THE TECHNOLOGY IMPRINT AND ITS EFFECTS ON TECHNOLOGY FREQUENCY OF USE

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TABLE OF CONTENTS

ABSTRACT

Attitudes toward technology and technology acceptance have traditionally been studied from a cognitive perspective, focusing on attitude measures such as perceived usefulness and perceived ease of use. This experiment examines the effects of emotional elements on technology frequency of use. The technology imprint model presented in this study is based in part on existing psychological theories and constructs, but is an independent model explaining a phenomenon not previously explored. A negative technology imprint is an acquired predisposition based on cognitive and affective elements that is stronger and harder to change than any attitude and negatively biases behavior toward technology-related target objects. An imprint is a result of the technology's external characteristics and one's own experiences. The study combines cognitive elements from the widely used technology acceptance model with an affect-based imprint index whose components are likeability and attitude strength. Using linear regression, the effects of these variables on the frequency of use of three technologies (Internet, ATMs, and mobile phone imaging) were examined. Questionnaires were used to collect the data from 302 participants. The sample was composed of Texas Tech University students and members of the local community. Results showed that the imprint index significantly reduced the frequency of use of all three technologies; Internet, $\beta = -.128$, $t(301) = -2.335$, $p = .02$, ATM, $\beta = -.196$, $t(301) = -2.495$, $p = .01$, and mobile phone, $\beta = -.280$, $t(295) = -4.558$, $p < .01$. Additionally, the cognitive and affective variables explained a significant proportion of frequency of use variance; Internet, $R^2 = .34$, $F = 38.16$, $p < .01$, ATM, $R^2 = .34$, $F = 37.40$, $p < .01$, and mobile phone $R^2 = .46$, $F = 61.77$, $p < .01$. Of the six null hypotheses of the study, two were rejected for all three technologies, three were rejected for two technologies, and one was rejected for one technology.

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION TO RESEARCH

"The only time most people have talked to their computers has been when cursing them" (Khalid, 2001, p. 1387).

1.1 History and Background

On October 4, 1957, the USSR launched Sputnik, the first artificial satellite in history, into orbit (Segaller, 1998; Zakon, 2002). The Soviet satellite presented an unprecedented threat to the US because of the new possibilities it offered. It was a great cause of concern in the US government – one that had to be dealt with not only by taking precautionary measures and protection in case of any aggression, but also by acquiring even newer technology to counteract this new threat. While some scientists were researching how to make weapons more destructive, others were studying ways to survive a massive nuclear attack (Cringely, 1998b). It was the beginning of the most popularized technology race of the modern world.

During that period, the destructive capabilities of nuclear power had been demonstrated in Japan with grave consequence (Cringely, 1998b). One of the US's greatest concerns at that time was a communication breakdown in the case of a Soviet nuclear attack. Meanwhile, a scientist by the name of Paul Baran employed by the RAND Corporation think-tank, which specialized in national defense, began developing the concept of a distributed network and comparing among centralized, decentralized, and distributed networks (Baran, 1964; Cringely, 1998b). The distributed network would allow any number of computers to connect without the need of a central server and would not rely on any one computer or device; rather any computer connected to the network would contribute to its processing and storage power and would act as a server on its own. This would prevent any attack from completely disabling the communication network between different US institutions around the country and the world.

Through Baran's work, along with that of numerous other scientists (Abbate, 1999; Baran, 1999; Brandel, 1999; Davies, 2001; Diamond and Bates, 1995; Halliwell, 2002), this network quickly developed into what is now known as the Internet. In 1971,

Ray Tomlinson wrote an email application and sent the first email in history, to himself (Festa, 2001). Users began to communicate with immediacy and efficiency never before possible, without having to use the phone. Though at the time Tomlinson didn't realize the significance of his application (Festa, 2001), he had revolutionized communications technology the world over. The new technology quickly grabbed the attention of commercial establishments as the profit potential became apparent. The explosion of popularity and enormous growth in registered domains and number of hosts in the mid-1990s was almost instant (Zakon, 2002).

Technology plays an undeniably powerful role in today's world. Individuals are constantly interacting with technology, on which many of their decisions are based (Edison and Geissler, 2003). Users rely on technology for many of their daily tasks and the attitudes held by individuals toward technology influence their behavior (Edison and Geissler, 2003). Among countless functions of the Internet, for example, it can be used to pay bills, transfer money, play games, check the weather, conduct scientific research, trade stocks, and buy and sell goods (Joseph, 2000).

The Internet is a unique technology because of the tremendous impact it has had in such a short period of time. However, with the rate of advancements currently being made in the technology sector, a product is often fully developed and has been through many updates before a user has even heard of it. Mobile phones, for example, have been available for over two decades (Maney, 2005). However, not everyone has experience using them. In 2002, less than half the US population owned a mobile phone (Ropeik and Gray, 2003). Similarly, automatic teller machines (ATMs) have been around for about three decades (Hone et al., 1998), but a study in 1996 found that only 38% of those surveyed used them (Chan and Khalid, 2003; Rogers et al., 1996).

Some of the reasons users shy away from technological products are skepticism (Sjöberg and Fromm, 2001), unacceptable speed (Khalid, 2001), its inaccessibility (Hone et al., 1998), or a number of other factors (Hone et al., 1998; Sjöberg and Fromm, 2001). Some individuals, for example, particularly those in remote or rural areas, do not have access to mobile phones because the service is not provided in their locations. Research shows that emotional and affective elements also play an important role in user

technology acceptance (Khalid, 2001). Some individuals simply do not find using the technology enjoyable and would prefer to interact with a human.

User interaction with technology is a subject of exhaustive research, and has been for years. This is due to the essential role technology continues to occupy in everyday business and personal life. Models have been developed with the specific purpose of explaining user behavior toward technology. Perhaps the most impactful of those models is the technology acceptance model (TAM) introduced by Fred Davis in 1986, which examines the effects of cognitive factors on technology acceptance. The model presented in this study examines the effects of emotional factors, along with TAM's cognitive factors, on user behavior toward technology.

1.2 Problem Description

The average user is not aware of most of the framework supporting each specific technology, such as that discussed above about the Internet. With the exception of a small group of users that experience firsthand the transformation of a technology from a development stage into a mainstream commodity, users generally do not transition gradually into using it and learning about it. Instead, for many, the technology is suddenly available as was clearly the case with the Internet. For many users, it is sufficient to know how to use a technology to perform the specific operations that are most useful to them. Others would prefer not to use technology products at all (Edison and Geissler, 2003). On the other hand, some individuals are fascinated with technology and are always keen to stay up to date on technology news, products, and gadgets. Some are even regarded as being addicted to certain technologies (Sjöberg and Fromm, 2001).

Konrad Lorenz is a renowned scientist, pioneer, and Nobel laureate in the field of modern ethological science, a field in which animal behavior is studied. Imprinting is one of the most significant concepts introduced and studied extensively by Lorenz. In 1975, Richard Evans interviewed Lorenz. In the interview, Evans asked Lorenz to explain exactly what he means by imprinting. Lorenz responded with the following (Evans, 1975):

> Before giving a definition, I'd better tell you how the phenomenon of imprinting was discovered. Whitman and Heinroth reared young birds. They were both particularly interested in the ontogeny of behavior, so they

> studied young birds reared by "foster parents." Some were reared by them personally, some by other related species. They found that in many cases, these birds could not be bred because they reacted sexually only to the species of the "foster parent," not to their own. This proved to be absolutely irreversible. I observed this in my own third jackdaw. I occupied myself a great deal with that bird while it was young, and later it turned out to be sexually fixated on humans. So the fixation of an innate behavior pattern is one characteristic of imprinting. The second is its irreversibility. And the third is that it is effected [sic] during a comparatively short phase in the individual life of the animal. For instance, as Hess (1973) has shown, the "following" response of a duckling is fixated on its object at about the seventeenth hour after hatching. The curve of imprintability is a very steep one with a maximum at seventeen hours. At twenty and twenty-three hours it is already down. Imprinting has been studied extensively in the "following mother" response of ducklings and chickens. There's a great difference between the two because imprinting merges into any kind of learning which can be restricted to a period. I'm sorry to say that domestic chickens, on which many experiments have been done, are not good subjects for the demonstration of imprinting. The term "imprinting" was coined mainly with sexual behavior in mind. (p. 12-13)

Later in the interview, Evans asks how imprints could relate to human behavior. He acknowledges that "that's a very, very big leap, of course, I realize that" (p. 14). Lorenz agrees that it is a big leap and proceeds to explain that "if you read the work of a very old and almost forgotten psychiatrist, Krafft-Ebing (1950), on fetishisms, you get the impression that some of his patients' behaviors were analogous to imprinting" (p. 14-15). He asserts, however, that the imprinting effect on humans is unverifiable and cannot be validated (Evans, 1975).

The definition of imprint used in this experiment handles imprints differently than Lorenz's ethological definition. According to Lorenz, the conditions and properties of imprints are as follows:

1. Only animals can be imprinted.
2. The behavior to be imprinted is innate.
3. The behavior is fixated in the mind.
4. It is irreversible.
5. The imprint can only be created during a certain period in the life of the animal, generally a relatively short one.

This study is obviously not concerned with imprinting in animals. The main objective is to investigate imprints related to technology. In ethology, the term imprint itself has implications of being a property related to animal behavior. This research is in no way using the term with the same associations. There are some properties shared among ethology imprints and technology imprints. Lorenz states that imprints are fixated in the mind and are irreversible. While it is not believed that technology imprints are completely irreversible, it is believed that they are very difficult to change. In that sense, they are similar to Lorenz's definition of imprints. As for being created during a certain short period of time, that is believed to be true with technology imprints as well. It is hypothesized that they are created during a period of initial contact with the technology based on few experiences and social influence factors while later experiences only work to reinforce or weaken the imprint, however difficult the process of change may be.

While imprinting in humans may not necessarily exist according to Lorenz, it has been shown that different psychological models with varying properties can account for different behaviors related to imprints. Concepts such as mental models (Borgman, 1999; Von Hecker, 2004), conditioning, memory, and learning (Clore and Schnall, 2005; Delgoulet and Marquié, 2002; Terry, 2000), moods and emotions (Clore and Schnall, 2005), and beliefs, intentions, and attitudes (Fishbein and Ajzen, 1975) are well documented in the literature and are commonly used to explain individual differences (Langston and Sykes, 1997). They are also used throughout this experiment to explain various aspects of imprints.

The underlying assumption in this study is that an individual's behavior and attitudes toward technology are affected by a certain set of factors that can, in some specific cases, lead to the formation of technology imprints. These imprints, while having unique characteristics, are a form of extreme attitude that can either positively or negatively bias the individual toward technology. It is hypothesized that imprinted individuals exhibit behavior and attitude patterns that are consistent over a broad range of general technological tools, instruments, concepts, or products.

From an industrial engineering standpoint, negative technology imprints can result in losses, the most important of which are money and time. Understanding the causes of this phenomenon can help managers reduce its consequent losses. While flaws

inherent to the technology itself can also cause losses (Von Meier, 1999), this research focuses only on expanding the scientific understanding of the characteristics of the technology user. It is believed that technology imprints are a natural progression in the study of attitudes toward technology and technology acceptance.

How does the user interact with technology? What are the specific factors that affect user behavior? A seemingly endless body of previous research has addressed this issue. However, the concept of a technology imprint is novel. Many studies examine the usability of specific technologies such as websites, mobile phones, ATMs, and software applications (Chan and Khalid, 2003; Chi, 2002; Ling and Van Schaik, 2004; Manning et al., 1998; Perlman, 2002). The findings of such studies are generally based on the characteristics of the technology itself and not the cognitive or affective elements influencing the user's attitude and behavior.

The technology acceptance model (TAM) addresses acceptance of new technologies in an organizational setting. According to the model, the two cognitive factors perceived usefulness (PU) and perceived ease-of-use (PEOU) explain user acceptance of technology (Davis, 1986; Davis et al., 1989). It is believed that an essential aspect of any model explaining technology usage is affect, or emotion. If a user has a strong dislike for technology for whatever reason, usage patterns can be affected, regardless of whether or not the user finds the technology useful or easy to use. This hypothesis acts as the foundation for this study.

1.3 Research Question

This research attempts to answer the question of whether or not negative technology imprints exist, and if users are influenced by negative technology imprints that unfavorably bias their behavior and frequency of use of technology.

1.4 General Hypotheses

The tests and analyses conducted in the research test the hypotheses in Table 1.1. The hypotheses deal mainly with the cognitive and affective factors believed to influence technology imprints. These hypotheses and variables are discussed in detail in the following chapters.

Table 1.1. List of hypotheses.

Number	Hypothesis
H_1	Imprints have a negative effect on frequency of use.
H_2	Perceived usefulness has an effect on frequency of use.
H_3	Perceived ease of use has an effect on frequency of use.
H_4	Likeability has an effect on frequency of use.
H_5	Attitude strength has an effect on frequency of use.
H_6	Attitude strength is negatively correlated with likeability.

1.5 Assumptions

In order to conduct this research, some assumptions must be made. This is necessary because of the lack of existing data about imprints. The following are the most critical assumptions of this research.

1. Imprints are an extreme form of attitude.
2. Imprints can be either positive, favoring technology, or negative, disfavoring technology.
3. Positive and negative imprints do not have the same characteristics acting in an opposite manner. They have completely different properties.
4. The Internet, ATMs, mobile phones, and computer-powered equipment in general can be considered *technologies*.

1.6 Research Purpose

The purpose of this research is to better interpret the dynamics of user interaction with technology based on the understanding of imprints. Cognitive and emotional factors affecting the frequency of use of technological objects are analyzed. Imprints cause users to interact with technology through an unfavorable perspective and predetermined bias and rejection of technology. Consequently, user behavior becomes much more

predictable and understandable. Studying the effects of technology imprints leads to a better understanding of consistent unfavorable behavior from the user toward technology and possibly, in future research, finding solutions to minimize such behavior.

1.7 Research Objectives

The research objectives for this study are listed below:

1. Finding through testing and data analysis whether technology imprints exist.
2. Investigating the relationship between cognitive and affective factors and their effects on frequency of technology usage.
3. Determining whether the imprint, an affective factor, has the ability to override cognitive perceptions.
4. Testing significance, correlations, and directional effects of the cognitive and affective independent variables.

1.8 Delimitations

There are no existing models addressing technology imprinting, or any other type of imprinting as defined in this research. The model, therefore, is novel and incorporates ideas from concepts developed in ethology, social psychology, memory, and others. As such, the resultant error may be higher than desired.

Psychology literature and previous research do not establish a cutoff point that separates attitudes and extreme attitudes. Initially, one of the goals of the study was to find such a cutoff point to differentiate between imprinted and non-imprinted users. Based on findings in the literature and a previously conducted pilot study, a cutoff point was calculated. However, the collected data forced the use of a scale rather than a cutoff point as will be discussed in the following chapters.

It is believed that imprints exist in all areas and not just technology. Every significant event in the life of an individual can create an imprint that biases behavior from that point onward. This is especially true of events strongly associated with emotions (Eagly and Chaiken, 1993; Fishbein and Ajzen, 1975). Different modalities in the mind can be imprinted based on their function and the stimuli to which they respond.

However, only negative technology imprints are addressed in this study. Other forms of imprints, including positive imprints, may be the focus of future studies.

Imprints can be caused by many variables related to the user's personal experience and history, social factors, cognitive factors, affective factors, and culture. However, not all factors causing imprints are examined in this study. It is not the purpose of this study to explain the origin of imprints; rather to find whether they actually exist or not and to measure their effect on frequency of technology use. This study can then be used as the foundation upon which other imprint-related research can expand.

1.9 Relevance of the Study

The study is of relevance to many areas. In industrial engineering, it is crucial for management to have a good understanding of their workforce and the factors influencing their interaction with technology. In many of today's business environments (offices, manufacturing facilities, warehouses, etc.), employees are interacting with technology on a daily basis. The Internet, for example, is a main part of many employees' workday. It is therefore important to understand the possible limitations and behavioral patterns put forth by imprints.

1.9.1 Need for the Study

In recent years, technology has become a more integral part of our daily lives. Computers and technological products are now used in education, training, work, recreation, commerce, and other areas. Computers also play more subtle but equally as important parts controlling cars, homes, electronics, medical devices, and much more. In addition, recent polls show that most people, when asked what technology is, will respond with *computers* (International Technology Education Association, 2002). Understanding the weaknesses of the human in dealing with technology and computers can aid in overcoming many of today's obstacles set forth by the limitations of our human resources.

1.9.2 Benefits of the Study

The findings of this study provide valuable information for a variety of professionals, managers, manufacturers, researchers, scholars, and academics. The results of the study will help future research explain why some people are less productive when using technology than others and whether there are methods to reduce the wariness and anxiety some people have toward technology. Knowing the causes of these problems can help address the solution.

1.10 Research Outputs and Outcomes

The findings of this study examine whether there is reason to believe that technology imprints exist. The following is a list of outcomes.

1. A model explaining negative technology imprints and how they affect frequency of use of three technologies (the Internet, automatic teller machines (ATMs), and taking pictures using mobile phones).
2. A method of ranking users based on the level of imprint-like characteristics they exhibit.
3. Questionnaires to identify potentially imprinted users.
4. An introduction to understanding the effects of imprints on human behavior and their degree of irreversibility and strength.

CHAPTER 2
REVIEW OF THE LITERATURE

2.1 Introduction

A review of the literature on attitudes regarding technologies, acceptance of new technologies, and the elements affecting technology usage was conducted. Specific areas, as well as general technology, were investigated. The purpose of studying specific aspects of certain technologies was to identify the characteristics of the factors that are believed to be the most influential in their respective fields. This information was used to develop test hypotheses on the effects of imprints on technology usage.

One study examined the "impact of computers on organizations" and concluded that predictions made decades earlier have all seemed to materialize (Eason, 2001, p. 323). According to Eason, those who made predictions about the impact of technology during the dawn of the "computer revolution" (p. 323) in the early 1960s fell in one of two groups; optimists and pessimists. The optimists saw that through the use of computers individuals and organizations would become more efficient by putting the powerful new tool to good use. On the other hand, the pessimists saw computers as an intrusive device that would eventually be used to automate all processes and put workers out of their jobs. Pessimists also predicted that those who kept their jobs would always be under the control of the centralized power of the organization, or *Big Brother* where the computer would be the power that monitors all workers.

Eason's study compared the early predictions to actual data obtained recently in the same field and pertaining to the same subject of technology impact. The findings showed that as contradicting as some of the original predictions seemed, they all eventually came true. From the most pessimistic to the most optimistic of predictions, evidence of their correctness existed in recent studies. In addition to the early predictions, recent studies also revealed trends that had not previously been predicted.

The vast array of effects computer technology has had on organizations is attributed by Eason to the "enormous potential to transform organizational life" (p. 324) possessed by computers and the communication technologies that have evolved as a result of extensive computer involvement in organizational culture. "This technology," he

states, “is perhaps the single most powerful force currently shaping the way we work” (p. 324). It has a certain flexibility that allows it to act both as Big Brother (in the form of mainframe computers) and as a personal assistant (such as notebook computers) simultaneously.

One of the specific fields investigated was that of electronic commerce. Most studies reviewed concluded that there are a few main areas believed among researchers to be influencing factors on user e-shopping experiences and behavior. Among those factors are motivation (Volk, 2002), purchase intent (Shim et al., 2001), and website design (Zhang et al., 2001). These factors represent both intrinsic characteristics of the user (motivation and intent) and properties specific to the technology (website design).

Each of these areas has been studied numerous times and various results, mostly in agreement, have been reported. Zhang et al. (2001) claim that not enough effort has been put in trying to deduce scientific evidence of the relationship between the user and the influencing elements:

> Most studies provide some guidance for designers based mostly on heuristics or rules of thumb. These studies do not identify Web site design features that contribute to consumer satisfaction or dissatisfaction, address different quality expectations, nor do they provide any insight into whether some features are perceived as more important than others by the users. (p. 78)

Reference to the possibility of the existence of a technology imprint that influences, and in some ways dictates, user behavior towards technologies in general, was not directly found in the literature. This technology imprint is believed to be a result of an array of factors, possibly based on user background, individual differences, exposure to technologies, and past experiences. It is believed to be generalizable among technologies. If a user is imprinted, the effects of the imprint will come into effect when the user is dealing with any technology. This is based on the idea that most modern technologies rely on the same technology; computers. One researcher states that when interacting with a new technological system, “individuals are expected to anchor their system-specific perceived ease of use of a new system to their general beliefs regarding computers and computer use” (Venkatesh, 2000, p. 345).

The concept of a technology imprint, although not specifically defined, is found in the literature. Previous researchers may have never used the same term, or in fact any label at all, but Stinchcombe (*ed.* March, 1965) wrote the following:

> Aside from these conditions encouraging men to start new organizations, there are poorly understood conditions that affect the comparative death rates of new and old organizations. As a general rule, a higher proportion of new organizations fail than old. This is particularly true of new organizational *forms*, so that *if an alternative requires new organization*, it has to be much more beneficial than the old before the flow of benefits compensates for the relative weakness of the newer social structure. If there are, therefore, populations in which the "liability of newness" is exceptionally great, organizational innovation will tend to be carried out only when the alternatives are stark (generally in wartime). What sort of things, then, make up the liability of newness, and how do social conditions affect the degree of liability?
>
> (a) New organizations, especially new types of organizations, generally involve new roles, which have to be learned. In old organizations, former occupants of roles can teach their successors, communicating not only skills but also decision criteria, responsibilities to various people who have relations to the role occupant, devices for smoothing over persistent sources of tension and conflict, generalized loyalty to the organization, what sort of things can go wrong with routine procedures, and so on. New organizations have to get by with generalized skills produced outside the organization, or have to invest in education (including especially the cost of inefficiency until people learn their roles). Clearly, the distribution and generality of skills outside the organization, the socially induced capacity to learn new roles (especially without visible role models), and the ease of recruitment of skills to new organizations will affect the degree of disadvantage of organizational innovations. (p. 148)

Although Stinchcombe did not directly mention a technology imprint, it seems that the illusive problem he is discussing could be the technology imprint. Stinchcombe attributes organizational success or failure to how the employees of the organization handle and respond to the "liability of newness" (p. 148). Presumably, in the case of an organization whose employees have a strong technology imprint, the negative effects of the liability will be weakened.

2.2 Historical Background

What is a *technology imprint*? Is it an original idea? If not, where did the idea of an imprint originate?

The idea of imprinting in general is by no means an original idea nor is it a new one. The term *tabula rasa* has been used for centuries to refer to the theory that the mind is initially a blank slate, imprinted with whatever thoughts and experiences it is exposed to that will influence it throughout its journey of life. It is not clearly understood where or when the term was first used. It is a fact, however, that the term has been used repeatedly in many periods and eras to describe what is more or less the same ideology and school of thought (MSN Encarta, 2004).

The term tabula rasa comes from the two Medieval Latin words *tabula*, meaning tablet, and *rasa*, meaning erased. In ancient Rome, before paper was used, wax tablets were used for writing. The ability to wipe the wax smooth gave them the characteristic of being reusable (Altman, 2001; MSN Encarta, 2004). A tablet on which the writings had been erased (tabula rasa) was therefore a tablet that was devoid of any writing, leaving it ready to be imprinted with letters and words that would last for a long period of time. Many thinkers, philosophers, and psychologists liken this blank slate to a human mind before being polluted with information and experiences.

This theory is the foundation of the school of philosophy commonly known as empiricism in which the idea of the *a priori* is dismissed. In empiricism, the experiences in the physical world surrounding the human are what shape and form the mind, not innate ideas. The empirical world is that which can be sensed; seeing, hearing, feeling, touching, smelling, and tasting all contribute to the empirical world (Baldwin, 1913). Anything the human mind is exposed to creates imprints on what is initially the blank tablet, or the tabula rasa. Thus, in time, the mind (represented by the blank tablet) becomes cluttered with information and imprints (Locke, 1689).

