limitations and Lessons Learned from Piloting the Instrument

The instrument used in this study was a questionnaire especially designed for researching emotional design. As discussed in Chapter 3, my intention was to use a pre-existing and already-validated instrument for quantitative data collection. Therefore, I extensively researched the literature and the DAI (Dissertation Abstracts International) database for an instrument to fulfill the requirements of the research. After I exhausted the search for an instrument, and I decided, together with my supervisor, to design one, piloting and testing the instrument became another purpose of the research design.

The instrument designed was adequate for this study: it provided rich data to satisfy the quantitative stage in the process of addressing the research questions, and to prompt a very productive qualitative stage. My intention is to continue this research in a longitudinal study that will have a quantitative component and to use an instrument (questionnaire) based on the current one. Therefore, I observed the data collection and analysis with a critical eye to identify strengths and weaknesses. The questionnaire had strengths in the following areas:
Benefits of On-line Delivery

Data collection was highly facilitated by the on-line format. One of the participants who works for Electronic Arts in Burnaby was currently in San Diego and the fact that the questionnaire was on-line did not prevent his participation. Also, this format allowed for responding anytime, anywhere without restrictions in terms of data format (.pdf, .txt, etc.) or operating system compatibilities.

Share Point Technology

Share Point was easy to use. The system administrator of the server where the questionnaire was made accessible, who is a colleague from British Columbia Institute of Technology, confirmed that setting up the privileges for me was very easy. Share Point is very intuitive and allowed me to easily create the questionnaire, test it, and collect data. The best features of this technology were security and capabilities already built in to allow for simple statistics to be performed automatically. Therefore, at the end of the quantitative stage I already had simple descriptive statistical data and I did not need to convert data to software like Excel or SPSS. However, Share Point currently has only limited capabilities. The charts created for data analysis of the quantitative stage were produced with Excel.

Effectiveness of the Instrument

I believe that the instrument helped collect data that were meaningful to the purpose of this study (piloting the instrument, determining the participants and the content of the qualitative stage, and creating a framework for future research). However, more attention should be given to issues like terminology and purpose. For some questions, many
participants responded with “neither agreed nor disagreed” and I was concerned that these items were not discriminative. However, during the qualitative stage participants argued that there are other issues like the novelty of the field, and lack of experience, knowledge and understanding that may have influenced a lack of discrimination on some items. Participant T stated: “the field [of emotional design] is probably too ill defined right now and we don’t understand this phenomenon. What do you mean by affective computing? What do you mean by emotions in a computer application?”

The instrument needs the following improvements:

**Terminology: Better Clarification**

One participant commented: “The questions are brief and require more clarification” and another cautioned that “this survey assumes understanding of UI [User Interface] terminology”. Some participants wanted clarification especially for terms like identity formation, system of values, and mechanics of games. Even the concept of embedding emotions in software applications needed clarification for one participant. E-mail exchanges allowed for fast communication with the participants and clarification of ideas. However, not all participants e-mailed their concerns. It will be possible to implement in the future a feature from the realm of user modeling that will automatically offer clarifications based on the participant’s needs, which will be in fact in close correlation with the purpose of this study. The next iteration of the instrument following this pilot phase should define various terms for the participants.
Differential Surveys

This questionnaire was intentionally very general to allow different kind of data to be collected from a large variety of participants in terms of experience in the IT field. The reason for a general questionnaire was actually the lack of instruments to measure this phenomenon with precision. However, based on the experience gained by designing and piloting this questionnaire, a better instrument design will take into consideration differences in views, competencies, and professional experiences of different participants. Therefore, for the future study I will design a questionnaire with items that differentiate based on professional criteria: for example, some items will apply only to participants from the gaming industry, some only to HCI specialists, etc.

6.1.3 Limitations of this Study

One limitation for this study is the external validity of the quantitative stage. Two aspects hindered conclusions from the quantitative stage: 1) the instrument was in a pilot form, and 2) the small number of participants (35) and various demographics (e.g., variety of work settings, experiences and backgrounds).

