OCCURRENCE OF FRUSTRATION IN HUMAN-COMPUTER INTERACTION: THE AFFECT OF INTERRUPTING COGNITIVE FLOW

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ABSTRACT

Despite a growing awareness of the importance of emotion, HCI has emphasized the severity of usability incidents as the best method towards creating an enjoyable experience. This study collected the remembered frustrating incidents with technology of 66 participants (132 incidents). Incidents were then coded into one of the five high-level categories of the User Action Framework, a schema for classifying incidents in relation to their occurrence in the interaction cycle.

It was found that the majority of remembered frustrating incidents occur in the Outcome phase, which addresses issues with the system's internal response to the user's actions. This is in contrast to where most usability issues occur, in the Translation phase, which addresses issues with the user translating intentions into plans for physical actions. In addition it was found that remembered Outcome incidents are more often low priority usability incidents whereas remembered incidents in Translation are usually high priority usability problems. Finally, those incidents remembered in the Outcome phase are primarily incidents that interrupt cognitive flow.

BIOGRAPHICAL SKETCH

Helena Mentis graduated from Virginia Tech in 2000 with a Bachelor of Science in Psychology, concentration in Cognitive Psychology. She spent most of her time there assisting with research in the Human-Computer Interaction Lab and Neurocognitive Lab. Working at these two distinctively different labs led her to question how HCI has failed to address emotion. Thus, after taking some time off to work as an intern at Philips Research, she entered Cornell to study emotion in HCI.

Since she arrived at Cornell in August 2001 she has been focusing her work on emotion, affective computing, and the user experience with Geri K. Gay in the Human-Computer Interaction Lab. She has also worked as a teaching assistant for the following classes in the Communication Department: Human Computer Interaction, Computer Mediated Technology, Psychology of TV, Impact of Information Technology, and Discourse for Usability. This thesis project reflects the culmination of her work in the occurrence of emotion in HCI and the beginning of her work in creating a conceptualization of the user emotional response to technology.

For my parents, Tom and Jean,
For being my inspiration in more ways than one.

You will never know how much you have done.

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CHAPTER ONE: INTRODUCTION

Since its inception, Human-Computer Interaction (HCI) focused on creating usable systems that improve user's task performance. This approach presumes that efficiency is the goal of all interfaces, an assumption that emerged from the roots of HCI that lie in work environments and desktop computing. Human Factors, the precursor to HCI, arose from studies of the sensorimotor components of fatigue, performance, and, ultimately, efficiency. Interest in human operation of computers developed from this conceptualization of the work environment, and along with it came efficiency as a metric of success (Hewett et al., 1996). Because of this foundation the effect an incident has on the user's efficiency is to this day still considered the standard method of rating and prioritizing.

This focus has served HCI well to date, but concern for the user experience has been conspicuously absent from much of the field's work. The concept of the user experience is more concerned with the induction of enjoyment, fun, and satisfaction and less with efficiency. Especially as ubiquitous computing grows, computers are migrating from the task-driven workplace into our everyday lives. Thus, we can no longer consider efficiency to be the primary concern in all situations. Sometimes – perhaps even most of the time – the user's overall perception of the experience matters more.

With this rising interest in the user experience, researchers and designers alike have been trying to create computer systems that take emotions into account. The first major undertaking in this direction of research was an effort to engineer machines to detect and respond to human emotions. Picard (1997) coined the term "affective computing", meaning "computing that relates to, arises from, or

deliberately influences emotions" to describe this field of endeavor (p.3). Affective computing has inspired many studies that aim at creating machines that both sense and respond to the user's emotional states. At both IBM's Almaden Research Center and MIT's Media Lab, researchers are developing and studying systems that sense affect. For instance, one particular study showed that users squeeze the mouse more when frustration was induced (Qi, Reynolds & Picard, 2001). In addition, physiological signals such as pulse and galvanic skin response have been shown to correlate with various emotions such as joy, frustration, and anger (Vyzas & Picard, 1999).

A number of companies have begun to take users' emotions into account in the design of their products. Toyota has designed a concept car that attempts to express emotions through anthropomorphic features and respond to the emotions of the driver (Arimoto, 2001). Developed in collaboration with Sony, the car measures drivers' pulse and galvanic skin response and offers feedback via color-changing lights and other displays to help the drivers modify their emotional state. For instance, lights in the car change color to reflect the emotion it is sensing to those in the car as well as those on the road.

Industrial designers have also begun to consider affect explicitly, but rather than writing algorithms, they are interested in developing interfaces that "elicit bodily actions which are rich in emotional content" (Wensveen, Overbeeke, & Djajadiningrat, 2000). Researchers at Delft University of Technology have designed an alarm clock that elicits emotion conveyance from the user through tangible knobs that monitor direction, force, and speed of input. The researchers focused on the visual and tactical design of the knobs to elicit as much feedback from the user in order to determine his or her emotional state. In contrast to

previous work done in the field of affective computing, they spent little time on the algorithms to translate the manipulation of the knobs into reliable emotion indicators.

These efforts to create a system that responds to the user's emotional reactions attempt to improve the user experience by creating systems that are easier to use and leave the user more satisfied with their experience. This is a logical goal since in human-to-human interpersonal communication "the higher the rewards and lower the costs involved in an interaction, the stronger the tendency to approach the other" (Buck, 1984, p. 308). If we consider difficulty a cost and emotional satisfaction a reward, we see from Buck's claim that a user will be more likely to use a technology that is easy to use and provides a satisfying experience.

Research Problem

The majority of the research in affective computing has focused on determining ways to sense when a user is feeling a particular emotion and then devising ways for the system to react in a beneficial manner. Unfortunately, this has narrowed the field down to one that is interested primarily in signal processing. For example, Scheirer, Fernandez, Klein, & Picard (2002) created a model based on user's physiological signals to identify frustration. Less work, however, has been done in modeling the user's emotional responses to a computer system. Since even humans recognize emotions better given some situational context, a clearer understanding of under what circumstances various emotions occur could make signal processing of emotions easier. To date, researchers have been relying on psychology literature on emotion to guide the creation of such a system; however, this literature might not be particularly applicable to the human-computer interface.

For instance, the psychological literature defines frustration loosely as the thwarting of a goal. But, all usability incidents thwart goals in some sense, and yet not all usability incidents frustrate users in the same manner. Clearly, we require a more detailed definition of frustration.

In order to design for emotion, the fields of HCI and affective computing need a better understanding of the occurrence of particular emotions in a computing environment. Generalized negative affect would be a particularly applicable place to begin, since it frequently occurs during the use of computer interfaces. Recently, a study by Compaq reported that more than half of 1500 respondents had felt so frustrated that they wanted to fight with their computers, and 80 percent had seen their colleagues vent frustration at their computers (Compaq, 2001).

There have been some attempts to quantify where frustration occurs and how it affects efficiency (Ceaparu, Lazar, Bessiere, Robinson & Shneiderman, 2002; Bessiere, Ceaparu, Lazar, Robinson & Shneiderman, 2002a; Bessiere, Ceaparu, Lazar, Robinson & Shneiderman, 2002b). These studies had participants set aside one hour of work to record frustrating incidents in a time diary. The researchers sought to minimize the amount of information lost to underreporting and to maximize the possibility of recording all types of frustration. Their studies found that error messages; timed out, dropped, or refused connections; freezes; long download times; and missing or hard-to-find features were the most common frustrating incidents. These incidents were also found to have a large impact on efficiency – participants lost one-third to one-fifth of work-time to these incidents. Participants rated the incidents on a 1 (not very frustrating) to 9 (very frustrating) scale. The mean rating was 6.74, SD = 2.13. The researchers concluded that

frustration correlates positively with the amount of time it takes to fix the incident, the amount of time or work lost due to the incident, and the importance of the task.

In this work, as in older HCI research, a reliance on efficiency is driving the research questions. This thesis seeks instead to consider what types of frustrating incidents significantly affect the user experience. Thus, this study is more concerned with the user's perception of frustration than with the consequences of productivity being thwarted in a particular task.

Research Questions

To create a more enjoyable user experience, it is important to understand what incidents lessen enjoyment and how emotional arousal influences perception of the incidents. Ceaparu et al. (2002) and Bessiere et al. (2002a, 2002b) focused on actual incidents without showing which are best remembered afterwards and therefore most significantly shape the user's experience. In contrast to their approach, understanding the occurrence of frustration in this study is best achieved through analyzing what *users* deem most important in their personal experiences with the technology – what types of incidents are most prominent in *their* minds. The method of this study differs from those previous studies in both collection and analysis. The method of collection is aimed at finding which frustrating incidents from the set of all frustrating incidents really affect the user experience. The method of analysis seeks to understand why particular incidents are more frustrating than others. To that end, I propose the following research questions:

1. What types of incidents are most memorable to the user?
2. What about them causes them to be memorable?

3. Does the type of technology being used affect which incidents are important?

Definition of Terms

Affect/Mood/Emotion

In various literature, affect, mood, and emotion are sometimes interchangeable and other times refer to very different phenomena (Izard, 1977). Thus, it is important to specify the difference between these terms and how they will be used in this thesis.

The terms "emotion" and "affect" can be used fairly interchangeably. Usually the term emotion refers to a specific, identifiable state, whereas affect refers in a broader sense to a positive or negative valence. For example, emotions include anger, fear, and disgust, which are negative affective states, and happy and excited, which are positive affective states. "Positive" and "negative" affect refer to the normative experience of these states. Negative affective states are not necessarily unhelpful, though. A fight-or-flight response from fear when one encounters a bear in the woods is a useful negative affective response. In addition, positive and negative affect do not necessarily have different effects on cognition (Isen, 1999). For instance, both highly positive and highly negative valence events are more memorable than neutral events (Burke, Heuer, & Reisberg, 1992).

"Mood" is a fundamentally different concept from affect or emotion. A mood is a continual, long-term affective state that can arise from a series of emotions on affective experiences over time. Emotions are directed towards an object or experience. One can be scared *of* a bear or angry *with* a friend. A mood, however, is not directed at a particular identifiable cause.

In this thesis, we will concern ourselves with the concepts of emotion and affect, but not mood. In general, I use emotion and affect interchangeably. When referring specifically to affect, though, I will specify positive or negative affect. Likewise, when referring to emotion, I will specify the name of the particular emotion in question, which for this thesis is frustration.

CHAPTER TWO: LITERATURE REVIEW

Introduction

An overview of the research on emotion in human experience is needed to further explain why we should consider emotion important for the user experience. The following literature review describes research on the user experience, the importance of emotion in interpersonal communication, the effect of emotion on cognitive functioning, the human tendency to interact with mediating technology as though it were another person, and finally a focus on the conceptualization of frustration.

The User Experience

Recent work in psychology has considered what constitutes experience and how experience occurs. Csikszentmihalyi (1990) claims that an *optimal experience* comes about when a person's skill level closely matches the difficulty of the task at hand. If the challenge is too great for the person's skills, then he or she feels anxiety. The opposite condition creates boredom. This theory of optimal experience refers to the result of an appropriate match as *flow* – "the state in which people are so involved in an activity that nothing else seems to matter" (p. 4). Flow does not occur when one's goals are overly optimistic (i.e., challenge is too great for skills). Rather, flow is the intense enjoyment one finds on the path toward *achievable* goals.

Within the HCI community, one of the first attempts to determine what constitutes an experience was an article written by Alben (1996). Alben defined the concept of "experience" in interaction design as the fulfillment of all the

characteristics of using an interactive product. She then specified five aspects of the experience of a product: “the way it feels in their [the users’] hands, how well they understand how it works, how they feel about it while they’re using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it. If these experiences are successful and engaging, then they are valuable to user” (p. 12).

Since then, the term “user experience” has gained currency in the HCI literature even in the absence of a precise definition and guidelines for designing for it. This has led some researchers to take a closer look at how the term has been used by the community in an effort to reach common ground. These researchers reported three distinct uses of the term: experience, an experience, and experience as a story (Forlizzi & Ford, 2000).

The first use of the term, experience, refers to the physical moment of being in the experience, “the constant stream that happens during moments of consciousness” (p. 419). This derives from the theory of consciousness known as Experienced Cognition (Carlson, 1997), which takes an ecological approach to psychology, “emphasiz[ing] that persons are organisms acting in and on environments” (p. 4).

The second use of the term, an experience, refers to that which “has a beginning and an end, and changes the user, and sometimes, the context of the experience as a result” (Forlizzi & Ford, 2000, p. 420). This use has its roots in concepts defined by the philosopher John Dewey (1934). He refers to an experience as a period, which has been finished and can be demarcated in relation to other experiences and from the life experience. Whereas Carlson uses the concept of

experience to signify all that occurs while conscious, Dewey prefers to use the concept to encapsulate notable events.

The third use of the term, experience as a story, relies on the significance of the user's reflection on his/her own experience. "Stories are the vehicles that we use to condense and remember experiences and to communicate them in a variety of situations to certain audiences" (Forlizzi & Ford, 2000, p. 420). This way of thinking about experience has its roots in Schank's (1990) work in artificial intelligence. His work aimed to develop machines that could model the human experience of storytelling; he believed that "[f]inding a relevant past experience that will help make sense of a new experience is at the core of intelligent behavior" (p. 2). Through his model, he shows that the unique relating of an experience reveals what the storyteller feels are the most significant aspects of the experience. In addition, the storyteller may alter the meaning of a story depending on his or her reason for telling the story and the audience to which it is told.

Finally, Bell and Kay (2002) have noted the history of technology in the home, particularly kitchens, have focused on streamlining functionality without acknowledging that people's fondest memories of kitchens have to do with smells, conversations, and food rather than how fast they were able to cook a meal (Bell & Kay, 2002). Thus, their conceptualization of enhancing the user experience is where technology enhances already enjoyable experiences, not replacing them or adding a new experience.