The first documented use of the tabula rasa theory can be found in Aristotle's *De Anima* (On the Soul) written around the year 350 B.C. In his writing, Aristotle specifically mentions an analogy between the mind and a writing tablet. According to his statement, the mind is "nothing until it has thought" (available online at http://classics.mit.edu/Aristotle/soul.html) which is a rejection of the concept of innate

ideas. The tablet starts off clean and empty and is filled in time with characters that represent the human experiences and interactions leaving their imprint on the mind. In Book IV, Part V Aristotle writes:

> Have not we already disposed of the difficulty about interaction involving a common element, when we said that mind is in a sense potentially whatever is thinkable, though actually it is nothing until it has thought? What it thinks must be in it just as characters may be said to be on a writing tablet on which as yet nothing actually stands written: this is exactly what happens with mind. (http://classics.mit.edu/Aristotle/soul.html)

But Aristotle was not the only thinker to make this argument. In fact, the whole British empiricist movement that started in the 17th century advocated this theory. John Locke (1632-1704), generally recognized as the father of empiricism, was known for his writings on government, politics, tolerance, and human behavior. In 1689, in his Essay Concerning Human Understanding, John Locke reintroduced the tabula rasa theory. In Book I, Chapter I he wrote:

> Not on the mind naturally imprinted, because not known to children, idiots, etc. For, first, it is evident, that all children and idiots have not the least apprehension or thought of them. And the want of that is enough to destroy that universal assent which must needs be the necessary concomitant of all innate truths: it seeming to me near a contradiction to say, that there are truths imprinted on the soul, which it perceives or understands not: imprinting, if it signify anything, being nothing else but the making certain truths to be perceived. For to imprint anything on the mind without the mind's perceiving it, seems to me hardly intelligible. If therefore children and idiots have souls, have minds, with those impressions upon them, they must unavoidably perceive them, and necessarily know and assent to these truths; which since they do not, it is evident that there are no such impressions. For if they are not notions naturally imprinted, how can they be innate? And if they are notions imprinted, how can they be unknown? To say a notion is imprinted on the mind, and yet at the same time to say, that the mind is ignorant of it, and never yet took notice of it, is to make this impression nothing. No proposition can be said to be in the mind which it never yet knew, which it was never yet conscious of. For if any one may, then, by the same reason, all propositions that are true, and the mind is capable ever of assenting to, may be said to be in the mind, and to be imprinted: since, if any one can be said to be in the mind, which it never yet knew, it must be only because it is capable of knowing it; and so the mind is of all truths it ever shall know. Nay, thus truths may be imprinted on the mind which it never did,

nor ever shall know; for a man may live long, and die at last in ignorance of many truths which his mind was capable of knowing, and that with certainty. So that if the capacity of knowing be the natural impression contended for, all the truths a man ever comes to know will, by this account, be every one of them innate; and this great point will amount to no more, but only to a very improper way of speaking; which, whilst it pretends to assert the contrary, says nothing different from those who deny innate principles. For nobody, I think, ever denied that the mind was capable of knowing several truths. The capacity, they say, is innate; the knowledge acquired. But then to what end such contest for certain innate maxims? If truths can be imprinted on the understanding without being perceived, I can see no difference there can be between any truths the mind is capable of knowing in respect of their original: they must all be innate or all adventitious: in vain shall a man go about to distinguish them. He therefore that talks of innate notions in the understanding, cannot (if he intend thereby any distinct sort of truths) mean such truths to be in the understanding as it never perceived, and is yet wholly ignorant of. For if these words "to be in the understanding" have any propriety, they signify to be understood. So that to be in the understanding, and not to be understood; to be in the mind and never to be perceived, is all one as to say anything is and is not in the mind or understanding. If therefore these two propositions, “Whatsoever is, is,” and “It is impossible for the same thing to be and not to be,” are by nature imprinted, children cannot be ignorant of them: infants, and all that have souls, must necessarily have them in their understandings, know the truth of them, and assent to it. (http://etext.library.adelaide.edu.au/l/locke/john/l81u/)

And from Book II, Chapter I:

All ideas come from sensation or reflection. Let us then suppose the mind to be, as we say, white paper, void of all characters, without any ideas:- How comes it to be furnished? Whence comes it by that vast store which the busy and boundless fancy of man has painted on it with an almost endless variety? Whence has it all the materials of reason and knowledge? To this I answer, in one word, from EXPERIENCE. In that all our knowledge is founded; and from that it ultimately derives itself. Our observation employed either, about external sensible objects, or about the internal operations of our minds perceived and reflected on by ourselves, is that which supplies our understandings with all the materials of thinking. These two are the fountains of knowledge, from whence all the ideas we have, or can naturally have, do spring.” (http://etext.library.adelaide.edu.au/l/locke/john/l81u/).

From empiricism stemmed several other movements, most notably the *enlightenment*, whose thinkers and followers also believed that experience creates

thought and the French *encyclopedists* who published a 17 volume encyclopedia on thought in the period between 1751 and 1765. The editor of the series, Denis Diderot (1713-1784), was an empiricist as were many others involved in the work including François-Marie Arouet (1694-1778) (more commonly known by the name with which he signed his books, Voltaire, also recognized as the father of the enlightenment) and Jean-Jacques Rousseau who wrote about education in his famous work *Emile, ou l'education*. In Chapter I of Emile, Rousseau wrote "We are born sensitive and from our birth onwards we are affected in various ways by the objects that surround us" (http://projects.ilt.columbia.edu/pedagogies/Rousseau/em_eng_bk1.html). In the same chapter, Rousseau also wrote:

> [14:] We are born weak, we need strength; we are born lacking everything, we need aid; we are born stupid, we need judgment. All that we lack at birth and that we need when we are grown is given by education.
> "[15:] This education comes to us from nature, from men, or from things. The inner growth of our organs and faculties is the education of nature, the use we learn to make of this growth is the education of men, and what we gain by our experience of our surroundings is the education of things. (http://projects.ilt.columbia.edu/pedagogies/Rousseau/em_eng_bk1.html)

Many scientists, thinkers, and philosophers other than the ones listed above of many eras and of different backgrounds, cultures, and beliefs agree in theory with the tabula rasa concept. It would therefore be inaccurate to assume that imprinting of the mind is a new idea. The brief historical overview of tabula rasa, imprinting, and empiricism mentioned above is not intended to enter the debate over rationalism versus empiricism. That is not of any interest or value to this dissertation. It is not meant in any way to support the argument of empiricism. The discussion above was merely intended to reveal that the idea of an imprint (related to technology or otherwise) has been an ongoing philosophical debate for millennia.

2.3 Theoretical Model

The previously mentioned philosophers considered experience in general an imprinting factor that leaves impressions on the mind through which the individual gains knowledge and finds truth. The imprints of which they spoke were not necessarily extreme attitudes such as those explored in this experiment. However, the concept of

forming opinions, and consequently attitudes that influence behavior, based on experience is shared among the two theories.

2.3.1 Background

With regards to new technologies, the mind can in many ways represent a blank slate ready to be positively or negatively imprinted. Today, many individuals who were old enough in the mid-1990s to be using computers probably remember a time in their lives when the word *Internet* meant absolutely nothing to them. The concept of a network that could potentially connect every single computer in the world, large or small, regardless of the type or function of the computer, simply did not exist.

It is rumored that in 1899, Charles H. Duell, then commissioner of the U.S. Office of Patents said "everything that can be invented has been invented" (Williams, 2002, http://www.entrepreneur.com/startingabusiness/inventing/article54604.html). It is not confirmed that Duell ever made that statement and it is believed by some to be merely a rumor (Williams, 2002). But whether Duell ever uttered those words or not, what is important is the statement itself. Can it possibly one day become a reality? Assuming that day is believed to have arrived, how would minds function when it is thought that the limits of knowledge have been reached…that all the inventions that exist are all that will exist until the end of time?

While the answers to those questions cannot yet be answered, the situation itself can in some way help explain what imprinting means. A new technology introduced at such a time would have a tremendous impact on perceptions, attitudes, and beliefs. This new technology would probably create imprints in the minds of many based on their perceptions of it, the social influences of those around them, and their own personal experiences with the technology. For years to follow, it would be hard for some individuals to abandon the imprint that would dictate their behavior toward the technology from that point on.

The introduction of the Internet to the vast majority of the public in the mid-1990s may have created a similar effect. Regarding information access and communications, societies had grown accustomed to using telegram, telephone, and fax to communicate with each other, while using printed material, radio, and television for entertainment,

information, and news. The need for a new communication method simply did not exist among the general population of the world. There was probably a desire for cheaper fees for the technologies that did exist, but it seems that societies were otherwise satisfied with what was available. It was almost as if everything in the communications arena had already been invented.

Today, most commercial establishments around the world would not exist without technology. The Internet, for example, allows them to communicate openly, quickly, and with cost effectiveness not previously possible. In many cases, the Internet is also the only outlet for a company's services or products. Thousands of companies provide services for companies that provide services for companies that provide services for companies that make the Internet possible. Without the Internet, economies, academics, politics, jobs, entertainment, research, finance, security, commerce, information, and numerous other essential elements of our lives would not be the same. Simply put, without technology, our entire world would not be the same. This is much different than the effect other innovations have had. The Wankel engine, for example, as magnificent a technology as it is, has not affected everyday lives the way the Internet has. If the rotary engine ceased to exist today, our world would still function normally with the exception of a limited number of specialized institutions and products. The disappearance of the Internet, on the other hand, would bring both personal and business worlds to a standstill. Today, even governments rely heavily on the Internet in many aspects. National elections will soon be conducted online in some countries (Richardson, 2002; Schoen, 2003).

This leads to the observation that in history, some inventions have had more of an impact than others. Consequently, some technologies can create imprints that are stronger than others. It is not necessarily assumed that the more historically significant a technology is, the stronger the imprint it creates. However, it is hypothesized that the more a technology affects an individual's life, the more likely it is to create a strong imprint for that individual. An imprint that stays with an individual a very long time, possibly his or her entire life, is stored in the memory and retrieved every time a stimulus invokes that part of the memory (Eagly and Chaiken, 1993).

In 1690, John Locke described the relationship between perceptions (which he states are ideas that were at some previous point "imprinted" in the mind) and memory. In Book II, Chapter X, he wrote the following:

> The other way of retention is, the power to revive again in our minds those ideas which, after imprinting, have disappeared, or have been as it were laid aside out of sight. And thus we do, when we conceive heat or light, yellow or sweet,- the object being removed. This is memory, which is as it were the storehouse of our ideas. For, the narrow mind of man not being capable of having many ideas under view and consideration at once, it was necessary to have a repository, to lay up those ideas which, at another time, it might have use of. But, our ideas being nothing but actual perceptions in the mind, which cease to be anything when there is no perception of them; this laying up of our ideas in the repository of the memory signifies no more but this,- that the mind has a power in many cases to revive perceptions which it has once had, with this additional perception annexed to them, that it has had them before. And in this sense it is that our ideas are said to be in our memories, when indeed they are actually nowhere;- but only there is an ability in the mind when it will to revive them again, and as it were paint them anew on itself, though some with more, some with less difficulty; some more lively, and others more obscurely. And thus it is, by the assistance of this faculty, that we are said to have all those ideas in our understandings which, though we do not actually contemplate, yet we can bring in sight, and make appear again, and be the objects of our thoughts, without the help of those sensible qualities which first imprinted them there. (http://etext.library.adelaide.edu.au/l/locke/john/l81u/)

Eagly and Chaiken (1993) argue that attitudes are stored in the memory and are activated by the attitude object or other related stimuli. Terry (2000) describes the relationship between learning and memory such that in learning, the individual acquires knowledge, but with memory, he or she retains it. According to Terry (2000), learning is a long-term change in behavior and is a result of one's own experiences.

How a technology imprint is created, or what creates it, is not yet known. But like learning and memory, imprints are believed to be stored in the mind after a certain experience, or set of experiences, probably coupled with a variety of personal characteristics, and persistently acting to negatively affect the user's interaction with the technology. As such, the imprinting process can be broken down into two parts; the first stage during which the idea is imprinted in the mind, and the second stage during which

the imprinted user interacts with the environment and responds to stimuli in ways consistent with, and biased by, the imprint.

In order to answer the question *what is a technology imprint?*, one must first understand the terms *technology* and *imprint*. There are numerous definitions for both terms; some are in a scientific context while others can be found in dictionaries and other reference books. A literature review revealed many of the most widely used definitions for both terms. The following are the findings.

2.3.2 Technology

Most casual readers have some sort of perceived understanding of what technology means. While they may not have a scientific operational definition of the term, they assume they have knowledge of the word and understand it when it is used. To a non-researcher, technology may simply represent any futuristic innovation, invention, or new gadget. To a researcher, however, such a loose definition is not acceptable. A more appropriate definition should differentiate between products and technologies as well as provide conditions under which a certain concept or object qualifies as a technology.

Numerous definitions of technology can be found in books, research papers, and other publications. However, it is difficult to find a commonly used and agreed upon definition of technology. This is probably due to the complexity and breadth of the concept of technology, even though defining it would seem like a simple task at first glance. Technology seems to be a very flexible word that can be used in any field to refer to almost anything. Researchers in most areas have defined the term from the perspective of their field as it relates to their specific interests. The term "applied science" is commonly associated with the definition of technology although some researchers view this as a misconception (Bybee, 2000).

While researchers do not agree on one standard definition of the term, they do agree that there are hundreds of definitions available, mostly related to the field of their corresponding authors. Fernandes and Mendes (2003) state that "different sciences consider different parts of the global concept of technology" (p. 153). Flick and Lederman (2003) ask, "when you hear or use the word technology, what do you think

of?" (p. 314). They go on to answer their question; "if you are like many educators we have talked to, the word connotes 'computer' and associated concepts such as 'telecommunication' and 'software.' What does the word connote to our students? To them, technology generally means 'entertainment,' as they offer reference to the alphabet soup of TV, VCR, MP3, CD, and DVD" (p. 314).

Young et al. (2003) state that most people "think of [technology] only in terms of tangible products: computers, aircraft, pesticides, water-treatment plants, and microwave ovens, to name a few. But the knowledge, skills, and processes used to create and operate these products are equally important. A critical area of knowledge is the engineering design process, of starting with a set of criteria and constraints and working toward a solution – such as a device or process – that meets those conditions" (p. 141). Gradwell and Welch (2003) state that "we have automated bank tellers, smart houses, voice recognition software, and virtual reality games, yet few people can give a comprehensive definition of technology" (p. 18). They also state that technology is "both complex and multi-dimensional" (p. 19).

In Webster's Revised Unabridged Dictionary (1913), it is defined as "industrial science; the science of systematic knowledge of the industrial arts, especially of the more important manufactures, as spinning, weaving, metallurgy, etc." (http://machaut.uchicago.edu/websters).

Many dictionaries provide a simplistic definition of *technology*. For example, in the American Heritage Dictionary (2000), technology is defined as "the application of science, especially to industrial or commercial objectives…the scientific method and material used to achieve a commercial or industrial objective…electronic or digital products and systems considered as a group: *a store specializing in office technology*…the body of knowledge available to a society that is of use in fashioning implements, practicing manual arts and skills, and extracting or collecting materials" (http://www.dictionary.com).

In the Merriam-Webster Online Dictionary (2004), technology is defined as "the practical application of knowledge especially in a particular area…a capability given by the practical application of knowledge…a manner of accomplishing a task especially

using technical processes, methods, or knowledge …the specialized aspects of a particular field of endeavor" (http://www.dictionary.com).

As mentioned above, researchers have different ways of defining technology, usually depending on their area of expertise and the perspective from which they need a definition of the term. From an engineering education standpoint, Fernandes and Mendes (2003) argue that technology is "part of culture and is knowledge embodied in material forms, in a cumulative fashion" (p. 152). Some educators define technology as "the process by which humans modify nature to meet their needs and wants" (Young et al., 2003, p. 141). The International Technology Education Association (2000) defines technology as "the innovation, change, or modification of the natural environment in order to satisfy perceived human wants and needs" (http://www.iteaconnect.org/TAA/Resources/TAA_Glossary.html).

Historians such as Melvin Kranzberg and Carroll Pursell often discussed the relation between technology and society. Kranzberg and Pursell (1967) view technology as "nothing more than the area of interaction between ourselves, as individuals, and our environment, whether material or spiritual, natural or manmade" (Stine and Tarr, 1998, p. 610). Others studied technology from the perspective of the environment in which the technology exists and with which it interacts. DeVore (1980) argued that "the use of new kinds of technology on a global scale is the source of greatest environmental concern" (Stine and Tarr, 1998, p. 610). The effects of technology on urban environments, pollution, buildings, parks, wastewater systems, public and occupational health, industry and manufacturing, natural resources, and politics have also been studied (Stine and Tarr, 1998).

Perhaps no definition of technology is complete. It may be for this reason that Kranzberg (1986) decided to describe it rather than define it. Kranzberg intentionally designed his description of technology to be all-encompassing by creating a set of 6 rules (according to him, based on historical facts) that he named *Kranzberg's Laws*. The laws are as follows (Kranzberg, 1986):

1. Technology is neither good nor bad; nor is it neutral.
2. Invention is the mother of necessity.
3. Technology comes in packages, big and small.

4. Although technology might be a prime element in many public issues, non-technical factors take precedence in technology-policy decisions.
5. All history is relevant, but the history of technology is the most relevant.
6. Technology is a very human activity – and so is the history of technology.

Besides stating that technology is a human activity, Kranzberg's set of laws do not define technology. They do, however, explain what technology is and is not, as well as how it functions, its properties, what affects it, and how it has played an important role in history. This description of technology is generally agreed upon by many researchers and is widely cited in the literature.

2.3.3 Attitudes and Imprints

When defining the term imprint, it is essential to highlight the similarities, and more importantly the differences, between imprints and attitudes, as well as other constructs such as values and traits. These constructs are commonly used in psychology to explain different aspects of behavior. They are often used to describe each other and occasionally used interchangeably. This research makes clear distinctions between imprint and the others, especially attitudes, although it will be shown that they are closely related.

According to Eagly and Chaiken (1993), values are a form of attitude with which one evaluates "abstract goals or end states of human existence (e.g., equality, freedom, salvation)" (p. 5). In other words, the set of personal evaluative attitudes about abstract issues of right and wrong comprise one's set of values.

The term attitude is widely used in many areas (scientific or otherwise), often with varying implications. A definition that has become very popular in recent years is that attitude is "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly and Chaiken, 1993, p. 1). Attitudes can be positive, negative, or neutral (often being referred to as non-attitudes (Converse 1964)), while they are frequently considered a causal factor and predictor of behavior (Kelman, 1961; Sherman and Fazio, 1983). Numerous properties are attributed to attitudes.

Eagly and Chaiken state that their definition implies three distinct characteristics of attitudes. First, they describe attitudes as *tendencies*, which they say means that attitudes are internal states and must in fact exist, if even for a short period. They are not merely psychological theories used to explain phenomena. Eagly and Chaiken also argue that the definition gives attitudes an *evaluative* property, meaning attitudes affect the stimulus such that the response is influenced by the attitude. In a way, the attitude is a filter through which one sees and evaluates the *attitude object*, which is the third property of attitudes the definition implies. An attitude object is the object being subjected to the evaluation of the attitude holder. It could be abstract or concrete, tangible or intangible, and can range from concepts such as freedom to objects such as cars.

Other researchers also state various attributes of attitudes. Unlike traits, they must be associated with an object (Sherman and Fazio, 1983). Since attitudes are always directed at an object, they are therefore also evaluative of that object (Sherman and Fazio, 1983) and determine whether the feeling toward the object is positive, negative, or neither. Research has shown that attitudes can be changed (Kelman, 1961; Krosnick and Petty, 1995; Olson and Fazio, 2001). Table 2.1 shows some of the more historically significant definitions that have been given of attitude over the years.

Table 2.1. Definitions of attitude.

Year	**Author**	**Definition**
1929	Lundberg	[An attitude] denotes the general set of the organism as a whole toward an object or a situation which calls for adjustment.
1931	Bogardus	An attitude is a tendency to act toward or against something in the environment, which becomes thereby a positive or negative value.
1931	Krueger and Reckless	An attitude, roughly, is a residuum of experience, by which further activity is conditioned and controlled…We may think of attitudes as acquired tendencies to act in specific ways toward objects.
1931	Thurstone	Attitude is the affect for or against a psychological object.
1934	Cantril	[Attitudes represent] a more or less permanently enduring state of readiness of mental organization which predisposes an individual to react in a characteristic way.
1934	Warren	[Attitudes connote] a condition of readiness for a certain type of activity.

Year	Author	Definition
1935	Allport	An attitude is a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related.
1947	Doob	Attitude is…an implicit, drive-producing response considered socially significant in the individual's society.
1956	Smith, Bruner, and White	An attitude is a predisposition to experience, to be motivated by, and to act toward, a class of objects in a predictable manner.
1957	Osgood, Suci, and Tannenbaum	[Attitudes] are predispositions to respond, but are distinguished from other such states of readiness in that they predispose toward an evaluative response.
1960	Sarnoff	[An attitude is] a disposition to react favorably or unfavorably to a class of objects.
1962	Krech, Crutchfield, and Ballachey	Attitudes [are] enduring systems of positive or negative evaluations, emotional feelings, and pro or con action tendencies with respect to social objects.
1970	Bem	Attitudes are likes and dislikes.
1986	Fazio	Attitudes are summary judgments of an objector event which aid individuals in structuring their complex social environments.
1993	Eagly and Chaiken	Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor.

Eagly and Chaiken (1993) state that attitudes are stored in memory. When a stimulus related to the attitude object is encountered, the attitude is retrieved from memory to impose its evaluative properties on the object. Likewise, in order for an imprint to exist, it has to be stored in the memory and retrieved once it is triggered by a certain stimulus related to it. The imprint process is believed to forge into the memory a certain set of attitudes and behaviors, so strong, that it is unlikely to change, even with time and experience. That attribute of strength is the main factor to consider when making a distinction between attitudes and imprints.

Petty and Krosnick (1995) discuss the different properties of attitudes that make it possible to define an attitude in terms of its strength. Based on previous research (Converse, 1964; Eagly and Chaiken, 1993; Hovland, 1959; Hyman and Sheatsley, 1947; LaPiere, 1934; Petty and Cacioppo, 1981; Schuman and Johnson, 1976; Wicker, 1969),

they conclude that attitudes are generally stable and do not change much after they are formed. They vary in strength and can be very predictive of behavior in some cases (such as political viewpoints), while in other studies, it was proven that attitudes can be very poor determinants of behavior. It was also shown that it is possible, and sometimes very easy to change attitudes. Additionally, in some cases they are called non-attitudes.

In this experiment, it is suggested that there are three specific features of an imprint that distinguish it from other psychological constructs; strength, irreversibility, and polarity. The degrees of strength and irreversibility of attitudes determine whether they are extreme or not, and consequently whether they are candidates for potential imprints or not. The polarity of the attitude determines whether the potential imprint is positive or negative. This was accounted for in earlier models. Extreme attitudes found consistently in a certain half of the normal distribution curve (depending on wording and polarity of the questionnaire items) indicate potential negative imprints, and are the focus of this experiment. Those in the right half of the curve indicate potential positive imprints. Findings from previous research reinforce this argument as shown below (Krosnick and Petty, 1995):

> Attitudes are presumed to vary along an evaluative continuum ranging from a strongly positive orientation to a neutral orientation to a strongly negative orientation. This continuum can be decomposed into valence (i.e., positive or negative) and extremity (degree of favorability). Both valence and extremity might be related to strength in that, for example, holding extremity constant, negative attitudes might be more durable or impactful than positive ones. However, most research attention has focused on extremity. Extremity is the extent to which the attitude deviates from neutrality. The more extreme an attitude is, the more an individual likes or dislikes the object. (p. 5-6)

According to Krosnick and Petty (1995), an attitude is defined by its valence (polarity, i.e. whether it is positive or negative) and extremity (its degree of favorability). They also argue that durability and impactfulness are two features of attitude strength and can either be considered its causes or effects. Durability represents persistence and resistance, while impactfulness represents guiding behavior and impact on information processing and judgments. They argue that "an attitude is strong to the extent that it manifests either durability or impactfulness or both. The more of each feature an attitude

possesses…the stronger it is" (p. 3). They refer to these features as "the defining features of strength" (p. 3). They also state that "an attitude's strength is the degree to which it possesses these features" (p. 4). According to this rationalization, more extreme attitudes will be more persistent and resistant to change. In other research, it was found that stronger attitudes guide behavior, whereas weaker attitudes are often influenced by behavior (Holland et al., 2002). Imprints, being a form of extreme attitudes, therefore have the strongest resistance to change and the strongest impact on behavior of all types and levels of attitudes.

Several indices have been identified and associated with attitude strength. These indices include attitude importance, certainty, accessibility, direct behavioral experience, latitudes of acceptance and rejection, vested interest, and affective-cognitive consistency among others (Eagly and Chaiken, 1993; Krosnick and Petty, 1995; Raden, 1985). They have been studied extensively over the years (Bright and Manfredo, 1995; Davidson et al., 1985; Fazio et al., 1989; Fazio and Williams, 1986; Fazio and Zanna, 1978; Franc, 1999; Sample and Warland, 1973; Sherif et al., 1973; Sivacek and Crano, 1982). Questionnaires typically use a combination of these factors to measure attitude strength. Importance, certainty, and centrality are among the more common measures (Holland et al., 2002).

This discussion demonstrates an important difference between an attitude and an imprint. Neutral attitudes, or non-attitudes, are also considered a form of attitude. In other words, attitudes are represented by a continuum of positive and negative attitudes and everything in between. However, there is no such psychological construct as a non-imprint. A non-attitude is a neutral attitude toward a certain issue. There can be no neutral imprint and there can be no strong or weak imprints. One is either imprinted positively or negatively or not imprinted at all. Imprints are attitudes of very high strength that are so deeply planted in the mind that it is very difficult to reverse their effects.

This distinction was made by philosophers in the Enlightenment. David Hume (1739), another empiricist, discusses a similar concept in his Treatise on Human Understanding. He described an impression that is created with "most force and violence" and explained why it is clearly not just an idea

(http://etext.library.adelaide.edu.au/h/hume/david/h92t/). He made a distinction between the two and stated that the differences are so great that they could not be confused. He wrote the following:

> All the perceptions of the human mind resolve themselves into two distinct kinds, which I shall call IMPRESSIONS and IDEAS. The difference betwixt these consists in the degrees of force and liveliness, with which they strike upon the mind, and make their way into our thought or consciousness. Those perceptions, which enter with most force and violence, we may name impressions: and under this name I comprehend all our sensations, passions, and emotions, as they make their first appearance in the soul. By ideas I mean the faint images of these in thinking and reasoning; such as, for instance, are all the perceptions excited by the present discourse, excepting only those which arise from the sight and touch, and excepting the immediate pleasure or uneasiness it may occasion. I believe it will not be very necessary to employ many words in explaining this distinction. Every one of himself will readily perceive the difference betwixt feeling and thinking. The common degrees of these are easily distinguished; tho' it is not impossible but in particular instances they may very nearly approach to each other. Thus in sleep, in a fever, in madness, or in any very violent emotions of soul, our ideas may approach to our impressions, As on the other hand it sometimes happens, that our impressions are so faint and low, that we cannot distinguish them from our ideas. But notwithstanding this near resemblance in a few instances, they are in general so very different, that no-one can make a scruple to rank them under distinct heads, and assign to each a peculiar name to mark the difference. (http://etext.library.adelaide.edu.au/h/hume/david/h92t/)

One of the definitions of the word imprint in the Merriam-Webster Dictionary (2004) is “to fix indelibly or permanently (as on the memory)” (http://www.m-w.com). While the early thinkers stressed that a mind is like a blank slate ready to accept imprints caused by experiences, they usually also claimed that this is the case for a child’s mind at birth. None of the early works gave reference to imprinting in an adult’s mind. In the interest of the current study, the term imprinting is used to refer to the imprinting of an idea in any person’s mind, child or adult, regardless of age. Therefore, in this study, it more closely resembles the Merriam-Webster definition than that of John Locke’s. No commitment is made to emphasize or prove an empiricist definition of imprinting. In addition, imprinting in this study does not refer to the type of ethological sexual/mate

imprinting stressed by scientists such as Konrad Lorenz and Klaus Immelmann as discussed previously.