According to Gay, Mills and Airasian (2006), for quantitative research it is common to sample 10% to 20% of the research population. In a study allowing for generalization, the population size of the IT professionals in Vancouver would be accurately calculated and a sample size would have been calculated from this. However, this study intended to explore awareness of emotional design, pilot an instrument, and identify a theoretical framework for future research that will be later used in a large study. Therefore, given the intention of the
study, the time constraint of a MA thesis, and the snowball effect of participant recruitment, the number of participants exhausted at 35.

The participants in the quantitative stage of this study were selected by purposive sampling from a population composed of analysts, designers, programmers, testers, managers, researchers and educators involved in developing applications for human interaction. My intention was to involve participants with various backgrounds and experiences. However, when I analyzed the data, I found that the number of participants with a specific background would be insufficient for generalization. Therefore in a future study, a more specific population should be targeted. Based on the experience gained in this study, I believe that a future study will be effective if two samples of specialists are targeted: specialists with a background in HCI and game designers. Data collected from the two samples would be interpreted comparatively using descriptive statistics, correlation, and analysis of variance.

Another limitation of this study was the fact that the opinion of the participants who did not agree with emotional design was not followed-up. In a future study, the questionnaire should include items that allow the participants to justify their responses or a second level questionnaire could be employed to collect additional data aimed to revisit data collected in the first stage.

A third limitation of this study was that no clear definition was given to emotions and emotional design and no clear distinction was made between emotions generated in users by using an application and emotions recognized and responded to by applications. Therefore, I have no way of knowing if participants in the survey referred to applications that generate emotion in users or applications that recognized the users’ emotional state and responded to
it. This open-ended approach was intentional, but for future study and use of a revised questionnaire, the participants will be provided with a definition of emotion and with a clear-defined framework for their responses.

For the next iteration of the questionnaire, an item analysis should be conducted to help with decisions on what items to keep, revise or discard. Also, some of the Likert items may be better rephrased as statements rather than questions. In summary, the research provides a very productive data set for revising the pilot questionnaire for future surveys.
### 6.2 Summary

Table 6.1 summarizes the results of data analysis from the quantitative and qualitative stages:

#### Table 6.1: Meta-Matrix: Results of Quantitative and Qualitative Stages

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantitative Stage Conclusion</th>
<th>Qualitative Stage Conclusions</th>
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| Awareness, Attitude and Involvement | Importance of emotions in the software design of computer applications  
Lack of awareness/involvement | Lack of awareness  
Novelty of the field resulting in lack of experience, knowledge and understanding  
Issues related to the cognition/emotion paradigm  
Technical difficulties  
Ethical issues related to emotional design  
Need for research and exploration |
| Heuristics                      | Differences between games and other applications  
Infering the goals and needs of users  
Interface design  
Responding to the user’s emotions  
Responsibilities: designers/analysts/testers  
Stages: design/analysis/testing  
User’s experience is strongly influenced by emotion. | Differences between games and other applications  
Need for different methodologies for emotional design  
User modeling  
Infering the goals and needs of users: special attention to frustration  
Responsing to the user’s emotions raises ethical issues  
Responsibilities: designers and other participants in software lifecycle  
Responsibilities: technical and ethical |
| Strategies and Techniques       | Artificial Intelligence (AI)  
Audio/Visual aspects  
Capturing the user profile  
Differential design  
Engagement of user in design  
Identity immersion  
Recognizing the users’ profile  
Usability issues | No methodology or process for emotional design outside the gaming industry  
Even in gaming industry, small companies do not employ any process  
The process in gaming industry involves: intelligence (AI), interface, and mechanics (game play)  
Mechanics don’t have a good technical or methodological solution |
| Consequences and Values         | Eroding boundaries between humans and machines  
No issue related to identity formation  
No clear conclusion related to the user’s system of values | Eroding the boundaries between humans and machines is a debatable issue in the IT community  
Identity formation is not considered an issue by HCI specialists  
Complying with a user system of values is difficult because of the variety of users and systems of values and of ethical concerns  
More clarification should be given to terminology in future research  
Ethical issues related to emotional design |
The following findings emerged from the research questions:

**To what extent is there awareness of emotional design in the IT community?**

**What are the strategies and techniques applied by different participants in the process of software design and development aimed to incorporate emotions in a software application and respond to users’ emotional needs?**

A large majority (94%) of participants in the quantitative component of this study and all participants in the qualitative component agreed that emotion influences the user’s experience. However, currently software design and development does not take into consideration the emotional state of users. About 89% of the participants in the survey indicated participation in development of applications with user interfaces but only 6% developed software that recognized or responded to the user’s emotions. From the seven participants in interviews, three were directly involved in emotional design, two in the gaming industry and one in research.

