

AFFECTIVE DESIGN IN TECHNICAL COMMUNICATION

by

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ABSTRACT

Traditional human-computer interaction (HCI) is based on ‘cold’ models of user cognition; that is, models of users as purely rational beings based on the information processing metaphor; however, an emerging perspective suggests that for the field of HCI to mature, its practitioners must adopt models of users that consider broader human needs and capabilities. Affective design is an umbrella term for research and practice being conducted in diverse domains, all with the common thread of integrating emotional aspects of use into the creation of information products. This thesis provides a review of the current state of the art in affective design research and practice to technical communicators and others involved in traditional HCI and usability enterprises. This paper is motivated by the developing technologies and the growing complexity of interaction that demand a more robust notion of HCI that incorporates affect in an augmented and holistic representation of the user and situated use.

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LIST OF ACRONYMS

ACT-R	Adaptive Character of Thought - Rational
HCI	Human Computer Interaction
MCD	Mobile Computing Device
QUIS	Questionnaire for User Interaction Satisfaction
RSD	Relative Subjective Duration

CHAPTER ONE: INTRODUCTION

During the summer of 2003 I observed a usability evaluation of prototypes of mobile computing devices (MCDs) being developed for fieldworkers conducting data collection for a large nationwide survey. During the evaluation session, test users completed a mock interview and collected data on a tablet PC configured to replicate the workflow outlined in the product specifications in development. In addition to the interview segment of the evaluation, test users performed several tasks designed to guide the development of the device on a more general level. Screen space is a commodity of particular value when designing for MCDs, and therefore, the smallest size an icon can be displayed on the screen and still be manipulated with a stylus is an issue of great interest. To address this issue, the evaluation session included a task where users were presented with a series of icons of various sizes which they were instructed to drag and drop into a target area. The tablet PC automatically recorded data regarding the user's accuracy and efficiency in completing this task.

As the users received increasingly small icons, test administrators often noticed changes in their behavior and mood: repositioning themselves in their seats, sighing, muttering inaudibly under their breath, and increasingly frustrated facial expressions. During one trial, as the icons reached a size of four pixels by four pixels, a test user's grip on the stylus changed from one typically used to grasp a writing implement to one typically used to clutch a stabbing implement. The data later supported our test user's sentiment; a size of four pixels by four pixels was too small for a usable icon.

The design and execution of this MCD evaluation exemplifies the most prominent model of usability in practice today: consideration for the dimensions of the user's accuracy, efficiency,

and satisfaction while performing tasks with the system. The MCD example also illuminates limitations in how the third dimension of usability, user satisfaction, is most commonly addressed. Classically, a satisfying system means that “the system should be pleasant to use, so that users are subjectively satisfied when using it; they like it” (Nielson, 1993, p. 26); however, the human computer interaction (HCI) design and evaluation process most frequently accepts the absence of overtly negative responses to a system as an acceptable level of success in achieving user satisfaction. Traditionally, HCI is viewed as the discipline charged with developing quality interfaces between people and their computers by employing knowledge from both the social sciences and the technical disciplines such as computer science and engineering.

The traditional approach to HCI design concerns itself primarily with constructing a system that matches the users’ cognitive models of that system. If the system supports ease of learning, ease of use, efficient use, low error frequency, and graceful error recovery, then by definition, the system is usable. This approach has won vast improvements in the relationship between users and their technology, but there is an emerging view that HCI must mature past this limited conception of how user emotions affect the processes and outcomes of human use of technology. The argument that the models of cognition upon which usability is based are incomplete without accounting for emotion and, therefore, a less than optimal foundation for design serves as the impetus for affective design—HCI that considers user emotion an essential aspect of successful design.

Affective design is a step forward in the maturation of HCI. This perspective is newly emerging and in many senses still in the process of identifying its core theories, methods, and other identifying characteristics. Broadly, affective design can be thought of as “both the notion of affective interfaces, and design as an aesthetic discipline that deals with the instilling of

certain affects in the user. The focus of affective design, then, is both the interplay between efficiency and affect, (for example—can a task be performed better by integrating bodily affect cues?) and the more hedonistic qualities of products, where positive experiences are ends in and of themselves” (Bødker, Christensen, & Jorgensen, 2003, p. 136). Affective design is an umbrella term for research and practice being conducted in diverse domains, all with the common thread of integrating emotional aspects of use into the creation of information products. Although there is a community of researchers and practitioners who identify what they do as affective design, there is a much broader collection of literature that falls under the purview of current conceptualizations of affective design yet does not identify itself as such. Ostensibly, in this study, anything that adheres to the paradigm shift “It is how the user evaluates rather than how to evaluate the user” (Khalid, 2004, p. 1) is considered affective design. Major contributors to the nascent discipline of affective design include computer scientists, psychologists, industrial designers, and technical communicators.

The field of technical communication, with its roots in rhetoric and technology, has an ideology or perspective that is conducive to considering affective issues in design of information products. Carliner’s three part framework of information design emphasizes the affective level of use, in conjunction with the cognitive and physical levels. In the simplest of terms, Carliner’s framework decomposes information design into the users’ ability to find information (the physical level of design), the users’ ability to understand the information (the cognitive level of design), and “the ability to feel comfortable with the presentation of the information” (Carliner, 2000, p. 564). Therefore, the inroads for affective design in technical communication and interaction design have been laid, yet current frameworks, like Carliner’s and like those of traditional HCI, suffer from the limited consideration of emotional issues in design. Even though

academicians do make room for affect in information design, the distance between theory and practice is large; recognizing the need for affective design and developing a solid methodology grounded in theory are two very different things.

Muriel Zimmerman speculated that emerging technologies would force a migration of the locus of user accommodation to technology from the documentation to the interface itself. In keeping with this reasoning, technical communicators have redefined their roles as user advocates in the design process from document designers to information designers to interaction designers. The shift in job titles represents positions with an augmented set of skills but a consistent philosophical foundation. Creating help systems and designing interfaces are indeed different tasks, but the underlying motivation of “improving relations between people and their computers” (Zimmerman, 2001, p. 200) is the same. Zimmerman challenges the field to adapt early in an effort to expand the boundaries of technical communication. She argues that the progression is inevitable and that the underlying competencies of technical communication will remain constant as the surface appearance of the work co-evolves with the technology. As a consequence, she predicts that, in the future, technical communicators “will still be called *technical writers* just as drivers of diesel trucks are still called teamsters”(Zimmerman, 2001, p. 204).

As a progression of the notion of interaction design, affective design is relevant to technical communicators and usability specialists. Therefore, the aim of this thesis is to provide a review of the current state of the art in affective design research and practice to technical communicators and others involved in traditional usability enterprises. HCI evolves with the demands of new technologies and the understanding of interaction derived from its multidisciplinary constituency. This study is motivated by the developing technologies and the

growing complexity of interaction that demand a more robust notion of HCI that incorporates affect in an augmented and holistic representation of the user and situated use.

To achieve this end, this thesis reviews philosophical, psychological, and computational underpinnings of affective design, the theories called upon to actualize affective design. In addition, this study analyzes the emergent practice based methods that have grown out of a practical need for information products to address aspects of user emotion. This market and workplace demand for models of product design and evaluation that include user emotion has outpaced the formation of a solid theory of affective design. Chapter 2 documents the shift in dominant ideas about the nature and purpose of emotions in humans, both in terms of a philosophical departure from the mind/body duality and from the perspective of recent developments in the areas of cognitive neuroscience, psychology, and related disciplines. After surveying the current state of thinking about notions of emotion in humans, Chapter 2 turns to the nature of emotions in computing and to the idea that there is a definite need for computers to have capabilities analogous to human emotions. After treating the issue of affect separately, in humans then in computers, Chapter 3 provides a treatment of current theories of interaction between technology and users. Chapter 4 describes emerging methods of design and evaluation as well as aspects of current relevant methods of HCI employed by technical communicators and information designers and relates these methods to the theories presented in Chapter 3. The central argument of Chapter 4 is that technical communicators are versed in the foundations of affective design practice and, by applying knowledge of core affective design themes, they are capable of meeting the goals of affective design. Chapter 5 makes connections among the issues presented in this thesis, current technical communication, and traditional usability practice and

makes the argument that affective design is not an academic exercise, but a necessary evolution of HCI that can be realized in practical settings.

Although the technology to create truly ubiquitous, pervasive, and effective holistic and affective interaction is not yet common in the marketplace, that day is near and progress in design practice on today's technologies can be greatly increased with a broader notion of user interaction. Affective design can create safer, more productive, and more satisfying HCI. The complexity of future technologies will both demand the use of affective design and allow for its full development. By taking on the goals of affective design with today's technology, designers can create a more satisfying and efficient experience for users of technology while simultaneously positioning themselves as early adapters of new computing technologies and models of interaction. Research and practice in HCI guided by the metaphor of people as information processors has yielded incredible advances in the usability of information products, particularly in the area of efficiency. These successes are not to be washed away but to be augmented by the ascendancy of more robust and realistic models and methods of HCI.

CHAPTER TWO: AFFECT IN HUMANS AND COMPUTING

As the discipline's name implies, "Human Computer Interaction (HCI) lies at the intersection between the social and behavioral sciences on the one hand, and computer and information technology on the other" (Carroll, 2003, p. 1); and, therefore, HCI progresses as a discipline not only through developments within its own bounds but also through developments within the many parent disciplines that investigate the nature of each side of the interaction independently. In general terms, interaction can be viewed as a two component equation with knowledge about the user(s) (that is, the understanding of the basic nature of human thought and behavior as individuals and in groups) being the first component, and technical ability (that is, knowledge about how to construct technical systems) being the second. Essentially, this model means that, as information designers, we need to know what abilities and limitations in the user we need to support and then how to go about doing that with our information products.

Therefore, to mature and engage a broader range of user needs, HCI as a discipline must do two things. First, HCI must develop a more complete method of representing how users think, feel, make decisions, and generally live their lives. Secondly, HCI must work in a methodical manner to meet these needs with technology by becoming skillful designers who effectively incorporate the level and type of technology best suited to supporting the needs of the user community.

To that end, this chapter explores research from relevant fields that can contribute to a method of interaction design in which user affect plays a central role. Section 2.1 addresses the need of HCI to adopt a broader notion of users by surveying the current understanding of emotion from the perspectives of philosophy, neuropsychology, and cognitive psychology as well as a review of how this understanding has been translated into a research metaphor that can

be used to investigate and design user experience. The intent behind this section is not to provide a review of the substantial literature from the numerous fields researching human emotion but to document the broad strokes of the current knowledge and the philosophical shift in the approach to understanding emotions. This will simultaneously validate an interaction design perspective that considers user emotion as well as guide in the development of its theory and practice. Section 2.2 addresses research aimed at representing and simulating affect in computing as well as reviewing computers that can recognize and respond to affect in the user. Section 2.3 situates these broadened representations of users and advanced notions of computing ability by discussing the significance of people interacting with technology in this augmented manner.