2.3.4 Definition of Technology Imprint

Based on the literature reviewed and previously discussed, several properties of the technology imprint can be identified:

1. A technology imprint has a biasing evaluative nature; once it is created, it will from then on bias the person either for or against certain technology-related entities/object.
2. Attitudes have varying levels of strength that can be represented on a scale. However, a true imprint has to be on an extreme end of the strength scale, whether positive or negative.
3. Imprint objects exist in technology imprints much like attitude objects exist in attitudes. An imprint object is the entity upon which the imprint acts to bias the person and must be technology-related. It should be noted that it is not the intention of this study to suggest that imprints are only technologically-based. In fact, it is believed that imprints of all kinds exist. This work, however, only deals with technology imprints and as such, imprint objects must be technology-related. Further studies of other types of imprints may provide information about the nature of those imprints with regards to type, function, difference from technology imprints, etc.
4. Imprints are affected by external characteristics of the technology as well as experience, personal traits, beliefs, and values, and possibly social influences.
5. An imprint is not just theoretical; rather it is a real construct that can be defined in scientific terms and measured using the appropriate tools.

Based on the previous considerations and for the purpose of this study, negative imprint is defined as a predisposition stronger than any attitude, harder to change than any attitude, and always acting to negatively bias behavior toward target objects.

Further, negative technology imprint is defined as an acquired predisposition stronger than any attitude, harder to change than any attitude, and negatively biasing

behavior toward technology-related target objects, as a result of the technology's external characteristics and one's own experiences.

Not only does this definition imply various degrees of strength, it also stresses that technology imprints are at the extreme ends of the attitude strength scale. In addition, a distinction is made between imprints and attitudes; while imprints are almost irreversible, attitudes have been reported by many researchers to be easily changeable (Kelman, 1961; Petty and Krosnick, 1995; Olson and Fazio, 2001). The evaluative nature of imprints is also clear in the last section of the definition. It is hypothesized that imprints act as a filter through which the person perceives the imprint objects. They are similar to colored sunglass lenses which when worn only allow the person to see in that specific color, although what lies on the other side of the lenses is really a full spectrum of colors. This can be seen in Figure 2.1 below.

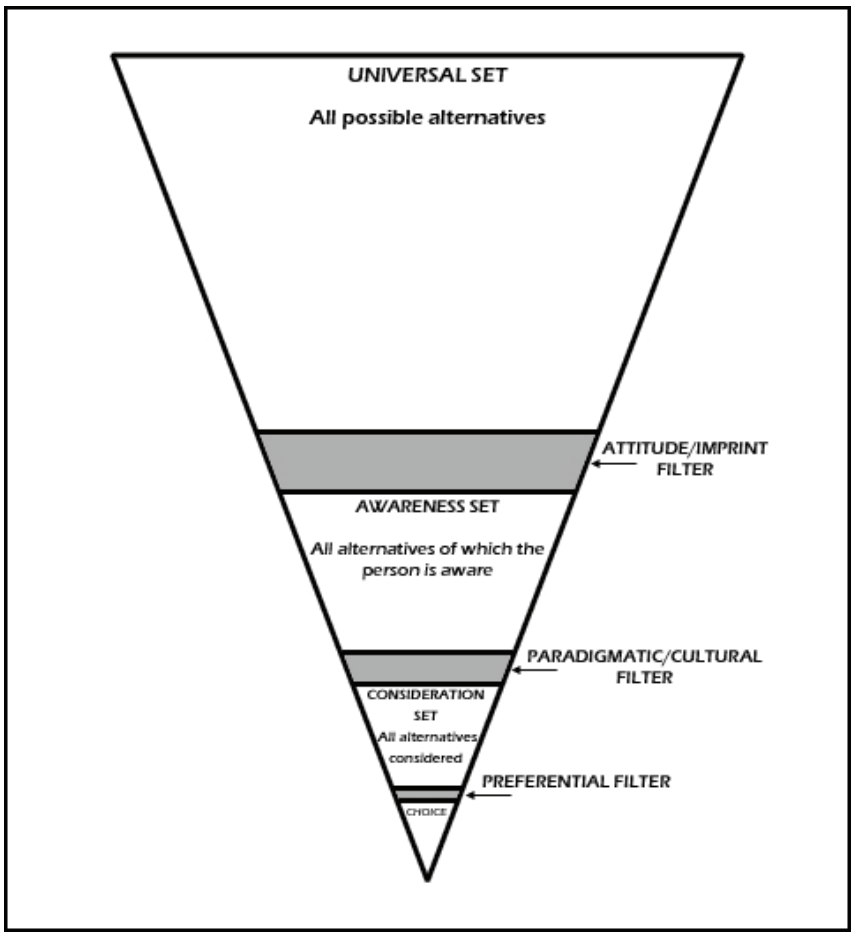

Figure 2.1. Filtering effect of imprints, adopted from Howard and Sheth, 1969.

The figure shows how a response is chosen when a stimulus is encountered. The process flows from top to bottom. For any stimulus, there are numerous possible responses, not all of which will necessarily result in good or correct outcomes. According to Howard and Sheth (1969), this set of all responses possible is called the universal set. That comprehensive set of responses is then narrowed down to the awareness set, which contains all the responses of which the individual is aware, again, not necessarily resulting in positive outcomes. It is hypothesized that the attitude/imprint filter is the filter that acts to reduce the number of all responses to from universal set to the awareness set. The reason for this hypothesis is that imprints are assumed to be extremely strong forms of attitudes. Such strength results in a bias that is very strong and very difficult to overcome. It will therefore override all other filters and no response can be considered without first being permitted by the imprint filter.

Terry (2000) proposed a model in which any stimulus to which a person is exposed is analyzed and compared with short-term memory and long-term memory. The outcome of the comparison determines the person's response to the stimulus. A possible outcome is an orienting response in which the person reacts by calibrating to the stimulus then responds appropriately (Terry, 2000). Terry suggests that this response is more oriented toward survival. The model is shown in Figure 2.2 below.

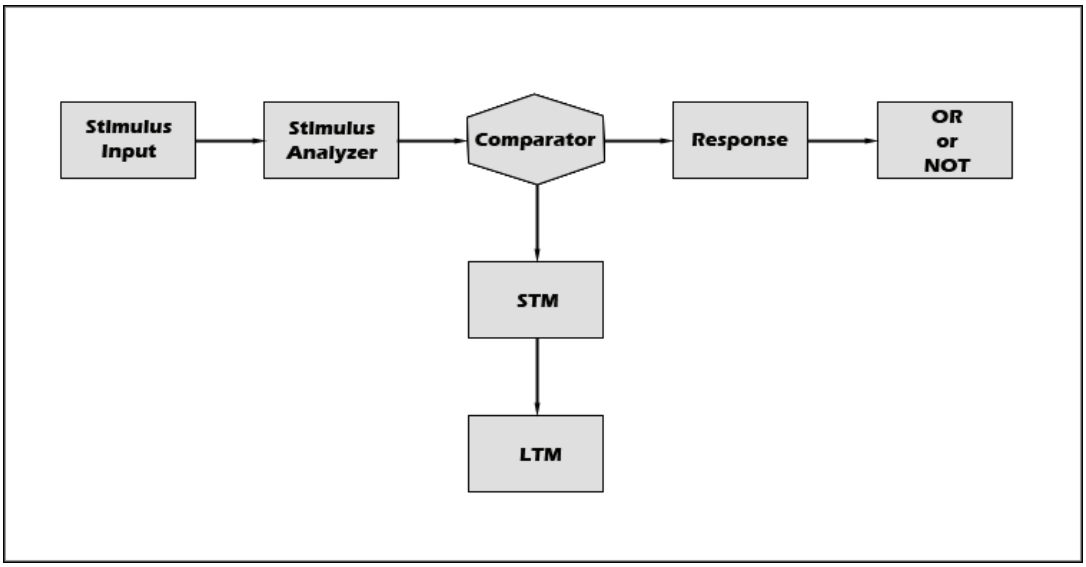

Figure 2.2. Generalized cognitive model of habituation (Terry, 2000).

The similarity between this model and that of technology imprint lies in the fact that the response in both cases relies on some sort of comparison with memory. The stimulus is analyzed through what may be likened to a filter before the corresponding response is executed. In the case of a blank slate, or a non-imprinted mind, this would not be the case. There would be no filter by which the perceptions and responses are affected.

One might argue that a blank slate is a hypothetical and unrealistic situation because for every stimulus experienced, there exists in the memory at least a similar experience to use as a reference for comparison. While that may be true, it does not necessarily mean that an imprint already exists. It merely demonstrates the likelihood of existence of a memory of a similar stimulus or a form of learning or habituation that helps the person react to any situation. It is probable that people occasionally experience new or novel stimuli. However, it can be argued that the accumulation of knowledge and experience gained throughout the life of a person is at any point sufficient to produce effective responses to those novel stimuli. According to Wasson (1979), this type of stimulus does exist. A person will match a novel stimulus with "patterns developed from past experience, and…respond accordingly" (Wasson, 1979, p. 365).

One of the drawbacks of Terry's model is that it does not discuss a feedback loop or explain how previous experiences and responses affect future analyzing and decision-making processes. With this model, it is not possible to understand how the stimulus analyzer is created and how it changes and matures with experience. There are, however, models that do rely on feedback loops to explain behavior and decision-making. Many of these models are found in the field of consumer behavior. The adjustment function (Katz, 1960), for example, stresses that the reward or penalty of a certain event will influence the actions of a person. Katz attributes this behavior to the fact that the consequences of one's actions (whether positive or negative) will change a person's environment in a way that will either cause a perceived improvement or deterioration of the current environment. Based on this theory, Katz states that attitudes are "either the means for reaching the desired goal or avoiding the undesirable one, or are affective associations based upon experiences in attaining motive satisfactions" (p. 171). This is called the *utilitarian* attitude.

Attitude adjustment that relies on the outcome of a certain interaction makes the feedback process obvious. This attitude will affect the person's decision-making in future interactions. According to the utilitarian theory, attitudes are created and reshaped by making adjustments based on perceptions of certain experiences. Katz (1960) states that:

> The clarity, consistency, and nearness of rewards and punishments, as they relate to the individual's activities and goals, are important factors in the acquisition of such attitudes. Both attitudes and habits are formed toward specific objects, people, and symbols as they satisfy specific needs. The closer these objects are to actual need satisfaction and the more they are clearly perceived as relevant to need satisfaction, the greater are the probabilities of positive attitude formation. (p. 171)

Katz also explains the value-expressive function in which a person is more satisfied by positive attitude changes that improve the person's self image and more accurately reflect his or her personal values and beliefs. This aids the person in "establishing his self-identity and confirming his notion of the sort of person he sees himself to be" (Katz, 1960, p. 173).

Kelman (1961) describes his theory of social influence as being comprised of three parts; compliance, identification, and internalization. Compliance, in Kelman's view, refers to a person's influence by others in order to gain their approval and acceptance. Identification is the adoption of certain behavior because of a personal desire to maintain a relationship with others with whom the behavior is associated (Kelman, 1961). Adhering to the behavior instills in the person a feeling of self-definition because it emphasizes the existence of the desirable relationship (Kelman, 1961). Identification is frequently exhibited in an attempt by a person to be like, or imitate, someone else (Kelman, 1961). Internalization is similar to Katz's value-expressive function. They both instill a feeling of satisfaction by being compatible with a person's values in one way or another. The influence in this case is caused by the fact that adopting a specific behavior will return intrinsic rewards by emphasizing one's own beliefs and values (Kelman, 1961).

The term normative function is sometimes used to explain social influence (Burnkrant and Cousineau, 1975). It implies a perception that the approval of others will allow one to fit into the norm, which is a desirable condition for some. Punishment or

reward resulting from an action could play a large role in determining behavior, according to the normative function. This would depend on how important it is for the person to receive the reward or avoid the punishment (Burnkrant and Cousineau, 1975).

Many researchers have contributed to the area of social influence throughout the years, but they have not always necessarily agreed on the theories and terminology. However, in principle, many of the conclusions were the same. Some studies combine the utilitarian and value-expressive functions into the more general term normative function, while others break down normative social influence into compliance and identification or utilitarian and value-expressive functions (Batra et al., 2001; Bearden and Etzel, 1982; Bearden et al., 1989; Burnkrant and Cousineau, 1975; Deutsch and Gerard, 1955; Katz, 1960; Kelman, 1961; McGuire, 1968).

The discussion of social influence is significant to the topic of technology imprint because it is an element likely to have an effect on determining whether a person is positively or negatively imprinted, or if an imprint is created at all. Social influence plays an important role when one's main source of information about a less-known issue or product is through word-of-mouth and media rather than direct exposure and interaction. That is often the case with many new technologies. The Internet was subject to this kind of publicity in its early stages. Until today, there are parts of the world where the Internet access is possible only for the privileged few (International Telecommunication Union 2003). It is hypothesized that the environment and culture in which a person is immersed will have a strong effect on the creation of new opinions and more importantly, imprints.

2.3.5 Technology Imprint Model

The technology imprint is based in part on existing psychological theories and constructs. It is, however, an independent model explaining a phenomenon not previously explored. Imprints are hypothesized to be influenced by personal experience, which includes the background, culture, and history of the person upon whom the imprint will be created. The main model studying technology acceptance, TAM, relied only on cognitive variables (Davis, 1986, 1989). This is believed to diminish the strength of the model since cognition cannot be separated from emotions in real-life interactions. These

affective elements are discussed further in later sections. Another category contributing to the formation of imprints is cognitive factors, which are also discussed in more detail.

Cognitive and affective factors are not independent of each other. There is believed to be constant interaction and feedback among them. TAM acknowledges the role of affect in technology acceptance and expresses a belief that cognitive variables interact with affect (Davis et al., 1989). It is hypothesized that the imprint is created by a combination of elements acting simultaneously and that once it is forged, it is difficult to reverse.

Upon being confronted with a technology interaction situation, ideas are believed to be generated by first being filtered through a technology imprint. The imprint narrows down the number of possible responses to any given interaction. The resulting limited group of responses produces a biased response. The relationships between the factors and the technology imprint are shown in Figure 2.3 below.

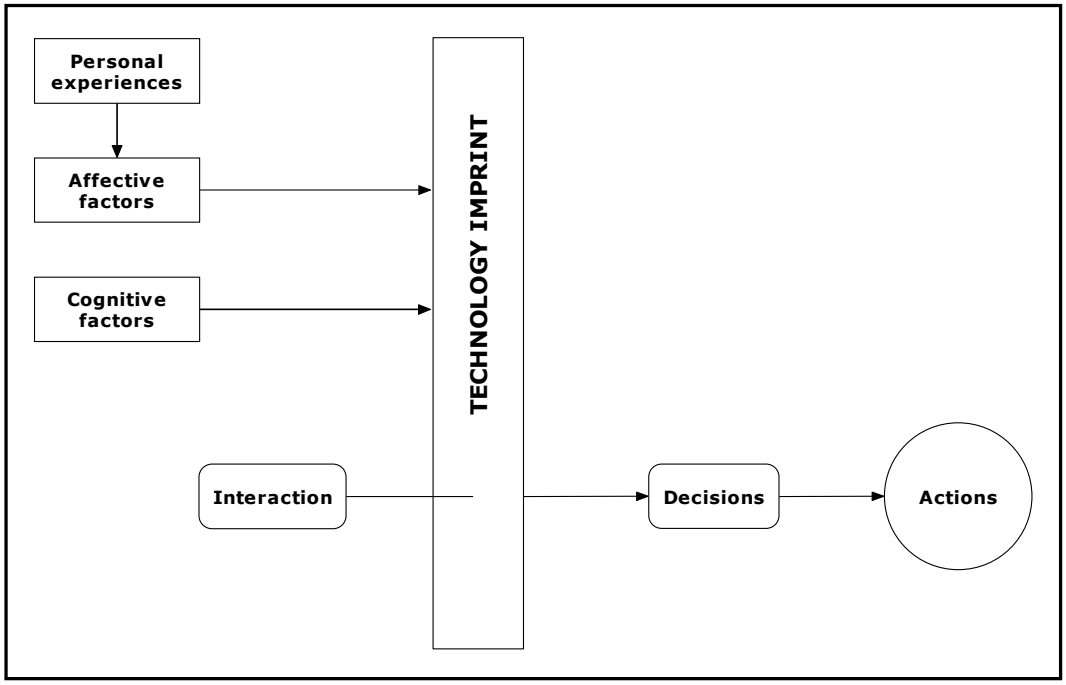

Figure 2.3. Formation of technology imprints and how they influence actions.

Technology imprints are not expected to be one single entity existing in every person's behavioral pattern. Instead, it is believed that multiple imprints can and do exist,

each relating to a specific issue. While technology use is believed to be a situation where imprints are created, it is also believed that imprints are created in other areas, and maybe even detailed enough so as to vary among different components of the same group. However, this experiment only investigates negative technology imprints. Any attempts to study other imprints are reserved for future studies.

CHAPTER 3
TECHNOLOGY IMPRINT MODEL BACKGROUND

3.1 Introduction

The technology imprint model expands on research previously conducted in the area of technology acceptance and attitudes toward technology. The emergence of computers as the core of modern technology has generated lots of interest in this field since the 1980s, especially after the publication of the technology acceptance model (TAM) (Davis, 1986). The purpose of this chapter is to introduce the background and theories on which the technology imprint model (TIM) presented in this study is based.

It was decided to focus the study on negative technology imprints rather than both positive and negative. This decision was made because it is believed they are fundamentally two different types of imprints. In other words, imprints on the left side of the normal distribution curve possess different characteristics than those on the right. They are not necessarily created by the same causes. Similarly, it is believed that they do not share properties or produce the same effects. This belief is supported by findings in the literature. Krosnick and Petty (1995) state that "holding extremity [of an attitude] constant, negative attitudes might be more durable or impactful than positive ones" (p. 6), while Homer (2006) simply states that "positive and negative forms of affect operate differently" (p. 35).

3.2 Technology Acceptance Model and the Theory of Reasoned Action

The theory of reasoned action (TRA) (Fishbein, 1967; Fishbein and Ajzen, 1975) and the technology acceptance model (TAM) (Davis, 1986, 1989; Davis et al., 1989) are both models that address attitudes toward objects in one way or another. TAM focuses specifically on acceptance of information systems in an organizational setting (Davis, 1986; Davis et al., 1989). TRA is claimed to be designed to explain any behavior toward any object (Ajzen and Fishbein, 1980). TIM is intended to explain user behavior based on the influence of imprinting toward technology.

TAM uses TRA as its foundation and builds upon it (Davis, 1986). Both models indicate that action is based on motivation or intention to act, but they have not always

agreed when it comes to the factors affecting motivation. In their simplest forms, however, such belief-based models can be represented as shown in Figure 3.1, with the arrows indicating influence.

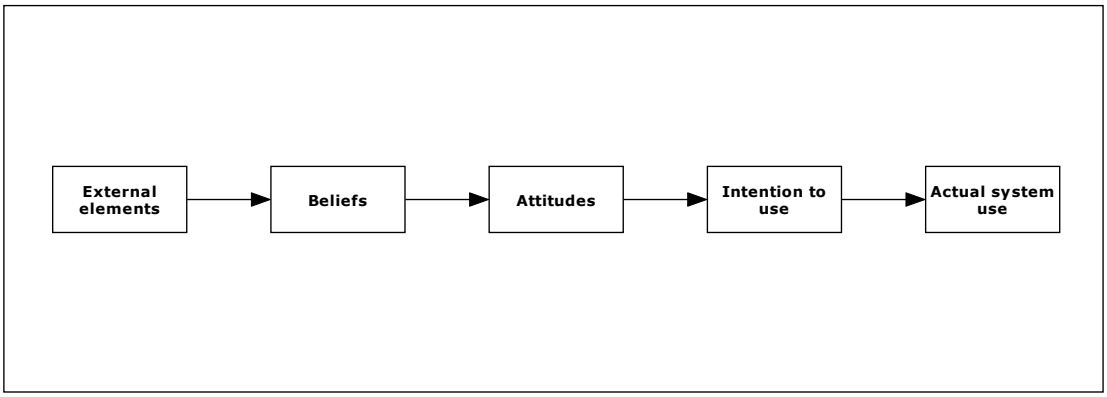

Figure 3.1. Fundamental concept behind belief-attitude models.

In TRA, motivation is represented by behavioral intention (BI) (Fishbein and Ajzen, 1975). TAM agrees with TRA that BI determines system usage but argued that BI was affected by both attitude (A) and perceived usefulness (PU) (Davis et al., 1989). However, data analysis showed no significance for A. Consequently, it was omitted from the model (Davis et al., 1989).

Subjective norm (SN) is one of the factors influencing behavioral intention in the theory of reasoned action. According to Fishbein and Ajzen (1975), SN is defined as "a person's perception that most people who are important to him think he should or should not perform the behavior in question" (p. 302) (see Appendix B for complete list of definitions). It is, in effect, a term that represents social influence. However, on different occasions, TAM revisions abandoned SN citing two reasons:

1. TAM was intended to measure acceptance of systems not previously known to users. The system would be new to everyone in the organization, therefore, no relevant social normative effect can be expected (Davis, 1986).
2. Ajzen and Fishbein's (1975) acknowledgement that SN "is one of the least understood aspects of TRA" (Davis et al., 1989, p. 986).

In the extended technology acceptance model (TAM2), SN was revisited. Three variables were included in the model to represent social influence; subjective norm, voluntariness, and image (Venkatesh and Davis, 2000). They were found to significantly influence user acceptance of new technologies at the workplace, as were the findings in another study (Taylor and Todd, 1995). Earlier studies, however, did not find SN to have any significant effects on intention (Davis et al., 1989; Mathieson, 1991). Due to this inconclusiveness and based on the previous claim that SN acts through PU and PEOU (Davis et al., 1989), it was decided to include SN in TIM as an exploratory variable only.

The most characteristic aspect of TAM is its utilization of the cognitive variables perceived usefulness (PU) and perceived ease of use (PEOU) to explain technology acceptance. Davis et al. (1989) state that this is "inspired by TRA's view that attitudes toward a behavior are determined by relevant beliefs" (p. 987). These cognitive variables represent properties specific to the technology itself.

TAM is based on TRA (Ajzen and Fishbein, 1980; Davis et al., 1989; Fishbein and Ajzen, 1975), a more general theory explaining the relationship between intention and behavior. PU and PEOU (termed U and EOU, respectively, in TAM) were identified by Davis as the two measures that will empirically determine whether a user will accept or reject a new technology (Davis et al., 1989). The two measures, and TAM in general, later received significant attention in the literature (Adams et al., 1992; Igbaria et al., 1997; Legris et al., 2003; Ma and Liu, 2004; Shih, 2004; Straub et al., 1997; Szajna, 1996). By the year 2000, TAM had already been cited in at least 424 journal articles (Venkatesh and Davis, 2000). Its well-documented robustness and parsimony have placed it among the popular theories in social psychology.

In the original technology acceptance model, perceived usefulness is influenced by perceived ease of use. Davis's reasoning is that a system that is perceived to be easy to use will also be perceived to be more useful (Venkatesh and Davis, 2000). External factors, characteristics that are specific to the system itself, were associated with PEOU in TAM (Davis et al., 1989). But an extension to TAM, commonly referred to as TAM2, later identified several external factors contributing to PU as seen in Figure 3.2 and Figure 3.3 below (Venkatesh and Davis, 2000) (see Appendix C for complete TAM and TAM2 questionnaires).

Davis (1989) defines perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p. 320). Perceived ease of use, on the other hand, is "the degree to which a person believes that using a particular system would be free of effort" (p. 320). TAM states that PEOU influences PU in such a way that if the technology is perceived to be easy to use, the user will be more likely to rate the technology's usefulness higher (Figure 3.2).

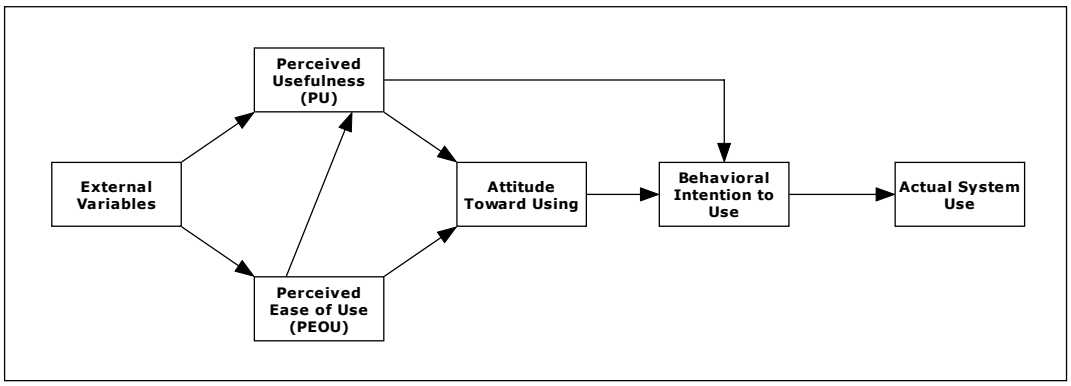

Figure 3.2. TAM, from Davis et al. (1989).