In conclusion, even if emotional design was considered to be important to my participants, there is apparently little awareness of it in the IT community. The reasons are lack of experience, knowledge and understanding of emotional design, the novelty of the field and a nascent field that needs to be further researched and communicated. There is no methodology containing a set of validated principles, strategies and techniques in this respect. Participants in this study were consistent with Freeman’s (2004) “emotioneering” techniques, confirming that gaming industry uses a set of techniques and conventions generally derived from the film industry to emotionally engage the player. It was also
reported that a formalized process to include an emotional context in games is not currently employed.

What are the heuristics of emotional design?

Based theories of affective computing, HCI principles, and on the results of this study, I offer a set of directions for heuristics that can be applied to emotional design:

- The user's experience is strongly influenced by emotion. Responding to the user's emotions is essential for computer applications.

- Designers, analysts, and psychologists should be primarily responsible for emotional design and the responsibility should be distributed among all participants in the software lifecycle. In addition to technical responsibilities there are ethical responsibilities of emotional design.

- The most important stage of the software lifecycle with respect to embedding emotions in an application is the design stage.

- There are differences between computer games and other applications, which must be accounted for in emotional design. These differences are worth exploring in future emotional design research.

- Inferring the goals and needs of users is an important HCI principle that applies to emotional design. Under this principle, reducing user frustration should be one of the mandates of emotional design.

- Testing for emotional design has a developed methodology in the gaming industry. Other industries don't seem to employ emotional testing.

- Responding to users' emotions is an issue that raises important ethical issues.
The directions identified in this study are consistent with an HCI principle of inferring the goals and needs of users, but go beyond current models by filling the gap of emotional needs. User modeling offers expertise in this respect: adaptive interfaces that respond to the users' emotional needs should be considered for solutions aimed to overcome current problems due to the increasing complexity of human-computer interaction. The cognitive approach of intelligent user interfaces and intelligent agents should also include adaptive characteristics based on emotional behavior. A possible solution is a model that provides a user profile of user's abilities, beliefs, knowledge, and goals and plans for achieving these goals. Providing a human-computer interaction that is consistent with the user’s profile can also satisfy emotional needs and prevent negative experiential emotional reactions like frustration. This approach is consistent with Picard and Klein’s (2002) interactive system designed and evaluated to sense human emotional expressions and respond with emotionally supportive interaction to the users’ needs when frustration and other negative emotions are detected. The micro-analysis employed in the qualitative stage of this study provided clarification and consolidated the principles identified in the quantitative study and in theory. However, the study did not provide a framework for building a design methodology and emotional design model. I will leave these tasks for a larger study that will follow the current research.

I suggest that future research should focus on identifying criteria for evaluating applications for emotional design. Designers could identify a set of requirements that should be employed for their products such that users have a positive, pleasant experience (Astleiner, 2000). An important aspect that resulted from this study included the participants’ comments related to frustration experienced when interacting with technology. Detecting and
avoiding frustration should be a criterion for emotional design. Depending on the application, other criteria can be determined. For example, in the case of educational software employing a computer tutor for language learning, the effectiveness of the application should be taken into consideration. Did the application sense when the student struggled and responded accordingly? For example, did the application repeat the question, or offer a hint? Did the computer tutor exhibit emotions that corresponded to the conversation that was taking place?

To what extent are these strategies effective and what are the ethical consequences of development of software applications that are designed to trigger affective responses from users?

The answer to this question was based mainly on the qualitative stage because the quantitative stage did not provide the participants with opportunities for elaboration. There is a debate over whether the effectiveness of strategies employed for emotional design. Apparently, there is a consensus that the strategies used in the game industry are effective; however, there are limitations. To what extent is it possible to create a machine that understands and emulates human behavior is a fundamental question related to issues of physical limitations that was debated in theory and raised by the participants in this study.