2.1 Affect and Cognition in Humans

Until recent decades, emotion has remained a generally ignored topic in empirical research; its existence has been explained away as an antiquated evolutionary throwback destined to dissolve away as humanity matured into a state of pure logical rationality. The reasons for the absence of consideration of emotion are twofold. Firstly, as represented in the statement above, the philosophical tradition expressed in the Cartesian duality of mind and body placed emotions outside the bounds of scientific inquiry; they were perceived as ephemeral in origin and irrational in nature. Secondly, regardless of whether or not emotions were considered a significant area of research, the perceived vagueness and subjectivity involved in the experience of emotion makes investigation in that area seem a daunting if not impossible task (Lane & Nadel, 2000). Due in no small part to questions raised in the pursuit of artificial

intelligence, a large-scale reevaluation of the commonly perceived antagonistic relationship between emotions and cognition has been undertaken by researchers working in diverse and numerous fields. Though these efforts remain relatively nascent and little is truly understood about emotions from any perspective, the research points toward a view of emotions as a legitimate subject of inquiry and an integral element of rational behavior as well. The following sections document likely contributions from varied disciplines to models and methods of affective design.

2.1.1 Philosophical Perspectives on Affect and Cognition

The nature of human emotion has been an area of interest for philosophical study since the earliest eras of western civilization. In The Art of Rhetoric, Aristotle devotes considerable effort in expounding upon the role of emotion in persuasion. Aristotle defines the nature of rhetoric as that of judgment and suggests that persuading the listener to make a certain judgment involves putting the listener into a certain emotional state. In doing this Aristotle makes an acute observation about the nature of human perception and cognition; specifically, that factors affecting a judgment “do not seem the same to those who love and those who hate, nor to those who are angry and those who are calm, but altogether different or different in magnitude” (p. 141). Therefore, the careful manipulation of the listener’s (or the user’s in modern terms) emotional state is central to the art of leading that listener to the conclusions and judgments desired by the speaker (or the designer). The use and study of language are increasingly being recognized as fundamentally important to advanced notions of HCI. See section 3.6 for a discussion of the importance of language and section 3.7 for a discussion of persuasion in

affective interaction design. As discussed in these sections, the importance of the themes of language and persuasion in the affective design literature position technical communicators to be early adopters of an affective perspective on the development of information products.

Language is a mechanism of social organization, and emotion has long been considered to be a driving and guiding force in how people interact in groups. Adam Smith, the father of modern economics, outlined his conception of the purpose of emotions in his Theory of Moral Sentiments (1759). Smith was strongly influenced by Stoic philosophy and the ancient Greek thinkers. This influence is evident in his economic theory as well as his work on emotions in society. He considered emotions to be the glue by which a society maintained coherence and by which it balanced the goals of its citizens. The central idea of Smith's extensive treatment is that our ideas of justice and propriety are based on our emotions and, more specifically, our ability to sense the emotions of others and to imagine our own emotional reactions to situations that we have not or are not currently experiencing. To Smith, complex and modern (from his vantage) civilization would be impossible without the abilities made possible by human affect. Being that a key function of emotions involves social aspects of human interaction, a more robust understanding of the social context of computers and technology use is necessary for truly affective design. We return to the theme of embedded and situated technology use in section 3.7.

The subject of emotion is enjoying a renaissance in modern philosophy, a period of renewed interest motivated in part by the demands placed on people in fast paced and information rich environments. In The Rationality of Emotion, the philosopher de Sousa explores how emotions affect rationality and how emotions can be the subject of an evaluation based in objectivity. His treatment of the topic is significant in many regards, but key features in the general context of information technology are his idea of emotion as a solution to the

“Philosopher’s Frame Problem” (de Sousa, 1987, p. 192) and emotion as learned phenomenon; respectively, these constitute the purpose and nature of emotions. Both of these ideas manifest in the “warming” of cognitive psychology (See section 2.1.3), that is, in the transition from cognitive models based in an information processing metaphor to models that incorporate social and affective elements of an interaction experience.

Objectivity is central to de Sousa’s examination of the nature of emotions. He adopts the perspective that the outside world elicits emotions and rejects the notion that emotions are projected onto reality. Borrowing from Plato’s Euthypro, de Sousa asks whether “we love something because it is lovable, or call it lovable because we love it?” (de Sousa, 1987, p. xv). His argument is for the former. And, derived from the idea that emotions are a response to objects and occurrences in the real world, de Sousa asserts that the depth and breadth of our repertoire of emotions are learned through our experience in what he calls paradigm scenarios. There are two components to the paradigm scenario: the objects of a certain emotion type, and a set of normal responses to the object. Essentially, something in the environment triggers some emotional response from a set of possible and rational emotional responses. The responses start as biologically based, but as the person develops, the emotional reactions become more culturally based.

Emotions are purposive according to de Sousa; they are vital to rational behavior in that they work to find solutions to problems when people either know too little or too much about the situation to make a purely logical decision. This, in part, is the philosopher’s frame problem: to make a decision, we only call upon relevant information, but relevance cannot be surmised until we’ve called upon the information. It is de Sousa’s hypothesis that “emotions are species of determinate patterns of salience among objects of attention, lines of inquiry, and inferential

strategies” (de Sousa, 1987, p. 196). Essentially then emotions are a knowledge management tool, blocking access to irrelevant information and drawing our attention to information and methods of action most likely to be effective in a given situation. Emotions limit the number and type of options available so as to increase the likelihood that the correct choice is made.

So from de Sousa, we can take a sense of the purpose and nature of emotions. They are objective, learned (especially in their higher order manifestations), and intertwined with cognition in a dependant manner. This perspective warrants entry of concern for affective issues into the design of information products intended to accomplish work; that is, entertainment is not the sole domain of affective design. Technical communicators sponsored to develop information products that impart the knowledge and ability to accomplish a task or to develop the interface tool by which the user carries out the task need to concern themselves with the emotions of the user. The work of de Sousa foreshadows a recurrent theme: designing to support a user’s cognitive functioning is not enough when that user is immersed in a complex information rich environment. Affective design is not the development of fun, cute, or pleasurable products; it is the continuation of traditional HCI in that it seeks to improve the relationship between users and computers as tools.

2.1.2 The Nature of Affect in the Human Brain

Human emotion has not enjoyed the lengthy history of exploration in the areas of psychology and neuroscience that it has in philosophy. However, recent trends in the research are beginning to compensate for the relative and historical lapse in attention devoted to this subject by these disciplines. This section is devoted to reviewing exemplars of theory and

research into the nature of human emotion taking place in the fields of psychology and neurology. This is by no means a comprehensive review of the subject as that is well outside the scope of the space available. In addition to the works covered here, interested readers are referred to Panskepp (1998) and Lane and Nadel (2000) for a review of the neuroscience of emotion, and Eich, Kihlstrom, Bower, Forgas, and Niedenthal (2000) and Frijida, Manstead, and Bem (2000) for contemporary psychological perspectives on the subject.

The work of the neurologist Damasio (e.g. 2003; 2000; 1999) lends physiological credence to de Sousa's ideas about the purposive nature of human emotions and their role in decision-making. Damasio has put forth the concept of somatic markers as an explanatory mechanism for empirical evidence of the role of emotions in expediting the human decision-making processes. The idea of somatic markers is akin to de Sousa's comments on emotions as solutions to the philosopher's frame problem. Essentially, emotions act as signals that tag the alternative courses of action and options in the decision space with a positive or negative marking of varying intensity. This marking of options allows the reasoning process to consider fewer options and, in some circumstances of intense association of emotion, makes the reasoning process superfluous.

In a related thread of research, Lazarus (1991) put forth a theory of emotions as appraisal of the environment. Stemming from his early work on stress, Lazarus's theory, called the cognitive-motivational-relational theory of emotion, is an ipsative theory of emotion; that is, it focuses on the various components of an individual, and how those components are synthesized in that one individual as opposed to a normative theory that focuses on what people in general are like. Lazarus argues that emotion cannot be understood by looking at either the individual or the environment in isolation and that the individual's appraisal of the ever-changing environment

is the proper locus for the understanding of emotion. Therefore, the individual's evaluation of his or her present situation in the environment or any specific aspect of that (i.e. the relation) is evaluated against that individual's goals (i.e. motivations) and assessed to be either goal congruent and ascribed positive emotions, or goal incongruent and ascribed negative emotions (i.e. appraisal).

Many of de Sousa's ideas concerning the nature of emotions resonate in Orotony, Clore, and Collins' The Cognitive Structure of Emotion, which attempts to formulate a theoretical model of emotion that includes origin, global structure, interrelation, and characteristics of individual emotions. On whole, their model is an attempt to map the conditions that cause specific emotions as well as the variables that influence the intensity with which they are felt. Though still theoretical, their model solidifies many of the ideas present in de Sousa's work into a state that can be empirically evaluated. Orotony's approach parallels the objective perspective of de Sousa in that emotions are viewed as reactions to the outside world, with the caveat that the world that is reacted to is a world construed by the individual and not necessarily a world as it really exists.

2.1.3 An Augmented Research Metaphor

Work such as that of Damasio, Lazarus, Panskepp, Orotony & Clore, and others promises to yield great returns in the areas of affective design as it will produce a greater and more detailed understanding of how the human affective system functions and, therefore, allow for predictions to be made of how design choices will affect user's emotion and how the user's emotional state and reactions will affect performance. Much research is needed before this type

of predictive model of human affect could be fully developed and employed in a design situation. However, by expanding the research metaphor of humans as information processors to include some of the issues discussed in the above sections, researchers and designers will be more effective at addressing social and affective issues in the use of technology.

Classically, HCI has employed the metaphor of humans as information processors. This is referred to as ‘cold’ cognition in that it emphasizes the role of information encoding, storage, and retrieval, and casts humans in mechanistic roles. This has been a valuable tool for increasing the understanding of human cognition and it is especially convenient for the HCI community; using a metaphor rooted in one side of the interaction to understand the other side simplifies the object of inquiry. However, ‘cold’ cognition has constrained understanding in several regards. First, the computer metaphor does not allow for motivation and emotional issues such as those described above. Secondly, it is difficult to explain social interaction and behavior in terms of information processing, and, therefore, much of the research conducted under the auspices of ‘cold’ cognition focuses on the individual and ignores the social context. The need to address these limitations has spurred the adoption by many researchers of an increasingly ‘warm’ conception of cognition.

Schwartz (1998) documents this ‘warming’ of cognition and discusses a broadened metaphor for understanding human cognition; instead of the humans as information processors, Schwarz advocates the perspective of humans as motivated tacticians. This metaphor is designed to capture the ideas of social cognition and is characterized by humans “having multiple information processing strategies available, selecting among them on the basis of goals, motives, needs, and forces in the environment” (Taylor, 1998, p.75). The motivated tactician metaphor

communicates the adaptability and flexibility of the user as well as the context dependent nature of how the user will interact with technology.

2.2 Intelligence and Affect in Computing

Historically, one side of the HCI equation has been artificially reduced to match the other through the metaphor of people as information processors. The previous section examined alternatives to this metaphor of understanding users that have two parallels in computing. First, for computers to reach their full potential as information processors, they must possess or simulate an affective system. As highlighted in section 2.1 of this chapter, there is a growing consensus among researchers that the emotions are an integral component of reasoning and decision-making processes. Only when computers can be provided with a system analogous to human emotion will they be able to function outside of strict rule based systems. Second, in order to maximize the interaction between humans and technology, computers must be able to identify emotions in the user and respond appropriately. In this way, computers can interact with users in a social manner. Social interaction is central to the idea of invisible computing (Norman, 1998)—HCI in which the computers are ‘invisible’ in the sense that they don’t interfere with human social interaction—which in many regards is seen as the ultimate goal in HCI. The following two sections deal with each of these issues: (1) computers that exhibit emotions, and (2) computers that can sense and respond to emotions in human users.