In this thesis, I am interested in combining Schank's definition of experience with Dewey's definition. In essence I believe that those demarcated experiences that we remember (Dewey's) are the ones that are noteworthy enough to be recounted as experiential stories (Schank's). In keeping with Bell and Kay's

assertion, that users often want not a new, more efficient experience, but rather enhancement of an already enjoyable experience, I will focus solely on understanding the experiences that users are already having with technology and how designers can enhance those experiences.

Emotion and Interpersonal Communication

The user experience is linked to the user's emotional response to his or her interactions with the computer interface. To understand how and why emotions arise in this context, it is important to understand the purpose of emotions in everyday experience.

The study of the evolutionary significance of human emotional communication started with Charles Darwin's groundbreaking book, *The Expression of the Emotions in Man and Animals* (1965). In this seminal work, he discussed how facial expressions and other external indicators play a vital role in the communication of a human's emotional state to others during social and information interactions. From an evolutionary perspective, Darwin argued that the successful nonverbal communication of fear and anger conferred a survival advantage on members of a linguistically under-developed society or on those with no common verbal language. As humans evolved, their communication with one another also had to improve in order for the species to endure.

This evolutionary theory is evident in the ability of higher-order primates to convey emotions through facial expressions. For instance, Eibl-Eibesfeldt (1972) contends that human eyebrows are an adaptive characteristic that enhances the display of emotion through their ability to be raised or furrowed. He suggests that

this is evidence for the natural selection of those with the ability to display affect facially.

Since Darwin's work, these evolutionary theories have been substantiated by studies of the universality of facial expressions. Ekman (1994) has been a leader in this effort, showing that both recognition and expression of most basic emotions transcend geographical borders and are able to communicate information reliably across cultures.

Ekman's studies, along with work by Izard (1977), lend evidence to the Differential Emotions Theory, which states that emotions must be universal because the same facial patterns are found in many different cultures around the world. These similarities exist even between cultures that have had little or no contact. Further supporting this notion is the universality of facial displays of emotion in infants, who have not had time to acquire them from others (Ekman, 1994).

However, other theorists who address the purpose of emotions contend that, despite the evidence for some universality, emotions are still social and contextual (Barrett, 1993). The functionalist perspective on the nonverbal communication of emotion contends that "social communication is a central function of the emotion process" (Barrett, 1993, p. 165). One of the functionalist perspective's most interesting propositions is that "communication of emotion always is embedded in a context: [t]here are no movements that can be considered clearcut, context-free expressions of emotion, at any period of development" (Barrett, 1993, p. 159). This idea suggests not only that physiologically similar emotions can be explained differently in various cultures, as has been observed, but also, more importantly, that emotions are fundamentally connected to cognitive processes. Emotions affect the

cognitive understanding of information being communicated from one being to another.

Although functionalists believe that the development of nonverbal communication of emotion for social purposes conflicts with the universality of facial expression of emotion, I argue that in fact they complement one another. Both approaches essentially contend that emotions have developed to help the organism adapt to the environment around them. Emotions aid the internal regulation of one's psychological state, behavioral regulation for different environments, and social regulation in a variety of situations.

The statements of Darwin, Eibl-Eibesfeldt, Ekman, Izard, and Barrett on the evolution and importance of emotional displays follow the same guidelines as Darwin's postulates in *The Origin of the Species* – in essence, that those who are better adapted to their environment will have a better chance of survival, and thus natural selection will favor them. Yet, how specifically does the communication of emotions ensure survival for the human species?

Emotion is information about an organism's inner state, and being able to transfer and receive this information gives an individual additional context that confers a survival advantage (Metts & Bowers, 1994). Communication skills are of paramount importance for highly social species. The passing on of emotional information is vital to "aid in the coordination of social behavior"; thus, the more explicit and less ambiguous the coding of that information is without breaking social norms, the better the society functions (Buck, 1984, p. 35).

Thus, most psychosocial theories focus on emotions as a social phenomenon brought about by the environment or the human's perception of his or her environment. The following summary of findings supports this belief.

deRivera (Metts & Bowers, 1994) states that emotions are social relationships that are brought about through the individual making four interpersonal "choices": toward whom the emotion is directed, the positive or negative valence of the emotion, whether the individual is giving or wanting to get something, and what the person wants. A constructivist theory argues that the individual learns emotions through social rules, not innate behavior or physiological arousal (Metts & Bowers, 1994). In this theory, emotions are part of an interaction between beings in the context of social norms that are influenced by one's culture. Finally, Lazarus (Metts & Bowers, 1994) believes that humans are "sense-making creatures" who assess situations for benefit or harm and then subconsciously adopt the necessary quality and intensity of emotion to cope with the situation.

All of these theories highlight the idea that emotions are more than inner occurrences that serve no purpose besides providing personal experiences for those who feel them. Rather, interpersonal communication relies heavily on the outward communication of emotions; even to the degree that we can argue that one of the primary purposes of emotions is to communicate feelings and needs to others (Andersen & Guerrero, 1997).

Evidence for this assertion lies in research that shows that the outward expression of emotions is seen primarily in public situations and is less prominent in private. For instance, one may laugh heartily in a movie theater with others who are also laughing; however, one may not laugh as loud or perhaps out loud at all while watching the same movie alone at home.

Two types of information are conveyed through the outward expression of emotions to another. The first is the inner emotional state of the person, e.g., he is surprised by something that has been said. The second is information regarding the

environment around them, e.g., there is danger nearby (Cosmides & Tooby, 2000). Both types are evolutionarily adaptive.

Conveying one's inner state not only informs others but also might influence their behavior (Levenson, 1994, p.125). The latter confers evolutionary benefits on the displayer of emotion. For instance, an infant experiencing discomfort shows its inner emotional state outwardly, perhaps by crying, this in turn elicits a comforting response from the child's caretaker. This response to the outward expression of emotion ensures the care and nurturance of the child, ultimately assisting in its survival.

The occurrence of emotions plays a significant part in human interpersonal communication. They have evolved to affect our cognition and action pervasively. As a result, computer interfaces that do not take the emotional reaction and expression of the user into account are incomplete.

Affect and Cognition

Situations or events that alter affect have a much greater effect on human performance than those that do not. Changes in affect can effect cognitive and behavioral changes. Mild positive affect (such as that induced by finding a coin in a pay-phone or receiving a small bag of candy) has been associated with pro-social behavior, efficient problem solving and improved memory, learning, and creative thought (Isen, 1970; Isen, 1999; Isen, Daubman & Nowicki, 1987).

As can be expected, positive affect increases pro-social behavior. In one particular study, shoppers in a mall who used a public telephone unexpectedly found a dime in the coin-return. These unsuspecting shoppers were more likely than those

who did not find a dime to help a person who dropped a pile of papers in front of them (Isen 1970, Isen & Levin, 1972).

Positive affect also effects creative problem solving, such as the following example by Isen, Daubman, and Nowicki (1987). In this study the researchers document the effect of positive affect on Duncker's candle task. The candle task tests creativity by presenting the participants with a book of matches, a candle and a box of thumbtacks and asking them to attach the candle to the wall with only the materials they have before them. In the positive affect condition, participants were able to solve the problem more effectively and complete it more quickly than any participants in the control group.

Word association studies, such as the Mednicks' Remote Associates Test, have been used as a validated measure of creativity by presenting a participant with three "remotely-associated words" and asking for a fourth word. Studies that have used this test to measure increased creativity after positive affect induction have found an effect of more diverse as well as more unusual words given than the control group (Isen, Daubman, & Nowicki, 1987).

As a more applied, real-world example of how affect can affect cognitive functions the following study examined the ability of physicians in a mildly positive affective state to diagnose patients. Positive affect reduced the need of the physicians to hold on to an initial hypothesis, which caused them to determine the afflicting disease more rapidly than a control group (Estrada, Isen & Young, 1997). This ability to move past the initial hypothesis and consider other possible diseases was attributed to positive affect facilitating the physicians to not "distort or ignore information that would not fit with their [initial] hypothesis" (Isen, 1999).

In his book *Descartes' Error*, Damasio (1994) relates stories of people who have sustained damage to the frontal lobes of the cortex (the seat of high-level cognition and emotion). Most of these people recovered with fairly normal basic cognitive functioning, including memory, verbal skills, and word recognition. However, all of them suffered from various deficits in emotional ability, such as difficulty in recognizing emotions and poor social skills. Because emotion affects cognition, these emotional problems led to higher-level cognitive problems with tasks like decision-making. Through studies like these it is beginning to become a well-accepted notion in psychology that emotion is closely tied to cognitive functioning.

Emotion also affects memory. Numerous studies have shown that emotionally rich events in one's life are remembered more often and with more clarity and detail (Christianson & Loftus, 1990; Rubin & Kozin, 1984; White, 1989; Rapaport, 1950; Revelle & Loftus, 1990; Schacter, 1996). Vivid memories have been shown to have attributes of consequentiality and surprise; these attributes seem to induce a greater emotional change than those of non-vivid memories (Rubin & Kozin, 1984). Other studies have supported these findings and assert that the type of emotion is not as important as the level of arousal when the memory is formed (Reisberg, Heuer, McLean, & O'Shaughnessy, 1988).

In addition, emotionally tagged memories seem to be forgotten more slowly then those formed at a time of less intense affect. This slowing of forgetting is thought to be a product of three factors: physiological arousal itself, the distinctiveness of emotional events, and the extra attention and rehearsal that one devotes to emotional events (Heuer & Reisberg, 1990).

Studies have also shown that physiological arousal affects glucose metabolism, which aids in memory encoding (Gold, 1987; Hall, Gonder-Frederick, Chewning, Silveira, & Gold, 1989; Manning, Hall & Gold, 1990). It also causes the person to pay more attention to the arousing event. This relates to the survival advantage of emotions in certain situations that Darwin proposed. Stemmler, Heldmann, Pauls, and Sherer (2001) showed this concept in their study, which found that the context of an emotion-eliciting event has a strong relationship with the level of physiological arousal in the subjects.

It also seems likely that these emotionally arousing events are distinctive to the subject because they are more likely to have serious consequences on one's life; this in itself may promote memory (Hunt & Elliott, 1980; McDaniel & Einstein, 1986). Finally, one reflects on emotional events more often than others primarily because they are more "personal" and more closely connected to one's thoughts and feelings (Burke, Heuer & Reisberg, 1992; Christianson & Loftus, 1991; Heuer & Reisberg, 1992).

The accuracy and reliability of recalled memories, of course, have been called into question. Neisser has brought up many cases regarding the fallacy of recalled memories, specifically what are termed "flashbulb memories". Flashbulb memories are memories that are "subjectively compelling recollections of an occasion when we heard an important piece of news" (Neisser, 1982, p.43). Neisser also asserts that the significance of these memories are due to them being imprinted due to rehearsal and discussion

The previous sections have explained why people feel emotions from a social and evolutionary standpoint as well as how they affect cognitive processing. These studies highlight the importance of emotions for human communication and

functioning; the following section describes how these emotional reactions are still present and important in interactions with media.

The Media Equation

Emotional reactions are not confined to humans and their immediate physical environment. People also respond emotionally to media. The human tendency to treat media as a sentient being is primarily due to millennia of evolution. Not until the last 60 years has the human race been confronted with electronic media objects; whereas, up until then, man had been primarily communicating needs and emotions with other humans. Although it is not difficult to accept that humans have emotional reactions to other people, it makes less sense that humans respond emotionally when interacting with media. However, a significant number of studies have shown that, despite their conscious awareness that media are not sentient, subjects innately follow the same social rules of emotional interaction.

In *The Media Equation*, Reeves and Nass (1996) summarize many of their 35 studies that generally show that humans interact with media in a “fundamentally social and natural” way, and, thus, “media equal real life” (p. 5). In their studies, they tested experienced users, thus controlling for the possibility that their responses to the computers were due to "misunderstanding or fallacious belief about the capabilities of computers" (Nass, Steuer, & Tauber, 1994, p. 72). Examples in *The Media Equation* showed that participants followed the same social rules that they apply to other humans, including attributing various personalities to different computers or synthesized voices and applying gender stereotypes.

In one set of studies, they showed that emotion occurs in a media environment in much the same way that it occurs in a human-to-human context. They determined this by comparing the electrical impulses on each hemisphere of the brain to the type of stimulus that was shown on a television. Previous work has shown that the two hemispheres process different types of emotional stimuli: positively and negatively valenced. Positive stimuli have been associated with the left hemisphere, and negative stimuli have been associated with the right hemisphere. If their hypothesis, "media equal real life", is true, then positive and negative stimuli presented in a media environment would yield the same electrical changes in the hemispheres of the brain. The study, conducted on 16 adult, right-handed women, found that the electroencephalogram (EEG) of activity in each hemisphere coincided with positive or negative stimuli presented on a television. These signals matched patterns seen during human-to-human positive and negative interaction; thus, they showed that the same emotional reactions manifest themselves in a mediated environment.

In another study, Reeves and Nass (1996) set out to show that the law of hedonic asymmetry, the idea that memories of bad experiences dominate those of positive experiences, applies equally in media environments. One of the study's research questions was whether people will remember negative experiences with media better than positive ones. The researchers had participants watch two different types of news stories on subject matter such as airplane crashes and disease in children. Both conditions used the same stories; however, one condition had neutral pictures instead of pictures of the negative subject matter being discussed, whereas the other condition included graphic depictions of the negative subject matter. Two months after viewing the stimuli, the participants were asked what

they had remembered from the experiment. As expected, the participants remembered the news stories with highly negatively arousing pictures better than those with neutral pictures. This study gives evidence to the notions that people remember negative experiences, arousing stimuli can be kept in memory for a long period of time, and negative experiences seen through media are still capable of creating emotional reactions.