Important ethical concerns were also raised by participants in this study. Issues related to eroding boundaries between humans and machines, identity formation, manipulation, and valuing were debated (Table 6.1 summarizes the results). One participant in the survey was very concerned with possible consequences of machines that respond emotionally:
In my opinion, there is the line that we should not cross. Like everything we do in our life we have to know [the] limits. Otherwise, we can do more harm than good for our future children. Emotions are something that live beings possess and only live beings can recognize and respond to them. Making machines do that [responding emotionally] is taking responsibility that no one on Earth is capable of handling. Sometimes, when you make certain steps in life, there is no way back. To me this is the same as asking [the] question whether or not to go on with cloning humans. That is not our mission. The same is with human emotions. We have emotions; it is something we are born with. However, they should stay within that boundary and we should not be playing with them.

The responsibility of emotional design in the process of software development was viewed not only from technical perspectives, but from ethical perspectives as well. Participants in this study identified ethical responsibilities as a major aspect of software design. An error in program execution can lead to disastrous consequences if emotional responses are involved. Telling a story of stolen identity, Participant K cautioned: “Now that wasn’t a computer doing that manipulation, but if we moved to the point where you can’t tell the difference between a computer and a human and the computer makes those kinds of mistakes because the software doesn’t get it right, there are real consequences” (Participant K).

In conclusion, participants in this study strongly recommended that emotional design should carry standard ethical guidelines for games and any other applications.
6.3 Practical Implications

In parallel with this study, research was conducted by Yifei Wang (2008) at University of British Columbia that investigated user-centered speech-driven multimodal adaptive language learning interface design. Wang observed users interacting with a chatbot application and evaluated their emotional needs. She concluded that responding to the users' emotional needs is beneficial in the context of language learning. She recommended a better design:

Future user-adaptive language learning interfaces should be able to change automatically in response to experiences or user performance. These new interfaces will change to suit the skills, emotions and knowledge of an individual user. Such a user-adaptive interface will no longer be constructed for a stereotypical average user, but for users' varying abilities or different skills by providing information and exercises at levels to match their current needs. (Wang, 2008, p. 139)

However, more research should be employed for determining a methodology for emotional design. I argue that the HCI field needs to include, within user modeling, a subfield designated to understanding and responding to users' emotional needs. In the near future, efforts should be made to combine results from this study (focused on the designers' perspective) and Wang's study (focused on users' perspective), to establish principles of emotional design, and evaluate them in a practical process of design and implementation of an emotionally-adaptive interface.

The results of my study can also be used to generate awareness of emotional design in the IT community. The instrument designed and evaluated in this study can be improved and used in future research.
6.4 Recommendations for Future Research

Future research should focus on determining heuristics and principles of emotional design. After principles are formulated, they should be validated in practice. However, emotional design should be treated differently for computer applications: for some applications the interface should be as non-obtrusive as possible and for some should be attractive and engaging. Expertise from research, especially from user modeling and from industry, should be combined. There is some experience in emotional design gained in the gaming industry. I believe that other industries and to a lesser extent the HCI community should investigate what lessons had been learned in game design with respect to engaging the user affect or emotion. For example, testing for emotional reactions is already an established practice in the gaming industry. Collaboration between gaming and other industries is needed.

I recommend the continuation of this study on a larger scale involving more participants. I argue that a methodology for researching emotional design needs to be established and evaluated in a practical project. I also recommend that research should focus on user frustration towards technology and minimizing this should be a mandate of software design. Considering possible negative implications, efforts should be made to identify ethical regulations for emotional design.

6.5 Conclusion

Many participants in both quantitative and qualitative stages indicated that this kind of research is needed and encouraged me to continue. For example a participant in the survey
stated in one of the open-ended questions “Quite interesting research” and another wrote: “It is a very interesting research and I am looking [forward] to what comes out of it. Gook luck!”

Participant T commented on this research: “I think that this is actually very interesting because it is an extension you are taking human interface to another level. I think that is really helpful”. This study also had immediate benefits by creating awareness of emotional design in the IT community and engaging participants in discussions and thinking. Hence, it is appropriate to close with the comment that participant R made in his interview:

Mirela: “Is there anything that you would like to add about this topic that was not addressed in this survey or interview?”