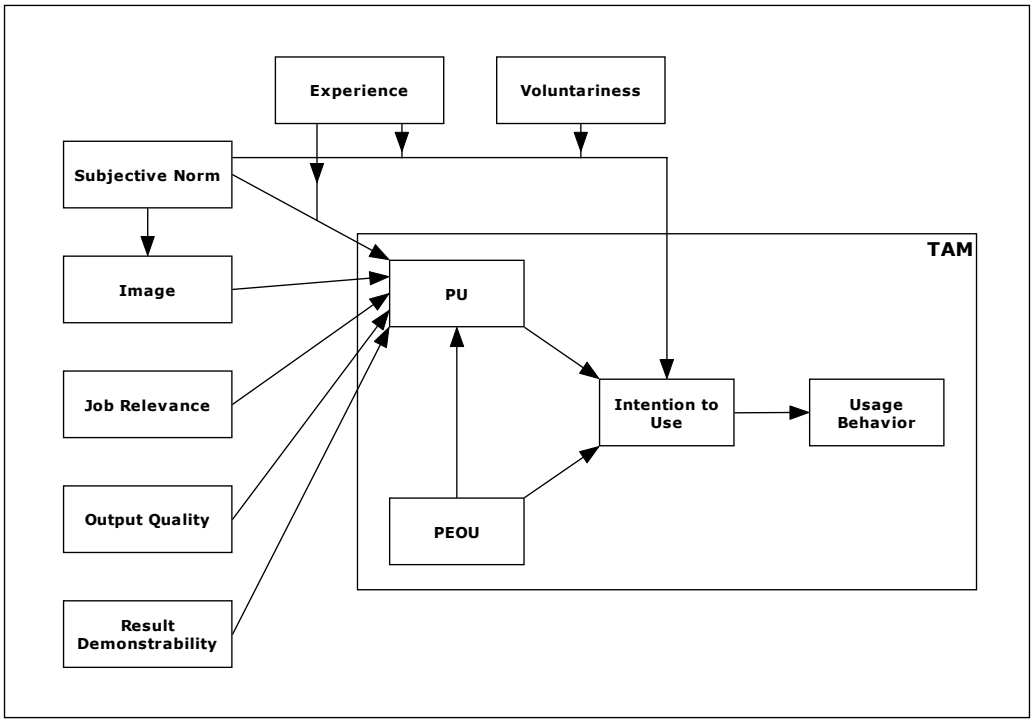

Figure 3.3. TAM2, from Venkatesh and Davis (2000).

Below are the TRA and TAM equations in a simplified form. Equations 3.1 through 3.3 represent TRA, while 3.4 through 3.6 represent TAM (Davis et al., 1989). In both models, the weights and error terms (not shown) are estimated by regression. It is important to note that these equations are not additive; they are functions that represent relationships between the different variables.

$$BI = A + SN \tag{3.1}$$

$$A = \sum b_i e_i \tag{3.2}$$

$$SN = \sum nb_i mc_i \tag{3.3}$$

$$BI = PU + PEOU \tag{3.4}$$

$$PU = PEOU + \text{External variables} \tag{3.5}$$

$$PEOU = \text{External variables} \tag{3.6}$$

Where:
BI ≡ behavioral intention
A ≡ attitude
SN ≡ subjective norm
b_i ≡ salient beliefs about the consequences of performing a behavior
e_i ≡ evaluation of the consequences of performing a behavior
nb_i ≡ normative beliefs (perceived expectations of specific referent individuals or groups)
mc_i ≡ motivation to comply with these normative expectations
PU ≡ perceived usefulness
PEOU ≡ perceived ease of use
External variables ≡ object properties (e.g. in the case of computers; menus, icons, mice, and touch screens)

TAM addresses usage of systems that have not yet been implemented. Davis et al. (1989) state that "if, after briefly exposing potential users to a candidate system that is

being considered for purchase and organizational implementation, management is able to take measurements that predict the future level of adoption, a go/no-go decision on the specific system could be made from a more informed standpoint" (p. 989). For this reason, intent to use is an acceptable predictor of system usage among those who have little to no experience with the system if the study is conducted over a time frame that does not allow measuring actual system usage. However, this study is concerned with technologies that are already in use. It is suggested that imprints not only affect usage of future systems, but also usage patterns and behaviors of users when dealing with current technologies. Because of this property of TIM, frequency of use (FOU) is incorporated into the model rather than intent.

3.3 Emotion as a Factor Affecting Technology Use

Previous research suggests that users interacting with new technologies use what is referred to as an "anchoring and adjustment" method to establish their perceptions of the technology's perceived ease of use (Venkatesh, 2000, p. 342). At first, the system-specific beliefs are anchored to general technology perceptions. These anchors are a result of "individual difference variables and general beliefs regarding computers based on prior experience with computers/software in general and other systems" (Venkatesh, 2000, p. 345). Later, and as a result of interacting with the new technology, the user makes adjustments to the initial general assessment. The technology imprint model suggests that the imprint overwhelmingly acts as the anchor and it is strong enough to not allow significant further adjustments.

Although the two technology acceptance model variables PU and PEOU are cognitive, Davis et al. (1989) do acknowledge that they can influence affect. According to them, this is a result of an automatically induced positive feeling toward actions associated with positively rewarding outcomes. They also state that a technology that is perceived to be easy to use will increase the user's sense of efficacy, which will in turn influence affect (Bandura, 1982; Davis et al., 1989). Salient beliefs in TAM are the individual scale items, the averages of which would yield PU and PEOU (i.e. each of the cognitive variables are represented by a set of beliefs) (Davis, 1986).

Affective elements were considered contributing factors to strong attitudes in early social psychology research (Eagly and Chaiken, 1993; Sherif and Cantril, 1947). In the 1960s and 1970s, studies focused on cognitive elements as contributors to strong attitudes (Eagly and Chaiken, 1993). In more recent research, motivational and emotional factors have again been addressed (Eagly and Chaiken, 1993). Emotional commitment (Abelson, 1988) was considered an indicator of strong attitudes, and the emotional force of attitudes was defined as "the power of the belief to evoke strong feelings in the individual" (Abelson and Prentice, 1989, p. 376). In other research, attitude importance was defined as "the degree to which a person is passionately concerned about and personally invested in an attitude" (Petty and Krosnick, 1995, p. 417). These studies all indicate the importance of affect in attitude research. Attitudes toward technology are no exception.

This experiment focuses on an imprint variable (I), linked with emotion. A central belief in this experiment is that an affective element is an important aspect of any model explaining attitudes and behavior toward technology. This is supported by findings in the literature (Agarwal and Karahanna, 2000; Chung and Tan, 2004; Norman, 2002; Zhang and Li, 2005). Affect is seen as an element that has the ability to enhance or deteriorate a user's experiences with technology. It is hypothesized that affect is strong enough to influence behavior, giving it the ability to deteriorate the effects of cognitive-based attitudes such as PU and PEOU. This is supported by Eagly and Chaiken's (1993) claim that favorable or unfavorable evaluations of an attitude object that are based on affect do not necessarily change beliefs about the object.

The discrepancy between an individual's overall evaluation of an object and the abstract beliefs held about it is referred to as evaluative-cognitive inconsistency (Eagly and Chaiken, 1993). According to Eagly and Chaiken (1993), this inconsistency could be caused by either true conflicting beliefs and attitudes or simply a lack of beliefs about the object. On the other hand, the inconsistency between the overall evaluation toward the object and affect is referred to as evaluative-affective inconsistency, and has not been studied on a large scale and adequately explained (Eagly and Chaiken, 1993). Studying the consistency between evaluation and cognitions, affect, and behavior is encouraged by Eagly and Chaiken (1993).

While the idea of affective elements influencing technology usage is not novel, and has been suggested by previous researchers, no references to concrete models were found in the literature. Most models have focused on the properties and characteristics of the technology or system itself and have largely ignored the user. Venkatesh (2000) states that "typically, researchers and practitioners have restricted their attention to system design characteristics (e.g., Davis et al., 1989) or training (e.g., Venkatesh, 1999) when trying to enhance user perception of the ease of use of a system, thereby overlooking other controllable variables such as individual difference variables and variables that are a result of a system-user interaction" (p. 343).

Venkatesh (2000) explored the effects of three different affective elements, or what he referred to as anchors, on technology acceptance; control, intrinsic motivation, and emotion. In his model, control is either internal or external and refers to the user's "perception of the availability of knowledge, resources, and opportunities required to perform the specific behavior" (p. 346) or in other words, the user's perceived level of control over the system. Internal control, relating to the user, represents computer self-efficacy, while external control, relating to the system or the environment, represents facilitating conditions (Venkatesh, 2000). Intrinsic motivation represents computer playfulness. This variable refers to the perceived personal pleasure and satisfaction gained in using the technology without taking into consideration the effects of extrinsic motivation (rewards and other positive material outcomes) (Venkatesh, 2000). Other research defines computer playfulness as "an individual's tendency to interact spontaneously, inventively, and imaginatively with microcomputers" (Webster and Martocchio, 1992, p. 202). As a factor possibly affecting technology usage, playfulness is a large departure from the cognitive variables of TAM.

Venkatesh (2000) also discusses emotion, which represents the level of computer anxiety, as an anchor to perceptions about technology. Computer anxiety is the user's fear and apprehension of using computers (Simonson et al., 1987; Venkatesh, 2000). This may be the most relevant of the three anchors examined by Venkatesh. Previous researchers have addressed computer anxiety in their studies.

Of the studies relating to computer anxiety (CA), one used psychometric scales to compare between common beliefs and realities about the phenomenon (Howard and

Smith, 1986). Another found significant effects of variables such as computer training and gender on CA (Igbaria and Chakrabarti, 1990). CA was found to be the "strongest predictor of negative attitudes toward microcomputers" in another study (Igbaria and Parasuraman, 1989, p. 373). The determinants of CA were explored in yet another study in which demographic and personality variables did not have an effect among women, while among men age, external locus of control, and math anxiety did show significant effects on CA (Parasuraman and Igbaria, 1990). Similarly, many other studies examined various aspects of CA (Anderson, 1996; Havelka et al., 2004; Martocchio, 1994; Morrow et al., 1986; Scott and Rockwell, 1997; Todman and Monaghan, 1994). Perhaps the most relevant study was one that reevaluated TAM adding new variables, one of which was CA. The study found a strong effect of CA on system usage (McFarland and Hamilton, 2006).

Norman (2002) discusses his experience with color monitors when they were first made available. He states that from the cognitive standpoint, early color monitors had no value. Limitations imposed by the software, hardware, and computing power available at the time made it impossible to maximize the full potential of color screens. Color merely made it possible to have colored text and other visual enhancements that in no way changed the effectiveness or usefulness of the system. In his quest to understand the hype surrounding color screens, he borrowed one and used it for a certain period of time. His self-observation confirmed to him that the popularity of color monitors stemmed from an affective reaction. He states the following:

> After the allocated time, I was convinced that my assessment had been correct – color added no discernible value for everyday work. However, I refused to give up the color display. Although my reasoning told me that color was unimportant, my emotional reaction told me otherwise. (p. 37)

Norman's assessment of the color screen's popularity captures one of the most important implications of this research: that affect can be strong enough to cloud, and sometimes override, one's attitude based on logical and cognitive beliefs. This phenomenon, in effect, defines the technology imprint. A user's emotions, not cognitions, and not external properties of a technology (interface, design, colors, functionality, etc.),

can, in some situations, have a commanding effect on how the user interacts with the technology.

Support for the overpowering nature of affect is also found in Eagly and Chaiken (1993). They present an example in which a person had dinner at a Japanese restaurant. The patron did not find the food tasteful and left hungry. They explain that this person could eventually stereotype as a result of this experience, and possess very strong attitudes toward Japanese restaurants in general. Because of the negative implications of this experience, they argue that this could be the patron's last visit to a Japanese restaurant.

Davis et al. (1989) acknowledge the significance of affect on behavioral intention. They state that "all else being equal, people form intentions to perform behaviors toward which they have positive affect" (p. 986). This statement reinforces the importance of affect on behavior toward technology. However, it is believed to be incomplete as negative affect will also influence BI, but will contribute to a different type of behavior. In addition, TAM does not specifically include an affective element. Equation 3.4 defines BI as being influenced by only PU and PEOU. Therefore, affect is considered to have an indirect effect on BI through PU and PEOU, if it has any influence at all. This study addresses that aspect, seemingly a deficiency of TAM.

3.4 Proposed Technology Imprint Model

It is believed that affect has the power to significantly influence frequency of use, whether it is positive or negative. However, in this study, only negative affect (a dislike toward technology) is investigated. While positive affect has the ability to enhance the user's interaction with the technology from an efficiency and productivity standpoint, negative affect does not. From an engineering management standpoint, studying negative affect is the priority because of its potentially adverse effects. A specific variable is included in the study to represent positive or negative affect on user attitude. This variable is referred to in the model as likeability (L).

Another variable, attitude strength (S) measures constancy and whether the user is likely to change his or her behavior patterns. Previous research has shown that attitudes are a combination of valence and extremity (Krosnick and Petty, 1995). Attitude strength

is meant to measure the extremity of attitudes to asses whether they can be considered an imprint or not. A number of indices have been shown to provide accurate measurements of attitude strength. These indices include attitude importance, certainty, accessibility, direct behavioral experience, latitudes of acceptance and rejection, vested interest, and affective-cognitive consistency to name a few (Eagly and Chaiken, 1993; Krosnick and Petty, 1995; Raden, 1985). It is recommended to use a combination of these elements to obtain a more accurate measurement (Pomerantz et al., 1995; Raden, 1985).

TAM argues that in an organizational setting, PU, a cognitive factor, trumps affect and will result in intention to act regardless of the conflict caused by affect (Davis et al., 1989). They state that the PU-BI relationship in equation 3.4 "is based on the idea that, within organizational settings, people form intentions toward behaviors they believe will increase their job performance, over and above whatever positive or negative feelings may be evoked toward the behavior per se" (p. 986). In the technology imprint model, it is argued that in the case of imprinted individuals, the exact opposite of that statement is true. Negative imprints will influence FOU regardless of other factors.

One of the limitations of TAM's cognitive approach is its strict use of material rewards to explain usefulness. The model seems to imply that the only reason a technology would be perceived to be useful is if it rewarded the user with "raises, promotions, bonuses, and other rewards" (Davis, 1989, p. 320). This is believed to be a restrictive assumption as there are many cases where a certain item can be described as useful without necessarily returning any material rewards. An example is an individual using the Internet from home to communicate with family; useful because it helps them stay in touch, but will not result in a promotion or any other monetary reward.

Since frequency of use and behavioral intention were found to be significantly correlated (Davis et al., 1989), and since this study is concerned mostly with current technologies already in use, FOU was used instead of BI. Equation 3.7 below represents the technology imprint model in its simple form. Equation 3.8 is the secondary equation in TIM and shows the effect of technology likeability and attitude strength without the user necessarily being imprinted. The two variables L and S were not combined with I in the same equation because of collinearity, since I depends on L and S.

$$FOU = PU + PEOU + I \quad 3.7$$

$$FOU = PU + PEOU + L + S \quad 3.8$$

Where:

FOU ≡ frequency of use of the system

PU ≡ perceived usefulness

PEOU ≡ perceived ease of use

I ≡ imprint

L ≡ likeability

S ≡ attitude strength

Equation 3.8 is based on the relationship between I and its two components L and S, which will be discussed in depth in the following chapter. The main idea behind this relationship is that I is a function of L and S as shown in Equation 3.9.

$$I = L + S \quad 3.9$$

It is believed that the imprint variable (I) is determined by likeability (L) and attitude strength (S). An individual with a low L score and high S score is likely to be imprinted, in which case I will have a significant impact on frequency of use. The effect of the negative imprint will diminish the effects of PU and PEOU resulting in lower FOU. This is based on the hypothesis that L and S are negatively correlated.

Considering the technology imprint model main equation and hypotheses, Figure 3.1 can be modified to express the relationship between the cognitive and emotional variables. As previously stated, it is hypothesized that emotion has an overriding effect on cognition, resulting in diminished FOU when a negative imprint exists. Figure 3.4 reflects these changes.

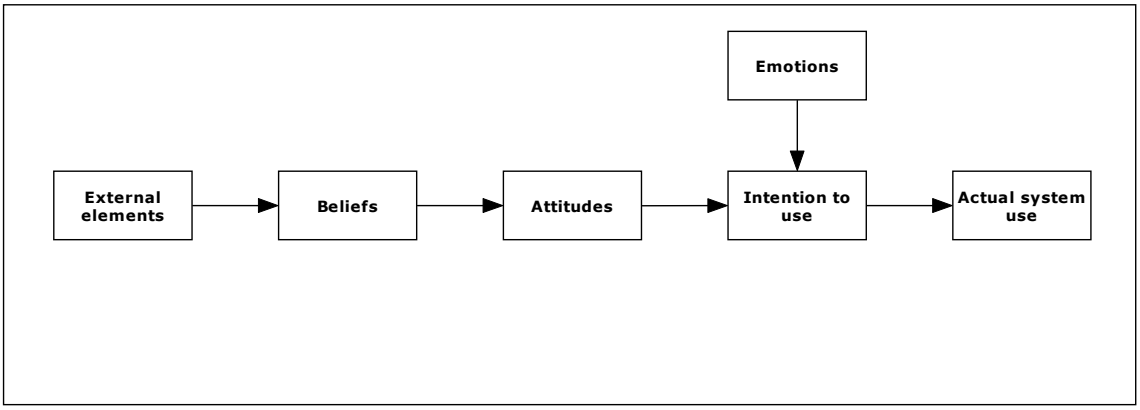

Figure 3.4. Effect of emotion on belief-action models.

CHAPTER 4
RESEARCH METHODOLOGY

4.1 Introduction

The purpose of this chapter is to introduce the methods and instruments with which the technology imprint model (TIM) was tested. The experimental design as well as data analysis will be discussed along with the tests that were conducted in order to evaluate the theory and hypotheses. Elements affecting the technology imprint, response and predictor variables, testing conditions, methodology, instruments, data analysis procedures, and the logic behind the chosen methods will be presented.

4.2 Experimental Design

A combination of random and targeted selection of the sample was used. In order to increase the likelihood of finding subjects demonstrating imprinting characteristics, specific demographic groups, traditionally believed to be less accepting of technology, were asked to participate in the study. Participants in the study were recruited from Texas Tech University, a local store that provides non-technology related goods, and local community groups. The sample size was 308.

The model incorporates one dependent variable; frequency of use (FOU), and five independent variables; perceived usefulness (PU), perceived ease of use (PEOU), imprint index (I), likeability (L), and attitude strength (S). A combination of previously tested and established psychometric instruments and others developed specifically for this experiment were used to measure the effect of imprinting on frequency of use.

4.3 Hypotheses

This experiment attempted to validate the imprint model as outlined by the hypotheses in Table 4.1. Since I is a function of L and S, the effects of L and S on FOU were also tested. This is reflected in the hypotheses and equations below. The equations are listed first in their complete forms with coefficients and error terms, followed by the hypotheses.

$$FOU = \beta_{o1} + \beta_1 PU + \beta_2 PEOU + \beta_3 I + \varepsilon_1 \quad 4.1$$

$$FOU = \beta_{o2} + \beta_1 PU + \beta_2 PEOU + \beta_4 L + \beta_5 S + \varepsilon_2 \quad 4.2$$

Table 4.1. List of null hypotheses, test statistics, and alternate hypotheses.

	Null hypothesis	**Test statistic**	**Alternate hypothesis**
H_1	Imprint (I) has a positive or no effect on frequency of use (FOU).	$\beta_3 \geq 0$	Imprint (I) has a negative effect on frequency of use (FOU).
H_2	Perceived usefulness (PU) has no effect on frequency of use (FOU).	$\beta_1 = 0$	Perceived usefulness (PU) has an effect on frequency of use (FOU).
H_3	Perceived ease of use (PEOU) has no effect on frequency of use (FOU).	$\beta_2 = 0$	Perceived ease of use (PEOU) has an effect on frequency of use (FOU).
H_4	Likeability (L) has no effect on frequency of use (FOU).	$\beta_4 = 0$	Likeability (L) has an effect on frequency of use (FOU).
H_5	Attitude strength (S) has no effect on frequency of use (FOU).	$\beta_5 = 0$	Attitude strength (S) has an effect on frequency of use (FOU).
H_6	Attitude strength (S) is positively correlated, or not correlated at all, with likeability (L).	$r_{S\text{-}L} \geq 0$	Attitude strength (S) is negatively correlated with likeability (L).

4.4 Population and Sampling

The sample of 308 participants consisted of 159 students recruited from Texas Tech, 93 customers of a local store, and 56 members of various community groups. Participants were recruited on a voluntary and availability basis.

Participation was voluntary and incentives were offered only to participants in the store, in the form of a small discount toward their purchase. As expected, screening showed that the university sample's mean age was relatively low and had a narrow

standard deviation. In order to maintain stratification of the data, an attempt was made at the store to invite customers to participate who appeared to be older than the average university student. However, everyone who asked to participate, in response to the posted sign, was allowed to. Additionally, because screening showed that most subjects were responding with very highly positive attitudes toward the technologies, it was necessary to use purposive sampling (Leedy and Ormrod, 2005). Certain groups, traditionally believed to be less accepting of technology, were asked to participate. That included religious study groups and book review groups with much higher mean ages (expected and observed) than the university student group, and even the store group.

The sample size was chosen based on previous studies involving attitudes toward technology (Adams et al., 1992; Burton-Jones and Hubona, 2005; Davis, 1989, 1993; Davis et al. 1989; McCloskey 2004; Wang et al. 2003; Yu et al. 2003). An average sample size commonly used in those studies is 125. It was decided to use 250 subjects in this study since 125 was thought to be too small to include enough subjects with negative attitudes. However, screening showed that attitudes were negatively skewed (highly positive attitudes), so an additional 58 subjects were tested in order to improve the quality of the data.

The responses were checked for irregularities and missing data. Four of the 308 collected questionnaires were deemed inadequate and permanently removed from the database because of insufficient data required to calculate the independent variables. During testing, many participants complained about the length and repetitiveness of the questionnaire. The section of the questionnaire measuring attitudes toward technology was repeated three times; one for each of the technologies. This resulted in each questionnaire item in those sections being repeated three times with only the name of the technology changed (e.g. *I find the Internet to be useful*, *I find ATMs to be useful*, and *I find using a mobile phone to take pictures to be useful*). Therefore, it was expected that some of the questionnaires would be incomplete. Additionally, this may have introduced error into the data because of fatigue of the participants. However, it was necessary to use this method in order to conduct a within subjects analysis.

One of the four rejected questionnaires contained neutral responses (3 on a 5-point Likert scale) starting at the 50th item (of 83). Another participant stopped

responding at the 54th item. One skipped a complete page and simply didn't respond to enough of the questionnaire items necessary for calculating the imprint indexes. The last rejected questionnaire contained responses that were inconsistent and clearly random. Overall, three of the rejected questionnaires did not contain sufficient responses to calculate the imprint index for at least one of the three technologies.

4.5 Variables

All the dependent and independent variables incorporated in the model are assumed to be continuous. They are all measured on scales with at least 5 possible responses, in which the differences between responses have implications to more than just ranking order. Intervals between two adjacent responses on the scale are equal, while intervals between every other response are their double. This can be treated as an interval scale and considered continuous (Miles and Shevlin, 2001).

The response and predictor variables in the experiment are based on the model's equations discussed previously and listed again below. The complete set of equations used in this experiment can be found in Appendix F. Frequency of use (FOU) is the main response variable. Perceived usefulness (PU), perceived ease of use (PEOU), and the imprint variable (I) are the main predictor variables. Additionally, subjective norm (SN) was included in a separate exploratory analysis as a predictor variable.

$$FOU = PU + PEOU + I \tag{4.3}$$

$$FOU = PU + PEOU + L + S \tag{4.4}$$

$$FOU = PU + PEOU + SN + I \text{ (exploratory)} \tag{4.5}$$

$$FOU = PU + PEOU + SN + L + S \text{ (exploratory)} \tag{4.6}$$

Where:

FOU is frequency of use of the system

PU is perceived usefulness

PEOU is perceived ease of use

I is imprint

L is likeability

S is attitude strength

SN is subjective norm

The main equation in the model, Equation 4.3, defines the relationship between FOU and the variables PU, PEOU, and I. This relationship determines whether or not I has an effect on FOU, which is the main hypothesis of the model. This relationship shows the effect of emotion on the use of technology, in addition to the cognitive variables PU and PEOU.

Two of the independent variables, the cognitive variables PU and PEOU, are adapted directly from the technology acceptance model (TAM) (Davis, 1989). Davis's original TAM was designed specifically to measure usage behavior in information systems (Davis et al., 1989). The original TAM questionnaire items can be customized to measure behavior toward any technology by changing the word or phrase in the questionnaire item to the desired attitude object. In this study, the Internet and automatic teller machines (ATMs) were chosen as the technologies toward which behavior is investigated. An additional exploratory technology, mobile phone imaging, was included. Data on general computer usage attitudes and behavior patterns were also collected to help detect any correlation between variables representing attitudes toward the different technologies. This will ultimately determine the generalizability of technology imprints.