This phenomenon occurs even when the user states that social rules do not apply to computers and that they would not obey them when working with a computer. In a study by Nass, Steuer, Tauber, and Reeder (1993), users participated in a tutoring session with a simple computer-based agent as the tutor. Even though at debriefing the users indicated their belief that they would not react socially to a computer, the data showed otherwise. The users exhibited the social principles of accuracy (evaluations of others are more valid than evaluations of self) and friendliness (praise of others is friendlier than praise of self and criticism of self is friendlier than criticism of others). The researchers gave the name *ethopoeia* to this process of making social attributions even when they believe they are inappropriate.

Another study in Reeves and Nass (1996) showed that participants apply rules of politeness to interactions with computers. Participants were nicer in their evaluation of a computer's performance when the computer itself asked for feedback than when they were to give feedback in a paper and pencil format. Reeves and Nass felt that this politeness *to* the computer is also an indication of the user's expectation of politeness *from* the computer. Thus, the user might feel the same types of emotions in response to interruption from a computer as they would to interruption from a co-worker.

Ethopoeia and anthropomorphism can be useful in that they help the user feel more comfortable with the system. If the user can consider the computer to be semi-human, it can decrease the amount of attention and cognitive effort needed to interact with the computer, thus creating a system that feels more transparent to the user (Marakas, Johnson, & Palmer, 2000). However, the negative aspects of anthropomorphism can be just as detrimental to the usability of a system as the positives are helpful. Perceptions of the computer as human can mask the differences between user and computers and encourage the user's assumption that the system is more capable and flexible that it really is (Marakas et al., 2000). This can increase the amount of blame that the user places on the computer when a usability problem occurs, thus increasing frustration, even when, at times, it is actually the user's mistake that causes the problem.

Frustration and Interruption

As of this writing, researchers have yet to agree on a definition of frustration. The concept of frustration has its roots with Sigmund Freud. Freud primarily addressed the effect of frustration on neurosis; however, he was also the first to postulate the idea of a specific emotion arising in reaction to an obstacle to satisfaction (Freud, 1921). Many psychologists over the years have agreed that frustration is a product of goal attainment being thwarted. Lawson (1965) defined frustration as “the occurrence of an obstacle that prevented the satisfaction of a need”; he also stated that frustration and aggression are co-dependent. Amsel (1992) classified frustration as the emotion that occurs from a delay of reinforcement. Some theories have stated that the thwarting itself of an action is not

the frustrating incident. Rather, it is the expectation or anticipation of attainment of the goal that frustrates the actor (Berkowitz, 1978).

The blocking of goals can be internal or external (Shorkey & Crocker, 1981). First posited by Freud, an internal block is a product of the participant not knowing how to complete the goal, whereas an external block is an outside force thwarting the goal (Freud, 1921).

A number of factors influence the level of frustration experienced. The theory of goal commitment relates the importance of a task with the belief that it can be attained (Dollard, Doob, Miller, Mowrer & Sears, 1939). In addition, the level of frustration is linked to the degree of interference with goal attainment, which is based on the severity and unexpectedness of the block (Dollard, et al., 1939). This frustration level could be lower, though, if the user believes the interruption to goal attainment was socially acceptable (Baron, 1977).

Andersen and Guerrero (1997) have linked negative affect specifically with events that are interruptions. The reason for this reaction might be that humans can focus on only a limited number of tasks at once, and an interruption represents at least two additional, possibly unwanted tasks: how to handle the interruption itself and how to handle the reason for the interruption (McFarlane, 1999). Thus, when a person is interrupted they have one of four possible responses to that interruption: take up with full compliance, take-up with alteration, decline, or withdraw (Clark, 1996). However, each of these possible responses is a task for the user to complete before they can return to their original task. Thus, when interrupted, the user must allocate cognitive resources to completing a response task and experience negative affect from the subsequent cognitive load.

Interruption also seems to have an impact on memory. One study showed that people are able to recall interrupted tasks better than uninterrupted tasks (VanBergen, 1968). This phenomenon, called the The Zeigarnik Effect, was attributed to the quasi-need that is left unfulfilled when a task is interrupted. Thus, tension builds up in the person, leading to frustration and a greater likelihood of remembering the uncompleted task.

Research Problem Revisited

Because we know that emotions are important for social communication and that emotion occurs in interactions with media, researchers in affective computing have been attempting to develop systems that sense and respond to the emotions of the user in order to improve the user experience. However, as Barrett has stated, the context of emotions is important for recognizing and communicating emotion. To gain context, it is important to know what types of incidents lead to certain emotional responses. For this study, I examined what types of frustrating incidents affect the user experience most strongly.

In order to determine what types of incidents *significantly* frustrated users, I recorded users' memories of frustrating incidents. "Memory-work" is a technique first employed by Haug (1987); its aim is to find memories that are intrinsically entwined with everyday experiences. The underlying theory is that remembered events are those that are subjectively significant to the subject. Because emotionally laden incidents are the most salient to the user's experience, they will be most clearly remembered.

The foundation of HCI rests on usability problems and the steps to understand and repair them. Even though researchers have demonstrated the

importance of the user experience the effect of an incident on the user's efficiency remains the standard method of rating and prioritizing incidents.

One such method of categorizing usability incidents is the User Action Framework (UAF). In his book, *The Design of Everyday Things*, Norman (1990) argues that users go through Seven Stages of Actions towards goal attainment. Norman's model builds upon the Stages of Execution, doing something to achieve a goal, and the Stages of Evaluation, comparing the environment's response to one's intended goals (Figure 1).

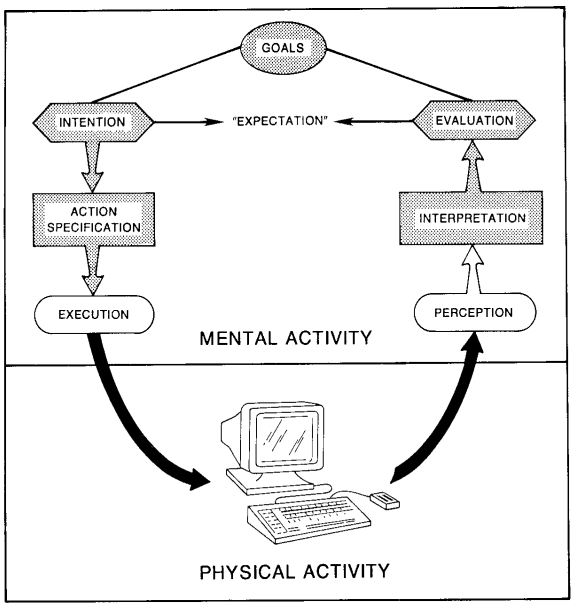

Figure 1: Norman's Model
(Norman, 1990, pg. 47)

From this concept, researchers elsewhere developed the User Action Framework (UAF) (Hartson, Andre, Williges, & van Rens, 1999; Andre, Hartson, Belz, McCreary, 2001). The UAF builds upon Norman's seven stages to classify

usability incidents. It is based on the user's cognitive and physical interactions with the computer. The Interaction Cycle of the User Action Framework has five high-level phases: Planning, Translation, Physical Action, Outcome, and Assessment (Figure 2). Table 1 shows which issues each phase of the UAF addresses. Success in Planning, Translation, and Assessment relies on the user's cognitive processing of the problem. Physical Action relies on the user's motor systems. Outcome is the system's internal reaction to the user's commands; it is also the only phase not associated with the user's abilities. Previous work with the UAF has shown that incidents in the Translation phase are the most common usability problems (Hartson, Andre, Williges, & van Rens, 1999). All incidents that occur in the UAF cycle are considered equally important in the user's perception of the system. Incidents evaluated by most usability analysis, including with the UAF, determine the importance of an incident by how much time it takes to recover from the usability problem.

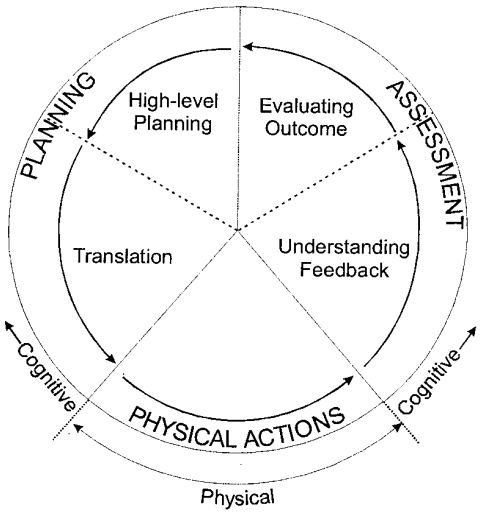

Figure 2: UAF Model
(Adapted from Hartson, Andre, Williges, & van Rens, 1999)

This method and similar ways of looking at the process of task execution focus solely on the user's rational cognitive functioning. They fail to address the user's emotional reaction, and in doing so they portray the user as just another computational component, much like a computer program. We know that human responses are more nuanced. Nonetheless, because I wish to facilitate comparison with more traditional studies of usability incidents, we use the UAF in this study as a way to categorize frustrating incidents.

Table 1: UAF Phases and Issues they Address

Phase of the UAF	Issue it Addresses
Planning	Establishing goals, tasks, and/or intentions
Translation	Translating intentions into plans for physical actions
Physical Action	Making physical input actions
Outcome	System internal response to user's actions
Assessment	Perceiving, understanding and evaluating outcome

Research Questions Revisited

Since current psychological literature states that frustration occurs from the thwarting of a goal, one might assume that an incident at any stage of the UAF would frustrate equally, since all usability incidents thwart a goal. In fact, it seems that not all usability incidents have the same frustrating effect on users. Thus, the research questions for this study ask whether there are differences among the frustration levels people feel as a result of incidents at each of the UAF stages.

As stated before, the following research questions have guided this study:

1. What types of incidents are most memorable to the user?
2. What about them causes them to be memorable?
3. Does the type of technology being used affect which incidents are important?

From the literature review, the following hypotheses have been developed. Since emotionally arousing events are found to be remembered better and for a longer time, the most important incidents in this study are considered to be those that are most memorable. Incidents in the Outcome stage of the UAF are not reliant on the user's abilities and thus are external interruptions. Because frustration has been linked with interrupting incidents, it is hypothesized that Outcome incidents will be most frustrating. Thus, when users are prompted to recall frustrating events:

1. More Outcome incidents will be mentioned than incidents in any other phase.

For the second research question, since Outcome incidents are more arousing and thus are remembered better, users will rate Outcome incidents as more frustrating. In addition, because repetition and rehearsal cause events to be encoded better and for a longer time, it is hypothesized that users will perceive Outcome incidents as occurring more often than those of any other phase.

2. Outcome incidents are more frustrating than incidents in any other phase.

3. Outcome incidents are perceived to occur more frequently than incidents in any other phase.

Finally, I hope that the findings from this study are generalizable across various technological contexts and even add to general knowledge about the cause of frustration. However, there is no indication that this is so, thus, the third research question remains without a hypothesis for exploratory analysis.

CHAPTER THREE: METHODS

Introduction

To collect frustrating experiences I asked participants to look back on their own experiences of frustration while using a variety of applications. However, I did not specify what I meant by frustration to the participants. All of the responses from the participants fell easily into one of the two categories previously mentioned: an obstacle to a goal or a delay of reinforcement. An obstacle to a goal can be seen as not being able to complete a task and a delay of reinforcement can be seen as not receiving adequate feedback from the system.

In general, I was looking for incidents of negative affect. I let the participants decide for themselves what constituted frustration. Since this study primarily concerns user's memory and perception of incidents, I felt that the most important definition of frustration came from the user. I sought negative valence, medium- to high-arousal incidents, which include the emotional states of annoyed, upset, stressed, nervous and tense.

As stated before, I relied on the users to remember their frustrating incidents. Emotionally laden incidents are the most easily remembered and also the most consequential and influential incidents in the user's experience, so this method should successfully capture appropriate incidents.

Participants

Sixty-six participants (n = 66, 31 men, 35 women) were recruited from two undergraduate communication classes, one undergraduate psychology class, and one graduate psychology class at a large upstate New York university. Since some

participants expressed interest in completing the study but failed to actually take the survey, we had a 67.3% response rate. All participants were given extra credit in their respective classes by their professors for participating in the experiment. The median age of students was 20, with a minimum of 18 and maximum of 45.

Survey

For the success of this study, it was essential to address the following issues: to have the participants remember as many frustrating incidents as possible, to be able to describe them as fully as possible, and to remember incidents using a variety of applications and contexts. To address the first and second issues I decided to give the participants as much time as they needed to recall their experiences with various applications. Also, it was important to let the users return to using the application in question to better describe the incident. To address the third issue, it was decided that prompting the users to think back to using various applications was not going to contaminate the results in an undesirable way. Having the questionnaire online was deemed necessary in order to allow the participants an ample amount of time to recall frustrating incidents in addition to being able to reenact the incident in question for a better description.

In addition to asking the participants to remember and describe previous events, I wanted to know how frustrated they felt by each event and whether they felt it occurred often. Although there have been many validated measures of a user's satisfaction level, my search of the literature did not reveal previously used measures for determining the user's perception of their frustration level or perceived occurrence of an event. Thus I chose to devise my own scale for determining these two factors. For each incident, the participants were asked to rate how frustrating

the incident was on a scale from 1 to 10 (1 being slightly frustrating, to 10 being extremely frustrating) and then rate how often they felt the incident occurred (1 being rarely, to 10 being all the time). Since the measure I have used in this study is a single-item measure of the perceived frustration level and occurrence level, it will tell us less than had I used an empirically tested and validated measure. However, this study will hopefully lay a foundation or at least show the need for such a measure in the future. Since I had run this study, I became aware of the Bessiere et al. (2002a, b) and Ceaparu et al. (2002) studies on occurrence of frustration. They had used a frustration scale from 1 to 9 (not very frustrating to very frustrating) to measure frustration. They obtained a frustration rating on their rating system that was fairly close to the one I obtained (Bessiere: 6.74, SD 2.13; mine: 7.02, SD 2.23). However, their rating system is also an untested measure.