Participant R: “No, I think your questions did a good job of covering my experience and opinions. To be honest, this is the most thought I’ve ever put into the topic. I am very interested to see the results of the study though. Hopefully my comments help you reach some good conclusions.”
Bibliography


Appendix 1: Recruitment

Introduction letter:

Dear Tom (not a real name),

How are you? I am writing to invite you to participate in a study that I am researching at UBC. I am currently finishing a Master of Education and working on my thesis. The research targets specialists form the computing industry involved in design and implementation of applications with user interaction. If you agree to participate, you will respond to an online survey.

I will follow up with another e-mail.

Thank you,
Mirela Gutica

Invitation letter

Dear colleagues and participants,

Thank you very much for accepting to respond to my questionnaire!

Your input from an analyst/designer/programmer/researcher/educator perspective will be extremely valuable in observing awareness of emotional design and identifying strategies and techniques used for embedding emotion in computer applications and engaging the user emotionally.

Only mass results will be analyzed, which will not distinguish individuals. You will not be identifiable and all information will remain anonymous.

You will find the online questionnaire at:
I will continue to update you on the progress and development of my study. Let me know if you have difficulties using the online tool, and I'll be happy to assist you. If you have any additional comments, please do not hesitate to contact me.

Thank you,
Mirela Gutica

Thank You Letter

Dear Dr. Smith (not a real name),

Thank you for responding to my questionnaire. Your feedback is very valuable to me!

I will continue to update you on the progress and development of my study.

Thank you,
Mirela Gutica
Research Study of Technology and Emotion(s)

Who:
Programmers, Instructors, Designers, Analysts, Testers, and Software Engineers

What and Why: A team of researchers at the University of British Columbia is investigating the interface between technology and emotion(s). The current study is focused on affective computing and intends to identify what strategies are applied by different participants in the process of software design and implementation to incorporate emotions into software applications. The study will also analyze the effectiveness of these strategies and their social implications.

How: Participants will be invited to answer a survey. The participants, who will further agree, will be invited to an interview and to a focus group discussion. Questionnaire answers, interview comments, and focus group discussions will be used only with your permission and kept anonymous in any research reports. You will NOT be identified by name in any reports of the completed study.

Where: The questionnaire will be distributed via e-mail. Interviews will be taken at your convenience; the researcher will travel to your office. The focus group discussion will be organized at UBC or BCIT (the researcher works at BCIT).

Contact:
If you want to participate and for questions please contact:
Mirela Gutica at BCIT
For further information please contact:
Dr. Stephen Petrina at UBC

Computer Specialists are Needed!
A Study of Affective Computing

Who:
Programmers, Instructors, Designers, Analysts, Testers, and Software Engineers

What and Why: A team of researchers at the University of British Columbia is investigating the interface between technology and emotion(s). The current study is focused on affective computing and intends to identify what strategies are applied by different participants in the process of software design and implementation to incorporate emotions into software applications. The study will also analyze the effectiveness of these strategies and their social implications.

How: Participants will be invited to answer a survey. The participants, who will further agree, will be invited to an interview and to a focus group discussion. Questionnaire answers, interview comments, and focus group discussions will be used only with your permission and kept anonymous in any research reports. You will NOT be identified by name in any reports of the completed study.

Where: The questionnaire will be distributed via e-mail. Interviews will be taken at your convenience; the researcher will travel to your office. The focus group discussion will be organized at UBC or BCIT (the researcher works at BCIT).

Contact:
If you want to participate and for questions please contact:
Mirela Gutica at BCIT
For further information please contact:
Dr. Stephen Petrina at UBC
Appendix 2: Questionnaire

Affective Computing Questionnaire
(Version 8.0, 2008)

The purpose of this instrument is to help us describe trends and practices in affective computing. The first section involves basic demographic information and the second section provides statements related to affective computing. Please complete each section. Note that some items allow for more than one response. Thank you for completing this questionnaire!

Only mass results will be analyzed, which will not distinguish individuals. You will not be identifiable and all information will remain anonymous.

For each of the following questions, please select the choice that best describes you (If checkboxes are displayed, you can select more than one answer):

General Profile

1. **Consent:** The principal investigator for this study is Dr. Stephen Petrina, a member of the Department of Curriculum Studies, University of British Columbia, who may be reached at (XXX) XXX-XXXX. This research will be used for Master of Arts thesis of Ms. Mirela Gutica, student in the Department of Curriculum Studies, Faculty of Education, who may be reached at (XXX) XXX-XXXX.