2.2.1 Where is the Intelligence in Artificial Intelligence?

We now turn to an illuminating example from the state of the art in artificial intelligence. The Adaptive Character of Thought – Rational (ACT-R) cognitive architecture (Anderson & Lebiere, 1998) is arguably one of the most widely used and accepted cognitive modeling platforms. That is, ACT-R represents the academic world's most advanced method for simulating human cognition with computers. ACT-R is used as a research tool for issues in cognitive science and psychology, as well as in practical applications such as automated usability evaluations. In this applied process, an ACT-R cognitive model, representing a simulated human user, interacts with a simulated task environment (that is, a computer program that represents the design specifications of the product to be built). In this way, designers can gather information about use before the system is actually built, thereby saving time and money by finding design flaws even before an actual prototype has been constructed. However, there are arguments against the validity of using synthetic users to gather interaction data, the most prominent of which is that present artificially intelligent agents lack representation of affective systems.

For instance, Fum & Stocco (2004) present an interesting model of experimental data involving the Gambling Task (GT) that elucidates some of the specific limitations of cognitive models in ACT-R and some general issues in current artificial intelligence applications. The GT is a well known research paradigm that has been used to investigate the role of emotion in decision making (Bechara, Damasio, Damasio, & Anderson 1994; Bechara, Tranel, & Damasio 2000). The task involves real world factors such as uncertainty, real time decision making, and choices having personal consequences that could be rewarding or punishing. At the beginning of each session of the GT the session administrator gives the participants a certain amount of play

money. The session then proceeds through a series of trials. In each trial, the test administrator asks the participants to choose cards from one of four decks, each with a complex schedule of gains and penalties in the play money available to the participant. At the beginning of the session, the administrators inform the participants that their goal is to maximize the amount of play money they have left at the end of the session.

In this experimental task situation, two of the four decks provide gains over the long run and the other two yield losses, but the complexity of the pay off schedules makes it difficult for the participant to determine which decks have what type of long term outcomes. The classical experiments with this task involve comparing the performance of people with orbitofrontal cortex (OFC) damage (i.e. people with impaired affective functioning, but intact rational and logical thought capabilities) to the performance of people with no brain damage (Bechara et al. 1994).

Generally, people with no OFC brain damage tend to stop choosing from the two decks with negative outcomes, even before they are able to vocalize any thoughts about why they are doing so, while those participants with damage to their OFC and accompanying decrement in affective functioning continue to choose from the decks that have long term negative outcomes. Fum & Stocco created a cognitive model in ACT-R and a simulated task environment representing the GT. When the ACT-R data was compared to that of humans performing the GT, they found that the ACT-R cognitive model fit the data gathered from the brain damaged patients. Therefore, the ACT-R automated usability data is essentially gathering performance data on users who are treated as though they had OFC brain damage. This is a strong argument against current “cold” artificial intelligence use for gathering automated usability data for consideration in the design process.

The above example is illustrative of the downfalls of attempting to imbue computers with intelligence without addressing the role of the affective system. This is a well recognized issue within the artificial intelligence research literature. Minsky (1985) makes the argument that machines cannot be intelligent in any meaningful way without having some type of emotional capabilities. He predicted similar types of issues as those illustrated in the above example; that is, computers will be unable to make effective decisions in complex and ambiguous real world settings that do not adhere to strict rules. Minsky also argued that emotions are essential to guiding the behavior of intelligent systems; he believes that they are necessary in order to provide checks and balances for deciding upon courses of actions in ambiguous situations. Minsky explores the term “machine-like” to illustrate the shortcomings of computing without emotions. The first connotation of machine-like is “completely unconcerned, unfeeling, and emotionless, devoid of any interest” (p. 163) and the second is “being implacably committed to some single cause” (p. 163). Without emotions to guide and motivate behavior, computers cannot make decisions regarding priority of goals in real world situations. This inability to dynamically and independently prioritize goals and actions results in either the inability to focus on anything as described in the first definition above, or the fanatical devotion of all resources to one goal, as described in the second definition above.

The necessity of endowing machines with properties analogous to human emotions is generally accepted within the artificial intelligence community. Martinez-Miranda & Aldea review the current research in emotional artificial intelligent agents and report limited, domain specific successes. The majority of the research has been conducted in the areas of HCI, game development, entertainment software, and the modeling of human decision making processes

(Martinez-Miranda, & Aldea, 2005). The successes in any one situation or system, however, are not necessarily transferable to other domains.

2.2.2 Empathy in Computing

A separate, yet related, issue to computers that possess capabilities analogous to the human affective system is one of computers sensing and responding to user affect. In her seminal work, Rosalind Picard (1997) outlined the tenets of Affective Computing, the branch of computer science concerned with these issues. Picard argues that the mounting scientific evidence points to the conclusion that emotions are a vital part of human reasoning and that incorporating emotions into computer design and interaction will allow for richer interaction between computers and users. She lays out criteria for computers to recognize and express emotions. To recognize emotion in the user, the computer must be able to receive input (for example, facial and hand expressions, voice, physiological indicators of emotion) and predict the user's underlying emotions based on pattern matching procedures. The pattern matching includes complex activities such as reasoning about social context and user goals. The computer must also be able to get to know the user. In other words, it must be able to learn about the user in order to better carry out pattern matching. The computer learns about the user in the sense that it stores information about how the user reacts to information content and display as well as how the user alters behavior when in certain emotional states, as measured by affective input (for instance, voice, physiological measures). Lastly the computer must be able to output the assessment of user emotion in some kind of meaningful way. This expression of emotion involves input from the user or the computer itself if it has emotion-generating features.

Computers must have two emotional pathways: (1) intentional whereby the computer deliberately expresses an emotion, and (2) spontaneous whereby the system's outputs are modulated in a process akin to human moods. Lastly, social norms are crucial to the computer's expression of emotion; output must adhere to what is appropriate for the situation.

2.3 Towards Affective Design Theory

The fast-growing body of research being conducted in the area of human emotion is such that, as much ground as has been covered in this chapter, there remain many omissions. It truly is an exciting time in many disciplines as researchers seek fundamental understanding of the human affective system and means of creating computing environments that have and respond to emotions. The radical shift in thinking about emotions as essential components of thought and action is present in philosophy and bolstered by psychological theory and empirical evidence. Computer scientists and artificial intelligence researchers consider emotion in computing as an essential next step for increasing the repertoire of skills computers have. This chapter has reviewed the current state of both sides of the interaction equation: what we know about user affect and what we know about affect in computing.

The goal of much of the research presented in this chapter is the construction of a comprehensive model of human thought and action. This is a significant step for holistic HCI; a valid and comprehensive model of emotion and cognition would be a windfall for the field. To date, HCI has produced tremendous increases in the usability of products by employing the "cold" models of cognition. Therefore, the development of a "warm" model suitable for exploitation in the form of design strategies is a prerequisite to similar gains in holistic

interaction. While this chapter has shown that the prerequisite knowledge for creating such a model does not exist, it has documented a concerted effort by researchers working to meet that goal. The following chapter turns away from separate discussions of users and technology and examines the current state of affairs in the study of interaction and technology use. Chapter 3 is dedicated to reviewing the theories presently being developed in the literature and employed in affective design practice.

CHAPTER THREE: RESEARCH THEMES IN THE AFFECTIVE AND INTERACTION DESIGN LITERATURES

Affective design is a multidisciplinary research area, with contributions from computer scientists, psychologists, interaction designers, and technical communicators to name but a few. Each of these disciplines has the potential of employing a separate set of underlying assumptions about the nature of the world in their efforts at solving affective design related problems. Because of this diversity in perspectives used in studying and practicing affective design, there is a real possibility of knowledge loss between the disciplines and a high probability the researchers or practitioners that strongly identify with any one of these perspectives will be unaware of research or practical methods being used in a separate discipline. However, there are common threads running through the disparate research and practical approaches. By identifying themes in the research that span the disciplinary boundaries, the following sections will build a broad foundation upon which a thorough interdisciplinary understanding of affective design can be built.

Although there is a defined affective design research community, not everyone doing affective design research and practice, or work relevant in some other way to affective design, is a part of it; that is, the diversity of perspectives addressing affective design works against clear communication and the emergence of a cohesive research community. Similarly, there are no real theories of affective design, only of the individual components involved in affective design and of general interaction of people and technology. Therefore, any theory of interaction design or theory of any other origin that has implications for affective design should be considered in the development of methodology of design that incorporates user emotion. The starting point for this discussion is the collection and review of theories and models of interaction and design, but

other sources will be used to clarify discrepancies between the disciplinary thinking as well as to fill in gaps of missing information. This chapter presents a list of common themes that have emerged across the disciplines of research that focus on theories that have implications for affective design. These themes constitute the substance of this chapter. Each will be addressed below.

3.1 Art or Science?

As an evolution of HCI, affective design is halfway between art and science (or design and engineering) and the debate over the appropriate perspective to adopt for a unified cross-disciplinary approach continues. In traditional HCI there is a consensus that both approaches, a normative model and an artistic model, are valid and that each has its relative merits and shortcomings. However, the agreement surrounding this point in affective design is less solid. In fact, a reoccurring question in the literature asks, is a law abiding and nomothetic discipline (i.e. one based on normative theory) of affective design possible? For some the answer is a resounding no; Overbeeke, Djajadiningrat, Hummels, Wensveen, & Frens (2003) argue that the influences of engineering and psychological models of interaction are the very thing holding back the field of affective design. They adamantly support the dominance of the role of designers and creativity in affective design. Others, most notably Norman (2004), take an approach consistent with the ideas of de Sousa and Damasio discussed in Chapter 2, namely that human emotions are subject to objective study and rationality.

There is an interesting middle ground in this argument. As the underlying knowledge (or the gaps in knowledge concerning the nature of emotions in humans discussed in Chapter 2)

necessary for robust engineering models does not exist, some researchers in this area promote heuristics for making do until that knowledge is available. Sengers (2003), an artificial intelligence researcher working in design, argues that the richness and complexity of human experience can not be represented in a clean model of interaction (that is, an engineering model that follows strict rules). Instead, she offers several heuristics by which to create meaningful interaction with computers. First, she believes that focusing on human reactions is essential; designers should try to trigger complexity in the mind of the user rather than representing it concretely in the information product. That is, the human strengths of interpretation using cultural and contextual knowledge can replace an engineering model of the user. Secondly, she believes that systems can achieve the appearance of complexity and therefore rich and emotional interaction by bootstrapping off human complexity. In other words, systems can employ simple rules to react to the complexity of human behavior and, therefore, appear to be complex by virtue of the complex system input. Finally, Sengers suggests that designers focus on meaning rather than information. The common notion of emotion in affective computing (see Section 2.2.2) is that of a form of data that is to be extracted from the user and manipulated in some way; Sengers argues that designers should focus on perceptions of emotional valence—what the information means to the user.