The imprint index (I) is a measure of the degree to which a user exhibits imprinting characteristics. It is a continuous variable that compares users on an imprintability scale. Likeability (L) is the measure of whether the user likes or dislikes the technology. Attitude strength (S) measures how strongly the user dislikes the technology, if at all. The imprint index is determined by summing the scores of L and S, after correcting for polarity.

In the initial design of the experiment, screening was to be used to classify subjects into one of two groups: imprint and non-imprint. For inclusion in the imprint group, responses would have indicated that a negatively-biased association with technology exists. The responses from the questionnaire items relating L and S were to be used to make the distinction between the two types of subjects because they show the polarity and strength of the attitude.

Before computers were introduced, the number typically used to identify the most and least favorable questionnaire responses was 25% on either end of the distribution curve (Fishbein and Ajzen, 1975). In the pilot study (see Appendix A), only 8.7% of responses to "do you like the Internet?" were unfavorable (either *disagree* or *strongly disagree*). Based on these two points, the first requirement for inclusion in the imprint group was by responding to the L questionnaire items with higher or lower than *neutral,* based on the wording of the questionnaire items (i.e. *dislike* or *strongly dislike* the technology). This was to apply to L for all technologies ($L_{Internet}$, L_{ATM}, and L_{Phone}). There is a sufficient margin between the 25% traditionally used and the 8.7% found in the pilot study to make this judgment.

The same logic was to be used for the second screening requirement for inclusion in the imprint group; to score higher or lower than neutral (depending on how the question is phrased) on the attitude strength (S) questionnaire items. It should be noted that the questionnaire items measuring S are negatively phrased, whereas the items measuring L are positively phrased. Therefore, imprint candidates were expected to agree with S items and disagree with L items. Additionally, S items are strongly worded such that not all respondents who exhibit a dislike to the technology would have necessarily fallen in the imprint category. S values for all technologies were to be checked. This requirement addressed the constancy of the imprint, which cannot be detected using L alone. Participants with low L values (tending to dislike the technology) but low S values (not holding persistent attitudes) would not have been included in the non-imprint group.

After the data were collected, the group sizes were calculated in order to verify the suitability of this method. However, the number of participants in the imprint group was significantly less than expected, and less than that found in the pilot study. The reason for this discrepancy is not entirely understood. It is presumed that it is either a sampling error or a result of the specific technology (Internet) losing its novelty and becoming more of a mainstream commodity because of the elapsed time between the pilot study and the experiment. Or it could be a combination of both factors.

As a solution to this problem, it was decided to mathematically calculate an imprint index (I) based on L and S. This index does not make a cutoff point distinction between potentially imprinted and non-imprinted subjects. Instead, it expresses the level

of imprint-like characteristics exhibited by each subject. High scores on the scale represent a higher likelihood of being imprinted, and vice versa. A similar technique is often used in clinical psychology studies involving depression. In such studies, subjects do not necessarily fit depression criteria, but their responses are treated according to how much or how little they resemble those of patients diagnosed with depression. One such method is the Reynolds Adolescent Depression Scale (RADS), on which scores range from 30 to 120 with higher scores indicating higher levels of "depressive symptomatology" (Auger, 2004, p. 380).

To find this I value, L scores were inverted (1 became 5, 2 became 4, etc.) then added to S. The sum of those two values is I. A higher I value corresponds to the subject exhibiting higher levels of imprinting characteristics. This is based on the hypothesis that imprinting is a combination of low likeability and high attitude strength toward a certain technology.

4.6 Exploratory Variables

Similar to the technology acceptance model's claims that external characteristics of the system are mediated by PU and PEOU (Venkatesh and Davis, 2000), it is hypothesized in the technology imprint model that L and S are influenced by internal variables unique to the individual. Internal variables could be age, gender, locus of control, individual differences, education, cultural background, and so on. The effects of some internal variables on attitudes toward technology have been examined in previous research. A review of the literature revealed no specific defined set of internal variables commonly known to influence attitudes toward technology. However, some variables that have been investigated include gender and experience (Igbaria and Chakrabarti, 1990), external locus of control, age, and education (Igbaria and Parasuraman, 1989), and intuition-sensing (Parasuraman and Igbaria, 1990). Defining a complete set of internal variables is beyond the scope of this experiment, but effects of age, gender, and experience on I, L, and S were measured in an exploratory analysis.

Items measuring subjective norm (SN) were included in the questionnaire. The purpose for doing so is the inconclusiveness of previous studies in determining whether SN has an effect on technology acceptance. Since imprints are a different construct

altogether, it was important to measure the effect of SN rather than assume it to be insignificant. Additionally, it is possible that SN is more related to affective variables, which could explain why some versions of the strictly cognitive TAM rejected it (Davis et al., 1989). The SN questionnaire items were adapted from Venkatesh and Davis's (2000) revised technology acceptance model (TAM2). An exploratory analysis tested the effect of SN on FOU. The main and secondary exploratory equations below show the relationships to be examined.

$$FOU = PU + PEOU + SN + I \tag{4.7}$$

$$FOU = PU + PEOU + SN + L + S \tag{4.8}$$

Where:
FOU is frequency of use of the system
PU is perceived usefulness
PEOU is perceived ease of use
SN is subjective norm
I is imprint
L is likeability
S is attitude strength

In addition to measuring the effect of SN, other exploratory data included L and S for mobile phone imaging as well as general computer attitude questionnaire items. TAM studies investigating mobile phone acceptance were not found in the literature. Therefore, mobile phone imaging was used in this study to validate results of Internet and ATM imprinting. Data from this technology were also used in various correlation analyses investigating the generalizability of technology imprints.

4.7 Instruments

A questionnaire was used to collect data in the experiment (see Appendix E). The questionnaire, consisting mainly of 5-point Likert scale items, combines elements from the technology acceptance model (TAM) and other questionnaires, as well as items

developed specifically for this experiment, which were based on questionnaire design guidelines found in the literature (Bradburn et al., 2004; Leedy and Ormrod, 2005). Five-point, rather than 6-point, Likert scale items were used so that the participant could select a neutral response. In some cases, the user had little or no experience regarding the specific questionnaire item and needed a response to reflect that accurately. In other cases, the user was indifferent toward the questionnaire item. Since it was shown in previous studies that neutral non-attitudes do exist (Converse, 1964), it was important to have a neutral response option and an odd numbered Likert scale. The questionnaire measured attitudes toward both technologies under investigation by incorporating identical, repeated items targeting each of the technologies. No questionnaire items were repeated in order to minimize fatigue and consequently, error. This method of verifying response consistency could be used in future studies when only one technology is being investigated. The order of the attitude measurement questionnaire items was randomized.

According to Davis et al. (1989), frequency of use can be measured using two questionnaire items. The first is a 7-point scale inquiring about the frequency of the respondent's system usage with *infrequent* and *frequent* at the ends of the scale. The second item asks the respondent to check the box which most accurately represents their system usage, with *not at all*, *less than once a week*, *about once a week*, *2 or 3 times a week*, *4 to 6 times a week*, *about once a day*, and *more than once a day* as possible answers. When measuring ATM use, this item was modified by changing "week" to "month" and "day" to "week" since ATM use is not expected to be as frequent as Internet use. Davis et al. (1989) found significant correlation between frequency of use and behavioral intention (BI). They measured BI according to Ajzen and Fishbein's (1980) guidelines. Using this finding as justification, and because the technology imprint model investigates usage patterns rather than future usage, it was decided to use FOU instead of BI. The score of FOU was determined by summing the scores of the two items recommended by Davis et al. (1989).

Research has identified several indices of attitude strength. Among those commonly used in questionnaires measuring attitude strength are certainty, importance, and centrality (Holland et al., 2002). It is recommended to use a combination of these items to obtain the most accurate measure of attitude strength (Raden, 1985). Therefore,

some Likert scale items previously developed (Pomerantz et al., 1995) were customized to fit this experiment and used to measure S. In addition, a few items specifically developed for this experiment were included. The modified items are:

- *I can't imagine ever changing my mind about the technology.*
- *How likely are you to change your opinion about the technology?*
- *How certain are you about your attitude toward the technology?*
- *If I received information that is contrary to my opinions toward the technology, I would at all costs keep my opinions.*

The questionnaire also measures each of the variables perceived usefulness, perceived ease of use, and likeability. PU and PEOU are directly adapted from the TAM questionnaires, while L items were developed specifically for this experiment.

4.8 Procedures

Before any testing was conducted, a proposal was submitted to the Texas Tech University Protection of Human Subjects Committee. Research conducted at Texas Tech must be approved by, and comply with the regulations of the committee. According to the policies and procedures outlined by the committee, this experiment is categorized as *minimal risk* research (Raghavan and Solpietro, 2005). Consequently, participants were not required to sign a consent form.

Testing was started after the approval was granted. The experiment consisted of two phases: preparation and testing. In the preparation phase, the general research topic was explained to the participants through a brief introduction session. They were informed of the voluntary nature of the experiment and the confidentiality with which the responses would be treated. Any privacy concerns or questions from the participants were addressed. Additionally, the participants were asked to read a one page introduction (see Appendix D).

In the second phase of the experiment, participants were given the questionnaire to complete. The questionnaire consisted of 83 demographic and measurement items (see Appendix E).

4.9 Methodological Issues

Issues related to the study that were addressed are the reliability, validity, representativeness, bias, and generalizability of the data and results. In order for the research to produce accurate results, the data must be relevant to the problem and the phenomenon under investigation. Inaccurate data (regardless of the source of their inaccuracies) results in incorrect results that can be simply misleading, or in some cases, harmful (Goodman, 1996). In the sections below, these issues are discussed, as well as the measures that were taken to minimize the negative effects of compromised data.

4.9.1 Reliability

Reliability indicates that the data can be replicated using the same tools and the same population when retests are conducted. TAM questionnaire items have shown through repeated testing that they are reliable measures of PU and PEOU (Adams et al., 1992; Hendrickson et al., 1993). In addition, Cronbach's alpha, inter-item correlations, and split-half tests of PU and PEOU in the pilot study proved to be reliable.

After the data were collected, the reliability of L and S for the three technologies was tested using Cronbach's Alpha, which tests the extent to which a set of questionnaire items accurately measures the same variable (Hill and Lewicki, 2006). Results showed that L was a highly reliable measure for all three technologies, while S was less reliable (Table 4.2). Attitude strength indices are commonly used in different combinations, depending on the application (Pomerantz et al., 1995; Raden, 1985). The low reliability of S is likely a result of not selecting an ideal set of indices. It is believed that a better choice of indices to represent S would have resulted in higher reliability, possibly changing some of the outcomes of the data analysis discussed in the following chapters, particularly in regression analyses in which I was replaced with L and S. Additionally, higher reliability of S may have caused an increase the coefficient of correlation between S and I; a concern that is also discussed in the following chapters.

Table 4.2. Reliability analysis for L and S.

	Variable	Cronbach's Alpha
Internet	L	.826
	S	.082
ATM	L	.872
	S	.330
Phones	L	.786
	S	.371

4.9.2 Validity

Achieving an acceptable level of experimental validity is a task that requires plenty of attention and effort. In experiments involving psychological constructs, validity of the instruments is critical because of the difficulty in quantifying the constructs (Bonate, 2000). Previous researchers have found high levels of validity in TAM variables (Szajna, 1994). Additionally, the pilot study demonstrated high validity of the results obtained. There are many differences between the pilot study and the experiment, so the data were reexamined for validity.

Face validity represents the extent to which the experiment appears to measure what it is intended to measure. Content validity is the extent to which the experiment addresses all aspects of the actual phenomenon. Face validity was found to be high. Imprinting proved to have a negative effect on frequency of use in all three technologies. Results also indicated that most users find ATMs so easy to use, that their ease does not affect how often they are used. Content validity was acceptable since the experiment takes into account both cognitive and affective behavioral sides of interacting with technologies, and their effects, when combined in a linear regression model, were as expected.

4.9.3 Representativeness

Representativeness is the extent to which the data from the sample represent the population. In other words, it is how much different the data would be if the whole population was tested rather than sampled. Representative of this study was addressed by

including multiple sample groups with varying degrees of experience with the technologies examined. Texas Tech University students were tested, but the sample also included higher age groups subjects of both genders by targeting local community groups. The data collected at the store added to the representativeness of the sample by introducing a wide range of age groups, backgrounds, and technology experience to fill the void left by the other two groups.

4.9.4 Bias

As with any experiment, it was essential to eliminate or minimize any known biases that could occur when collecting the data. Selection bias may be of most concern due to the nature of this experiment. Attempts were made to include population groups traditionally believed to be less accepting of computers, and technology in general. This may appear to bias the results because the selected participants fall in a specific stereotyped group. However, this is not considered a selection bias that will introduce error and result in misleading results. The selection method was essential for the success of the experiment because the behavior under investigation is a predisposed dislike for technology. It is the properties of this specific segment of the whole population that are under investigation.

The purpose of the experiment was to determine whether individuals believed to be potentially imprinted have different behavioral patterns than those believed to be non-imprinted. Negative imprints are not believed to exist among every technology user. Therefore, it is not only acceptable, but also an inherent requirement of the experiment to screen and use such a narrowly defined sample in which negative technology imprints are expected to be found. In addition, if future researchers find ways with which to reduce the effects of negative technology imprints, it is this population specifically on which the methods or techniques will be applied. Therefore, it would be of limited value to study a sample that does not include users with negative opinions about technology.

Another important aspect considered was researcher bias, which occurs when the results of the experiment are biased toward the researcher's expected outcome. This was addressed by referring to expert opinion in the design process to confirm that the methods, tools, and analyses used are objective. Additionally, data analysis was only

conducted once all the data were collected in order to avoid influencing the researcher and causing unintentional changes that could bias the results.

4.9.5 Generalizability

Generalizability refers to the extent to which the results can be generalized in other similar areas. It is a very important characteristic of this study since one of the main assumptions is that TIM results can be generalized among technologies. For this reason, the same questionnaire was repeated for three different technologies and the results were checked for correlation between all three sets of responses. The results were found to be very similar, indicating that this method has high levels of generalizability. In addition, a large sample size was chosen to improve generalizability over the entire population.

CHAPTER 5
RESULTS AND ANALYSIS

5.1 Treatment of Data

The first task performed after entering the data into a spreadsheet was arranging the responses in the correct order. Next, the polarity of questionnaire items was corrected such that all items relating to one variable had the same polarity. Afterwards, average scores were calculated for each of the variables measured in the questionnaires. Likert scale items were scored and averaged as they were answered. For example, on 5-point scales, strongly disagree was assigned a score of 1, while strongly agree was assigned 5. The imprint index (I) for each subject, for each technology, was calculated.

The data were checked for normality. Internet frequency of use (FOU) was found to be negatively skewed, while mobile phone FOU was positively skewed. ATM FOU was slightly positively skewed. Generalized linear model (GLZ) analysis techniques were considered because they do not rely on the assumption of normal distributions (McCullagh and Nelder, 1983). GLZ treats dependent variables as categorical factors rather than continuous scales. In this study, the dependent variable (FOU) is continuous, and treating it as categorical has implications that may affect the interpretation of the results. After an extensive investigation of GLZ, it was decided to use linear regression instead in order to maintain parsimony, statistical power, and representativeness to the experiment at hand. Additionally, the assumption of normality is of little importance when large sample sizes are used, as indicated by the central limit theorem (McCullagh and Nelder, 1983; Miles and Shevlin, 2001). The theorem maintains that as the sample size increases, the data approach a normal distribution. The only requirement is that the variance must be finite (Bethea et al., 1975). This is a requirement fulfilled by the data in this experiment. Berk (2004) states that the central limit theorem justifies sidestepping the assumption of normality when statistics are computed from a sample, even in some cases where the sample size is as small as 30.

The Box-Cox method is used to address normality concerns of the dependent variable and improve homoscedasticity (the constancy of variance around the regression line for all values of the independent variables) (Box and Cox, 1964). An optimal

transformation parameter is used to approximately normalize the data (NIST/SEMATECH, 2006). The transformation is defined by Box and Cox (1964) as:

$$T(Y) = \frac{Y^{\lambda} - 1}{\lambda} \qquad 5.1$$

Where:

Y is the response variable to be transformed.

λ is the optimal power transformation parameter that maximizes a likelihood function and minimizes the residual sum of squares (Berk, 2004).

Since linear transformations do not affect analysis of variance, Box and Cox (1964) recommend reducing Equation 5.1 to:

$$T(Y) = Y^{\lambda} \qquad 5.2$$

The values of λ were determined to be 2.9 for Internet, 0.5 for ATM, and 0 for phone, which is substituted with a log transformation (Box and Cox, 1964). The transformations largely improved the skewness of Internet FOU and mobile phone FOU as can be seen in Table 5.1. Absolute skewness levels after transformation are below 1 for all three variables, which is an acceptable level according to Miles and Shevlin (2001). Skewness of Internet FOU, while close to 1, is acceptable. According to Miles and Shevlin (2001), even skewness values between 1 and 2 are acceptable, while those higher than 2 are a cause of concern. Transformation increased the absolute skewness of ATM FOU, but was still performed because of other benefits it provided that are discussed further in the chapter.

Table 5.1. Skewness before and after Box-Cox transformation.

	Skewness	
	Statistic	Std. Error
Internet FOU	-1.964	.140
Internet FOU (transformed)	-.969	.140
ATM FOU	.138	.140
ATM FOU (transformed)	-.228	.140
Phone FOU	.785	.140
Phone FOU (transformed)	.103	.140

Table 5.1 shows that for Internet FOU, skewness is greater than twice the standard error. This generally means that the skew is significantly different than what would be expected if the data were normal. However, Miles and Shevlin (2001) warn against giving that rule of thumb much importance, and go as far as to say that doing so would create a problem. The justification they provide is that it is not the significance that matters, rather the level of skewness itself. And according to their recommendations, that level in this case (0.967) is acceptable. P-P and Q-Q plots also showed significant improvements as a result of the transformations (Figures 5.1 to 5.6).

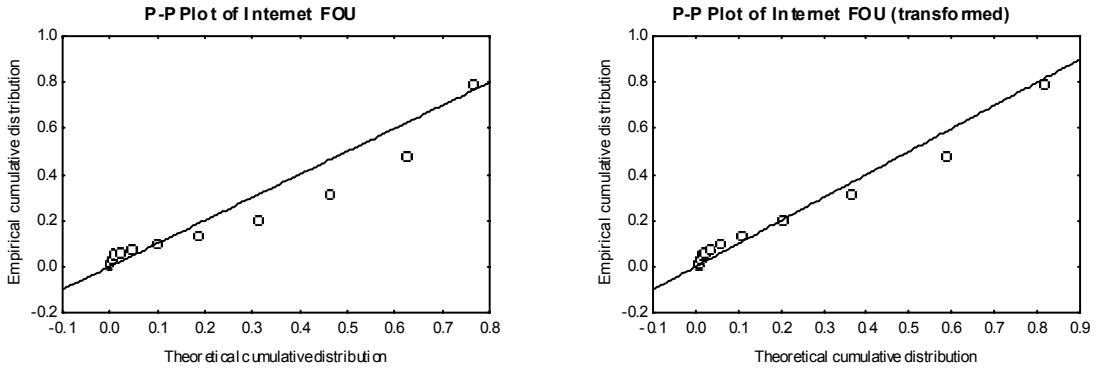

Figure 5.1. P-P plot of Internet FOU before (left) and after (right) Box-Cox transformation.

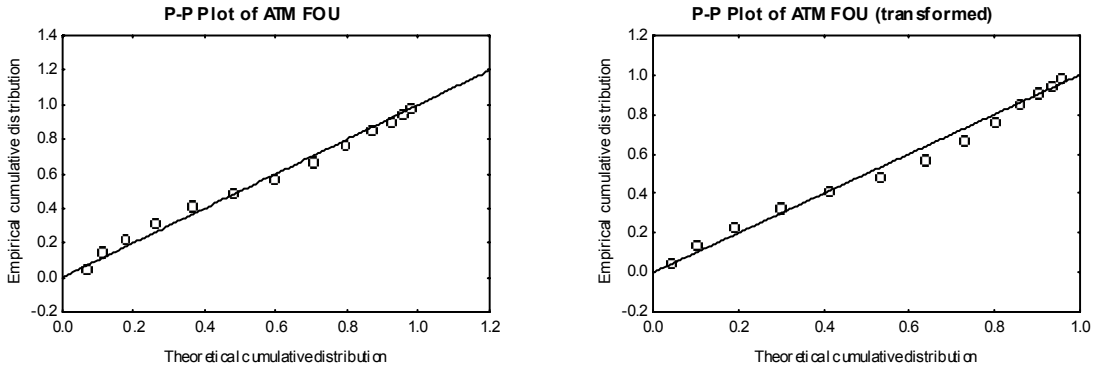

Figure 5.2. P-P plot of ATM FOU before (left) and after (right) Box-Cox transformation.

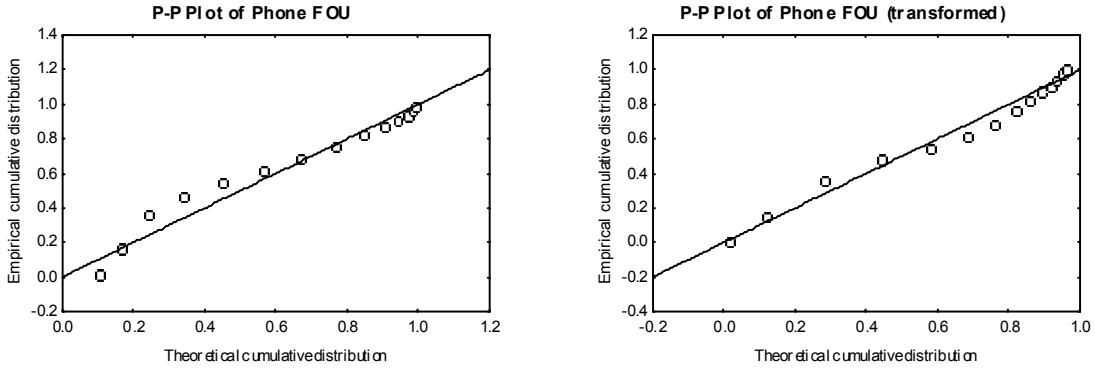

Figure 5.3. P-P plot of mobile phone FOU before (left) and after (right) Box-Cox transformation.

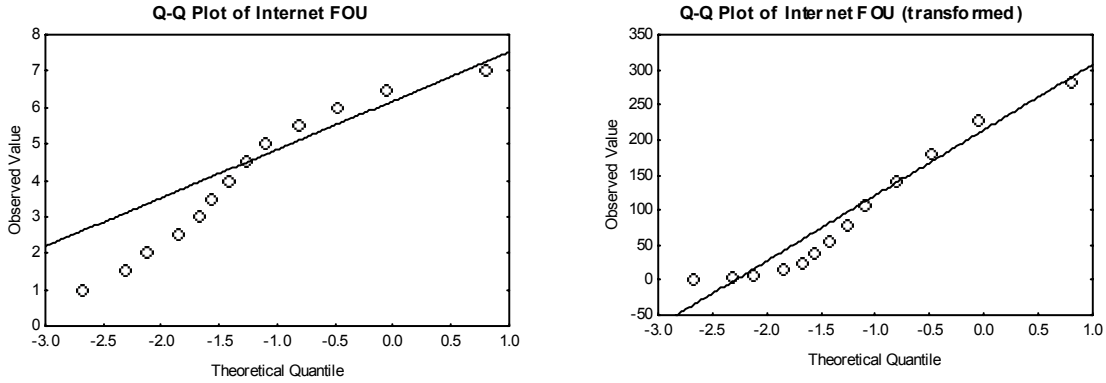

Figure 5.4. Q-Q plot of Internet FOU before (left) and after (right) Box-Cox transformation.

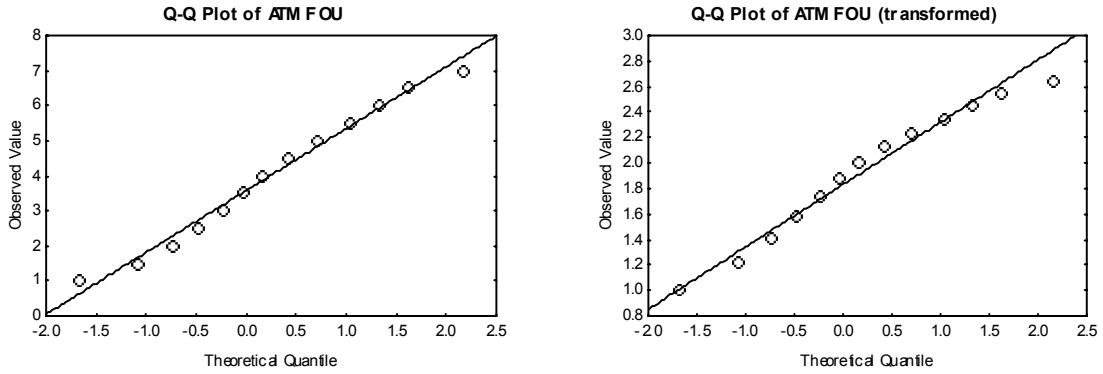

Figure 5.5. Q-Q plot of ATM FOU before (left) and after (right) Box-Cox transformation.