Study Purpose and Procedures
The purpose of this research is to provide an understanding of the role how emotions are designed into new media technologies such as digital animation, video games, chatbots and robotic pets. We are also interested in emotional responses to these technologies. The total time necessary to participate in the study is three to four hours per month over a three month period.

Confidentiality
Your identity will be kept strictly confidential. All documents will be identified only by code. Physical hard copies will be kept in a locked filing cabinet. Electronic copies will be encrypted and protected by password.

Contact Information
If you have any questions or desire further information with respect to this study, you may contact Dr. Stephen Petrina at (XXX) XXX-XXXX. If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information line in the UBC Office of Research Services at (XXX) XXX-XXXX.

Consent
Your participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time. Your agreement below indicates that you have received a copy of this consent form for your own records. Your agreement indicates that you consent to participate in this study.

I Agree  I Don’t Agree
2. Full Name: ___________________

3. E-mail address: __________________

4. Gender:
   Female   Male

5. Current position:
   Analyst   Designer   Educator   Manager   Programmer   Tester   Other

6. Total number of years in education or industry:
   1-5   6-10   11-15   16-20   21-25   more than 25

7. Your current work is in:
   Business   Gaming Industry   Web-development   Education   Other

For each of the following questions, please select the choice that best reflect your experience:

8. Have you been involved in any of the software lifecycle stages of a computer application that involved user interaction?
   Yes   No

9. Have you been involved in any of the software lifecycle stages of a computer application that recognized the user’s emotions and responded to them?
   Yes   No

10. If any of your answers for items 6 or 7 is yes, please describe the application(s) in few sentences.

11. What was your role in the development of this application (you may choose more than one answer)?
a. Analyst
b. Designer
c. Programmer
d. Tester
e. Specify your own value:

Awareness of Emotion in HCI

12. The following questions refer to software applications involving user interaction.

a. To what extent do you agree that emotion should be embedded in software applications involving user interaction?

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<th>Strongly Agree</th>
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b. To what extent do you agree that embedding emotions is (or could be) successful in applications involving user interaction?

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<th>Strongly Agree</th>
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c. To what extent do you agree that computers are capable of alleviating negative emotions (i.e. fear, confusion, anxiety), even when computers are the source of these negative emotions?

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13. Have you been involved in any of the software lifecycle stages of a computer application that was unsuccessful because of lack of consideration for the user's emotional state?

Yes        No
Heuristics

14. In your opinion, who is responsible for the emotional aspect of a computer application? (you may choose more than one answer)
   a. Analysts
   b. Designers
   c. Programmers
   d. Psychologists
   e. Specify your own value:

15. Are you aware of situations where testers were responsible for testing the function of the application as well as the emotional content?
   Yes    No

16. In what component of a computer application do you believe emotions are or should be incorporated? (you may choose more than one answer)
   a. The interface
   b. The mechanics of the application (the execution)
   c. The intelligence
   d. Specify your own value:

17. For the emotional content, in what stage of the software lifecycle should an expert on emotion be involved? (you may choose more than one answer)
   a. Analysis
   b. Design
   c. Implementation
   d. Testing
   e. Specify your own value:

18. What are the most important issues for the emotional content of a computer application? (you may choose more than one answer)
   a. Aesthetics
   b. Creating a user profile
   c. Inferring the goals and needs of users
   d. Universal usability and appeal
   e. Specify your own value:

19. In your opinion, to what extent is the emotional design of computer games different from other computer applications?

<table>
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<tr>
<th>Very Different</th>
<th>Different</th>
<th>Similar</th>
<th>Very Similar</th>
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156
20. The following questions refer to the affective domain:

a. To what extent do you agree that creating visual and sound stimuli to attract the user’s attention and awareness is important in a computer application?

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b. To what extent do you agree that collecting data that can identify the user’s emotional reactions is important in a computer application?

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c. To what extent do you agree that a user interface should be consistent with the user’s value system?

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21. The following questions refer to user’s experience:

a. To what extent do you agree emotions can influence the user’s experience of a computer application?

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b. To what extent do you agree that responding to the users’ emotions is important for computer applications?