3.2 There are at least Three Levels of Design

Theories and subsequent methods of affective design must in some way address the dynamic, systemic, and ever present nature of the effects of affect on human cognition and interaction with the environment. To this end, there is a need to organize thinking about how

emotion affects use. Frameworks for the categorization of affect in design have emerged from several sources, and, not surprisingly, similar patterns have emerged from the various perspectives. Table 1 lists the main components of three categorization schemes proposed for affective design: the three levels of processing model (Norman, 2004), the Four Pleasures (Jordan, 2000), and the framework for affective needs in product design (Khalid & Helander, 2004). This section will discuss these frameworks and the connections among them.

Table 1: Affective Design Categorization Schemes

The Three Levels of Processing (Norman, 2004)	The Four Pleasures (Jordan, 2000)	Framework for Affective Customer Needs in Product Design (Khalid & Helander, 2004)
<ul style="list-style-type: none"> • Visceral • Behavioral • Reflective 	<ul style="list-style-type: none"> • Physio-pleasure • Socio-pleasure • Psycho-pleasure • Ideo-pleasure 	<ul style="list-style-type: none"> • Holistic attributes • Styling • Functional design

3.2.1 The Three Levels of Processing

Norman’s model is very much a high-level information processing model of the brain’s affective system combined with design implications. The lowest level, the visceral level, consists of “pre-wired” processing. It is an automatic process that makes simple and rapid decisions about the environment through pattern matching. The visceral level of the brain reflects the earliest stages of human evolution; it sends messages directly to the muscles and higher stages of processing about the nature of objects and situations (such as, is this safe or dangerous? Is this good or bad?). Visceral responses to the environment are invariant across cultures (for example, the universal association of symmetry with beauty) and, therefore, considered to be “hard-wired” and non-modifiable, although the higher levels of processing can

override visceral judgments. The nature of visceral level processing emphasizes the importance of the physical properties of the technology, that is, of form and shape. Design responsive to the needs of a user's visceral system will focus on the immediate emotional response to how a piece of technology appears to the user. Visceral processing manifests as a gut intuitive reaction to a product. "Is this good or bad? Is this something I want to use or something I want to avoid?" Negative reactions can keep a person from using a product as well as affecting the way they use the product by feeding forward into the subsequent stages of processing.

The next level—behavioral processing—concerns a separate set of human needs and abilities. The behavioral level of processing controls everyday behavior. This level is not necessarily conscious, in that practiced tasks can achieve a level of automaticity. Behavioral processing is the domain of traditional usability engineering. It is about performance and functionality; appearance is not important. For a design to be responsive to a user's behavioral processing needs, the product must be functional, understandable, usable, and physically satisfying to use. To be functional, an information product must have a use and a purpose. It must help the user meet certain environmental or task requirements. Next, the technology must be understandable; the user must be able to have an accurate conceptual model of how the technology works so that he or she can adapt when things do not go as planned. Understanding comes in large part from continuous feedback from the system. After understanding comes usability. The user must not only know what to do with the technology, but the technology must accommodate the user's abilities in joint execution of tasks; it must be usable. Lastly, in behavioral processing the physical feel of the product must be satisfying and pleasurable to the user. Pleasure from products designed to support behavioral processing or visceral processing is quite different from that derived from the highest order processing—reflective processing.

Humans have the unique capacity to think about our actions; we can evaluate the total experience of using a product, consider its visceral and behavioral appeal, and relate that to our memories, culture, and social relationships. This constitutes the reflective level of processing—the message the product sends to the user and the user’s resultant self-image. So, even if a product supports visceral and behavioral processing, that is, it creates an immediate and positive emotional reaction in the user and it is functional, understandable, and usable, it may not contribute to the user’s self-image and larger personal satisfaction. Traditionally, reflective processing is not one of the mainstays of usability, namely performance and satisfaction. These types of reflective concerns are usually handled in the marketing departments where a product is often framed as connoting a certain degree of status, prestige, or other social identification to the people who use it.

3.2.2 The Four Pleasures

Jordan’s model is an application of a more general framework for classifying pleasure (e.g. Tiger, 1992) to the domain of design. This framework is representative of a marketing and consumer product development approach to affective design, in that it emphasizes pleasure above all else, or at the very least, it does not explicitly consider functionality. The four pleasures framework originated from an anthropological perspective and, therefore, is less cognitive in focus than Norman’s model. Jordan defines pleasure in the context of product use as “the emotional, hedonic and practical benefits associated with products” (Jordan, 2000) and categorizes four types of pleasure: physio-pleasure, socio-pleasure, psycho-pleasure, and ideo-pleasure. Physio-pleasure is positive affect derived directly from the sense organs. In terms of

product design, this would usually involve touch and possibly smell. In the design of information products, physio-pleasure applies to the tactile interfaces (for example, touch screen displays). Socio-pleasure is pleasure stemming from the interaction with others; products that give us socio-pleasure are those that make us feel as though we are socially accepted and comfortable in our relationships with others. Psycho-pleasure relates to a host of cognitive and emotional reactions engendered by use of a product, use that avoids causing negative emotions by overloading the cognitive abilities of the user is thought of as design that supports psycho-pleasure. This is representative of the current conception of satisfaction in usability: to avoid displeasure with the product. Lastly, ideo-pleasure involves the user's values and pertains to personal dreams and goals, aesthetic taste, and sense of morality.

3.2.3 Framework for Affective Customer Needs in Product Design

Khalid & Helander's model, unlike the previous two, is based expressly upon empirical research consisting of an extensive survey of user reactions to different types of products. Specifically, Khalid and Helander sought to assess what product attributes users preferred, what aspects of design satisfied people. They had research participants rate fifteen product features and then performed a factor analysis that yielded three distinct categories of user preferences: holistic attributes, styling, and functional design.

First, holistic attributes of a product can be thought of as the gestalt of the product, its "global organization of form" (Kahlid & Helander 2004, p. 31). Users tend to view the product as a whole and not in terms of its components. The principles of simplicity, balance, and symmetry are guiding principles when creating a positive holistic attribute; however, there are

exceptions to the rule as complexity can challenge and engage users. According to the study's data, users preferred designs that they perceived as fashionable, aesthetically pleasing, and innovative. Second, styling consists of the specific details of a design (for instance, the colors used in different aspects of the design, the type and layout of buttons, and modes of interaction). Lastly, functional design relates to the types of tasks that the product helps the user perform and is comprised of things such as issues of display size and type of information on the screen. An example of this was the design of icons for MCDs discussed in the Chapter 1. The framework is descriptive of the factors involved in a user's emotional appraisal of an information product; however, because it does not allow for predictions of user reactions it is not of direct value in the design of an information product, but is relevant in the evaluation of user responses to products.

3.2.4 Overlap of and Distinctions between the Frameworks

These frameworks seek to organize thought about emotion in design; they do not seek to define causal models. They exist to address the need left by the inadequate understanding of human affect as it relates to the use of technology. There are striking similarities among these three models of interaction. All three frameworks have representations that can be loosely categorized as functionality issues (i.e. behavioral processing, psycho-pleasure, functional design), aesthetic issues (i.e. visceral processing, ideo-pleasure, styling), and larger socially based emotional appraisals (i.e. reflective processing, ideo-pleasure, socio-pleasure, holistic design). These are loose arrangements, because of the subtleties of differences in meaning stemming from the origin and purpose of the frameworks. Norman's model addresses the issues from the vantage of how people process emotions in interaction; Jordan has a similar

perspective, but he is primarily concerned with pleasure—a limited range of emotions—and how this relates to products; Khalid and Helander approach the issue entirely from the vantage point of aspects of products, not processes of human interaction. In creating a framework of interaction design specifically for information products, it would seem prudent to adopt a three level approach for organizing research and practice.

Within technical communication, Saul Carliner's (2000) three-part framework for information design is another loose correlate of the frameworks presented in this section. Carliner's framework consists of physical, cognitive and affective levels. The physical level involves assisting the users in their efforts at finding the information they need. The cognitive level aims to facilitate the users understanding of the information once they have found it. And, the affective level is concerned with user motivation. Although Carliner's framework is not intended as an organization for affective design, it does include many of the key elements: consideration for functional, aesthetic, and broader social issues of use. His framework of information design is a valuable asset for technical communicators, as those who are familiar with it are already positioned to more fully adopt design that addresses higher order user needs.

3.3 A Hierarchy of User Needs

Maslow's hierarchy of needs emerges frequently in the affective design literature (Jordan, 2000; Shneiderman, 2003, Maxwell, 2002; Hancock, Pepe, & Murphy, 2005). However, it is employed for different purposes, usually as either a metaphor for the development of HCI as a discipline or as a guiding framework for HCI design itself. Both the commonality of Maslow's hierarchy and the variations in meaning leave an opportunity for confusion that I hope to dispel

in this section. To do so, this section first briefly introduces Maslow’s hierarchy in its original context then reviews its uses in the affective and interaction design literature.

In its original context, Maslow’s hierarchy of needs (1968) is a five level organizing framework of human needs consisting of (from bottom to top) physiological needs, the needs of safety and security, the needs for love and belonging, the needs of esteem, and the needs of self-actualization. Figure 1 illustrates the hierarchy. Generally, people continually work to meet their needs, first their basic needs, those at the bottom of the hierarchy (e.g. physiological needs), and as those are met, progressively complex needs are aspired to (such as, belonging and esteem needs). The bottom four levels of needs are considered deficit needs; that is, a person feels the need when he or she does not have enough of something and then feels nothing when the need is satisfactorily met. Central to Maslow’s hierarchy is the idea that lower needs must be met before a person can pursue meeting the higher order needs.

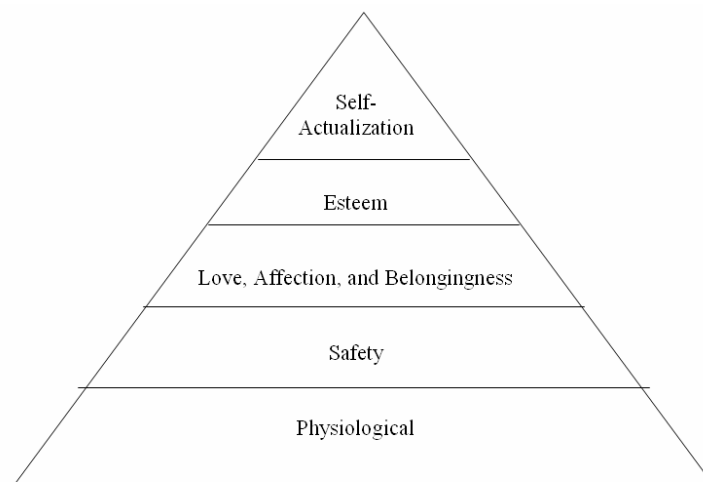


Figure 1: Maslow’s Hierarchy of Needs (Maslow, 1968)

Shneiderman (2002) invokes Maslow’s hierarchy as part of his conceptualization of the new computing, which he characterizes as centered on “supporting human relationships....,

participating in knowledge communities” (p. 13) and “focusing on what people want to do with their lives” (p. 13). In this sense, Shneiderman is using Maslow’s hierarchy as a means of refocusing standard practices of HCI in that he offers the hierarchy as a means of organizing thought in the development of technology. Shneiderman is attempting to break the entrenched technology focused bias in HCI design by giving developers a means of linking their work to basic and higher level needs with the ultimate aim of supporting the highest levels of human development possible.