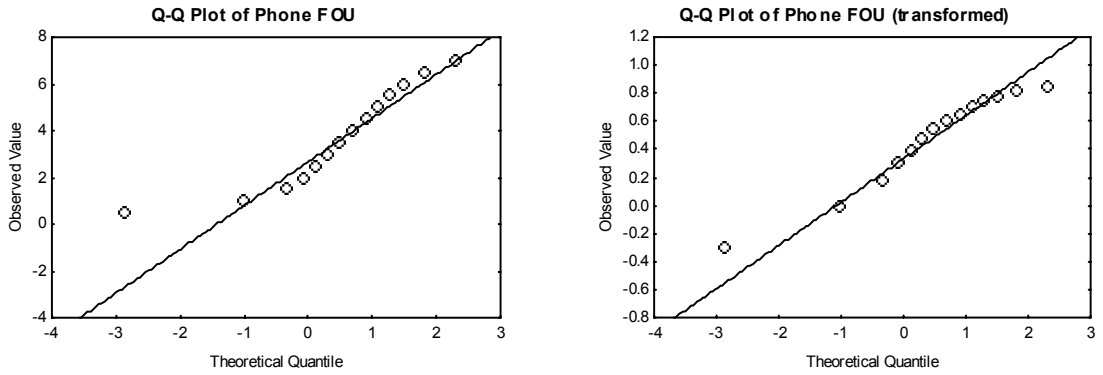

Figure 5.6. Q-Q plot of mobile phone FOU before (left) and after (right) Box-Cox transformation.

The data were checked for high multicollinearity. No significant correlation coefficients were found between perceived usefulness (PU), perceived ease of use (PEOU), and imprint index (I) for any of the three technologies. All absolute coefficients were below 0.8; the value at which multicollinearity issues become a concern (Kahane, 2001). Additionally, multicollinearity analyses revealed that all variables had relatively high tolerance and low variance inflation factors (VIFs), confirming that there are no multicollinearity concerns (Miles and Shevlin, 2001). These values are show in Tables 5.2 to 5.4.

Table 5.2. Collinearity statistics for the transformed dependent variable Internet FOU.

Model		Collinearity Statistics	
		Tolerance	VIF
1	Int PU	.564	1.773
	Int PEOU	.672	1.489
	Int I	.742	1.348

Table 5.3. Collinearity statistics for the transformed dependent variable ATM FOU.

Model		Collinearity Statistics	
		Tolerance	VIF
1	ATM PU	.378	2.643
	ATM PEOU	.718	1.393
	ATM I	.367	2.724

Table 5.4. Collinearity statistics for the transformed dependent variable mobile phone FOU.

Model		Collinearity Statistics	
		Tolerance	VIF
1	Ph PU	.516	1.939
	Ph PEOU	.764	1.309
	Ph I	.503	1.990

5.2 Statistical Analysis

Using multiple regression, the relationships between the independent variables PU, PEOU, and I and the dependent variable FOU were examined for the three technologies. The first hypothesis suggests that a negative relationship exists between I and FOU. The second and third hypotheses suggest that positive relationships exist between both PU and PEOU and FOU. These two hypotheses are a replication of the technology acceptance model and are employed to add strength to the experiment. The results of the regression analysis, combined with p-values, determined whether the first three null hypotheses were rejected. For example, in the first hypothesis, evidence of a significant effect of I on FOU compounded with a negative β_1 (I coefficient) were needed.

A correlation analysis was performed to check correlation between S and L. Finding significant negative correlation allows the rejection of the sixth null hypothesis of the model.

Regression analysis was conducted to measure the effects of the internal variables age, gender, and experience on the affective variables L, S, and I. The internal variables were considered independent, while L, S, and I were the dependent variables. Significance and directional effects were examined.

A correlation analysis was conducted to examine generalizability of the theory among technologies. This involved measuring correlation between the same variable for each of the technologies (e.g. $FOU_{Internet}$, FOU_{ATM} and $FOU_{Imaging}$ and so on for PU, PEOU, L, S, and I). This was used to determine if negative technology imprints are generalizable. If imprints are universal among technologies, as is hypothesized in the model, correlation should be found between the corresponding variables. The results of these analyses are presented and discussed below.

5.3 Experimental Results

After the data were collected, the polarity of the responses was adjusted and the score for each of the variables was aggregated into an average of all items relating to it. The data were then checked for normality by conducting a test of normality and visually inspecting histograms, P-P plots, and Q-Q plots. Based on the findings, it was decided to use linear regression to develop the model defining the relationship between the dependent variable frequency of use (FOU) and the independent variables perceived usefulness (PU), perceived ease of use (PEOU), and the imprint index (I).

As discussed in the previous chapter, I was calculated as the summation of attitude strength (S) and the inverted values of likeability (L). One concern when using this method was that one I value could result from several combinations of L and S responses. For example, one subject scoring L = 1 and S = 3 would yield the same I as another subject scoring L = 3 and S = 5. In order to address this issue, data were sorted by I scores and L and S values examined. It was found that the lowest L scores generally appeared first on the list, while the bottom of the list contained higher L scores. Similarly, high S scores were higher on the list. The relationships are demonstrated in Tables 5.5,

5.6, and 5.7. This supports the hypothesis that imprinting results from low L and high S scores. Although an argument could be made for the need for weighting the variables L and S when calculating I, it was decided not to weight them and to assume they have equal contributions to I. This was done for two reasons; 1) there was no justifiable reason to believe that one had a stronger effect than the other at the time the experiment was conducted, and 2) no previous research was found that suggests that attitude polarity is more important than attitude strength, or vice versa.

Table 5.5. Average values of L and S for the four quartiles of I in the Internet model.

	Q1	**Q2**	**Q3**	**Q4**
Average L	4.97	4.90	4.67	3.65
Average S	2.58	2.97	3.09	3.05

Table 5.6. Average values of L and S for the four quartiles of I in the ATM model.

	Q1	**Q2**	**Q3**	**Q4**
Average L	4.70	3.89	3.11	1.83
Average S	2.88	3.06	3.13	3.62

Table 5.7. Average values of L and S for the four quartiles of I in the mobile phone model.

	Q1	**Q2**	**Q3**	**Q4**
Average L	4.39	3.45	2.59	1.65
Average S	2.88	3.09	3.17	3.67

Additionally, correlation analyses were conducted to examine the relationship between I and L and S. This was also found to support the method with which I was calculated. In the case of the Internet, for example, I was found to be strongly negatively correlated with L (r = -0.86) and positively correlated with S (r = 0.42). Stronger correlations were found for ATM (L, r = -0.94 and S, r = 0.64) and mobile phones (L, r = -0.93 and S, r = 0.61). These correlation coefficients show that there was higher correlation between I and L than I and S. This implies that of the two variables, the

evaluative variable L is better at predicting I, supporting the argument that I is an affectively-based variable. However, this could be partly attributed to the low reliability of S. Figures 5.7 to 5.12 demonstrate these relationships.

While examining these correlations, two cases were found to be outliers. After further investigation and checking standardized scores, the same two cases were also found to have z-scores of greater than three standard deviations. As a result, they were removed from the database, bringing the total number of valid cases to 302.

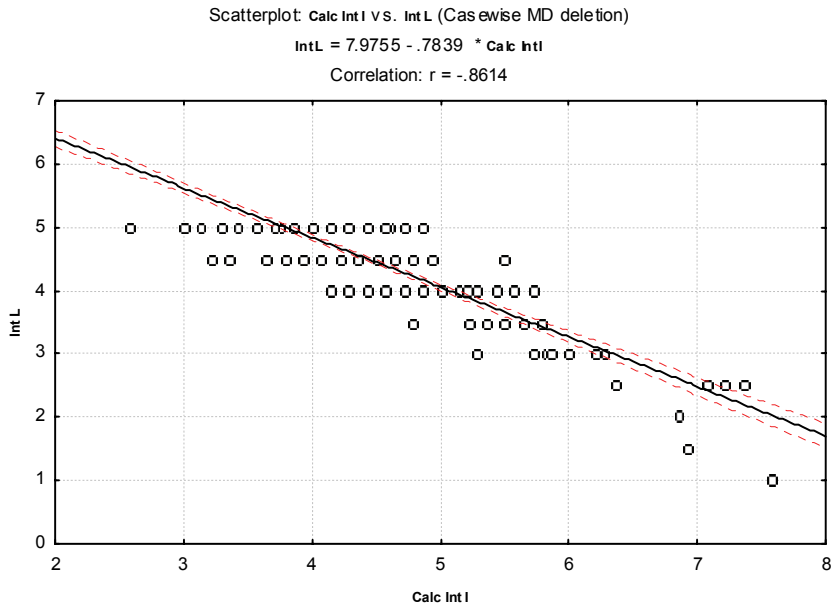

Figure 5.7. Correlation between Internet I and Internet L.

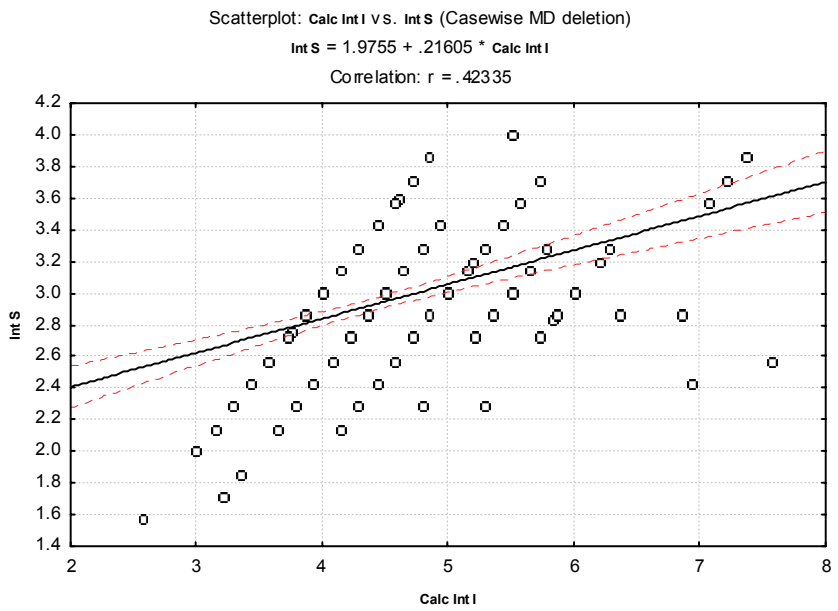

Figure 5.8. Correlation between Internet I and Internet S.

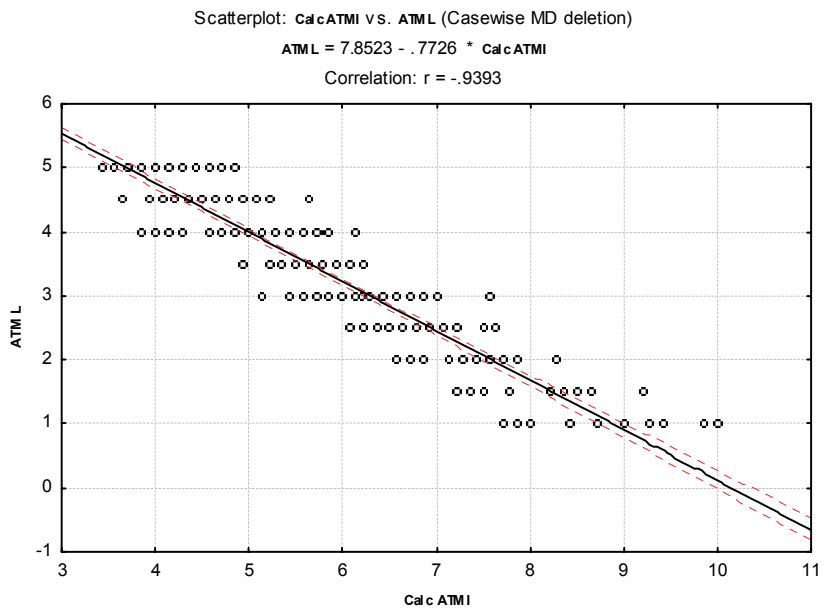

Figure 5.9. Correlation between ATM I and ATM L.

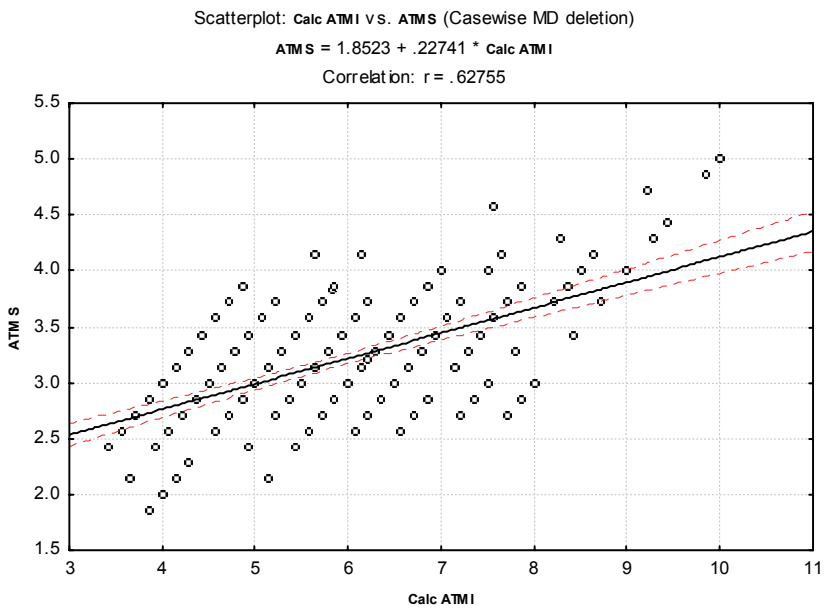

Figure 5.10. Correlation between ATM I and ATM S.

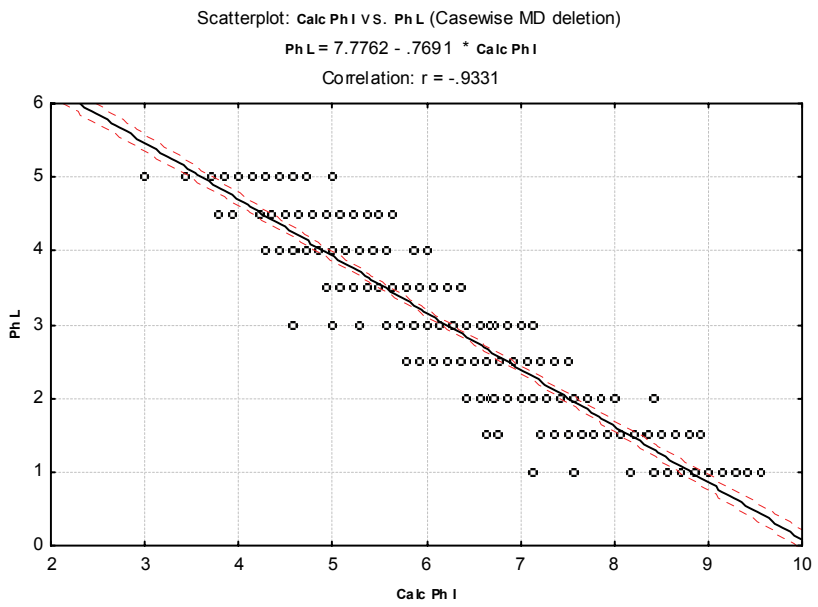

Figure 5.11. Correlation between phone I and phone L.

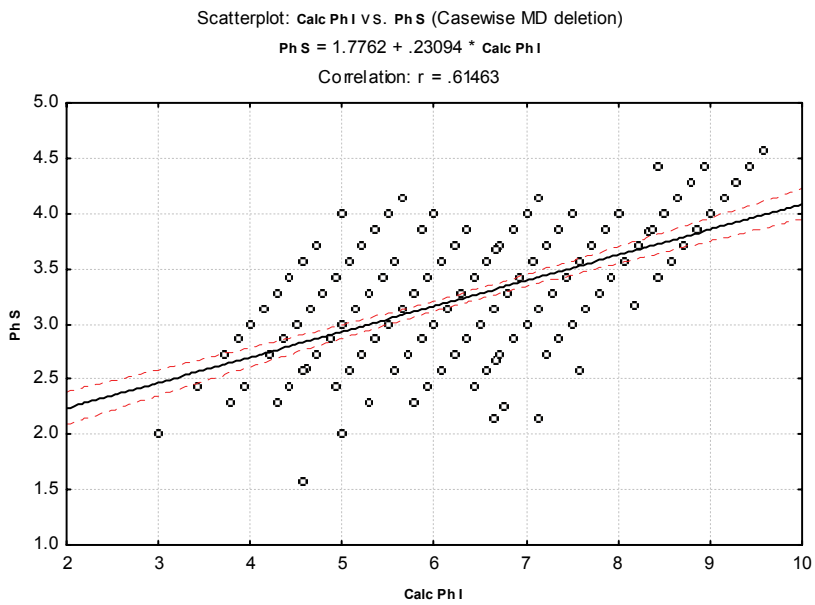

Figure 5.12. Correlation between phone I and phone S.

Linear regression analysis was conducted for each of the three technologies in the form of Equation 5.3. The results are reported in Tables 5.8 and 5.9 below.

$$T(FOU) = \beta_o + \beta_1 PU + \beta_2 PEOU + \beta_3 I + \varepsilon \qquad 5.3$$

Where:

T(FOU) is the Box-Cox transformed frequency of use

PU is perceived usefulness

PEOU is perceived ease of use

I is imprint index

β_o-β_3 are the regression parameter estimates

ε is the error term

Table 5.8. Regression parameter estimates.

	IV	Standardized β	t	p
Internet	PU	.196	3.115	<.01
	PEOU	.374	6.475	<.01
	I	-.128	-2.335	.020
ATM	PU	.393	5.079	<.01
	PEOU	.021	.374	.708
	I	-.196	-2.495	.013
Phone	PU	.192	3.165	<.01
	PEOU	.338	6.780	<.01
	I	-.280	-4.558	<.01

Table 5.9. Regression summaries and variances.

	R^2	Adjusted R^2	Std. error of the est.	F	p
Internet	.336	.329	67.465	50.045	<.01
ATM	.326	.320	.392	47.973	<.01
Phone	.446	.441	.214	78.220	<.01

In another analysis, I was replaced with L and S to test the fourth and fifth hypotheses of the study. The results are shown in Table 5.10 and Table 5.11. S showed no significance in the Internet and mobile phone models, which may be attributable to its lack of reliability as mentioned in the previous chapter.

Table 5.10. Regression parameter estimates for the model

$T(FOU) = \beta_o + \beta_1 PU + \beta_2 PEOU + \beta_4 L + \beta_5 S + \varepsilon$.

	IV	Standardized β	t	p
Internet	PU	.178	2.768	<.01
	PEOU	.336	5.307	<.01
	L	.171	2.715	<.01
	S	-.007	-.141	.888
ATM	PU	.442	5.481	<.01
	PEOU	.053	.907	.365
	L	.044	.511	.609
	S	-.157	-3.079	<.01
Phone	PU	.162	2.642	<.01
	PEOU	.286	5.411	<.01
	L	.351	5.248	<.01
	S	.003	.067	.946

Table 5.11. Summaries and variances for the model

$T(FOU) = \beta_o + \beta_1 PU + \beta_2 PEOU + \beta_4 L + \beta_5 S + \varepsilon$.

	R^2	Adjusted R^2	Std. error of the est.	F	p
Internet	.340	.331	67.352	38.159	<.01
ATM	.336	.327	.389	37.396	<.01
Phone	.460	.453	.212	61.768	<.01

Correlations between L and S for each technology were checked. In the Internet model, the two variables were not correlated, $r(300) = .096$, $p = .097$. In the ATM and mobile phones, the two variables were negatively correlated, $r(300) = -.342$, $p < .01$ and $r(300) = -.290$, $p < .01$, respectively. These correlation coefficients are at acceptable levels for studies involving socio-psychological measures. Cohen (1988) suggested that *r* values of .1 are small, .3 are moderate, and .5 are large, yet warned against strictly adhering to these guidelines. Instead, it was recommended to let the specific conditions and characteristics of the experiment determine the acceptable levels of *r*.

Exploratory analyses were also conducted. In these tests, subjective norm (SN) was included. Results of the regression are shown in Tables 5.12 to 5.15.

Table 5.12. Exploratory regression parameter estimates for the model $T(FOU) = \beta_o + \beta_1 PU + \beta_2 PEOU + \beta_3 I + \beta_6 SN + \varepsilon$.

	IV	**Standardized β**	**t**	**p**
Internet	PU	.191	2.951	<.01
	PEOU	.373	6.449	<.01
	I	-.126	-2.266	.024
	SN	.020	.395	.693
ATM	PU	.366	4.270	<.01
	PEOU	.023	.394	.694
	I	-.195	-2.456	.015
	SN	.045	.722	.471
Phone	PU	.153	2.242	.026
	PEOU	.338	6.756	<.01
	I	-.290	-4.733	<.01
	SN	.058	1.070	.286

Table 5.13. Exploratory summaries and variances for the model $T(FOU) = \beta_o + \beta_1 PU + \beta_2 PEOU + \beta_3 I + \beta_6 SN + \varepsilon$.

	R^2	**Adjusted R^2**	**Std. error of the est.**	**F**	**p**
Internet	.336	.327	67.561	37.466	<.01
ATM	.329	.320	.393	35.988	<.01
Phone	.453	.446	.213	59.685	<.01

Table 5.14. Exploratory regression parameter estimates for the model

$T(FOU) = \beta_o + \beta_1 PU + \beta_2 PEOU + \beta_4 L + \beta_5 S + \beta_6 SN + \varepsilon$.

	IV	Standardized β	t	p
Internet	PU	.178	2.722	<.01
	PEOU	.336	5.281	<.01
	L	.171	2.611	<.01
	S	-.007	-.141	.888
	SN	.001	.016	.987
ATM	PU	.418	4.691	<.01
	PEOU	.053	.903	.367
	L	.044	.513	.609
	S	-.156	-3.043	<.01
	SN	.040	.649	.517
Phone	PU	.130	1.915	.056
	PEOU	.282	5.295	<.01
	L	.365	5.456	<.01
	S	.003	.059	.953
	SN	.042	.777	.438

Table 5.15. Exploratory summaries and variances for the model

$T(FOU) = \beta_o + \beta_1 PU + \beta_2 PEOU + \beta_4 L + \beta_5 S + \beta_6 SN + \varepsilon$.

	R^2	Adjusted R^2	Std. error of the est.	F	p
Internet	.340	.329	67.466	30.424	<.01
ATM	.338	.327	.391	29.903	<.01
Phone	.468	.459	.210	50.491	<.01

Correlations between age, gender, and experience and L, S, and I were examined. The results are reported in Tables 5.16 to 5.18 below.

Table 5.16. Correlation between age, gender, and experience and L, S, and I for the Internet.

	Internet L		Internet S		Internet I	
	r	**p**	**r**	**p**	**r**	**p**
Age	-.0443	.443	-.0051	.929	.0377	.514
Gender	.0339	.557	-.1315	.022	-.0980	.089
Int. Experience	-.0397	.492	-.0077	.894	.0322	.578

Table 5.17. Correlation between age, gender, and experience and L, S, and I for ATMs.

	ATM L		ATM S		ATM I	
	r	**p**	**r**	**p**	**r**	**p**
Age	.0426	.461	.0404	.485	-.0204	.724
Gender	.0173	.765	-.0428	.460	-.0295	.610
ATM Experience	.3393	<.01	-.1193	.039	-.3207	<.01

Table 5.18. Correlation between age, gender, and experience and L, S, and I for mobile phones.

	Phone L		Phone S		Phone I	
	r	**p**	**r**	**p**	**r**	**p**
Age	-.3035	<.01	.000	1.000	.2501	<.01
Gender	-.0029	.960	-.0938	.104	-.0328	.570
Phone Experience	.0692	.230	-.0843	.144	-.0887	.124

Regression analyses were also conducted using age, gender and experience as the predictor variables and L, S, and I as the response variables for each technology. R^2 values for all three models were very low and no statistical significance was found, with few exceptions. In the Internet model, gender significantly predicted Internet S, $\beta = -.139$, $p = .02$, indicating that males had stronger attitudes toward the Internet. Experience significantly predicted ATM L, $\beta = .347$, $p < .01$, ATM S, $\beta = -.118$, $p = .042$, and ATM I, $\beta = -.327$, $p < .01$. Age significantly predicted phone L, $\beta = -.316$, $p < .01$, and phone I, $\beta = .266$, $p < .01$.

Correlation between the perceived importance of a technology and the value of the imprint index toward it was examined. High negative correlation was found for all three technologies as follows: Internet, $r(290) = -.596$, $p < .01$, ATMs, $r(290) = -.699$, $p < .01$, and mobile phones, $r(290) = -.563$, $p < .01$.

In order to test the generalizability of imprints across the three technologies, each dependent and independent variable was tested for correlation with the same variable in the other technologies (e.g. correlation between $FOU_{Internet}$, FOU_{ATM}, FOU_{Phone}, etc.). The results are reported in the Tables 5.19 to 5.24.

Table 5.19. Correlation between computer FOU, Internet FOU, ATM FOU, and phone FOU.

		Computer FOU	Internet FOU	ATM FOU	Phone FOU
Computer FOU	Pearson Correlation	1	.873**	.091	.040
	Sig. (2-tailed)	.	.000	.116	.486
Internet FOU	Pearson Correlation	.873**	1	.079	.101
	Sig. (2-tailed)	.000	.	.173	.080
ATM FOU	Pearson Correlation	.091	.079	1	.319**
	Sig. (2-tailed)	.116	.173	.	.000
Phone FOU	Pearson Correlation	.040	.101	.319**	1
	Sig. (2-tailed)	.486	.080	.000	.