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c. To what extent do you agree that affect-recognition applications pose potential concerns that outweigh the benefits?

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<th>Strongly Agree</th>
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22. Do you believe that embedding emotion in computer applications can have the following as consequence: (you may choose more than one answer)
   a. Reinforcing power
   b. Creating a status difference
   c. Eroding the boundaries between machines and humans
   d. Identity formation
   e. Developing relationships with machines
   f. Specify your own value:

Opinions

23. What techniques do you consider that are effective for embedding emotions in a computer application?

24. List any strategies that you find effective for engaging the user emotionally:

25. Comments:
Appendix 3: Interview Guide

Affective Computing Interview Guide
(Version 3.0, 2008)

1. There are two situations: one when applications are intended to generate emotions in users and the second one when applications recognize the user's emotional state and respond to it. In literature I found these two situations observed as: "affective computing", "emotional design", or "emotion engineering" (the last one was from the gaming field). In my view "embedding emotion into applications" refers to both these two situations. From my survey, I found that many participants (94%) considered that emotion influences the user's experience and only a small number (6%) neither agreed nor disagreed (nobody disagreed). However, when asked if emotion should be embedded in software applications, only 52% agreed and 37% neither agreed nor disagreed. In your opinion, what would be a reason for this response? What would be the main reason why emotional design would not be desired?

2. In what ways can emotions influence the user's experience of a computer application? What are the main reasons for responding to the users' emotions?

3. When asked how different computer games are from other applications in terms of emotional design ("In your opinion, to what extent is the emotional design of computer games different from other computer applications?") 82% participants considered it very different or different and only 18% similar or very similar. Four participants are specialists from the gaming industry. I assumed that their answers will give me a clue. To my surprise, for two of them it is very different, for one similar and for one is very similar. Can you elaborate on this topic? Your answer was "very different" (I'll use here the answer given by the participant). Why?

4. Designers, analysts and psychologists are responsible for the emotional aspect of a computer application. From your experience, can you explain to me what responsibilities are employed in this context? What does responsibility mean in this context?

5. What techniques are used by testers to test the emotional aspect of a computer application?

6. You indicated that you were involved in the life cycle of a software application that involved emotion recognition. Can you explain what techniques and strategies have been used to recognize the user's emotional state or response? (This question will apply only to participants who indicated involvement in emotion recognition.)
7. You indicated that you participated in the design or implementation of a computer application that was unsuccessful because of lack of consideration to the user’s emotions. Can you elaborate on this topic? (This question will apply only to participants who indicated involvement in design or implementation of computer applications that were unsuccessful because of lack of consideration to the user’s emotions.)

8. According to the results of my questionnaire, the most important issue for the emotional content of a computer application is inferring the goals and needs of users. Are you aware of a successful situation related to this issue? What about an unsuccessful situation?

9. According to the literature, a consequence of embedding emotion in computer applications is identity formation. However, only 25% of the participants of my study identified this aspect as a possible consequence. Do you see a reason why?

10. Eroding the boundaries between machines and humans was the main consequence of embedding emotion in computer applications observed by the participants in this study. Can you elaborate more on this subject?

11. Only 63% of the participants in my survey agreed and 31% of the participants in my survey neither agreed nor disagreed with the statement “To what extent do you agree that a user interface should be consistent with the user’s value system?” What would be a reason for this answer?

12. 31% of the participants in my study identified that affect-recognition applications pose potential concerns that outweigh the benefits, 14% disagreed, and a large number (54%) neither agreed nor disagreed. What is your opinion in this respect?

13. Is there anything that you would like to add about this topic that was not addressed in this survey or interview?

Thank you,
Mirela Gutica
Appendix 4: Testing Process

Play Testing Process

1. "Identify design intent.
   a. This is the most important aspect of the user research testing. You must have a clear goal of what you’re testing for. The designer specifies, in great detail, how they intend the user to ‘feel’ at every step of the application. For example: On level 1 they should feel calm and collective, on level 2 they should have high adrenaline and feel exhilarated, on level 3 they should feel sad and want to cry etc.

2. Carefully select your testing demographic
   a. Make sure you bring in testers from all backgrounds.
   b. Bring some fresh users as well as some experienced users.
   c. However, you should still stay in your target audience. If it’s accounting software, bring in accountants etc.