A different usage of the hierarchy metaphor involves conceptualizing the development and maturation of HCI as a discipline. Maxwell has proposed a model of the process maturity of HCI that is analogous to Maslow’s hierarchy of needs. To assess growth in HCI, researchers should not focus on the adaptive technologies available, the predictive power of models, or the efficiency of processes, but on the breadth of human needs that HCI is capable of addressing. He outlines three stages in the maturity of HCI: 1) basic usability, 2) collaborative, organizational and role-based interaction, and 3) individualized and holistic interaction. Each stage represents a broader notion of HCI and a broader range of human needs met by technology.

Jordan goes a step further than Shneiderman and Maxwell. Jordan does more than take Maslow’s hierarchy as an inspiration for design or a metaphor for the development of HCI as a discipline; he models a hierarchy of customer needs based on Maslow’s work, such that a framework of successively complex user needs from technology emerges. There are three stages to Jordan’s hierarchy of customer needs: functionality, usability, and pleasure. The base need is functionality, that is, a product must first be able to help the user complete appropriate tasks before usability needs can be addressed. Usability is the next level in the hierarchy of needs. After the product is easy for the user to work with, the design can address issues of pleasure,

namely, users will want the product to have emotional benefits after it has provided an adequate level of functional benefits.

This hierarchy of user needs implies that cognitive needs are base needs and that emotional needs are higher level needs, in the sense that emotion can only be addressed after the cognitive needs are met by a product. This idea runs contrary to the literature discussed in Chapter 2 regarding the nature of cognition and affect (i.e. that they are interacting systems of equal importance). The hierarchy of needs is useful to illustrate the idea that basic user needs (e.g. usefulness and usability) must be addressed before higher order needs can be addressed (e.g. pleasure based aspects of use), but it is limiting in that it does not directly address the affects of emotion in achieving the lower level needs. There is no representation of the affect of emotions on lower (that is, cognitive) aspects of the design.

Usefulness and usability are indeed essential aspects of product design, but user emotion has a role to play in achieving these base needs. This is analogous to the problem faced by traditional HCI in its early days: namely, that the usability of a system is addressed at the end of the design cycle, after the product has been designed with the constraints of the technology as the guiding force. This conceptualization of affective design has been accused of “slapping a stupid grin” on the product before it is released, as opposed to thoroughly incorporating affective considerations from the beginning of the development process (Overbeeke et al., 2003). The metaphor of Maslow’s hierarchy reinforces the idea of addressing affective issues at the end of the design after basic cognitive needs have been met; however, Maslow’s hierarchy of needs is more useful in representing the development of the field of HCI in general.

The discipline of HCI is now approaching the point where it can address user emotion issues and higher order needs. In this sense, the metaphor does not presuppose that these issues

are less important or wholly independent from traditional cognitive issues of design, but only that affective design requires that basic user needs be met by an information product (through the consideration of the interaction between cognition and affect) before that product can successfully address broader needs.

3.4 Individuation and Product Customization

Meeting the broader needs of users, needs that go beyond of strict functionality, has been identified by Maxwell and others as a motivation for developing affective and holistic design. The means of achieving this end demand both an increase in the customization of the information product to the individual user and the specialization of the tool to the specific requirements of the task.

Norman advocates an approach to design based on specialization of the tool, which he calls information appliances (Norman, 1998). The central idea is to overcome complexity by designing information products to fit a specific task. This approach is in contrast to information product design that focuses on creating flexible products capable of performing many tasks. There is great appeal in having one tool that can complete a great variety of tasks; however, in these instances the resulting complexity of the technology makes it difficult for users to perform any one task with the tool. Therefore, Norman advocates a greater specialization or customization of the tool. This harmonizes well with ideas of embodiment (see Section 3.7) and the importance of emotions generated from social contexts in that information appliances can be fitted to the exact situation in which the task will be carried out.

A related theme in the research is the idea that a product must offer a high degree of individuation, that is, it must be adaptable to the user's functional and aesthetic needs (Maxwell, 2002). Hancock, Pepe, and Murphy (2005) cite individuation as a central tenet of pleasure based design. They suggest that systems should be able to automatically adjust and adapt themselves to the user by sensing and responding to the affective states and task performance of the user, thereby maximizing the user's pleasure and productivity with the system. Schneiderman (2003) states that the general user community of information technology is increasingly diverse and that the dimensions by which they vary (for example, age, gender, general knowledge, computer ability, literacy, culture) have not been adequately addressed by traditional usability methods. These issues will continue to grow in importance as designers attempt to meet the higher order user needs of an increasingly diverse user population.

3.5 Embodiment

Several of the theories discussed in Chapter II challenge the Cartesian mind body duality by stressing the importance of emotions in human thought processes including how people construe or make appraisals of their environment. It is not surprising then that there exists a theme in the affective design literature of building methods and models from a phenomenological standpoint, a view that emphasizes the construction of meaning through interaction with the environment. Dourish attempts to build an HCI design perspective rooted in the tradition of phenomenological philosophers such as Husserl, Heidegger, Schutz, Merleau-Ponty, and Wittgenstien that culminates in embodied interaction, "the creation, manipulation, and sharing of meaning through engaged interaction with artifacts" (p. 126).

Dourish lays out five principles of embodied interaction. First, meaning arises on multiple levels; that is, systems must be developed to handle variations in meaning across social settings, organizational context, and as symbols in their own right. Secondly, users, not designers, create and communicate meaning. Thirdly, users, not designers, manage coupling, the process of building up and breaking down relationships between intention and action. Fourth, embodied technologies participate in the world they represent; embodied interaction involves discarding the separation between representation and object. That is, embodied interaction emphasizes greater dispersion of computing in the environment with more of an opportunity for the users to interact physically with information objects. Lastly, embodied interaction turns action into meaning; meaning is not inherent in a specific system or information in general. Meaning is created through action, by how the system or information is used.

3.6 Language as a Metaphor for Use

Several lines of research suggest that by using language instead of technology as a metaphor for HCI, a broader range of human needs can be supported. Krippendorff (2004) argues that the significance of the social and cultural aspects of language and how they account for the emotions and actions of people cannot be ignored in the development of affective design. Further, he states, “the suitable model for human-centered technology is not technology but language” (p. 50) and argues that traditional usability which focuses on performance evaluation of the machine misses the point in affective design. Language can account for more human aspects of interaction relevant to affective design: perceptions of system usability, the use of multiple meanings, and the socially embedded nature of interaction.

Krippendorff is not alone when he stresses the importance of language in the development of an HCI that is capable of meeting broader user needs. Clark's (1996) idea of common ground in language is a recurrent topic in the design literature. Specifically, he defines the common ground between two people as "the sum of their mutual, common, or joint knowledge, beliefs, and suppositions" (p. 93). This idea is central to his discussion of language as a joint action. That is, language use involves more than one person acting as a sender of a message and one as a recipient; it is the product of people working together, starting with common ground and engaging in joint action to build more common ground. Monk (2003) applies Clark's ideas of language to the design and study of computer mediated communication and employs three case studies to show that common ground theory is useful in making predictions about technology. However, the theory is not developed to the point where it is readily accessible and manageable to designers who do not have a high level of expertise in communication theory.

3.7 Interaction as Persuasion

Persuasion is a natural extension of the language metaphor of interaction design. Indeed, there is a growing body of literature on how technology acts in a persuasive manner. For the purposes of interaction design, a wide net is cast in defining persuasion so as to accommodate the broad perspectives and backgrounds of people involved. Specifically, persuasion can be thought of as the "the attempt to change attitudes or behaviors or both (without using coercion or deception)" (Fogg, 2003, p. 15). This section describes some conceptions of HCI that involve persuasion as well as some of the ethical concerns in the literature.

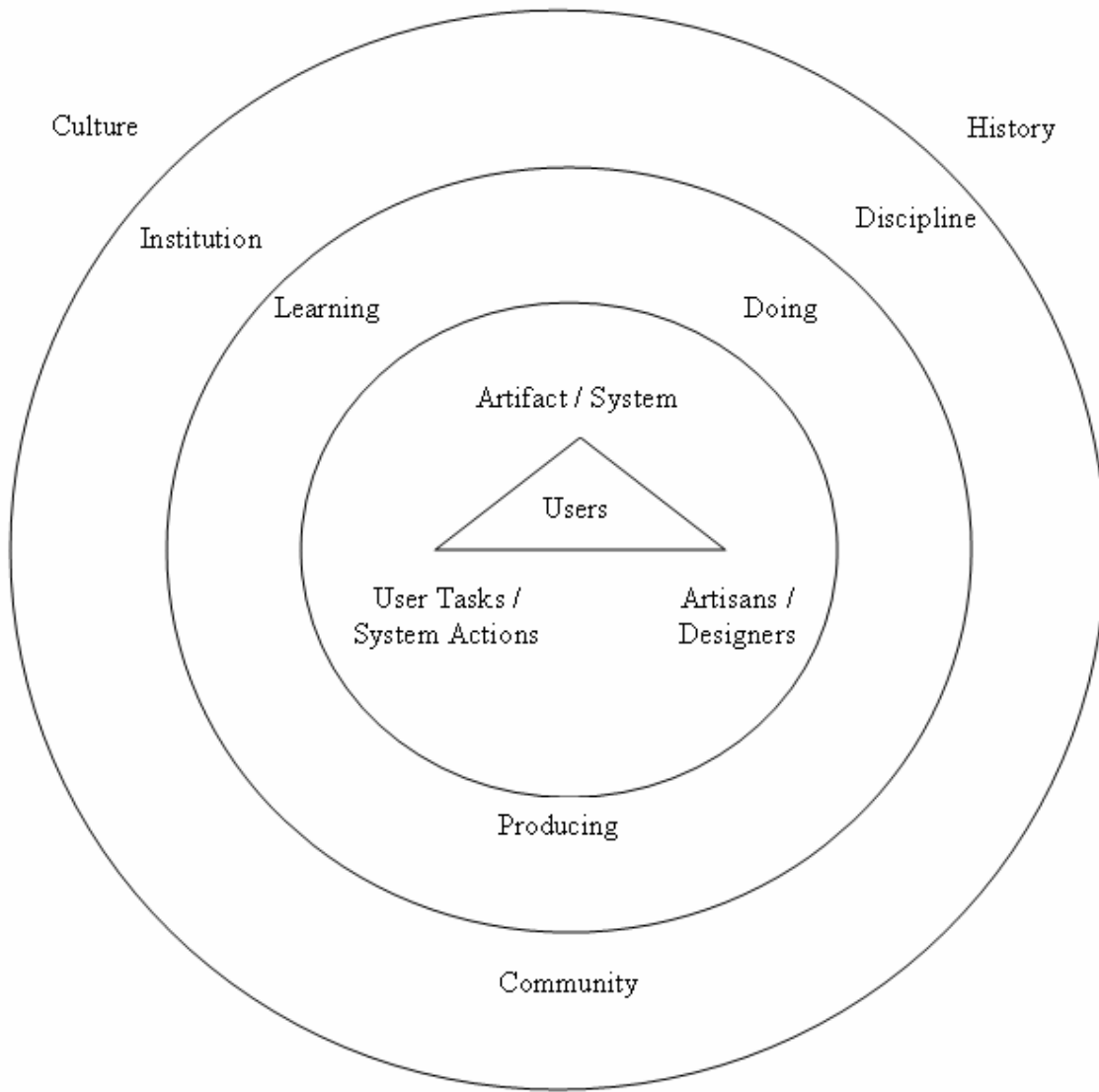


Figure 2: User Centered Rhetorical Complex of Use (Johnson, 1998, p. 39)

Johnson takes an approach to persuasion and technology by merging traditional studies of rhetoric and the traditional user centered design perspective. He starts with a version of the rhetorical triangle, placing the communication product at the center of the triangle and the reader

or audience, the writer or designer of the communication, and reality each at a point of the triangle. He combines this with the user centered design perspective to yield what he calls the user centered rhetorical complex of use (see Figure 2). This model is a rhetorical triangle with the users at the center. The triangle is surrounded by concentric circles representing the context of use (for example, institutional, community, disciplinary, cultural and historical factors). The user centered rhetorical complex of use has utility as a framework for audience analysis in the design of persuasive technology. Johnson's work draws clear lines between information design and the rhetorical tradition. This contribution to the literature offers technical communicators one possible model of interaction design that is amenable to the concepts of affective design.