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5.20 Correlation between Internet PU, ATM PU, and phone PU.

		Internet PU	ATM PU	Phone PU
Internet PU	Pearson Correlation	1	.183**	.016
	Sig. (2-tailed)	.	.001	.781
ATM PU	Pearson Correlation	.183**	1	.285**
	Sig. (2-tailed)	.001	.	.000
Phone PU	Pearson Correlation	.016	.285**	1
	Sig. (2-tailed)	.781	.000	.

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5.21. Correlation between Internet PEOU, ATM PEOU, and phone PEOU.

		Internet PEOU	ATM PEOU	Phone PEOU
Internet PEOU	Pearson Correlation	1	.274**	.371**
	Sig. (2-tailed)	.	.000	.000
ATM PEOU	Pearson Correlation	.274**	1	.374**
	Sig. (2-tailed)	.000	.	.000
Phone PEOU	Pearson Correlation	.371**	.374**	1
	Sig. (2-tailed)	.000	.000	.

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5.22. Correlation between Internet L, ATM L, and phone L.

		Internet L	ATM L	Phone L
Internet L	Pearson Correlation	1	.149**	.211**
	Sig. (2-tailed)	.	.009	.000
ATM L	Pearson Correlation	.149**	1	.147*
	Sig. (2-tailed)	.009	.	.011
Phone L	Pearson Correlation	.211**	.147*	1
	Sig. (2-tailed)	.000	.011	.

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5.23. Correlation between Internet S, ATM S, and phone S.

		Internet S	ATM S	Phone S
Internet S	Pearson Correlation	1	.324**	.174**
	Sig. (2-tailed)	.	.000	.002
ATM S	Pearson Correlation	.324**	1	.237**
	Sig. (2-tailed)	.000	.	.000
Phone S	Pearson Correlation	.174**	.237**	1
	Sig. (2-tailed)	.002	.000	.

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5.24. Correlation between Internet I, ATM I, and phone I.

		Internet I	ATM I	Phone I
Internet I	Pearson Correlation	1	.118*	.159**
	Sig. (2-tailed)	.	.040	.006
ATM I	Pearson Correlation	.118*	1	.141*
	Sig. (2-tailed)	.040	.	.014
Phone I	Pearson Correlation	.159**	.141*	1
	Sig. (2-tailed)	.006	.014	.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

As can be seen in the tables, a considerable number of correlations exists between the variables in many cases. PEOU, L, S, and I all show significant (although weak) correlations between the corresponding variables for the three technologies.

The proportion of variation explained by the regression models for Internet, ATMs, and phones were 33.6%, 32.6%, and 44.6%, with adjusted R^2 of .329, .320, and .441, respectively. When I was replaced with L and S, the models were able to explain a slightly larger proportion of variation (adjusted R^2 values of .331, .327, and .453, respectively).

In all three regression models (Internet, ATMs, and phones), imprint index, the only emotional factor, had a statistically significant relationship with FOU. The regression coefficients for I in the three models were negative. The combination of these two findings allows the rejection of the first null hypothesis of the study, H_{o1} in all three models.

The null hypothesis H_{o2} was also rejected in all three models as the parameter estimate for PU was positive with a p value less than .01. The third null hypothesis, H_{o3}, was rejected in the Internet and mobile phone models as no significant effect was found for PEOU in the ATM model.

The fourth null hypothesis, H_{o4}, was rejected in the Internet and mobile phone models, while H_{o5}, was only rejected in the ATM model. L coefficients significantly predicted FOU in only the Internet and phone models, $\beta = -.171$, $p < .01$, and $\beta = -.351$, $p < .01$, respectively. S was only able to statistically predict FOU in the ATM model, $\beta = -$

.157, $p < .01$. In all cases where L and S showed statistical significance in predicting FOU, their respective directional effects were as hypothesized.

The final null hypothesis, H_{o6}, was rejected in the ATM and mobile phone models, where L and S were significantly negatively correlated as hypothesized. In the Internet model, no significant correlation was found. The hypotheses are summarized in Table 5.25.

Table 5.25. Summary of hypotheses and findings. The result (1, 2, or 3) represents the number of models (Internet, ATM, and mobile phone) in which the hypothesis was rejected.

	Null hypothesis	**Result**
$\mathbf{H_{o1}}$	Imprint (I) has a positive or no effect on frequency of use (FOU).	3
$\mathbf{H_{o2}}$	Perceived usefulness (PU) has no effect on frequency of use (FOU).	3
$\mathbf{H_{o3}}$	Perceived ease of use (PEOU) has no effect on frequency of use (FOU).	2
$\mathbf{H_{o4}}$	Likeability (L) has no effect on frequency of use (FOU).	2
$\mathbf{H_{o5}}$	Attitude strength (S) has no effect on frequency of use (FOU).	1
$\mathbf{H_{o6}}$	Attitude strength (S) is positively correlated, or not correlated at all, with likeability (L).	2

Distribution of the residuals showed slight skewness from normality in the Internet and phone models, which can be expected because of the negative skewness of the observed data. Figures 5.13 to 5.15 show the residual distributions.

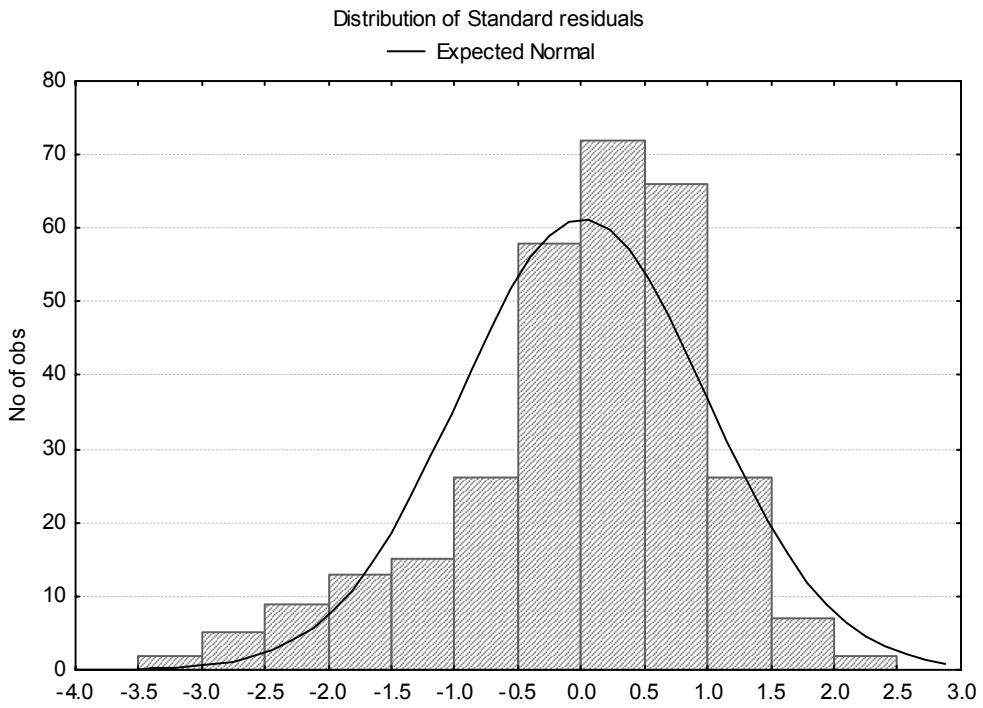

Figure 5.13. Distribution of standardized residuals for the Internet model.

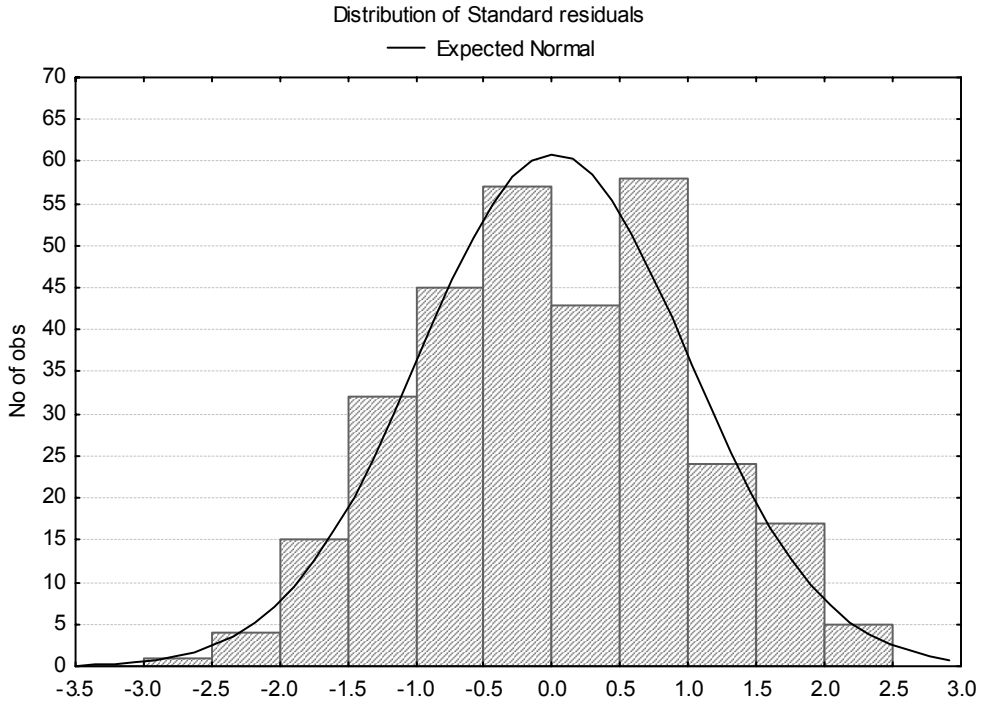

Figure 5.14. Distribution of standardized residuals for the ATM model.

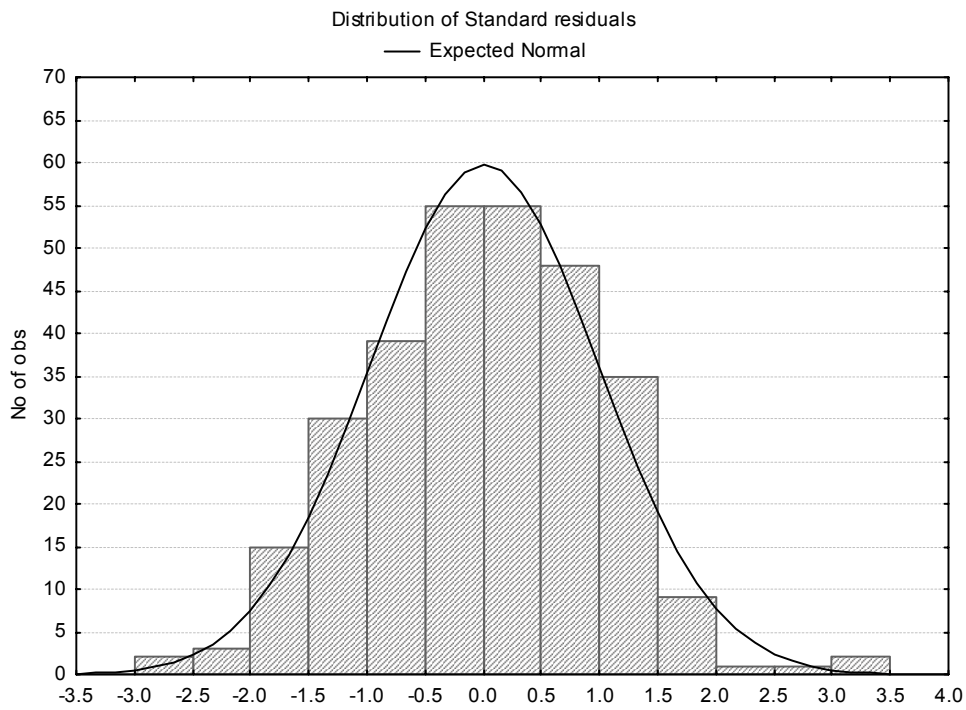

Figure 5.15. Distribution of standardized residuals for the mobile phone model.

Additionally, probability plots showed acceptable distributions as shown in Figures 5.16 to 5.18.

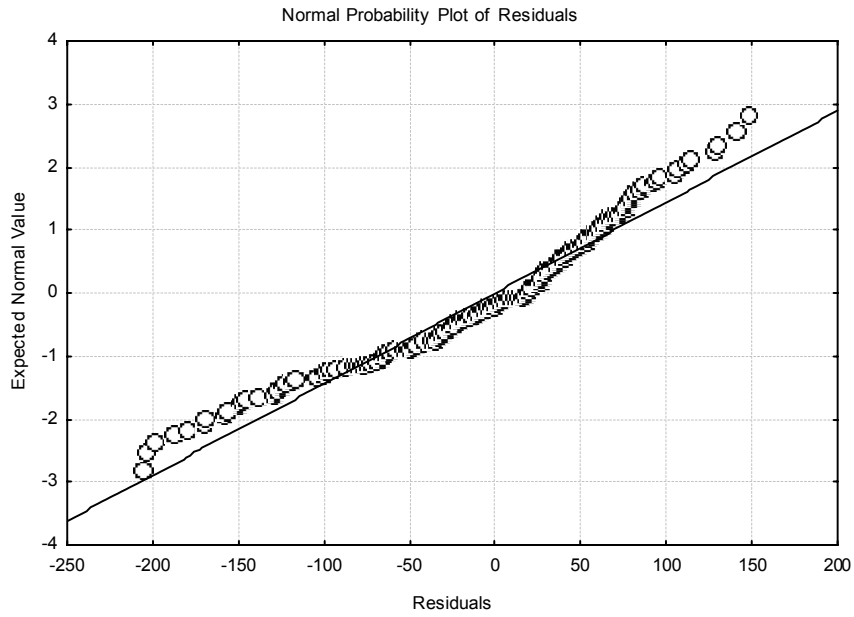

Figure 5.16. P-P plot of residuals for Internet model.

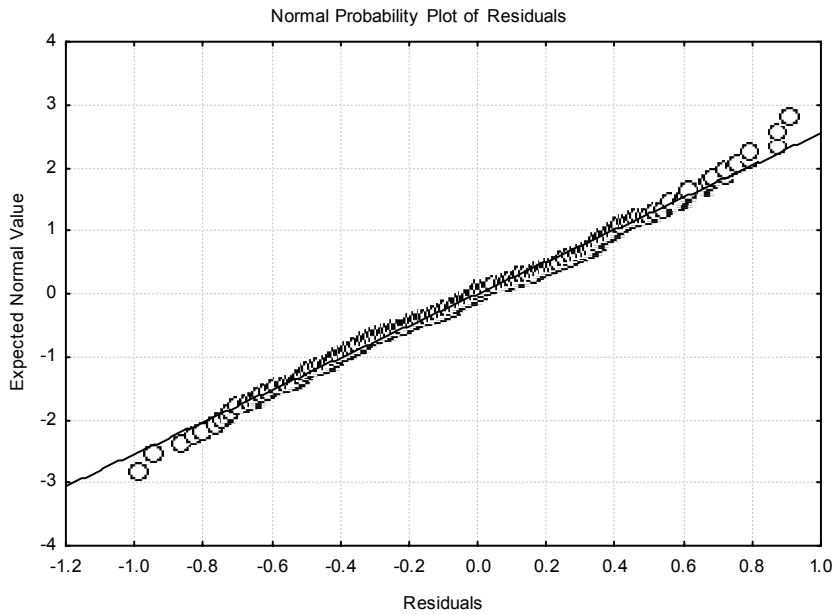

Figure 5.17. P-P plot of residuals for ATM model.

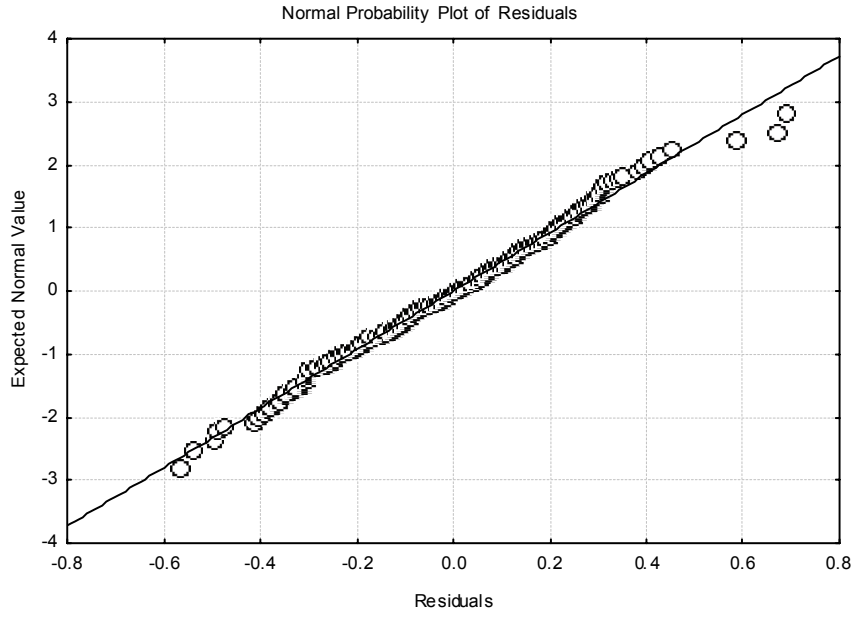

Figure 5.18. P-P plot of residuals for mobile phone model.

Distributions of the predicted values versus residuals for the Internet model are shown in Figures 5.19 to 5.21. The larger number of cases on the positive end of the x-

axis is due to the considerably larger amount of raw data available in that section. Because of the better distribution of the data in the ATM and mobile phone models, their scatterplots show a more random distribution. It is important to note that the data appear to be distributed in diagonal lines on the charts, which is due to the relatively small number of levels on the FOU scale. Although it is a continuous scale, there are only 13 possible responses (1, 1.5, 2, …, 7).

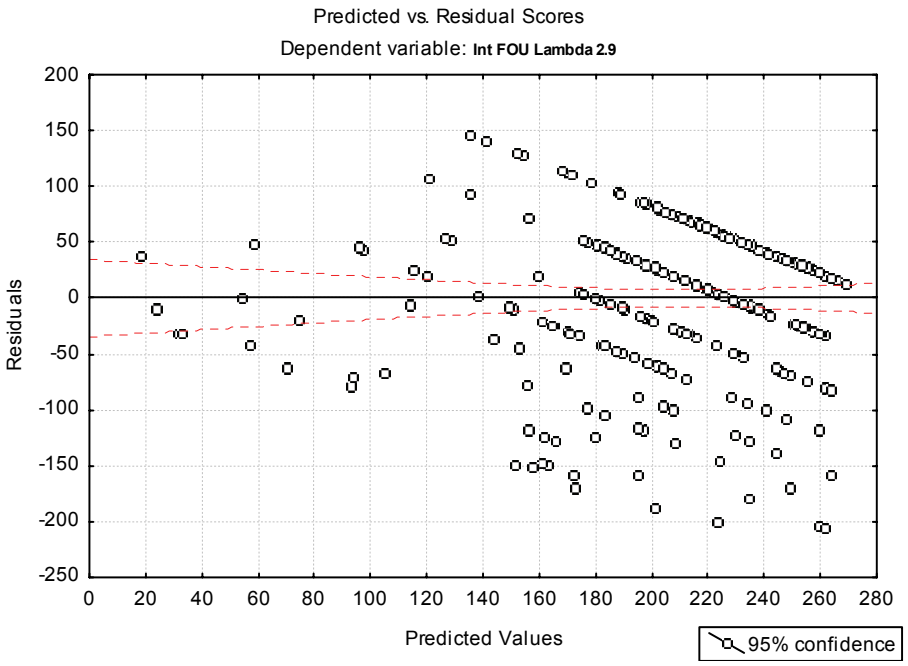

Figure 5.19. Predicted versus residual for the Internet model.

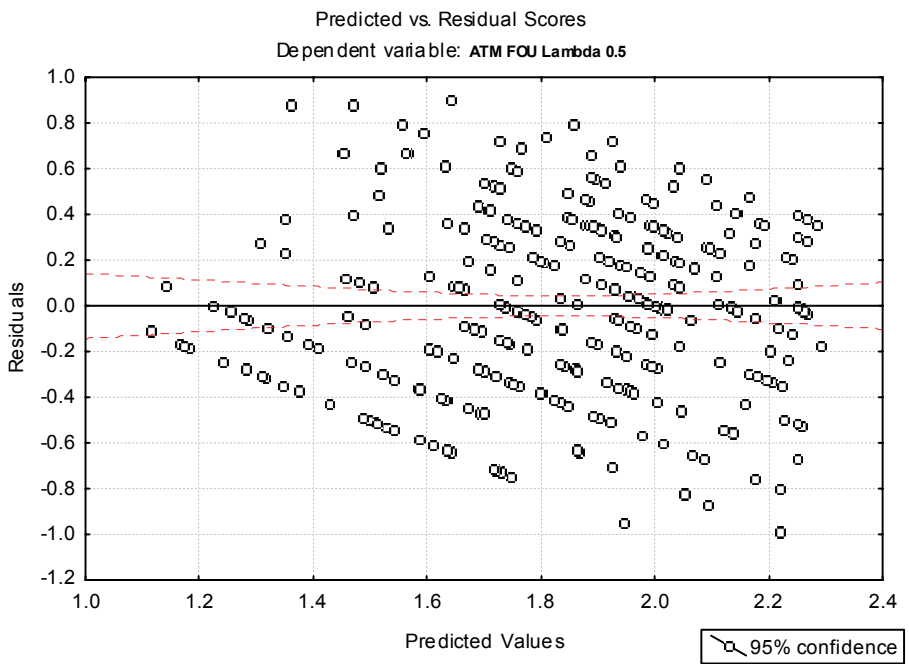

Figure 5.20. Predicted versus residual for the ATM model.

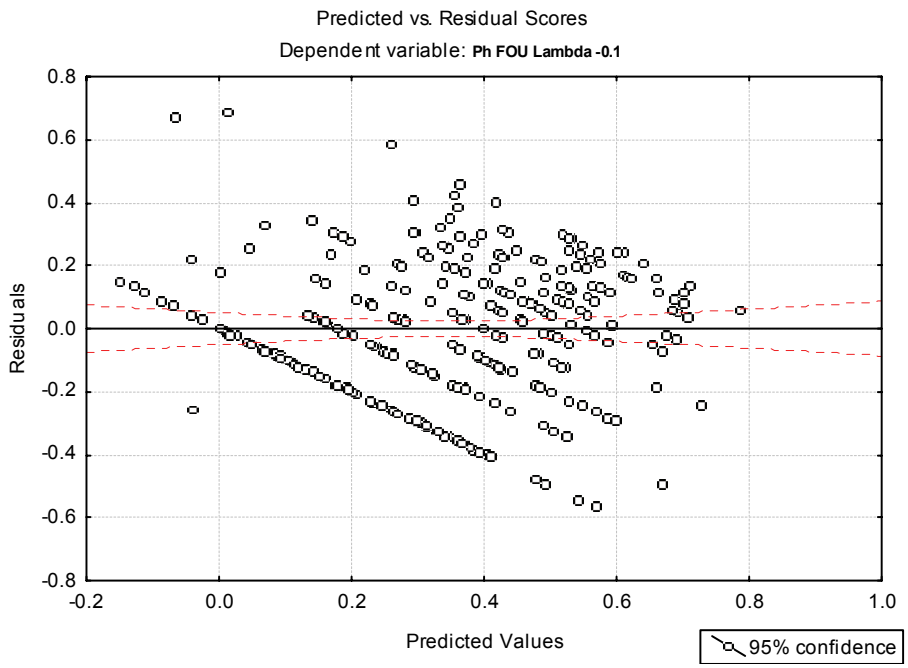

Figure 5.21. Predicted versus residual for the mobile phone model.

Based on the regression analysis, the three regression models are shown in Equations 5.4 to 5.9. While these equations are of little practical value, they are used to

express the importance of the imprint index in predicting frequency of use of technology. The equations demonstrate that in all three models, I has a negative coefficient. Additionally, they show that in absolute values, this coefficient is considerably large in relation to the cognitive variables. Results summary and hypothesis test results are shown in Tables 5.26 and 5.27, respectively.

$$T(FOU_{Internet}) = 14.1 + 21.9PU_{Internet} + 38.3PEOU_{Internet} - 14I_{Internet} \quad 5.4$$

$$T(FOU_{ATM}) = 1.6 + 0.2PU_{ATM} - 0.1I_{ATM} \quad 5.5$$

$$T(FOU_{Phone}) = 0.2 + 0.1PU_{Phone} + 0.1PEOU_{Phone} - 0.1I_{Phone} \quad 5.6$$

Or:

$$FOU_{Internet} = \left(14.1 + 21.9PU_{Internet} + 38.3PEOU_{Internet} - 14I_{Internet}\right)^{1/2.9} \quad 5.7$$

$$FOU_{ATM} = \left(1.6 + 0.2PU_{ATM} - 0.1I_{ATM}\right)^{2} \quad 5.8$$

$$FOU_{Phone} = 10^{\left(0.2+0.1PU_{Phone}+0.1PEOU_{Phone}-0.1I_{Phone}\right)} \quad 5.9$$

Table 5.26. Summary of results.