Procedure

Potential participants were given a brief description of the project along with a consent form and an invitation to contact the researchers if they had any other questions regarding the project. If the person was interested in participating in the survey, they returned the consent form. A unique identification number was given to all of the participants, and an email directed them to the online survey, which they began by entering the unique identification number included in the email. This ID number was used to ensure the confidentiality of the responses.

When the participant arrived at the site, they were instructed to enter the unique ID number that was assigned to them. If the number was valid they were instructed as follows:

The purpose of this survey is to determine where users feel they experience the most frustration when using technology. During your participation you will be asked to remember using certain types of technology and relating incidents you find frustrating. The experiment should take approximately an hour to complete. The results of each individual's participation will be strictly confidential. The results of your participation will be associated with number-letter combination only. With the exception of the researchers involved in running this study, nobody will be allowed to see or discuss any of the individual responses. All information collected will remain confidential except as may be required by federal, state, or local law. The objectives of the study will be explained as soon as you have completed your session. A summary report and explanation of the results will be made available to you when the study is completed if you so request.

A survey was used to determine user demographics and computer experience. The online survey began by asking the participants for their most often used operating system, browser, text editor, and email client along with their sex and age. Each subsequent page prompted the participant to think back to using one of the following: operating systems, browsers, websites, text editors, email clients, PDAs, digital video recorders, and any other technology. Specifically, they were instructed as follows:

> For each of the following types of applications, describe in detail incidents that you feel **frustrate** you most. Please include the name of the application or website if applicable and be as descriptive as possible.
>
> For each incident, rate how frustrating the incident is on a scale from 1-10 (1 being slightly frustrating, to 10 being extremely frustrating). Also,

> rate how often you feel the incident occurs (1 being rarely, to 10 being all the time). You do not need to limit your answers to the applications you have named previously nor do you have to give an incident for each situation presented to you.

There was a text box for the incidents description followed by two sets of radio buttons for the frustration rating and occurrence rating. At the bottom of the page they had a choice of two buttons: “save and add another to this category” and “save and go to the next category”. Participants were allowed to write multiple incidents for each category or if they had no experience with a particular technology or had no incidents to report, they could skip that category. All of the information that the participants provided was saved to a SQL database.

Analysis

The data was exported out of the SQL database into an excel spreadsheet for easier coding. Each participant gave an average of 5.72 frustrating incidents (ranging from 2-11), which yielded a total of 383 incidents to categorize. Each of the reported incidents was then coded into one of the five top-level categories of the UAF by two coders.

Coding the incidents into one of the five high-level categories of the UAF was the most crucial part of this study, as it is in any type of qualitative analysis. This task was made more complicated by not being able to witness the actual frustrating incident that was being described. The only way the coders could know what was the cause of the frustrating incident was to read carefully the description the participants gave. Thus, the question has been posed as to whether or not the

way the description was phrased made a difference in how the description was coded. However, as you can see in Table 2, one can easily ascertain what the problem was that caused the frustration. The coders could not be swayed with *how* the participants described the incident. For a complete list of incidents used in analysis with their UAF categories, frustration ratings, and occurrence ratings, refer to Appendix A.

Previous studies of the UAF have shown a 97.8% reliability rating of incidents in the five high-level categories (Andre, Hartson, Belz, McCreary, 2001). For this study, a test for intercoder reliability with our particular type of data was performed to ensure the validity of the coding. Using 10% of the data, two coders had a reliability rating of 90% using an approach illustrated in Holsti (1969).

Table 2: Incident Categorization Examples

Frustrating Incident	**UAF Category**
It can be hard to locate information on some websites, because they are not well organized.	Translation
When I'm trying to draw a line, it gets messed up very easily.	Physical Action
I hate making lists in word because it automatically starts continuing to number your list for you, and I never want to use the format it uses. I then have to fiddle with the format for awhile until I get it the way I want it	Outcome
When I receive an "error" message for some reason, the message is often in computer jargon that I don't understand.	Assessment

Since each participant could have given more than one frustrating incident (ranging from 2 to 11), a method was needed to ensure that no one participant would have more of an effect on the overall findings than another. There are at least two methods that could have been used. One method would use all reported incidents by weighing each one as a proportion of the incidents given by each participant. The second method would use an equal number of incidents from each participant for the analysis.

Each of these methods has flaws. The former would reduce the strength of individual incidents in the analysis just because a participant remembered more incidents than others, whereas the latter would discard data. Although it is usually not acceptable to discard data, I decided that allowing each incident to weigh equally was more important than allowing each participant to be fully represented. By only using two incidents from each participant, I ensured that each participant had an equal effect on the outcome of the study in addition to each incident having an equal effect. To ensure fairness, random selection was used for choosing the two incidents from each participant to analyze. Since the least number of incidents any participant provided was two, I randomly chose two incidents from each participant. After random selection there were 132 incidents left for analysis.

CHAPTER FOUR: RESULTS

Basic demographic information from the survey showed that the majority of the respondents used one of the Windows operating systems (*n*=64, 97%), primarily Windows 98 or XP (*n*=38, 57.5%). It also showed that the majority of participants used Internet Explorer as a browser (*n*=56, 84.8%), Microsoft Word as a text editor (*n*=60, 90.9%), and Eudora as an email client (*n*=32, 48.5%). Thus, this is not a comprehensive sample of all possible issues that arise in every application context that is available to users.

Analysis of Hypothesis One

The research questions that this study started with were: what types of incidents are most memorable to the user, and what about them causes them to be memorable? The first testable hypothesis that attempted to address these questions was "more Outcome incidents will be mentioned than incidents in any other phase". Figure 3 shows that once all of the incidents (*n*=132) were categorized into one of the five high-level UAF categories, 18.9% (*n*=25) were in Translation, 2.3% (*n*=3) were in Physical Action, 75.8% (*n*=100) were in Outcome, and 3.0% (*n*=4) were in Assessment. There were no incidents in Planning. $\chi^2(3, N = 132) = 190.727, p < .001$. This is in sharp contrast to previous work with the UAF, which showed that most usability problems occur in the Translation phase. Yet, when users are asked to recall their frustrating experiences from memory, they primarily remember incidents that occur in the Outcome phase. Thus, hypothesis one was found to be true.

An analysis of remembered incidents for men and women was then performed to ensure that generalizing for both sexes was appropriate. The difference in UAF categories remained significant for both men and women, and no difference was found between the sexes, $\chi^2(3, N = 132) = 1.253$, $p = .74$. Men remembered 19.4% (n=12) in Translation, 3.2% (n=2) in Physical Action, 75.8% (n=47) in Outcome, and 1.6% (n=1) in Assessment, $\chi^2(3, N = 62) = 90.129$, $p < .001$. Women remembered 18.6% (n=13) in Translation, 1.4% (n=1) in Physical Action, 75.7% (n=53) in Outcome, and 4.3% (n=3) in Assessment, $\chi^2(3, N = 70) = 100.743$, $p < .001$. Thus, users of both sexes remember more incidents in the Outcome phase.

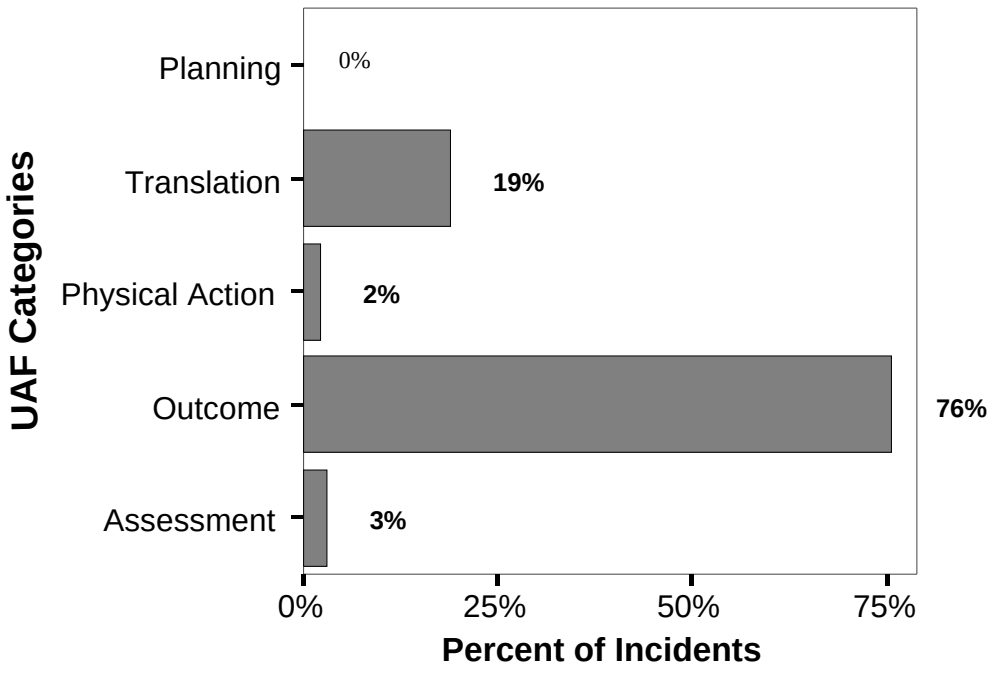

Figure 3: Incidents in UAF Categories

Analysis of Hypotheses Two and Three

In an attempt to explain the large number of incidents in Outcome (n=100), the second and third hypotheses were addressed. The overall frustration rating on a scale from 1 to 10 (1 = not very frustrating, 10 = extremely frustrating) for the 132 cases was 7.02, SD 2.23. Those in Translation had a mean frustration rating of 6.76, SD 2.35; Physical Action had a mean frustration rating of 6.33, SD 3.22; Outcome had a mean frustrating rating of 7.06, SD 2.20; and Assessment had a mean frustration rating of 8.25, SD 1.71. Due to the variance of each of these ratings, there is no significant difference between them, $F(3, 128)=.619$, $p=.60$. An independent t-test between Translation and Outcome also had no significant difference, $t(123) = -.601$, $p = .55$.

Again, to determine whether generalizing across genders was appropriate, I compared frustration ratings for both men and women. There was a significant difference between the overall frustration rating of men (6.45, SD 2.454) and women (7.53, SD 1.886), $t(130) = -2.84$, $p = .005$. In addition, there was a significant difference of perceived frustration in Outcome incidents between men and women, $t(98) = -2.308$, $p = .02$, but not Translation incidents, $t(23) = -1.411$, $p = .17$. Since there was no significant difference for frustration ratings between UAF categories, this is primarily an interesting note for future studies.

I then considered the frequency of occurrence as a reason why Outcome incidents might be remembered more often. The overall occurrence rating on a scale from 1 to 10 (1 = rarely, 10 = all the time) for the 132 cases was 5.93, SD 2.77. Those in Translation had a mean occurrence rating of 5.32, SD 2.41; Physical Action had a mean occurrence rating of 6.00, SD 4.00; Outcome had a mean occurrence rating of 6.05, SD 2.87; and Assessment had a mean occurrence rating of

6.75, SD 1.26. Again, due to the variance of each of these ratings, there is no significance between them, $F(3, 128)=.580$, $p=.63$. There was also no significant difference between males and females in perceived occurrences of incidents.

Post Hoc Analysis

Since there was no difference found for the first and second hypotheses, I continued to categorize the incidents by what type of technical issue caused the frustration. This categorization was done only by myself and thus is not able to be validated by intercoder reliability. Figure 4 shows that 15% ($n=15$) were attributed to pop-up windows, 17% ($n=17$) were attributed to auto-formatting, 33% ($n=33$) were attributed to computer errors or bugs, 20% ($n=20$) were attributed to a dropped Internet connection or slow system response, and 15% ($n=15$) were attributed to other issues. This suggests that all of the remembered Outcome incidents have one thing in common: they interrupt the cognitive flow of the user while he or she is trying to achieve a task. It is also interesting to note that men remembered more bugs and errors than women (males 47% vs. females 10.8%), whereas women remembered more dropped Internet connections and slow system responses than men (males 10.6%, females 28.3%).