Fogg (2003) offers one of the most comprehensive reviews of computers as persuasive technology; he has dubbed this area of research "captology," which is derived from the phrase computer assisted persuasion. Fogg views this work as a specific subset of HCI research that studies motivation and persuasion of users while interacting with technology (i.e. HCI) as opposed to people interacting with other users through the technology (i.e. computer mediated communication). Additionally, captology focuses on technologies that exhibit persuasive affects intended by the designers of the technology. In his efforts at defining a discipline of persuasive interaction design, Fogg puts forth a three-part framework for organizing roles fulfilled by technology and ignores emergent and unintended persuasive effects. The components of this framework are the tool (technology can make tasks easier to do), the medium (technology can provide experience), and social actor (technology can create relationships) levels. Within this framework he identifies two types of persuasion: microsuasion and macrosuasion. Macrosuasion is the name given to technology when its primary function is to change the user's attitude and beliefs (such as the use of simulation to allow users to experience different points of view), and

microsuasion refers to instances where technology employs persuasion, but as a means to some other end (for example, the use of positive feedback to engage the user and keep him/her on task for a longer duration). Fogg makes the general point that strategies and design choices involving persuasion will vary depending on the role (that is, tool, medium, social actor) that the technology is fulfilling. For example, technology acting as a tool can be persuasive by making tasks easier to accomplish and motivating through the type of data displayed. Technology acting as a medium can be persuasive by allowing users to experience motivating scenarios that enable the exploration of causal relationships. Technology acting as a social actor can be persuasive by motivating through feedback and social support.

A caveat regarding persuasion in interaction design comes from Norman, who echoes the sentiments of Aristotle's disdain for emotional appeals. He warns that manipulation of users is achieved through inducing particular emotional states; he calls this the devious side of design (Norman, 2004). Picard addresses similar concerns in her treatment of affective computing. She regards the privacy of users as an essential consideration in the development of affective computers (Picard, 2000, p. 50). That is, computers that can interpret cues such as tone of voice, facial expressions, verbal content, and physiological measurements in order to assess and respond to a user's emotional state are very much a threat to the user's privacy and that many people do not feel comfortable having a computer make these types of assessments. Some people prefer instead to enter affective information themselves—by clicking on an icon for example. Still others prefer not to give the computer any affective information at all. Picard suggests that people should be informed if a computer is collecting affective information and that users should be given the capability of selecting what type and amount of information will be used. This same approach is likely warranted when building interactive persuasive information

products; however, research should be conducted into the nature of people's concerns about emotional interaction with the intent to develop affective interaction that does not threaten or intimidate users.

3.8 The Current State of Affairs in Affective Design Theory

Research and theorizing about affective design are happening in many separate places and disparate disciplines, each bound to its own methods and assumptions but each recognizing the importance of developing technology that can address human emotion in the use of products, be it for pleasure or utility. There are points of agreement and points of contention between the disciplinary views, some of which seem irreconcilable (e.g. Section 3.1). It is not the purpose of this chapter to attempt to reconcile these differences, nor to propose standardization to any perspective. This chapter has attempted to provide a view of the current state of affairs in theory about and relevant to affective design by identifying common themes that appear across the different literatures. Because these research themes represent an effort at categorizing research into highly complex interactions with multiple intertwined processes at work, the themes are intertwined and not mutually exclusive categories of thought. Language and persuasion are fundamentally linked to ideas of embodiment in that the meaning is constructed at the level of interaction; common ground is built by interaction; persuasion is the modification of beliefs and attitudes through interaction. The three frameworks presented in Section 3.2 have striking similarities even though their specific purposes and disciplinary origins differ.

So what is the state of affairs in affective design theory? A predictive theory of how to explicitly involve affect in design does not exist as the underlying knowledge necessary for that

to be developed does not exist (see Chapter II). However, what has emerged from separate lines of research is a clear statement of what affective design must accomplish and the needs it must support. Bødker et al. (2003) argue that the nature of the postmodern world demands that technology consider user affect as a remedy for the fast paced, information glutted environment so many users find themselves occupying. Many researchers are producing rich and varied attempts at filling this need. Therefore, the state of affairs is strong—chaotic... yet strong. The diversity of ideas is exciting and healthy for a design perspective that has only recently begun to take shape.

So what is the place of the technical communicator in this burgeoning perspective of technology use? The diversity of perspectives at work in the affective design literature can be intimidating, but they all share a common link that technical communicators can easily recognize: improving relations between people and their technology. This is the aim of technical communication and many of the research themes are founded upon skills and concepts already germane to technical communicators. Johnson's work in conjunction with other conceptualizations of interaction as persuasion and language use is particularly valuable to technical communicators as it strongly pairs affective design and technology use with the very roots of technical communication, rhetoric. Therefore, technical communication can draw upon a wealth of knowledge stretching back to Aristotle to present times in the work of Johnson and Fogg. This grounding in the study of language use and persuasion uniquely positions technical communicators with expertise in what is possibly one of the pillars of the next level of HCI, one of the methods for supporting higher order user needs. The issue is not foreign to the discipline; Carliner (2000) encouraged technical communicators to consider affective issues in the design of

information products, but like the HCI community in general, the degree to which user emotion influences design choices has remained limited.

CHAPTER FOUR: CONNECTING THEORY AND PRACTICE

The relationship between affect and cognition in humans is not fully understood and consequently the implications of the interaction of affect and cognition for designing quality affective HCI are unclear. Therefore, it would be foolish (and in some circumstances dangerous) to advocate radical divergence from the traditional interaction design methods that have improved product use to date when there exists no fully developed theory of affective design upon which to base new methods. Instead, this chapter presents methods to augment traditional techniques of usability analysis and interaction design such that safe and usable products are not forfeited in the pursuit of pleasing products.

This chapter addresses two components of information product development, both of which will be familiar to the technical communicator: design and evaluation. The distinction between design and evaluation may seem artificial, as evaluation is a necessary component of the design process; however, the two are differentiated in the following manner: design methods focus on ascertaining user needs and developing appropriate means of meeting those needs while evaluation methods seek to assess the degree to which the product meets those needs. There is a definite and large amount of overlap in the methods employed to both design and evaluate information products, but distinguishing between the two is conceptually useful because in practice, technical communicators as well as HCI professionals in general may be engaged in either design or evaluation activities exclusively. That is, HCI professionals may evaluate products they did not design and design products they will never evaluate. However, this does not preclude evaluation techniques from being used in the design process.

As members of the HCI design and usability evaluation community, technical communicators are well versed in a number of information product design and evaluation methods (e.g. Barnum, 2002). Within the broad categories of evaluation and design, this chapter seeks to accomplish two objectives: (1) to demonstrate how methodologies in use today can be expanded to develop and assess information products that meet a broader range of user needs, and (2) to identify and introduce new methodologies that can be added to current design and evaluation approaches. Space limits my ability to exhaustively address either of these topics; however, by applying themes outlined in Chapter 3, technical communicators should be able to expand, to some degree, the methods they are using, whatever they may be. Similarly, by discussing some of the measures and methods that can be added to existing designs and evaluations, technical communicators should be able to surmise the types of alternatives available, and will hopefully stay apprised of unfolding developments. The criteria for addressing specific methods in this section include: ease of adopting the method into current practices, familiarity of the original practice to technical communicators, and return on investment (that is, how much utility can be gained by adopting new or augmenting old methods in relation to the amount of effort or resources involved in the using the new procedures).

As stated, this section is not an exhaustive review of how to do affective design, for presently there are no widely accepted methods or theory upon which to create such methods. However, by illustrating what value can be added to information products by adopting a broader, affective view to design and evaluation, this chapter aims to engender within the community of technical communicators involved in HCI a belief that affective design is not wishful thinking or an academic exercise.

4.1 Design Methods

This section details several methodologies that can contribute to the development of affective HCI without sacrificing the improved performance and satisfaction gained by traditional methods of usability. One of the methods in this section will be familiar to technical communicators involved in usability (participatory design) and the other is less likely to be so (analytic induction). The intent of this section is to juxtapose the old with the new in order to show the connections and perhaps compel practitioners to be early adopters of a broadened notion of HCI as well as induce within the practitioners an attitude that affective design is a realistic endeavor.

4.1.1 The Participatory Approach

The participatory design tradition has roots in Swedish industrial design in the 1970's (Ehn & King, 1987). The fundamental idea of the approach was to bring factory workers into the design process of the industrial manufacturing equipment that they would be using in the course of their jobs. Participatory design arose from the strong socialist political influence present in Sweden at the time and progressed into a means of developing complex technology with the input of the people who were actually using it. The distinguishing characteristic of participatory design is that actual users are present on the design team; this is contrasted with traditional user-centered design where the user has advocates on the design team and prototypes are tested with real users, but users are otherwise not present in the design process (Greenbaum & King, 1991; Muller, 2003). Sanders (2002) suggests that the lines between HCI researchers, designers, and the user community are blurring in that these three classes are coming to know the

language and skills of the others with greater frequency. The inclusion of users in all phases of product development can be achieved through a wide array of techniques, such as games, stories, and evolutionary prototyping (Muller, 2003). These methods attempt to bridge the gulf between users and designers; even though they may be seated at the same table, background differences between the two groups make effective communication difficult. Each of these participatory design techniques will be briefly reviewed in this section.

Games played by users and designers are employed in the participatory design process as a form of communication that inherently reduces the anxiety of working on an interdisciplinary team. By definition, participatory design teams are composed of members with highly heterogeneous backgrounds and consequently different communication styles and language sets such as organizational or disciplinary jargon not to mention the cultural and social differences. Games provide social scaffolding necessary to make communication between the users and designers more productive and less effortful than direct discussion. The use of games in participatory design has the following benefits: increased communication, enhanced teamwork, better description by users of their knowledge, perspective and requirements, and higher quality insights of designers that lead to better designs (Muller, 2003).

Stories are used in a similar manner as games, as a means of facilitating knowledge transfer in a heterogeneous design team. Muller (2003) lists three ways that stories can be of value in a participatory design team. First, stories can be used in much the same way as games, to trigger free flowing conversation. Second, the users can tell stories to the designers in order to inform them about their needs and requirements. Third, designers can tell stories to users to elicit feedback about design concepts. Story exercises often include visual aids, such as cards on which the users and designers can arrange various aspects of the design (such as portions of the

work responsibilities, components of the display) depending on the stage of development (e.g. Tudor, Muller, Dayton, & Root, 1993). The visual component of storytelling aids in bridging the language barrier. A different approach to storytelling as a design exercise involves the use of hypertext as the story telling medium (Beeson & Miskelly, 2000). The approach and aim is similar to other story-based methods or participatory design, but the use of hypertext allows for a broader range of users to participate; because the exercises are online, all of the users do not have to meet with the design team.