3. Silently observe.
   a. The tester goes in a room by themselves. The room has a one-way mirror so user researchers can look in and the testers have a headset with a microphone that they can talk into. The microphone allows one-way communication only and the testers are warned that they will not be able to ask any questions.
   b. Before the testing session starts, the user is told that they need to say all of their thoughts out loud. Every decision you make when using the application must be explained verbally: why am I doing it like this, I’m frustrated because of this, I’m exciting because of this. They need to talk constantly.

   a. Instrument and record every event that happens in the application and record all actions and responses from the user (video, audio, screen captures, everything)
   b. Instrumentation can be built into your application by logging all actions and state to a database. Each action should have a timestamp so the external
reporting tools used by the user researchers can link events to the other data. For example, a user playing a video game says they're frustrated at time 3:45. Go to time 3:45 in the database and look through every action that happened in the game around that time. Oh, you see the player was killed 20 times in 5 minutes; perhaps this was the cause of the frustration?

c. The more advanced your reporting tools are, the more efficient the user researchers will be in finding the source of the problems.

5. Provide solutions
   a. At this stage, the user researchers compile their results and send a list of action points to the designers, the designers then make the decision to act on the request or not.

6. Repeat
   a. Repeat this process over and over until design intent is reached"

Source: This document was provided by Participant R as an example of design process that was employed in his practice.
CERTIFICATE OF APPROVAL - MINIMAL RISK

PRINCIPAL INVESTIGATOR: Stephen Petrina

INSTITUTION / DEPARTMENT: UBC/Education/Curriculum Studies

UBC BREV NUMBER: H07-00080

INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:

- UBC

Other locations where the research will be conducted:
- UBC room 1224 (Lab space) Home of GRA (Lauren Hall)

CO-INVESTIGATOR(S):
- Teresa Dobson
- Lynn Fels
- Mary K. Bryson

SPONSORING AGENCIES:
- Hampton Research Endowment Fund

PROJECT TITLE:
- Encountering Emotion(s) and Technology
  - Amendment of B04-0615 (H04-80615)

CERTIFICATE EXPIRY DATE: March 8, 2008

DOCUMENTS INCLUDED IN THIS APPROVAL: DATE APPROVED:

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<td>Animators</td>
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<td>Questionnaire, Questionnaire Cover Letter, Tests:</td>
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<td>Theatre Questions</td>
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<td>Main Study Questions</td>
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<td>Letter of Initial Contact:</td>
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<td>Main Study Contact</td>
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The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

Approval is issued on behalf of the Behavioural Research Ethics Board and signed electronically by one of the following:

Dr. Peter Suedfeld, Chair
Dr. Jim Rupert, Associate Chair
Dr. Arminee Kazanjian, Associate Chair
Dr. M. Judith Lynam, Associate Chair
CERTIFICATE OF APPROVAL- MINIMAL RISK RENEWAL

<table>
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<tr>
<th>PRINCIPAL INVESTIGATOR:</th>
<th>DEPARTMENT:</th>
<th>UBC BREB NUMBER:</th>
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<tbody>
<tr>
<td>Stephen Petrina</td>
<td>UBC/Education/Curriculum Studies</td>
<td>H07-00080</td>
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<th>INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:</th>
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<td>Institution</td>
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<th>Other locations where the research will be conducted:</th>
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<tr>
<td>UBC room 1224 (Lab space) Home of GRA (Lauren Hall)</td>
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<th>CO-INVESTIGATOR(S):</th>
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<tbody>
<tr>
<td>Teresa Dobson</td>
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<tr>
<td>Lynn Fels</td>
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<td>Mary K. Bryson</td>
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<td>UBC Hampton Research Endowment Fund - &quot;Encountering Technology and emotion(s)&quot;</td>
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<td>Encountering Emotion(s) and Technology</td>
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*Amendment of B04-0615 (H04-80615)

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The Annual Renewal for Study have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

Approval is issued on behalf of the Behavioural Research Ethics Board

Dr. M. Judith Lynam, Chair
Dr. Ken Craig, Chair
Dr. Jim Rupert, Associate Chair
Dr. Laurie Ford, Associate Chair
Dr. Daniel Salhani, Associate Chair
Dr. Anita Ho, Associate Chair