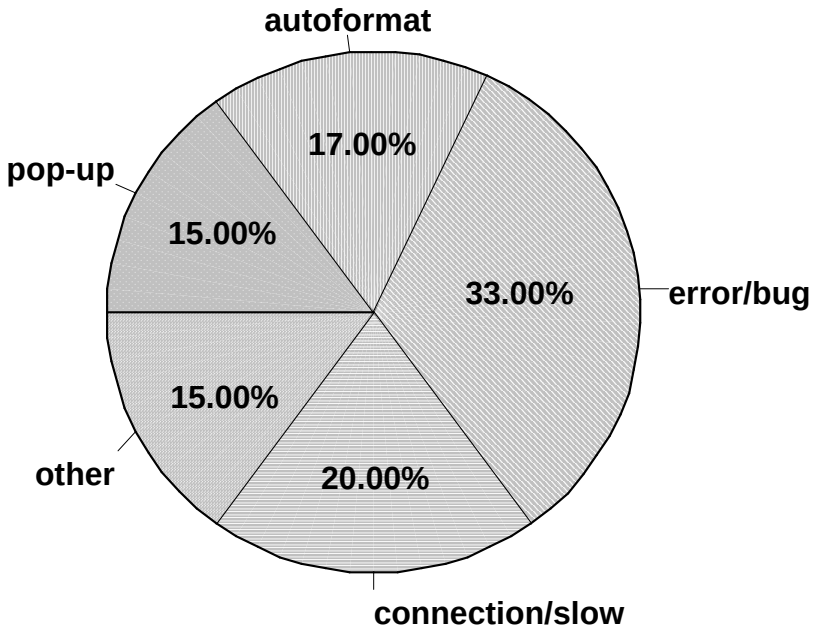

Figure 4: Reason for Incidents in Outcome

While reading over the related incidents, I found it striking how the reported incidents in Outcome were quite insubstantial. Primarily, they were issues such as pop-up windows or auto-formatting, which from my own experiences I know are annoying but are not large efficiency problems or usability problems. Thus, I decided to categorize the level of usability problem for the incidents that were listed in Outcome. I used a usability scale rating system (1=mild problem, 2=moderate problem, 3=big problem, 4=show stopper) based on severity ratings designed by Jakob Nielsen (1994). Nielson's severity rating scale was a 5-point scale (0=not usability problem, 1=cosmetic problem, 2=minor problem, 3=major problem, 4=catastrophe). Since all of the related incidents were usability problems, I chose to

only use the scale from 1 to 4. Again, this categorization was done only by myself and thus is not able to be validated by intercoder reliability.

I found that 64% of the problems in Outcome were either mild or moderate problems, whereas only 36% were big usability problems or show-stoppers (Figure 5). Thus, it was found that the severity of the usability problem is not a factor in how frustrating the incident is – rather, what is salient is how interrupting the incident is.

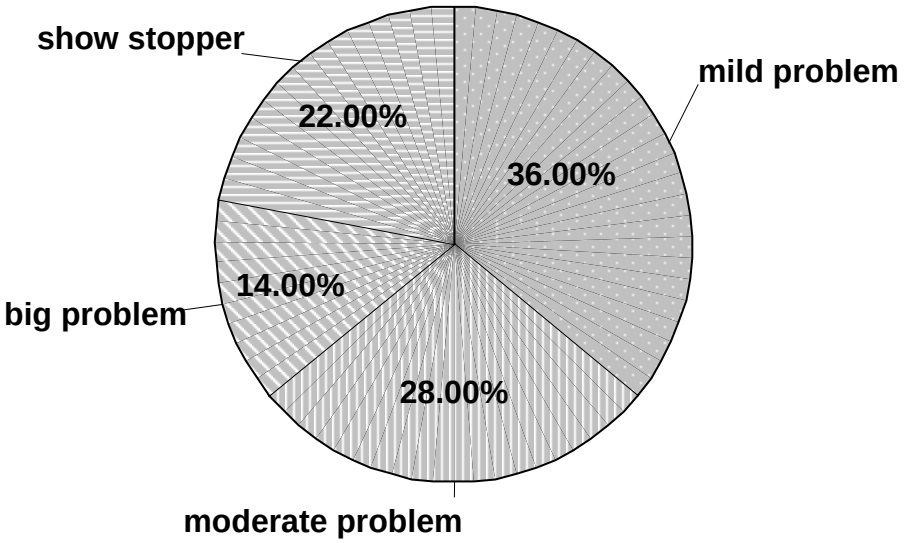

Figure 5: Usability Incidents in Outcome

For a comparison, I also considered the types of errors that the participants remembered in Translation. For these incidents, there were no clear-cut "cause" categories as with Outcome incidents; however, there was an interesting trend in the severity of usability problems that participants remembered. The Translation

incidents were classified by severity of usability incident, from 1 (mild incident) to 4 (show-stopper). Over half of the incidents (54.17%) were considered a big problem or a show-stopper (the user was unable to continue with the task or gave up) (Figure 6).

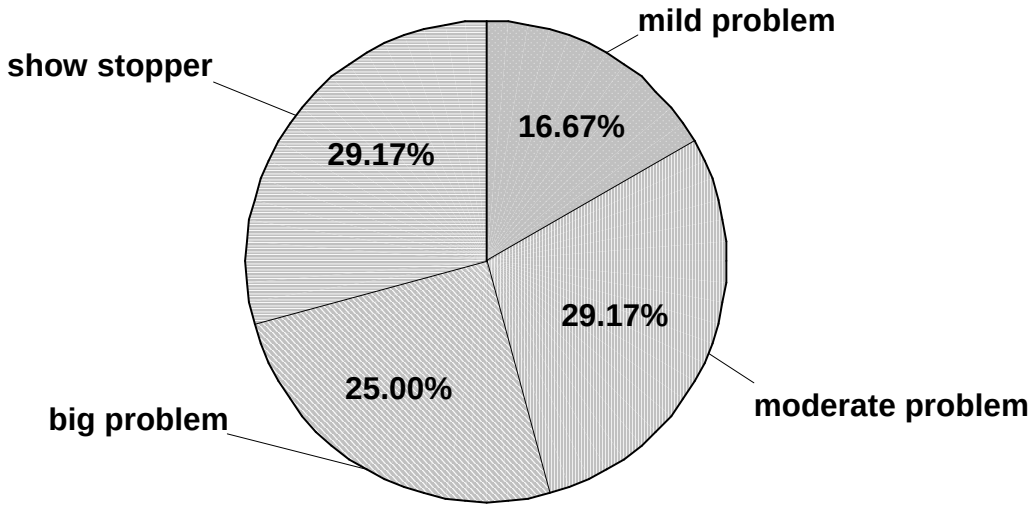

Figure 6: Usability Incidents in Translation

To further understand the interaction between severity of usability problem and frustration, I continued to look at how the participants rated their perceived frustration for each of the usability problem categories in both Translation and Outcome. As demonstrated in Figure 7 and Figure 8, the frustration rating for a given severity of usability problem differs depending on what phase the incident occurs in. Although differences for Translation incidents were not significant (F(3,

128)=.674, *p*=58), it is interesting to note that the frustration rating is higher for show-stoppers than for mild problems. This is in contrast to the frustration rating for Outcome incidents, which seem to be roughly the same for all severity of usability problems and even get slightly less frustrating with increased usability severity ($F(3, 128)=.159$, $p=.92$).

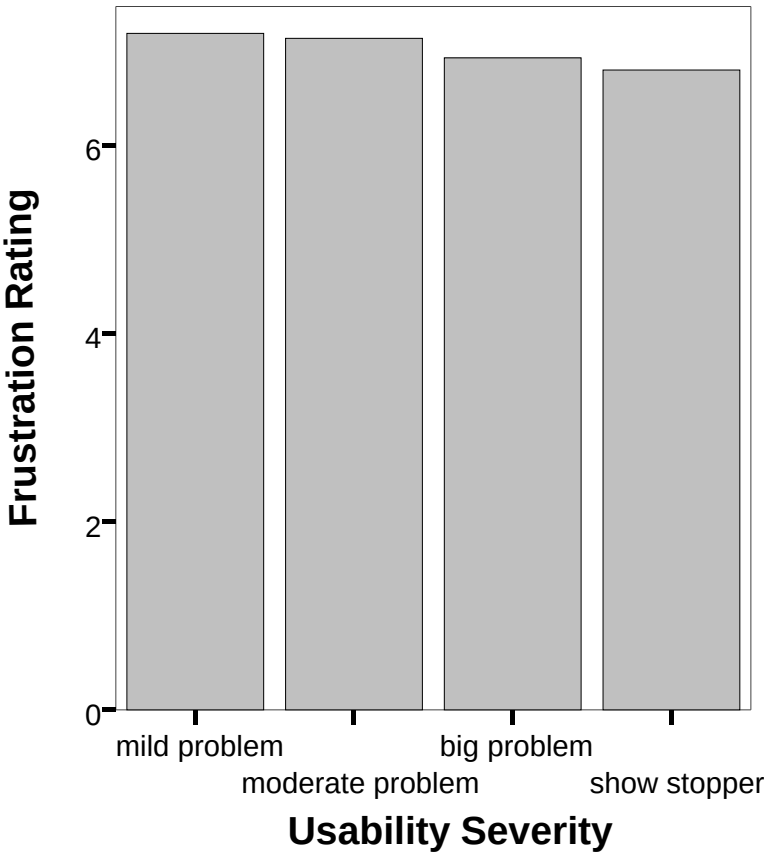

Figure 7: Outcome Incidents - Usability vs. Frustration

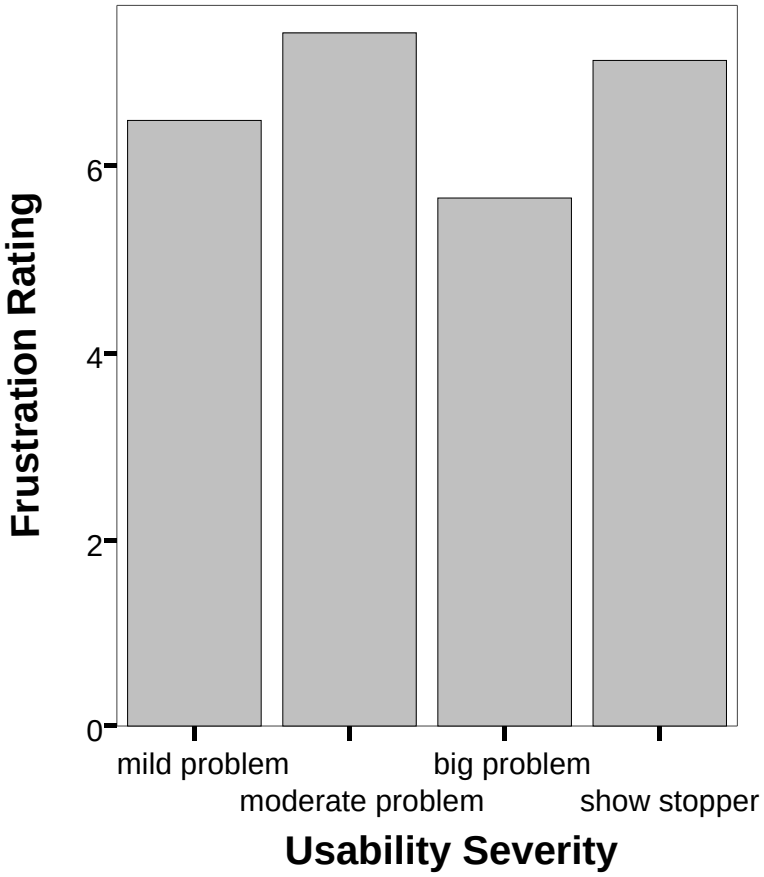

Figure 8: Translation Incidents - Usability vs. Frustration

Analysis of Research Question One

Since this study was aimed at capturing experience across a number of technological environments, an analysis of remembered incidents in each application category was then performed in order to address the final research question.

Of those incidents with operating systems (*n*=19), 5.3% (*n*=1) were in Translation and 94.7% (*n*=18) were in Outcome, $\chi^2(1, N = 19) = 15.211$, $p < .001$ (Figure 9).

Of those incidents with browsers (*n*=21), 4.8% (*n*=1) were in Translation, 90.5% (*n*=19) were in Outcome, and 4.8% (*n*=1) were in Assessment, $\chi^2(2, N = 21) = 30.857$, $p < .001$ (Figure 10).

Of those incidents with websites (*n*=35), 22.9% (*n*=8) were in Translation, 2.9% (*n*=1) were in Physical Action, 71.4% (*n*=25) were in Outcome, and 2.9% (*n*=1) were in Assessment, $\chi^2(3, N = 35) = 43.971$, $p < .001$ (Figure 11).

Of those incidents with text editors (*n*=21), 14.3% (*n*=3) were in Translation, 4.8% (*n*=1) were in Physical Action, and 81.0% (*n*=17) were in Outcome, $\chi^2(2, N = 21) = 21.741$, $p < .001$ (Figure 12).