A third technique for participatory design involves prototyping, specifically, evolutionary prototyping (Muller, 2003). This is a class of prototyping that involves users in the design as well as the evaluation phases. Evolutionary prototyping includes two separate types of activities, cooperative prototyping and iterated prototyping, that can occur in conjunction with each other or separately. Cooperative prototyping is just that, the collective effort of designers and users in developing prototypes of software tools. Iterated prototyping involves the development of several working prototypes that are actually used in context. The prototypes start with limited functionality, but they must serve a critical purpose in the users' work domain; that is, the user must actually need to use the prototype as they would the real software tool. Feedback is then generated from the contextual use and fed into the development of the next iteration of the prototype, which is then used in situ. Combining the cooperative and iterated prototyping approaches is a powerful design strategy.

Games, stories, and evolutionary prototyping are just three of the methods used in the participatory design process, but they are representative of the aims of the perspective: inclusion of users from the earliest stages of design. Participatory design is a valid approach to affective HCI because it offers an opportunity for the actual users to have input into the design process at

the earliest stages of development. Depending on the context, it is likely that participatory design adds positive reflective qualities to the product because the users have made decisions about the form of the product, a process that produces a sense of ownership. The technology is not imposed on the users, but chosen and developed by the users. In this way, participatory design is aligned with the theme of supporting socially based emotions discussed in Section 3.2 (e.g. ideo-pleasure, reflective processing, socio-pleasure). Participatory design is also more likely than traditional HCI methods to produce an accurate representation of user needs, and therefore allows for products to meet a broader range of needs (see section 3.3).

4.1.2 Analytic Induction

Affective design emphasizes the importance of situated use (see Section 3.7) and therefore designers committed to enhancing affective components of users' interactions with technology need to investigate how tasks are performed in their natural environment. Ethnography and contextual inquiry (see Section 4.2.2) are methods of gathering qualitative data commonly employed by researchers. Koskinen (2003) argues for a design methodology rooted in an investigation of situated use and employing the strategy of analytic induction, a powerful tool first developed to help sociologists make sense of ethnographic and other qualitative data (Emerson, 2001). The analytic induction process can be summarized in the following steps: (1) the researcher or designer generates a hypothesis about a group, (2) the researcher selects a case (an example of use) and rigorously examines the details to surmise if the case fits the hypothesis, (3) in the event that the case does not fit the hypothesis (a so-called deviant case) the researcher either modifies the hypothesis to accommodate the new information or revises the definition of

the phenomenon being investigated so that the deviant case is excluded. This line of reasoning is defended as valid because the technique demands that all relevant cases be completely explained by the hypothesis, and therefore the procedure leads to an accurate understanding of the phenomenon (Robinson, 1951; Miller, 1982).

Koskinen argues that analytic induction is an exemplary method for designing engaging and affectively stimulating products because it enables the designer to form an inclusive representation of the user community's needs. He outlines the broad strokes of a six step approach to design that incorporates this method of data analysis. The first step involves gathering data from three classes of users: primary, secondary, and deviant. The primary user group consists of people to whom the product is directly targeted (e.g. expert users); secondary users are people who may be interested in the product or have a need to use it at some point, but who are not the target audience; and the deviant user group consists of people with extreme needs (for example, people for whom the product is very foreign, people with disabilities). Generating hypotheses about user needs and attributes from this sample is the second step, followed by evaluating the hypotheses with the same sample data. After the hypotheses have been fitted to the original sample data, the designer uses negative cases (that is, cases typically from the secondary and deviant user classes) to refine the hypotheses. This process is continued until all of the data for all of the user cases is accounted for by the hypotheses; the end result of the process is an ordered framework of user needs, called an interpretation. Finally, Koskinen states that designers should validate the interpretation by comparing it to generalized empirical studies and in some cases by getting feedback from the user community upon which the interpretation was constructed.

Design methods based on analytic induction are consistent with several of the themes presented in Chapter 3. Specifically, the process builds an inclusive model of user needs, which helps designers to meet a broader class of user needs; this is consistent with trends in affective design (see Section 3.3). Similarly, because analytic design methodologies can focus on broad user needs such as social relationships and reflective processing, and not just task requirements, they support the embodiment theme of affective design (see Section 3.7). The work of Koskinen is rooted in commercial product design, but the concepts are applicable to the development of affective information products intended for more functional and pragmatic applications as well.

4.2 Evaluation Methods

Because affective design involves developing products to meet a broader range of user needs, it demands the creation of new forms of evaluation, to ensure that the information product is effective in meeting those needs. Evaluators equipped with the tools of traditional usability evaluation will not be able to answer the questions that the new affective perspective will ask such, as to what extent does this information product address higher order user needs? What follows is a review of techniques that can be incorporated into usability evaluations and iterative design processes.

4.2.1 Augmenting the Assessment of User Satisfaction in Laboratory Evaluations

Czerwinski, Horvitz, & Cutrell (2001) have proposed a metric for assessing user satisfaction with tasks and interfaces that has significant advantages over current methods. In a traditional usability evaluation, user satisfaction is assessed through questionnaires such as the

QUIS—questionnaire for user interaction satisfaction (Harper & Norman, 1993)—that ask direct questions about the user’s experience. There are well documented problems with this type of self-report data, such as users holding back their true feelings for fear of offending the designer or evaluators (Nielsen & Levy, 1994). Therefore, measures of user satisfaction that do not require the user to directly think about and state their feelings about a product add sensitivity to the usability evaluators’ ability to measure the emotional reactions of users. Czerwinski et al.’s measure, relative subjective duration (RSD), does not ask the user to make direct statements about their experience and therefore avoids many of the pitfalls associated with the self-report measures of satisfaction. RSD capitalizes on the empirical research findings concerning the subjective estimation of time. Specifically, RSD is an implicit measure of satisfaction based on the ‘time flies when you’re having fun’ maxim. When asked to estimate the amount of time they have been working on a specific task or using a specific interface, users will consistently underestimate the interval if the experience is engaging and they will consistently overestimate the interval if the experience has been unpleasant.

RSD increases the evaluator’s ability to assess users’ global emotional reactions to information products. As such, it represents a relatively simple addition to the laboratory usability evaluation tool kit that. Such laboratory methods are valid inclusions in a discussion of affective design for several reasons. First, as mentioned earlier, design aimed at meeting a broadened set of user needs must be evaluated and the tools for assessing interaction based on ‘cold’ models of user cognition (see section 2.1.3) will not suffice for this task. The counterargument is that the proper place for assessing affective reactions is in contextualized use; however, affective design requires that the user be included in the design phase from the

earliest points possible, just as in traditional HCI. Therefore, laboratory evaluations of prototypes will remain a necessary component of the affective design method.

4.2.2 Assessing Affective Design in the Field: The Importance of Contextual Inquiry

Although contextual inquiry could be construed as a design method, as well as an evaluation technique, it is uniquely suited as tool for gathering information about the situated use of an information process. This information about usage can be fed into an ongoing design process or can stand alone as an evaluation of an information product's effectiveness.

Contextual inquiry is based on ethnographic techniques and is valued for the depth of information gathered about technology use (Myers, 1999). However, this depth of information is also the drawback most frequently cited for contextual inquiry. It is a labor intensive exercise in that it requires a researcher to be on site for extended periods of time, and the copious amount of qualitative data gathered is more difficult to analyze than quantitative data. Similarly, the difficulty in generalizing from ethnographic results is also generally viewed as a substantial drawback. However, Ball and Ormerod (2000) have proposed a variation of pure ethnographic methods—cognitive ethnography—that seeks to limit some of the pitfalls of the approach by focusing on the concepts of observational specificity, purposiveness, and verifiability in the design and execution of contextual inquiries. Observational specificity means that the scheduling of observations is very selective and tuned to the exact interests of the evaluation in an attempt to mitigate the time costs of contextual inquiry. Purposiveness means that the interviewing is “informed by some intention to intervene with, or somehow affect, existing work practices” (Ball & Ormerod, 2000, p. 152). Lastly, verifiability means that contextual inquiry

results are validated across different observers and observation sites as well as compared with data generated with other methodologies.

Contextual inquiry is based on observations of real users using technology and information products in context and therefore lends itself for adoption as an early technique of affective design. It supports the embodiment theme (section 3.5) of affective design in that it enables evaluators to assess the technologies interaction with broader social factors in which the use takes place. Similarly, contextual inquiry allows researchers to assess the degree to which technology addresses higher order human needs (section 3.3) as well as how well the product has been customized to the targeted end environment of use (section 3.4). Because ethnographic methods are idiographic—individual focused—they are in line with theories of emotion such as that of Lazarus (section 2.1.2). Lazarus’s cognitive motivational relational theory of emotion and adaptation states that emotion can not be understood in terms of normative investigations (i.e. those dealing with averages across people) but must be understood by looking at individual people. Ethnography allows this type of idiographic investigation and modifications to the general methodology such as those proposed by Ball and Ormerod allow for a more cost effective inclusion of a more generalizable form of ethnographic data into affective design evaluations.

4.2.3 A General Framework for the Assessment of User Affect

Designing affective products means assessing a broader range of user emotions than is typical of traditional HCI. In addition to the augmentation of standard assessments of user satisfaction (e.g. RSD) designers need a method for determining what general categories of

needs their products should be addressing. To this end, Karat (2003) offers an organizational framework for selecting methods of assessing user experience based on the general purpose and nature of the product.

Karat's framework begins with the identification of three fundamental aspects of product use that are subject to evaluation: content, access and interaction, and context of experience. Content refers to the quality and relevance of the information presented by an information product. Access and interaction involves aspects of use that generally fall under the purview of traditional usability. Context of experience is the social context in which the information product or system will be used. The framework assumes that the relative quality of a user's experience will be a function of these three areas of use and therefore, that these are the broad categories that must be addressed in an evaluation of a product. However, Karat acknowledges that these three categories are not equally weighted in their contribution to the users' overall experience, nor are they weighted similarly for different types of products. The purpose and aims of the technology being developed determine the degree to which the product's content, access and interaction, and context of experience dimensions interact to produce the overall user experience and reaction to the product.

Given the distinctions among these three categories of evaluation, Karat suggests that the usability engineer assess the type of information product being evaluated. He identifies three categories of product purpose: content driven, communication driven, and experience driven. The framework ultimately seeks to provide the usability evaluator with a look-up table; given the purpose of the information product, an evaluator will be able to access a list of measurement techniques for each aspect of the product (i.e. content, access and interaction, context of experience).

This framework is useful to technical communicators and usability practitioners as a tool for organizing various measurement and evaluation methods. The framework is very high level and therefore lacks specificity in direction for practitioners evaluating affective products. Similarly, the framework is not fully populated with measurement techniques or evaluation tools. This will have to wait for the further development of evaluation tools designed for assessing the broader range of user needs addressed by affective design.

4.2.4 Other Techniques for the Measurement of Emotion in Users

The realization of affective computing (section 2.2.2) and affective design that automatically adapts itself to the user (section 3.4) will require information product developers to maintain an extensive repertoire of new measurement techniques, a sampling of which will likely include user neurological responses, autonomic activity, facial expressions, and voice characteristics (Brave & Nass, 2003). The absence of any discussion about neurological and autonomic data from a review of measurement and evaluation methods for affective design may seem to be a glaring omission; however, these techniques will not be reviewed here for three reasons.

First and most importantly, the techniques for using these types of measures in the evaluation and development of affective products have not been developed to the point where they are practical to apply in many situations. These are active and interesting areas of research, but they have not been proven effective in the commercial settings in which technical communicators most frequently function. Second, the cost of much of the equipment is prohibitory to inclusion in most evaluations. The recording and analysis of neurological and

autonomic activity requires a substantial investment of resources in both equipment and training; however, the cost of these technologies continues to drop and the ease of use of the systems and interpretation of the data continues to increase. Lastly, there are techniques that better suit the work done by technical communicators and the role they can play in affective design.

Specifically, there are several verbal and non-verbal measures of user emotion that can quickly and easily be incorporated into the product evaluations, thereby increasing the technical communicator's ability to add value to information products without requiring a substantial investment in equipment or training.

There are several cost effective ways to implement non-verbal user emotion measurement techniques. First, video taped usability sessions can be coded for the expressive reactions (for instance, facial expressions, posture, tone of voice) of the users (Desment, 2003). Usability evaluators often record sessions and log, or code, the video tape for certain behaviors; collecting expressive reaction data simply adds one more set of behaviors to code. There is software available that automatically codes facial expressions (Kaiser & Wehrle, 2001), but this would likely add a significant cost to the evaluation. Expressive reaction data is analyzed by means of cross-cultural research findings associating emotions with a specific set of behavioral manifestations (Ekman, 1994). In addition to non-verbal assessments of user emotion, usability practitioners should develop and employ self-report measures to assess subjective feelings of the users' experience.

4.3 Affective Design as Practical Technical Communication

The focus of this chapter has been pragmatics. All of the design methods and evaluation techniques reviewed can be implemented into the framework of a traditional usability evaluation with little or no added cost. Of course, the sampling of methods and measures is limited. The techniques here will not address all, or even most, of a technical communicators needs, but ostensibly, practicing technical communicators who are informed about the underlying aims of affective design can stretch the methods they employ to address affective issues.

This chapter's first goal was to demonstrate how methodologies in use today could be expanded to develop information products that meet a broader range of user needs. We have reviewed a technique familiar to current practice, participatory design, and one that is foreign, analytic induction. Participatory design has been actively used for decades in the HCI design community and is well equipped to address affective issues of design. Analytic induction is a new technique, but it affords technical communicators the ability to identify and address higher order user needs in the products they develop.

This chapter's second goal was to identify and introduce new methodologies that can be added to current design approaches. Again, techniques already a part of HCI repertoire such as self-report measures of satisfaction and the ethnographic methods of contextual inquiry show promise as valid tools for evaluating affective design. New techniques such as RSD and the coding and analysis of expressive reactions are cost effective ways for technical communicators to add value to their services.

Therefore, although a strong and complete foundation for affective design has not been laid by the parent disciplines such as psychology and computer science, there are options

available to technical communicators that will increase the value added to the information products they design. Technical communicators can avoid the hazards of wholesale dismissal of traditional techniques while simultaneously achieving positive gains in the affective quality of the information products by expanding the current methods and selectively adopting new techniques and methods. This evolution of design and evaluation methods should be guided by a thorough understanding of the aims of affective design. As in nature, adaptation is key to survival in technical domains. Therefore, by all signs, technical communicators would do well to adopt the philosophy that emotions matter in the production of information products, and to realize that this is an actionable stance.

CHAPTER FIVE: CONCLUSION

So, is affective design presently a speculative enterprise? Is this design perspective of significant value to technical communicators and HCI specialists who are often bound to strict time and budgetary constraints? Despite substantial progress, the underlying knowledge that ties the nature of emotion in humans to a theory of affective design does not yet exist. Similarly, emotive computers, those that sense and respond to emotions or those that have some analogous means of intuiting rather than deducing, are not far away from being viable products (Picard 1997). However, the growing complexity of the information age demands that information products be designed with models of users that account for the role of emotion in interaction (Bødker et al., 2003). In Chapter One I proposed that by taking on the goals of affective design with today's technology, technical communicators could create a more satisfying and efficient experience for users of technology while simultaneously positioning themselves as early adapters of new computing technologies and models of interaction. This thesis has explored the literature necessary to build the argument that affective design is a valid design perspective and one that is of practical utility to technical communicators. There are strong traditions that predispose technical communicators as early adopters of affective issues in HCI; specifically, the roots of the field in rhetoric and the recognition of user affect as a central component of information design (Carliner, 2000).

In this concluding chapter, I plan to accomplish three things. First, I will revisit and encapsulate the main points of the analysis of theory and practice presented in this thesis into an 'elevator pitch' for affective design. The goal of this effort is to provide technical communicators with a concise message that will allow them to gain interest from the sponsors of

their information products, a foot in the door for affective issues so to speak. Second, I will return to the example of MCD evaluation briefly discussed in Chapter One, and show how the process could be improved with the consideration of affective design issues discussed in this thesis. By doing this I hope to further convince technical communicators involved in HCI that affective issues can begin to be addressed without radical changes methods and without large investments in equipment or training. Lastly, I will speculate about the long term role that technical communicators could, and I argue should, play in this burgeoning approach to HCI.

5.1 Affective Design: The Elevator Pitch

Technical communicators completely convinced of the value of affective design still have to convince other people involved in the design or evaluation process of the value added to information products by consideration of user emotion in order to effectively accomplish the goals of design. Those who do not understand the aims of affective design will not understand why certain design activities are a part of a product development plan or why certain measures and techniques are included in the report of a product evaluation. Technical communicators will have to educate sponsors about the value of applying an affective design perspective to the development of their information products. Therefore this section provides the broad strokes of affective design and frames the perspective in terms of investments and returns in the development and evaluation processes. The idea behind an elevator pitch is brevity and clarity. It necessarily sacrifices detail in an effort to quickly communicate the essentials of the idea along with the benefits of pursuing it. The goal of the elevator pitch is to create the opportunity for a

broader and more in depth discussion of the idea. What follows is a summative description of affective design that will hopefully suffice as an effective elevator pitch.

Affective design is an approach to developing information products that takes as a central tenet the idea that people's emotions affect how they use technology. It is an evolution of traditional HCI in that it carries forth with the core goal of improving relations between people and their computers. It is new because it both expands the concept and elevates the role of user satisfaction; affective designers know that users' feelings about an information product and the broader social context in which they are using that information product affect how they think about the product itself, the information conveyed through the product, and how they perform tasks with their information tools. By looking at emotional issues in HCI design and evaluation, technical communicators are better able to meet the goals of traditional usability as well as creating information products that meet broader emotional and social needs.

There is a broad spectrum of methods for addressing emotional issues in design and evaluation; some of them have large costs in time and resources while others are relatively simple additions to existing practices. Affective design principles can be applied to information products no matter what the purpose of the product, from purely functional products to entertainment products. By adopting an affective perspective, technical communicators can create information tools that work better, and tools that people consequently want to use. Therefore, example payoffs include performance increases in products designed to meet needs at the functional tool end of the spectrum (i.e. the bottom of the hierarchy of user needs) and increases in appeal for commercial and entertainment based products.

5.2 Technical Communicators at Work with Affective Design

In this section, I return to the example of mobile computing devices (MCDs) discussed in Chapter 1 and illustrate how the principles and methods discussed in this thesis can be applied to a prototypical usability evaluation. The MCD evaluation scenario is characteristic of the type of usability evaluations conducted by technical communicators, and in fact, this evaluation was designed and conducted by technical communicators. User accuracy and efficiency were measured both through the analysis of video tapes and through data collected automatically by the prototype MCD. These measures were based on how successful users were at completing the tasks detailed in the task analysis and how long it took them to perform the tasks. Satisfaction was measured through a direct questionnaire of the user's experience after the task performance section of the session had ended. As discussed in Chapter One, this evaluation is representative of traditional usability analysis, one based on 'cold' models of user cognition. But, there are simple ways to add affective design considerations to the evaluation without driving the cost of the evaluation up or losing the valuable performance data collected.

First, the MCD was developed by technical people with consultations by HCI professionals. A more affective, and likely effective, approach would be include cooperative and iterated prototyping. The MCD was developed in house by the organization whose employees would be using the tool; therefore, access to actual users for inclusion on the prototype development team would not have been difficult. Similarly, instead of or in addition to a laboratory evaluation, the prototype could have been incorporated into the users' actual work environment.

Second, the measure of satisfaction used in the MCD evaluation was blunt in comparison to other options available; that is, the satisfaction questionnaire assessed the users' overall reaction to the product at one point in time and did not provide low level information to the evaluators. Accuracy and efficiency measures were broken down to the individual task level thereby providing evaluators information about how the MCD supported the performance of each step of the users' work. The bluntness of the single administration of the satisfaction questionnaire impedes a fine grained assessment of emotional qualities of interaction with the MCD. The sessions were video taped and coded for user behavior so adding a coding for expressive reactions would not entail a large addition of cost or time to the evaluation, but it would provide a rich, detailed and fine grained data set of how the user reacted to various tasks throughout the evaluation session.

The MCD evaluation was well planned and executed in that it did provide information useful in improving the design of the product. However, it was a traditional usability evaluation in that it did not account for user emotion outside of a single global assessment of satisfaction. The above examples of additional measures for evaluation and design methods are illustrative of the types of self-analysis of design and evaluation techniques that technical communicators can and should do. By analyzing their design and evaluation processes with the principles and goals of affective design in mind, technical communicators can increase both the type of user needs addressed and the effectiveness of the products they produce in meeting those needs.

5.3 Broadened Horizons

At this point, I hope that issues of the practicality and utility of affective design for technical communicators are clear to the reader. In this last section, I will briefly turn to issues of necessity. The transition from traditional HCI to affective and holistic HCI will likely be incremental and smooth; revolutionary change is not necessary, as traditional HCI and affective design share similar goals, the latter a broadened version of the former. However, incremental change affords the opportunity for technical communicators to adapt early and lead the evolutionary cycle of development. As Picard (2000) points out, the role that emotion will play in technology will vary with the intent of the technology, but on some level technical communicators can add value to their products by considering user emotion. Every type of information product will not necessitate consideration of the same degree of user emotion, but in order to work as a technical communicator in a broad range of products the future will likely require that technical communicators be proficient with the concepts and methods of affective design. The MCD design and evaluation example illustrates that even an in-house product development efforts for a largely utilitarian product targeted at a known and limited audience can benefit from the application of affective design principles. So, some degree of affective design sensibility seems relevant regardless of the product's intended purpose and audience.

The central argument of this thesis has been that affective design is relevant to technical communicators and that technical communicators are well equipped to be proponents of this new perspective. Along with the views of researchers and practitioners reviewed in this thesis, I believe that emotional aspects of use will continue to be an expanding area of interest for interaction designers and researchers alike. Currently, the perspective is disconnected from

mainstream HCI in practice today and is very much in need of conduit from theoretical and disparate applied manifestations to the everyday application of the principles and methods. Technical communicators are in an ideal position to serve this necessary function.

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