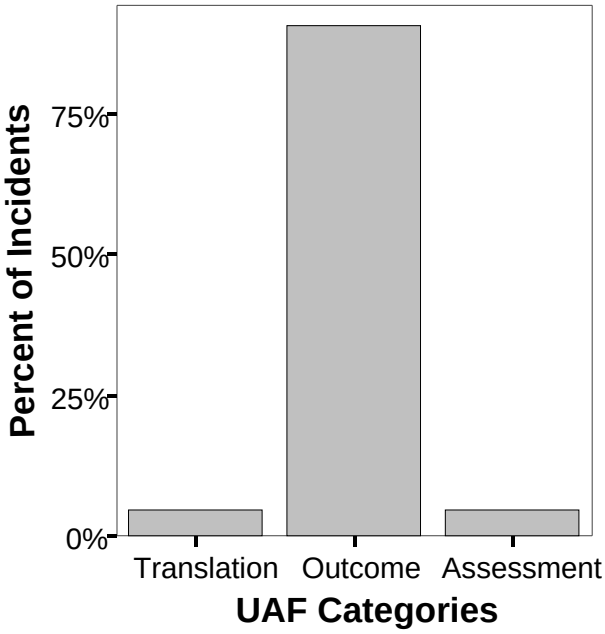

Figure 9: Operating System - UAF Categories

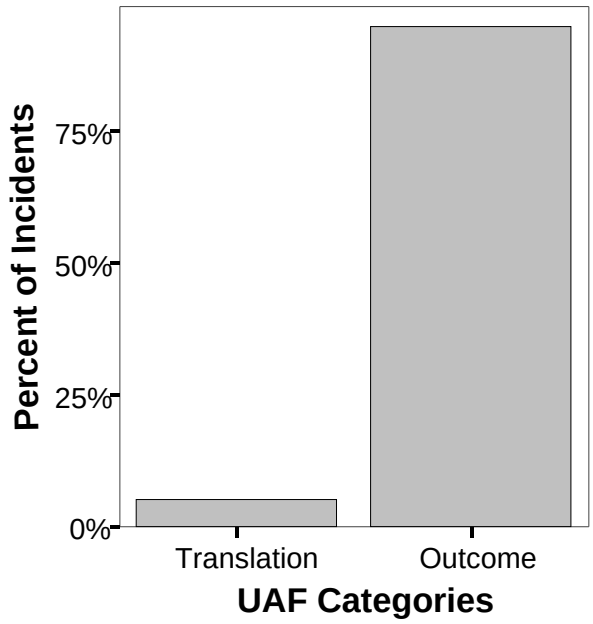

Figure 10: Browser - UAF Categories

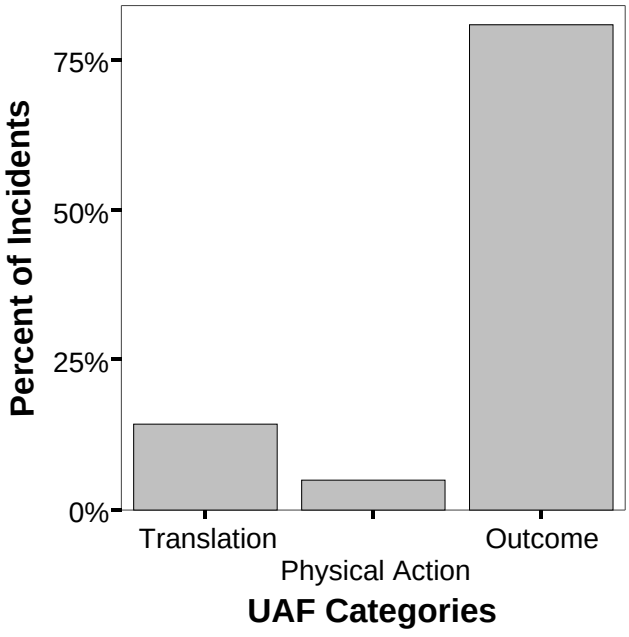

Figure 11: Website - UAF Categories

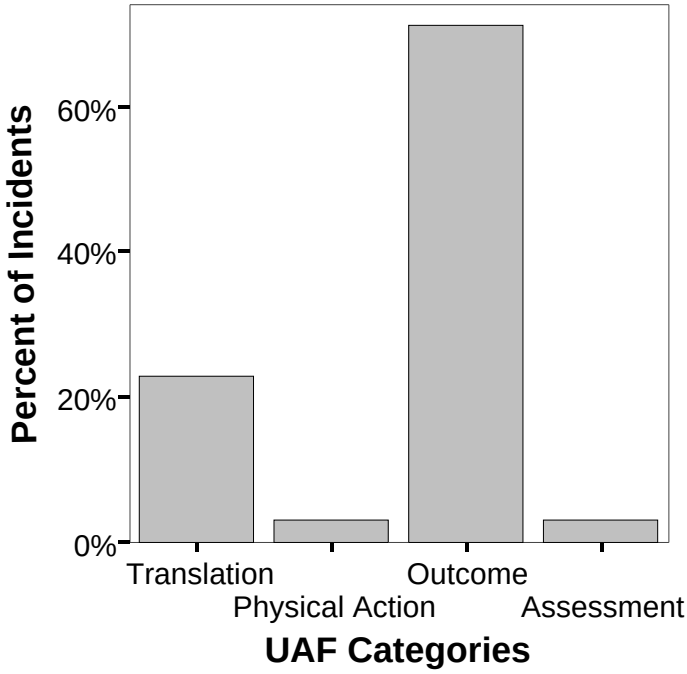

Figure 12: Text Editor - UAF Categories

Although the following applications did not yield significant results, primarily due to too few incidents reported, it is interesting to note the categorization of the incidents. Of those incidents with email clients (*n*=14), 35.7% (*n*=5) were in Translation, 57.1% (*n*=8) were in Outcome, and 7.14% (*n*=1) were in Assessment. Of those incidents with PDAs (*n*=3), 33.3% (*n*=1) were in Physical Action, 66.7% (*n*=2) were in Outcome. There was only one incident given for DVRs and that was coded as a translation incident.

The 8th category, "other," proved to be substantial, with 18 reported incidents, so I broke that category down further into incidents with video cameras and those with instant messaging. Video cameras (*n*=6) had 16.7% (*n*=1) incidents

in Translation and 83.3% (*n*=5) in Outcome. Issues with instant messaging (*n*=9) yielded 44.4% (*n*=4) incidents in Translation, 44.4% (*n*=4) in Outcome and 11.1% (*n*=1) in Assessment.

CHAPTER FIVE: DISCUSSION

The field of affective computing has attempted to improve the user experience by devising systems that sense and respond to emotion. However, thus far they have failed to address what contexts lead to particular emotions. For this study I focused on situations in which users *remember* being frustrated. This may not be an indication of where all frustration is actually occurring for the users. Previous work with the UAF indicated that the majority of usability errors occur in the Translation phase. However, this study shows that users are primarily remembering those problems that occur in the Outcome phase.

Summary of Results

Hypothesis One

In Chapter 2, the psychological literature states that frustration is brought about through the thwarting of a goal. However, all usability problems thwart goals in one manner or another. Thus, the first hypothesis of this thesis was to determine what types of incidents are most frustrating.

It is apparent that those incidents in Outcome are remembered more often than those in other areas. Incidents that occur in Planning, Physical Action and Assessment do not occur very often; thus, it is understandable that these have the lowest number of remembered incidents. However, Translation incidents are the types of usability problems that occur most often and yet Outcome problems are *remembered* most often. Thus, there must be something particularly arousing about these types of incidents that cause them to be encoded in the user's memory so vividly.

Hypotheses Two and Three

Hypotheses two and three attempted to address a reason for the finding in hypothesis one. I attempted to find a connection between the level of frustration experienced and the perceived occurrence level in the different UAF categories. However, this turned out not to be significant. This finding, I feel, is due to the conceptualization of the method. I was attempting to show that Outcome incidents are more emotionally arousing overall. However, obtaining emotion ratings of *all* usability incidents, not just those that are remembered, would be necessary to support this phenomenon. This is the same methodological conceptualization problem that occurred with the perceived occurrence ratings.

The additional coding to explain the differences found in hypothesis one showed that the majority of remembered frustrating incidents were attributed to auto-formatting, computer errors or bugs, a slow or dropped Internet connection, and pop-ups. These incidents all seem to have one thing in common: they are external to the user's cognitive processing and they interrupt the user's task. These external frustrating incidents take control away from the user. When users decide on what goal they want to achieve, they plan the steps that are needed to complete that goal. However, when there is an unanticipated interruption, the user has to compensate for that interruption, breaking the cognitive flow.

One factor in the level of frustration that has been suggested previously is the unexpectedness of the block to goal attainment (Dollard et al., 1939). This is evidenced in the amount of remembered Outcome incidents, which include unexpected interruption to goal attainment. The remembering of interrupting incidents is also evidence for the Zeigarnik Effect, which showed that people are able to recall interrupted tasks better than uninterrupted tasks (Van Bergen, 1968).

Translation incidents do not usually include this type of interruption. For instance, a user is attempting to format the title of their paper in boldface. The Translation phase of the goal is to find the "bold" menu item. If the user takes a little bit longer to find the item than is expected, it is considered a moderate usability problem; however, the flow of the user's cognitive processing was not broken to complete the task. Thus, the user might not find this frustrating at all. However, if the user succeeds in finding the Bold menu item but then the word processing program makes the whole text file boldface, this would be an Outcome incident. This requires the user to stop what they were planning and decide on a new path of execution to undo what the computer has done incorrectly. This type of incident is considered a mild usability problem, but from the perception of the user it might be very frustrating. Thus, for Outcome incidents, it is not the severity of the usability incident that determines how frustrating an incident is, but rather the level of interruption. For instance, although an auto-formatting incident such as I just described is easily recoverable, it accounts for 17% of remembered Outcome incidents.

This effect is evident also in the types of Translation frustrating incidents that were reported. The majority of incidents either were big usability problems or caused a total breakdown in use. Incidents such as being unable to find a certain function and thus giving up in trying to use that function were often reported. However, incidents such as these would be considered severe usability problems as well. Thus, to consider all types of usability incidents as the same in the way they affect the user's emotional reaction is to fail to see the intricacies of the human emotional and cognitive system.

Research Question One

Finally, with research question one, I was attempting to show that the emotional reaction to frustration that has been found by the previous two hypotheses is not platform- or technology-dependent. Unfortunately, I only had two Macintosh OS users report on their frustrating incidents, so they were not adequately represented. However, as the data for research question one shows, Outcome incidents are still more readily remembered than those in Translation no matter what type of technology is being used. Even for those technology categories that did not have enough incidents reported to achieve significance, more incidents were given in the Outcome phase. Thus, this implies that the occurrence of frustration is not limited to one type of technological context. However, since this was not a representative sample of some types of technology, further work should be done to validate this conclusion.

Implications for Affective Computing

From this study, we can see that there is a trade-off between system automation and user control that can cause many frustrating incidents. However, Affective Computing could solve this problem by monitoring the affective response of a user to automation. For instance, if an emotional reaction to auto-formatting is negative one time, then it is likely it will be negative another time.

In general, knowing the context of an emotionally arousing incident can give affect-sensing machines a better idea of what emotion is actually occurring rather than primarily relying on the signals that are obtained from measurements of physiological signals. This combination of perception with context in recognizing

the emotional reactions of the user is much like that which humans do to recognize emotions of others they are communicating with (Barrett, 1993).

Finally, the frustration reaction to interrupting incidents seems to be a noteworthy result for Affective Computing. The response of a system to detected affect should not interrupt the user's cognitive flow and should not take control away from the user. As with other types of computer automation, an affect-sensitive system that interrupts the cognitive flow of the user would cause more frustration, not less. A particular challenge for future designers of affective computers is to respond to the user's emotional state without taking away his or her control or interrupting cognitive flow.

There is one possible exception to this rule. An instance when interruption might be useful could be when a user is experiencing such a high level of frustration that they are stuck in tunnel vision. For example, if a user continues to choose the same menu item to format their text document, they are likely stuck in a continuous loop facilitated by the negative affect, and thus they would need to be interrupted or broken out of that cycle to be able to rethink their approach to the task at hand.

Implications for User Experience

There are also design implications for creating a better overall user experience. If one of the goals of usability design is to improve the user's perception of experience with technology it is important to focus on better design and reactive devices in areas that affect the Outcome phase.

One study shows just how taking control away from the user can lead to a negative effect on one's behavioral intention to use a piece of technology (Venkatesh, 2000). Built upon the Technology Acceptance Model (TAM), which

says that perceived ease of use and perceived usefulness determine one's intention to use technology, Venkatesh's model adds external control as a factor that influences perceived ease of use. Thus, incidents that have been reported as Outcome incidents in this study are those that are important factors in deciding perceived ease of use and thus future intentions to use the technology.

In general, this interruptions affect on frustration seems to be an important concept for interface design and responsive systems. Responses of a system should not interrupt the user's cognitive flow and should not take control away from the user. If there is a system response that could possibly be intrusive, allow the user to regain control easily, since these interruptions are remembered by the users and color their perception of the experience of using the system.

Most interestingly, though, when one considers experience and not efficiency, it is clear that, for the user, not immediately knowing how to do something is not always a bad thing. Perhaps ascertaining the solution to a problem is part of the experience or perhaps frustration is does not always take away from the experience. For instance, most examples of frustrating incidents in Translation were caused by big usability problems or show-stoppers. Thus, most Translation incidents are only remembered when they cause big, drawn-out problems, not problems that took a little time to figure out. In contrast, Outcome problems are remembered no matter how big or small a usability problem it was. Thus, external interruptions are shown to detract from the user experience in the user's eyes, no matter how little time it takes away from the task at hand.

I have primarily given examples of how to enhance the user experience within desktop computing. However, these rules are just as important outside of the desktop environment. Just as the user experience of writing a letter is about

expressing oneself and creating meaningful sentences, not using the text editing software, the experiences in our homes (i.e. cooking, socializing) are not about using technology but rather using technology that enhances and does not interrupt the already enjoyable experiences of the home. In order to support those experiences with technology, designers must create systems that do not interrupt the experience or take away control.

Limitations of Study

There were a number of limitations to this study that should be addressed in further studies. The first and possibly most controversial issue with this study is the method I chose for addressing the differing numbers of responses from participants. Although weighting the incidents to give each participant equal weight would allow me to keep all of the data, I felt that it would also allow one participant's incident to count more than another's, if the first participant reported fewer incidents overall. Thus, I did not feel that this was the best way to make sure each incident was fairly counted. Although eliminating some data is not normally accepted, I attempted to do so fairly (by random sampling). Had I chosen to use the weighting method, the results may have been different, but each approach has distinct advantages as well as disadvantages.

As stated before, the methodological conceptualization of the perceived frustration rating and perceived occurrence rating was faulty. I was attempting to show that Outcome incidents are more emotionally arousing overall. However, obtaining an emotion rating of *all* usability incidents, not only those that are remembered, is the only procedure that might give evidence for this phenomenon. For a future study, the frustration rating for *all* usability incidents should be

collected and compared to one another using the UAF. This should also be done for the occurrence rating. The occurrence rating of *all* usability incidents should be collected and compared to one another using the UAF.

In addition to the methodological problems with the frustration and occurrence ratings, there is also a limitation with the chosen single-item scale. As stated before, my search of the literature did not reveal previously used measures for determining the user's perception of their frustration level or perceived occurrence of an event. Thus, I chose to devise my own scale for determining these two factors. This measure will tell us less than an empirically tested and validated measure. However, this study will hopefully lay a foundation or at least show the need for such a measure in the future.

The final limitation was the sample size. In general, the overall sample size was adequate; however, in order to have a better representation of various technological contexts, a larger sample or better sampling method is needed for a future study of this type. In addition, a larger sampling of various OS users (especially Mac users) would be helpful in the generalization of the results of this study.

Directions for Future Research

Frustration

One question still remains: Are users being frustrated in the other phases as much as Translation and Outcome but not recalling the frustration later? From previous research with the UAF, it seems unlikely that there are that many other frustrating incidents occurring in Planning, Physical Action, and Assessment.

However, it would be interesting to see if a user starts to put more importance on incidents in Translation if there are no frustrating incidents in Outcome to cite.

In addition, how much do these cited incidents affect the user's perception of their experience? For instance, is frustration in other areas affecting their perception of software although they aren't consciously aware of this? Also, how much does negative affect actually alter the user experience compared to positive affect?

Positive Affect

As one can see from the literature review, a substantial body of work has been done on the effect of positive affect, however, we still know little as to what types of incidents induce positive affect and how designers can enhance positive affect in a technology environment. This study focused on what are the significant frustrating incidents while using technology, thus, it would be interesting to learn what types of positive affect incidents do people remember most when using technology. Are positive affect incidents that are remembered beneficial to the user experience or are they as well interrupting? And finally, do mildly positive affect incidents repair the damage done by the negative affect? Some of these questions could be answered by simply seeing what incidents users remember when you don't ask them to focus on a particular emotional state.

Internal vs. External

In order to understand exactly how far the external versus internal attribution of error reaches, it would also be interesting to ask the users who they feel is at fault for the frustrating incident. A few times, users said things like "I am sure this is just stupid user syndrome…" which indicated that they probably thought it was their

fault that the incident was occurring. However, it would be interesting to see whether the incidents that occurred in Translation were primarily attributed to bad design instead of the users' own ignorance in using the system and, thus, whether this is why they were frustrated by the problem.

Finally, a laboratory experiment could be conducted to validate the differences of the actual versus perceived incidents. However, it would be difficult to induce frustration consistently. Thus, it might be better to get a measurement from the Ceaparu et al. (2002) and Bessiere et al. (2002 a, 2002b) studies of what types of frustrating incidents are actually occurring and then compare this to the types of frustrating incidents that are being remembered.

CHAPTER SIX: APPENDICIES

Appendix A: Analyzed Related Incidents

Application Category	Description of Frustrating Incident	UAF Category	Frustration Rating	Occurrence Rating
Websites	The only time I get truely ticked or frustruated is when I accidentally (or intentionally) get on a porn site and try ro get out. More porn sites just keep popping up and it seems like it takes forever to get rid of them.	Outcome	8	2
Other	The problem I have when recording anolog through my sound card is an incredible hum. Especially if I am using a guitar.	Translation	10	8
Websites	whenever I go online all of the pop up things drive me crazy.. sometimes there are so many that they end up crashing my computer. they are all for casinos and things like that.	Outcome	8	9
Video cameras	The battery on my video camera does not last long enough. If I don't charge it every so often it runs out.	Outcome	5	7
Operating system	My computer often runs out of "stack pages," and the blue error screen shows up. I try Control+Alt+Deleting, but that doesn't work, so I end up selecting "Shut Down" from the Ctrl+Alt+Del window. But my computer never shuts down from there... it acts like it's	Outcome	8	7

	shutting down, but it ends up going into this limbo stage where it's just a black screen. I end up having to manually reboot my computer every time.			
Text editors	The automatic bullets in Word are always showing up when you don't need them, but I use bullets too frequently that it's not worth it to turn the automatic feature off!	Outcome	6	6
Text editors	Word sometimes has problems indenting. it ususally happens when i've been on it for too long. I try to indent the beginning of a paragraph and it ends up trying to indent the entire paragraph. I usually have to close word and start it up again to make it stop.	Outcome	7	6
email clients	not much frustration from eudora but outlook is very confusing therefore i don't use it. it seems to complicated.	2	5	5
Browsers	America On-Line: Everytime I open up AOL, I get an advertisement that I have to close before I can do anything.	Outcome	9	10
Browsers	America On-Line: Every time I sign off of AOL, the window closes and I get a box that says "please wait while AOL updates your files"...it happens everytime and I have to wait for it to go	Outcome	8	10

	away.			
Other	If I download things from the internet, such as movies, it frustrates me that my account can just be shut off without any previous notes or warnings. I get higly upset with this as well because my internet account get blocked off therefore making it impossible for me to access things I may need on the internet.	Outcome	10	10
Text editors	if you are writing a paper and you mean to write: they are very nice and you write: there are very nice words will not pick up on it.	Translation	2	6
Browsers	I'm not quite sure if this is really about the browser, or just the speed with which I access the internet, but things seem to pop up really slowly on my screen. This is the most frustrating thing about the internet. I feel like there is a lot out there that would be interesting, and helpful for school, but I don't have the patience to sit around and wait for it.	Outcome	8	7
email clients	The only problem I've really encountered was in creating entries to my address book. WHile this is probably just stupid user syndrome, it took me forever to figure out how	Translation	7	4

	to get the recipients on the drop down address list. It seems like this should have been more obvious when I was creating an address book entry.			
Browsers	When it says I performed an illegal function and immediately shuts off when I clearly didn't do anything out of the ordinary.	Outcome	10	5
Text editors	When the wizard comes up or when they automatically format what I am doing and I am unable to change it back.	Outcome	8	7
Browsers	Netscape will often cease to work. The program will load, but it will be unable to access the internet or at least display. It will not work until the computer has been restarted.	Outcome	4	3
email clients	Very slow to load.	Outcome	4	4
Websites	I use interent explorer and i find popups to be very annoying. I have to close them down regularly otherwise my computer will slow down imensely or crash.	Outcome	7	9
Websites	The length of time it takes most websites to load is a pain. I usually just want to do a quick check of the headlines and go on my way, but usually news sites have so many advertisments they take forever to load.	Outcome	7	10
Websites	I hate the little pop-up	Outcome	8	10

	windows that appear whenever you open the browser. You have to click them all closed so you can see the window you are working on.			
Text editors	I hate it when Word formats a document automatically such as putting in bullets when it is not the format that you want. You keep having to change it.	Outcome	8	5
Websites	Sometimes there is an error on page or page expired, so I can't get to the website.	Outcome	7	6
Text editors	I HATE it when word tries to autoformat. Then capitalization gets tricky, spacing is screwed up, etc. And the opposite is when it won't format your spacing correctly (i.e. alignment).	Outcome	9	9
email clients	I dislike the fact that in Outlook you have to send an email twice to get it sent. First you type the letter and hit send right there on the newly typed up document, but then you must hit the send/receive button for it to actually go through.	Translation	8	10
Instant messaging	Trying to set up a profile on AIM is extremely frustrating because it will not let you type past a certain spot often when there are many more available lines. For	Assessment	10	7

	instance I have had it not allow me more than 2 lines when other times I was allowed 15 lines. It is very inconsisten and frustrating			
Websites	Pop up windows, as you close on, another pops up.	Outcome	7	9
Video cameras	My software for my digital camera is not compatible with Windows XP.	Outcome	9	1
Websites	Some websites such as ballericons.com will have many pop-up ads that appear and continue to appear even after you close the windows. This can freeze up the website and take forever to get to what you actually want to look at.	Outcome	6	10
Text editors	The auto-format on Microsoft Word can get very frustrating. Sometimes it indents where you don't want it to or it won't let you indent without re-typing when you want to indent something.	Outcome	8	7
Text editors	word has frustrated me a few times, i hate when it does things automatically for you. like once i was writing a paper, and it kept putting things in outline form automatically, i didn't want it to do this, so it was bothering me.	Outcome	6	3
Browsers	aol frustrated me sometimes, but i dont think its aol all the time, i think its my computer.	Outcome	2	2

	when it just stops letting me do something for no reason. like all of a sudden it won't let me check away messaages or something, or it will just sign off automatically during the day sometimes.			
Operating system	I hated that when I had a slow computer, I couldn't do all the things I wanted to do at the same time. I like to listen to music, instant message, write a paper, browse the internet and maybe watch a movie clip at the same time. My computer my freshman year didn't have enough memory for that so it would say that I didn't have enough memory to run all the tasks and that I would need to exit one or more programs. Usually when I did exit one or more programs, that still wasn't enough. I don't run into that problem as much anymore but it still happens with the computer that I'm using right now. I just need to stop and reboot. In the older versions of Windows (I had 95), the blue screen would pop up pretty often. I use a 98 right now and it happens less often.	Outcome	8	8
Websites	I really hate it when buttons don't work. And you keep pressing and keep pressing but it doesn't	Outcome	9	3

	ever work.			
Operating system	My clock on the computer "loses time," i.e., it falls behind actual time. This oftentimes causes me problems when I'm trying to sign on to my NET ID in order to access my mail.	Outcome	7	10
Text editors	I mostly use Works, which I enjoy using very much, but occasionally I use Word. I hate Word. Word, to quote my brother's girlfriend, "has a mind of it's own." It doesn't let me space things out the way I want, it tells me my grammer is wrong when it isn't. It indents things when I don't want it to, etc.	Outcome	10	10
Websites	False advertising; especially ones with annoying flashing windows. IE "hit the monkey and win a prize" where if you hit anywhere it is the same link. Also links like, "you are today's lucky winner!" when every user gets the same message.	Outcome	9	9
Instant messaging	I would like to be able to doodle in the IM window.	Translation	5	2
Browsers	When IE is slow in either opening or if I click on a link and it takes a while to come up.	Outcome	5	3
email clients	Making a recipient list was hard to figure out. Everytime I try and create a new address book entry,	Translation	4	1

	my computer freezes. For my first year here, I could not use Eudora because my computer would not open it. It would say error everytime until I got Windows XP, at which point Eudora worked			
Operating system	Computer freezes, using windows ME. doing something, AIM, word processing, surfing web, and it totally locks up. I'm forced to turn off the computer manually, ctrl+alt+delete doesnt work.	Outcome	8	8
Video cameras	very buggy. using my webcam crashes my computer quite often.	Outcome	5	2
email clients	LOSING AN EMAIL as you are writing it.	Outcome	8	4
email clients	Not being able to send OUT messages on my computer b/c we have a router.	Outcome	8	10
Operating system	Windows 98 Sometimes I have problems with the formats of different types of templates and even just papers and outlines. It doesn't line up well, etc. and you could take time positioning and then it goes wrong.	Outcome	6	9
Browsers	Netscape: Taking forever to reach sites. Sometimes it will go directly to a site and other times it takes a long time or worse it can't bring up the site.	Outcome	9	8

Operating system	The thing that frustrates me most is when the operating system freezes when I am in the middle of something. Probably the times that it happened most was while using Print Shop 12. You would have something such as a card or a poster almost to the point of completion and the computer would freeze, causing you to lose everything that you had just been working on regardless whether it was saved.	Outcome	10	7
Video cameras	Using a Sony Mavica, I was very disappointed in the image quality. I had taken some pictures of a graudation and most pictures were extremely grainy. I basically didn't have one good picture to remember the ceremony by.	Outcome	10	7
Operating system	When the computer crashes for no reason.	Outcome	7	3
Text editors	When I'm trying to draw a line, it gets messed up very easily.	Physical Action	4	2
Operating system	Operating System: Windows ME The most frustrating aspect of this operating system involves the blue screens that occur when the computer is busy or an application fails to work. Most often when the blue screen occurs, you have to	Outcome	8	4

	improperly shut down the machine and start over again.			
Websites	Web Browser: Internet Explorer I'm unsure if this is part of the browser itself, but there are so many internet ads that pop up that get block the pages of desired information.	Outcome	6	10
Websites	pop-up windows, such as pop-up ads, that I did not directly go to. They just come up when I click on a website. I close them immediately, and don't even look at them...they slow up my computer, and they are really annoying.	Outcome	9	8
email clients	When it does not send emails. Sometimes, it just says "error" when I try to send emails, and I don't know why, it just doesn't work.	Assessment	10	6
Operating system	viruses that i don't know how to get rid of that screws up my cpu.	Translation	10	4
Digital video recorders	can't get the titles off the screen. i.e. Happy Birthday!	Translation	6	2
Operating system	Not as quick as newer versions	Outcome	9	9
Instant messaging	Random kicking-off on AOL IM if it is a high traffic time or my connection speed is slow.	Outcome	10	3
Websites	Embedded background music. I don't care if you found a "kewl midi of the	Translation	7	4

	Imperial March", I'm probably playing music of my own and I don't want to search for the embed to turn it off.			
Websites	Pop-ups, pop-unders, and any other form of non-banner advertising. For the last time, I do not want your damn tiny wireless video camera!	Outcome	7	10
Browsers	I build websites and i have a hard time making css style sheets to work in netscape and well as IE. i was building a website once and could not make the site function perfectly in both browsers.	Translation	10	8
Instant messaging	I don't like it when you can't transfer IM stuff over firewalls. I know that you can change your settings to allow this, but most people don't know how and it is really annoying. I understand that it is for security purposes with you router or firewall, but it is one of the most frustrating things. Especially if the file is big, because you can't email it.	Translation	10	7
Websites	I haven't any real problems with my online experiences. Although my experience with this website was some what of a problem b/c I wasn't able to log on to the site the first time I tried. So that would be my incident of the decade as far as most	Outcome	3	1

	annoying or problematic experience that I've had at cornell.			
Browsers	I hate how slow the connection rates going from page to page are on these websites. I tried and ordered a CD one time from buy.com and the page needed to be refreshed after I had entered my credit card info and all. it was pretty frustrating b/c I ended up getting a bill for something that I never got in the mail :(	Outcome	7	4
Operating system	the compatability of all the window programs has always been an issue when looking for new things. i have had problems finding things that are compatible.	Outcome	6	4
Websites	Popups	Outcome	8	8
Browsers	Netscape 4.7 crashes at random intervals when viewing certain webpages (especially message boards using vbulletin)	Outcome	8	8
email clients	I installed Mozilla to use its email reader to replace the copy of Netscape 4.74 that I was using before. Two days after installing it, Mozilla broke itself somehow and corrupted the GUI in the email reader, making it unusable.	Outcome	4	1
Operating system	Booting up. ME is insanely slow getting all	Outcome	7	5

	my applications running.			
Instant messaging	I like IM, but it is definitely irritating when people get kicked offline mid conversation. once or twice i have been able to receive messages but not send them, so i usually have to get offline and totally reboot my computer.	Outcome	6	4
Browsers	I was trying to install MS Data Access Components for a software project, but couldn't unless I installed IE 4.0.1. Although, my project had NOTHING to do with IE. There have been many times I've had to update my version of IE many times to enhance my programming environment.	Outcome	10	10
PDAs	I use the Palm OS. I can't stand that there aren't default printer drivers with the operating system and that I have to rely on third-party utilities (expensive) to simply print. OBEX is really limited since you have to use a very simple and rigid format of printing.	Outcome	10	10
Websites	the incident has more to do with a search engine - i hate when i'm looking for information about something and no websites come up with what i'm looking for.	Translation	10	4

Instant messaging	On AOL IM i get messages from solicitors, which is even more awful than telemarketers because it feels like a greater invasion of privacy.	Outcome	9	3
Websites	search engines: never come up with what i'm actually looking for. example: i was looking for University Bartending. it's a website (universitybartending.com), but i didn't know that - i simply knew that the site i was looking for had "university bartending" on it. well, i almost gave up before i found it, because the search engine doesn't bother to look at domains while searching. on the other hand, i half-expect that whenever i use a search engine i won't come up with results anywhere near what i wanted. hence, i don't use search engines often, and so my frustration with them isn't frequent.	Translation	6	5
Websites	what's frustrating is when my internet connection goes bad, and it signs off...then it decides to sign me back on hours later when the connection's better and i'm not home. and i can't figure out how to not let it do that while keeping the auto-sign on feature that i like when i turn on my computer.	Outcome	4	5

Browsers	When I receive an "error" message for some reason, the message is often in computer jargon that I don't understand. I feel the worst part of having trouble with a computer function is not being able to solve it. Sometimes the help-menues offer no guidance for the particular problem, and I can't decode the error message enough to find guidance elsewhere. This seems to be happening recently when I run Netscape.	Assessment	8	5
Text editors	This is a pretty specific frustration with Word. When typing in an atypical format, such as a rough outline, and I try to arrange the format after entering text, it can be difficult to manipulate the lines of text. For example, if only the first line of section is indented, and I want to indent subsequent lines in different ways, the program makes all the lines indented in the same way. I have to hard-return at the end of each line before I can place the next line where I want it.	Outcome	3	4
Websites	Certain websites which I use (e.g. to check my minutes used for my cell phone) have such complicated encryption schemes that logging in	Translation	4	5

	with an account number/user name and password is like going through an endless interminable process. If I, for example, accidentally hit back on my browser, the refresh option for this website is disabled, and I have to start all over at the beginning. This is indubitably time-consuming and frustrating.			
Video cameras	The most frustrating thing about using a digital camera is the very short battery life. Even with high-end Nickel-Cadmium batteries, the life of batteries in digital cameras needs to be improved. Otherwise, I have no other complaints.	Outcome	4	7
Websites	It can be hard to locate information on some websites, because they are not well organized. Searching for a particular item can be even more frustrating, because search results rarely come up with what you want.	Translation	5	7
Instant messaging	AOL IM is frustrating mostly because it is very distracting. If you keep the sound on, the noises of people signing off and on are bothersome.	Translation	7	9
Operating system	everything gets slower and slower until i restart	Outcome	7	10
Text editors	word makes it hard to	Outcome	9	2

	delete certain horizontal lines			
Browsers	Explorer: Slow response	Outcome	5	4
PDAs	Handspring Visor: This PDA uses batteries very quickly even when not in use. If I don't keep replacing the batteries it will lose all the memory, therefore i am forced to use it every now and then at least to change the batteries.	Outcome	8	10
Websites	Yahoo sites frustrate me because of all of the pop under adds that accumulate as I browse the site.	Outcome	5	6
Text editors	One of the most frustrating aspects of Microsoft word is the intrusiveness of all of the "helpful" features, such as the little help applet that always ask if you need help writing a letter, or the clipboard manager.	Outcome	6	3
Browsers	I hate when the browser freezes and you have to restart the application.	Outcome	3	5
Text editors	I hate making lists in word because it automatically starts continuing to number your list for you, and I never want to use the format it uses. I then have to fiddle with the format for awhile until I get it the way I want it	Outcome	10	3

Websites	the images take too long to download.	Outcome	8	10
Instant messaging	AIM is frustrating because it often kicks you off at random times or takes a while to sign you on.	Outcome	10	8
Operating system	In Windows 2000 (which is supposedly rather stable), frequently I get the message "error in explorer.... An error log is being created cancel." Then a bunch of my windows close, and I usually have many many windows open because I enjoy multitasking. But frequently it's only things like web browsers and my computer windows, so i hardly loose any information or work.	Outcome	3	8
Text editors	The most annoying is not getting formatting to be perfect. But it's also the printer's fault also. But frequently it will add in listing and bullet's for the user, or change the font's and indents. In the general case, I suppose it's helpful. But I think Word should not try to do stuff automatically unless it can be 100% sure that the user MUST have wanted that result.	Outcome	8	5
Browsers	Netscape always freezes on me, so I use Internet Explorer, which isn't as fast as I'd like it to be often.	Outcome	7	9

email clients	Sometimes Eudora is slow or can not connect to the server	Outcome	5	3
Websites	once i was using netscape and one of the websites i was looking at caused one of those little ads to pop up, which is always annoying. i tried to close it but that jsut caused another one to pop up, and when i tried to close the new one it jsut re-opened up the first...so this went on for awhile and i'm getting more and more frantic becuase to make matters worse they were ads for porn sites with lots of extremly gross pics and i was freaking out that my roommate who i didn't know very good at the time was going to come home and be like what the hell.	Outcome	10	4
Websites	i hate when there are blinking ads or links to some contest or whatnot on a website. i understand that they need to get money but when it blinks i cannot block it out and read about why i came to the website.	Physical Action	5	6
Operating system	When it frezes and my information is lost	Outcome	8	4
email clients	Rarely works right... won't open all the time and is extremely slow	Outcome	9	8
Operating	When I came back to	Outcome	9	1

system	school from vacation my Windows asked for a password even though I had never used one before. I could not log on and had to spend lots of time calling technical support.			
Websites	A lot of the pictures on Abercrombie.com don't come up a lot of the time and I have to keep refreshing the page.	Outcome	4	7
Browsers	web browser crashes, have to either ctrl alt del and end program or, if even that fails, reboot system.	Outcome	8	5
Websites	web page repeatedly fails to load.	Outcome	6	6
Other	Whenever i use some programs, some graphic intense program, like adobe photoshop or premier, there is always this dll error. The frustrating part is that it happens at random time. Just when you are preparing to save it, the system just crash. Probably because my video card is not good enough for the program, or win ME can't support it.	Outcome	4	5
email clients	I use outlook express. there are many times where i am sure that the senders have sent me some attachments, but outlook, for some particular reason, simply ignore them. SO i have no idea there are attachments on my e-mail.	Outcome	3	2

	So i e-mailed back the person and asked them to send the files again. But the same thing happened. Finally i decide that it is better to send files over IM, or some direct-transfer program.			
Websites	when they are under construction!!!!!!	Translation	7	7
Browsers	I have aol and sometimes it just kicks you off!	Outcome	9	5
Websites	It is really difficult to find what you are looking for on cuinfo. There are so many links and what you want to find never seems to be listed.	Translation	8	6
Text editors	I used to use Word Pro on my old computer, so I have a lot of documents saved in that format. I now have Microsoft Word, and it can't open the WordPro format (although WordPro has a very useful Word filter!). So if I want to open one of my old WordPro documents I have to email it to someone in my family (who still have wordpro), have them save it in another format, and email it back to me. So annoying. The only reason I got Word on my new computer when I got it a year ago is that everyone I know uses Word, and it is on all the computers in the labs on campus, and it makes it easier not to have	Translation	9	4

	to lose the formatting every time I use a computer that isn't mine.			
Browsers	When the pages don't load in netscape, but they will in internet explorer.	Outcome	3	2
Text editors	When I can never figure out how to add features like spread sheets.	Translation	7	5
Text editors	when i am writing and i want certain things in double spaced or certain things in an outline format, word changes EVERYTHING to that or does not cooperate and messes the format up.	Outcome	10	7
PDAs	on my palmpilot, learning ot use the "alphabet" assigned	Physical Action	10	10
Websites	The most frustated I've been with websites have been with online mail accounts such as aol.com and hotmail.com. Both these sites seem to have trouble toggling back and forth between inbox and reading messages, and often time-out and require me to re-enter my password and user name.	Outcome	7	5
Text editors	The most frustrated that I get with MS Word is with the autoformat and autocorrect features. It can be convenient when I make spelling mistakes, but other times when I try to type a certain word or format my page a certain way, Word can be	Outcome	5	4

	extremely stubborn in relinquishing control and letting the user determine these settings.			
Operating system	My only gripe about windows Me is its occasional instability. On several occasions, i have downloaded media files from file sharing programs, (kazaa, morpheus) but when i try to run them windows locks up and i am forced to restart my computer. Also, when a program locks up in windows ME, and i try to press crt alt delete to close that program, often the screen never appears, or a blue screen comes up, in which case my only option is to manually turn off and then turn back on the computer.	Outcome	7	4
Websites	My crappy computer didnt come with MS word, rather, it came with MS works, a by far inferior word prosser. For instance, any time a teacher wanted us to put page numbers on our papers i would have to write them in by hand because the works system for page numbering was incredibly difficult to use.	Translation	7	7
Websites	I don't like it when you're expecting a picture or graphic and instead you get that little icon that looks like a broken picture.	Outcome	5	2

Websites	Like I said before, pop up ad windows are the most frustrating thing there is because they always pop up in front of what you're doing and they take forever to open and close (no matter what your internet connection). These are my least favorite thing about the internet I think.	Outcome	10	9
Operating system	When I leave my computer on idle for more than 5 minutes, it gives me an error in some random program, and my computer freezes up. I then have to play around with it to respond. It responds by restarting.	Outcome	10	10
Text editors	When I am tabing in to indent a paragraph and then press enter and the next line I want on the margin, but it moves in 5 spaces. And when copying a line, it does the same thing. It indents automatically and I don't want it to.	Outcome	9	3
Text editors	MS Word is a great tool and I would never use any other word processor. However, I do find that it gets in your way a lot. First of all, it always indents text that you may not necessarily want indented. Some of its other auto-styling and layout features can get quite annoying. Although I	Outcome	3	3

	cannot remember many specifics, they're pretty blatant in the program. Second, and even worse, sometimes I will accidently use the wrong short-cut keys and turn on some feature which I really don't want on. It is very frustrating when that happens and you have no idea why Word has suddently decided to act strangely and, worse yet, do not know how to fix it. Finally, that DAMN Paperclip...			
email clients	Not many incidents, but once, when I was using an older version of Eudora, it crashed and I lost all of my email.	Outcome	1	1
Operating system	I'm using Windows XP, which is a bad system in term of translating Chinese characters. Sometimes, when I go to those chinese websites, I don't know what it is all about. That's because the system couldn't translate well even though I turn on the translating program.	Outcome	6	4
Websites	http://www.yedown.com/show.php?id=287 This is the website that usually visit for downloading movies. The thing that frustrate me about this website is that there is a thing that's moving around. Sometimes, when I try to	Assessment	6	8

	click on some spots on the websites, this floating thing block the mouse from click on the spots, or I instead clicked on that floating thing, which browse to some commercial websites. This is not the worst thing. The worst thing is that there are other stuffs pop out along with the commercial websites.			
Browsers	Popups are probably among the most annoying aspects of browsing the web. Some browsers, like Mozilla, have the option to prevent them, so the ones that lack this feature are less desireable.	Outcome	6	8
Video cameras	Many digital devices such as cameras and mp3 players require proprietary connections which limit interoperability with various systems.	Translation	5	2
Websites	www.sandbox.com where I participate in an online football league frequently has problems loading on my IE browser because of a java-runtime error. This causes IE to freeze for a few seconds, but I am able to end the program by pressing ctrl+alt+del.	Outcome	8	4
Instant messaging	One frustrating thing about IM is that I'm unable to message people using MSN messenger, Yahoo! messenger, or ICQ, so I often have to switch	Translation	4	8

	between these IM programs to talk to different people.			
Browsers	The constant freezing and slowness of web browsers frustrates me on a daily basis. Restarting a computer is frustrating becuase of the time it takes to reboot a machine. I work in a tech center on campus and rebooting computers is such a mundane process that seems to continually occur as the result of malfunctioning web browsers.	Outcome	6	9
email clients	I use Outlook Express primarily. I have had no problem with outlook whatsoever. When I used Eudora, I used to get frustrated becuase I could not send mail but I realized that was becuase I had the wrong address typed into my SMTP outgoing mail server box.	Translation	3	1

CHAPTER SEVEN: REFERENCES

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