Model	IV	Std. β	t	p	R^2	Adj. R^2	St. error of est.	F	p
Internet	**PU**	.196	3.115	<.01	.336	.329	67.465	50.045	<.01
	PEOU	.374	6.475	<.01					
	I	-.128	-2.335	.020					
ATM	**PU**	.393	5.079	<.01	.326	.320	.392	47.973	<.01
	PEOU	.021	.374	.708					
	I	-.196	-2.495	.013					
Phone	**PU**	.192	3.165	<.01	.446	.441	.214	78.220	<.01
	PEOU	.338	6.780	<.01					
	I	-.280	-4.558	<.01					

Table 5.27. Hypothesis test results (R = rejected, F = failed to reject).

Null hypothesis		**Model**	**R/F**	**Conclusion**
H_{o1}	Imprint has a positive or no effect on frequency of use.	Internet	R	Imprint has a negative effect on frequency of use.
		ATM	R	Imprint has a negative effect on frequency of use.
		Phone	R	Imprint has a negative effect on frequency of use.
H_{o2}	Perceived usefulness has no effect on frequency of use.	Internet	R	Perceived usefulness has a positive effect on frequency of use.
		ATM	R	Perceived usefulness has a positive effect on frequency of use.
		Phone	R	Perceived usefulness has a positive effect on frequency of use.
H_{o3}	Perceived ease of use has no effect on frequency of use.	Internet	R	Perceived ease of use has a positive effect on frequency of use.
		ATM	F	Perceived ease of use does not have any effect on frequency of use.
		Phone	R	Perceived ease of use has a positive effect on frequency of use.
H_{o4}	Likeability has no effect on frequency of use.	Internet	R	Likeability has a positive effect on frequency of use.
		ATM	F	Likeability does not have any effect on frequency of use.
		Phone	R	Likeability has a positive effect on frequency of use.
H_{o5}	Attitude strength has no effect on frequency of use.	Internet	F	Attitude strength does not have any effect on frequency of use.
		ATM	R	Attitude strength has an effect on frequency of use.
		Phone	F	Attitude strength does not have any effect on frequency of use.
H_{o6}	Attitude strength is positively correlated, or not correlated at all, with likeability.	Internet	F	Attitude strength is not correlated with likeability.
		ATM	R	Attitude strength is negatively correlated with likeability.
		Phone	R	Attitude strength is negatively correlated with likeability.

CHAPTER 6
RESEARCH CONCLUSIONS

6.1 Research Implications

The experiment examined the effects of both cognitive and affective variables on frequency of use of technology. As in other areas of attitude research, including the affective variables in technology-related attitude studies is believed to be necessary. As Homer (2006) states, "numerous [researchers] contend that non-cognitive factors, such as affect, have a significant impact on attitude formation, above that accounted for (mediated) by cognition" (p. 35). In TAM, affect is recognized, but believed to be mediated by the cognitive variables (Venkatesh and Davis, 2000). This is believed to be insufficient representation of the influence of affect on attitudes toward technology. The imprint index in this study, composed of both likeability and attitude strength, directly accounts for affect and the results demonstrated why it should be considered a necessary independent variable in attitude and imprinting studies.

Regression analysis showed high levels of statistical significance for the three main independent variables in all three models, with the exception of PEOU in the ATM model. This finding indicates that regardless of how easy or difficult to use the user finds ATMs, perceived usefulness is the only significant cognitive variable, implying that it may only be a matter of practicality. It could be inferred that users generally have little trouble dealing with ATMs and find them easy to use. It is only those who find them useful that use them. The only exception is when the user has strong negative emotions toward ATMs, as the imprint index (I) was shown to have significant negative correlation with their frequency of use (FOU). This could be attributed to ATMs being the oldest of the three technologies. It is believed that time gradually diminishes the status and significance of technologies as newer ones are developed and that eventually, any technology will seize to be viewed as a modern day technology. This finding strongly suggests that the relationships between user age, technology age, and user age when first introduced to the technology could play important roles in determining what constitutes *a technology*. Therefore, they should be carefully investigated in future studies.

An important aspect of this questionnaire is that it measured a general or overall attitude toward the technologies. If the attitudes were measured toward specific tasks, the results may have been different. For example, while most users are accustomed to withdrawing cash from an ATM, attitude scores may change if they were asked about their attitudes toward using ATMs to deposit checks, transfer funds from one account to another, or inquire about loans. This is also true in the cases of the Internet and mobile phones.

Tests showed that the negative correlation between I and likeability (L) is stronger than the positive correlation between I and attitude strength (S), which indicates that the emotional aspect of imprints plays an important role in determining the frequency of use of the technology. This supports the hypotheses examined in the experiment. However, it should be taken into consideration that if a different set of questionnaire items had been used to measure S, producing higher reliability, these correlations might have been different. It was not the only goal of the study to show that emotion is a predictive factor in technology frequency of use. The more important relationship under investigation was whether the affective element is stronger than cognitive elements in some cases. That was shown to be true in the case of ATMs where perceived ease of use (PEOU) was not able to significantly predict FOU, while the imprinting index was.

Perhaps an even more important finding is in the mobile phone model, where I showed stronger correlation with FOU than perceived usefulness (PU). This implies that, if both I and PU were to increase one unit, holding PEOU constant, the model predicted that FOU would decrease. This is a clear indicator that imprinting effects can sometimes override cognitive beliefs.

It is also important to note that in all three cases, I was negatively correlated with FOU and had significant predictive power. The ATM model showed why it is important to consider imprinting as a factor that is separate from L and S. Although correlation analysis showed I to be more strongly correlated with L, when I was replaced with L and S in the ATM model, L did not significantly predict FOU, while S did. Therefore, it is believed that studying I as an independent element is more appropriate than incorporating its components in the model.

Subjective norm (SN), which represents social influence, was decisively unable to significantly predict FOU. There were no significant relationships between SN and FOU in any of the three models, whether I was used or replaced with L and S.

Some internal variables (specific to the user) were examined in order to determine whether they had an effect on the emotional factors I, L, and S. While the findings were inconclusive, some interesting observations were made. With regards to the Internet, males had slightly stronger attitudes (S). Although no significant correlation was found between gender and I, this suggests that males are more likely to be imprinted, since higher S values are contributors to higher I.

Experience using ATMs was significantly correlated with all three emotional variables, I, L, and S. As expected, experience is positively correlated with L and negatively correlated with both S and I.

Mobile phone data showed that age was the only factor with relationships with the emotional variables. It was negatively correlated with L, positively correlated with I, and showed no correlation with S ($r = 0$, $p = 1$). Mobile phone imaging is the most recent of the three technologies investigated, and can generally be viewed as the least used. Descriptive analysis showed lower user experience with this technology than the other two. It is an important finding that user age negatively impacted affective elements only toward the youngest technology.

Generalizability of imprints, such that they cover technologies in general, was also of interest in this experiment. For that reason, correlations between the same measure for the different technologies, were investigated (Table 5.12 through Table 5.17). FOU and PU showed some correlations (e.g. PU_{ATM} was correlated with $PU_{Internet}$ and PU_{Phone}). But PEOU, I, L, and S showed correlations between all the technologies. This is a promising finding in terms of understanding the generalizability of imprints. In fact, of all the independent variables in the study, only $PU_{Internet}$ and PU_{Phone} were not correlated. However, this should not be taken to mean that imprints are decidedly generalizable. Further testing in this area is needed before such a claim could be made.

It could be argued that the Internet, ATMs, and mobile phones, for some users, are avoidable technologies, or luxuries. Other technologies, such as cars, may be considered less dispensable by some. If true, this could have affected the outcome of the

experiment. The indispensability of a technology is a relative factor. It could similarly be argued that all technologies are avoidable and dispensable one way or another. It is a personal factor. A technology that is perceived to be essential by one user may be considered useless by another.

6.2 Recommendations for Future Research

This study focused on determining whether or not strong affective elements have a predictive negative effect on frequency of technology usage. Results showed that there is a strong possibility that this phenomenon does exist. In fact, the effect was persistent among all three technologies investigated. However, the study was not able to provide a classification system to determine whether users are imprinted or non-imprinted.

There are three important paths for future research related to technology imprints. They are listed in order of importance and in the sequence in which they should be conducted:

1. Developing a definitive method to differentiate between imprinted and non-imprinted users.
2. Defining the factors contributing to imprints being formed, and explaining the dynamics of imprint creation.
3. Finding ways to reduce the effects of negative imprinting.

The experiment was able to confirm that strong negative attitudes have significant effects on technology frequency of use. This is an essential start – a stepping stone – in the development of technology imprint models. Follow-up studies should build upon this finding by establishing a set of conditions that enables the researcher to differentiate between potentially imprinted and non-imprinted users; a distinction this study was not able to identify. Without this step, it is inconsequential to develop methods with which to counter the effects of imprinting. That is because the users to whom these methods will be applied will remain unidentified until this objective is achieved.

Age, gender, and experience data were collected in this experiment and used to examine the factors affecting imprinting. Findings revealed that each of the three factors had some predictive significance in at least one case. However, no specific pattern was

detected. Among other reasons, this could be attributed to the lack of proper categorization of imprinted and non-imprinted users. When such a categorization method is established, these factors should be reexamined, along with other potential factors. Defining a list of elements that contribute to imprint formation is a necessary step in fully understanding imprints and how to minimize their negative effects.

Once conditions for imprinting have been explained and its causal factors identified, research should focus on developing strategies and methods with which to counter the effects of imprinting, or minimize the likelihood of imprints being created in the first place. Figure 6.1 graphically depicts these three stages of imprint research. In addition, it shows how this experiment is believed to relate to the totality of imprint research.

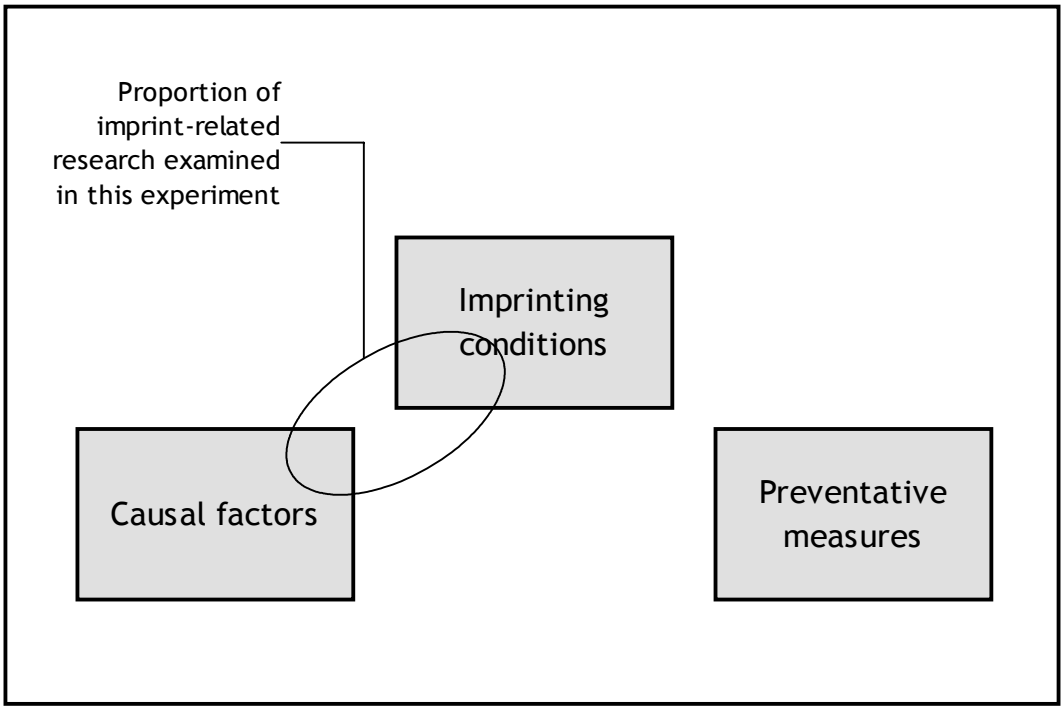

Figure 6.1. Three main components of imprint-related research and the contribution of this experiment.

Questionnaire accuracy is an important element of measuring attitudes (Hinkin, 1995). Any conclusions based on faulty measurement tools are false and unreliable and

are often invalidated by other researchers (Cook et al., 1981; Hinkin, 1995; Schmidt et al., 1985). In this experiment, every effort was made to ensure that the questionnaires used are based on reliable and appropriate measurement techniques. However, since these questionnaires were not originally designed or previously used to measure technology imprints, it is possible that they might not have been the accurate measurement instrument for this experiment. Because of the skewed responses to some of the questionnaire items, it was deduced that the questionnaire may have lacked depth in capturing all aspects of imprinting. Imprints are complex, multidimensional constructs that may require the questionnaires to be more intricate in order to fully understand. Therefore, future studies should consider making modifications to the current questionnaire and compare findings with this experiment (Peterson, 2000).

Attitude strength indices have been successfully established and utilized in previous research (e.g. centrality, importance, and certainty) (Krosnick and Petty, 1995; Pomerantz et al., 1995; Raden, 1985). Some of these indices were used in the study to measure the attitude strength variable (S), which was hypothesized to be a contributing factor and criterion for imprinting (I). Studies have found that accurately measuring attitude strength relies on the specific combinations of the indices used and their suitability for the experiment (Krosnick and Petty, 1995; Pomerantz et al., 1995; Raden, 1985). The chosen combination may have been a source of error in measuring imprints, as well as the reason for low reliability of S. Additionally, the measure for affect may need to be broken down into several components. For example, rather than relying on questionnaire items measuring subjective assessments of emotional preference toward the technology, it may be necessary to measure performance-related items such as frustration.

It was assumed in this study that when asked if they like computers, potentially imprinted users would generally respond with some negativity. However, the data revealed that users who would generally be expected to respond negatively to such questions (based on their other responses), often responded fairly positively. The justification for such seemingly unexpected responses could be that the generality of the question encourages the user to respond with a more universal view: “although I don’t personally like using computers, I recognize their importance and the advances they have

induced and I realize that they have, at least indirectly, improved my quality of life." However, asking about feelings toward uploading and downloading, handling viruses, or formatting a hard drive would probably produce very different responses. These are all points that should be considered in any future study measuring imprints.

It was important to use a general questionnaire to establish a foundation for future research in the field of technology imprints. It allowed the experiment to demonstrate the generalizability of the model across three different technologies. However, it is recommended in future research to address specific tasks a user performs by utilizing the technology. This specificity will provide more insight to the generalizability of imprinting and better interpretation of to the responses and analyses.

Future research should also consider a decay effect in imprints. This was evident in ATM data. Being the oldest of the three technologies investigated, ATM FOU was not affected by PEOU. This suggests that finding ATMs easy to use does not necessarily mean the individual will use them more often, and vice versa. This could be attributed to the decay in imprints or emotions toward older technology. Similarly, it could be a result of decay in the status of the technology itself. Every tool we use was a technology at some point in history. Pencils, for example, are no longer considered a technology, and have not been for a long time. When a perceived technology transforms to a perceived non-technology, the emotional associations users have with it may also transform into something different.

Overall, this experiment provided insight into an area that is important for researchers, engineering managers, and technology users. It demonstrated the effects of emotional attitudes with a high degree of strength on the frequency of use of technology. It showed that regardless of the technology in question, these imprinting characteristics restrict and limit technology usage. This has strong implications in a society that is heavily reliant on technology, and expected to become even more so in the coming decades and centuries. Therefore, it is important to continue exploring this area and to strive for gaining a better understanding of technology imprints.

REFERENCES

Abbate, J. (1999). *Inventing the Internet*. Cambridge, Massachusetts: MIT Press.

Abelson, R. (1988). Conviction. *American Psychologist, 43*, 267-275.

Abelson, R. (1995). Attitude extremity. In R. Petty & J. Krosnick (Eds.), *Attitude strength: Antecedents and consequences* (pp. 25-41). Mahwah, NJ: Lawrence Erlbaum Associates.

Abelson, R., & Prentice, D. (1989). Beliefs as possessions: A functional perspective. In A. Pratkanis, S. Breckler & A. Greenwald (Eds.), *Attitude structure and function* (pp. 361-381). Hillsdale, NJ: Erlbaum.

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS Quarterly, 16*(2), 227-247.

Afors, C., & Michaels, M. Z. (2001). A quick, accurate way to determine customer needs. *Quality Progress, 34*(7), 82-87.

Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly, 24*(4), 665.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior & Human Decision Processes, 50*(2), 179-211.

Ajzen, I. (2001). Nature and operation of attitudes. *Annual Review of Psychology, 52*, 27-58.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Allport, G. W. (1935). Attitudes. In C. Murchison (Ed.), *Handbook of social psychology* (pp. 798-844). Worcester, MA: Clark University Press.

Altman, R. (2001). *The writing world of the Dead Sea scrolls*. Retrieved Oct. 13, 2003, from http://www.st-andrews.ac.uk/~www_sd/altman_dss.html.

American Federation of Teachers. (2003). *2003 survey and analysis of teacher salary trends*. Retrieved June 15, 2005, from http://www.aft.org/salary/2003/download/2003Table1.pdf.

Anderson, A. (1996). Predictors of computer anxiety and performance in information systems. *Computers in Human Behavior, 12*(1), 61-77.

Anonymous. (1999). 25 shapers of the modern era. *U.S. News and World Report, 127*(25), 48-54.

Anonymous. (2000, August 2000). Quick research takes. *Harvard Management Communication Letter, 3,* 9-10.

Anonymous. (2001a, 4-17-2001). Internet at a glance. *Business 2.0, 6,* 94.

Anonymous. (2001b, 5/26/2001-6/1/2001). Over the counter e-commerce. *The Economist, 359,* 77-79.

Anonymous. (2001c, 4-28-2001). Scents and sensibility. *The Economist,* 83.

Anonymous. (2002, April 2002). Who's using the Net? *Poptronics*.

Aristotle. (350 BC). *De anima*. Retrieved Jan. 14, 2004, from http://etext.library.adelaide.edu.au/a/aristotle/a8so/.

Aristotle. (1963). *De Anima (On the Soul)* (J. A. Smith, Trans. Vol. 3). Oxford: Oxford University Press.

Arnott, D. C., & Bridgewater, S. (2002). Internet, interaction and implications for marketing. *Marketing Intelligence and Planning, 20*(2), 86-95.

Arvey, R., & Campion, J. (1982). The employment interview: A summary and review of recent research. *Personal Psychology, 35*, 281-322.

Athey, T., & Hautaluoma, J. (1994). Effects of applicant over-education, job status, and job gender stereotype on employment decisions. *Journal of Social Psychology, 134*(4), 439-452.

Auger, R. (2004). The accuracy of teacher reports in the identification of middle school students with depressive symptomatology. *Psychology in the Schools, 41*(3), 379-389.

Baldwin, J. M. (1913). *History of psychology: A sketch and an interpretation*. Retrieved July 1, 2004, from http://psychclassics.yorku.ca/Baldwin/History/chap1-8.htm.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*, 122-147.

Baran, P. (1964). *On distributed communications* (Memorandum No. RM-3420-PR): The Rand Corporation.

Baran, P. (1999). An oral history conducted by David Hochfelder. New Brunswick, NJ: IEEE History Center, Rutgers University.

Baran, P. (2001). The beginnings of packet switching: Some underlying concepts. *IEEE Communications, 40*(7), 42-48.

Barki, H., & Hartwick, J. (1994). Measuring user participation, user involvement, and user attitude. *MIS Quarterly, 18*(1), 59-82.

Barki, H., & Huff, S. L. (1985). Change, attitude to change, and decision support system success. *Information and Management, 9*(5), 261-268.

Bartlett, M. (2001). Web Is mainstream activity in American homes. *The Washington Post*.

Bartlett, M. (2002, 4-7-2002). Online travel lifts e-commerce to all-time high. *The Washington Post*.

Batra, R., Homer, P. M., & Kahle, L. R. (2001). Values, susceptibility to normative influence, and attribute importance weights: A nomological analysis. *Journal of Consumer Psychology, 11*(2), 115-128.

Bearden, W. O., & Etzel, M. J. (1982). Reference group influence on product and brand purchase decisions. *Journal of Consumer Research, 9*(2), 183-194.

Bearden, W. O., Netemeyer, R. G., & Teel, J. E. (1989). Measurement of consumer susceptibility to interpersonal influence. *Journal of Consumer Research, 15*(4), 473-481.

Bem, D. (1970). *Beliefs, attitudes, and human affairs*. Belmont, CA: Brooks/Cole.

Berk, R. (2004). *Regression analysis: A constructive critique*. Thousand Oaks, CA: Sage.

Beruvides, M., & Besheer, H. (2004). *Technology imprint: A systematic analysis on the impact and filtering effects of technology on user perception.* Paper presented at the ASEM Annual Conference, Washington, D.C.

Beruvides, M. G. (1997). A conceptual model for the understanding of white-collar knoweldge work learning curves. In C. G. Thor, J. A. Edosomwan, R. Poupart & D. J. Sumanth (Eds.), *Productivity and Quality Management* (Vol. 6, pp. 407-421): Institute of Industrial Engineers.

Beruvides, M. G., & Koelling, C. P. (1992). Management tools: A technological issue in white-collar/knowledge work. In T. M. Khalil & B. A. Bayraktar (Eds.), *Management of Technology* (Vol. 3, pp. 1357-1363): Institute of Industrial Engineers.

Beruvides, M. G., & Koelling, C. P. (1993). Technology space mapping of tools: A management issue in understanding work. In Sumanth, Edosomwan, Poupart & Sink (Eds.), *Productivity and Quality Management Frontiers* (Vol. 4, pp. 228-236): Institute of Industrial Engineers.

Beruvides, M. G., & Koelling, C. P. (2001). An investigation of the work characteristic composition in blue-collar, white-collar, and knowledge work. *International Journal of Human Resources Development and Management, 1*(2/3/4), 283-303.

Beruvides, M. G., & Omachonu, V. K. A systematic-statistical approach for managing research information: The state-of-the-art matrix analysis.

Beruvides, M. G., Omachonu, V. K., & Sumanth, D. J. (1988). A conceptual framework of work: The measurement of white-collar/knowledge productivity. In Sumanth, Edosomwan, Sink & Werther (Eds.), *Productivity Management Frontiers* (Vol. 2, pp. 39-46): Inderscience Enterprises Ltd.

Beruvides, M. G., & Sumanth, D. J. (1987). Knowledge work: A conceptual analysis and structure. In D. J. Sumanth (Ed.), *Productivity Management Frontiers* (Vol. 1, pp. 127-138). Amsterdam: Elsevier Science Publishers.

Beruvides, M. G., & Sumanth, D. J. (1991). An investigation of critical issues related to white-collar/knowledge work productivity measurement. In Sumanth, Edosomwan, Sink & Werther (Eds.), *Productivity and Quality Management Frontiers* (Vol. 3, pp. 22-28): Institute of Industrial Engineers.

Bethea, R., Duran, B., & Boullion, T. (1975). *Statistical methods for engineers and scientists*. New York: Marcel Dekker.

Bhattacherjee, A., & Premkumar, G. (2004). Understanding changes in belief and attitude toward information technology usage: A theoretical model and longitudinal test. *Management Information Systems Quarterly, 28*(2), 229-254.

Boehm, S. P., & Baran, P. (1964). *On distributed communications* (Memorandum No. RM-3103-PR): The Rand Corporation.

Borgman, C. (1999). The user's mental model of an information retrieval system: An experiment on a prototype online catalog. *International Journal of Human-Computer Studies, 51*(2), 435-452.

Box, G., & Cox, D. (1964). An analysis of transformations. *Journal of the Royal Statistical Society, 26*(Series B), 211-246.

Bradburn, N., Sudman, S., & Wansink, B. (2004). *Asking questions: The definitive guide to questionnaire design for market research, political polls, and social and health questionnaires*. San Francisco: John Wiley and Sons.

Brandel, M. (1999, 4-26-1999). The promise of packet switching. *Computerworld, 33,* 83.

Breakwell, G. M., & Fife-Schaw, C. (1987). Young people's attitudes toward new technology: Source and structure. *New Directions for Child Development*(35), 51-67.

Breakwell, G. M., Fife-Schaw, C., Lee, T., & Spencer, J. (1987). Occupational aspirations and attitudes to new technology. *Journal of Occupational Psychology, 60*(2), 169-172.

Bright, A., & Manfredo, M. (1995). The quality of attitudinal information regarding natural resource issues: The role of attitude strength, importance, and information. *Society & Natural Resources, 8*, 399-414.

Broll, W., & Fechter, J. (1996). Interaction and behavior in Web-based shared virtual environments. *IEEE*, 43-48.

Bruner, G., II, & Kumar, A. (2005). Explaining consumer acceptance of handheld Internet devices. *Journal of Business Research, 58*(5), 553-558.

Burgess, T. (2001). A general introduction to the design of questionnaires for survey research. In *Information System Services: Guide to the design of questionnaires* (pp. 4). Leeds, U.K.: University of Leeds.

Burnkrant, R. E., & Cousineau, A. (1975). Informational and normative social influence in buyer behavior. *Journal of Consumer Research, 2*(3), 206-215.

Burton-Jones, A., & Hubona, G. (2005). Individual differences and usage behavior: Revisiting a technology acceptance model assumption. *Database for Advances in Information Systems, 36*(2), 58.

Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research, 12*(2), 147-158.

Bush, V. (1945). As we may think. *The Atlantic Monthly, 176*(1), 101-108.

Business Week Online. (2000). *Salary survey 2000*. Retrieved June 14, 2005, from http://www.businessweek.com/smallbiz/salary/sb_naverage.htm.

Bybee, R. W. (2000). Achieving technological literacy: A national imperative. *The Technology Teacher, 60*, 23-28.

Byrne, M. D., John, B. E., Wehrle, N. S., & Crow, D. C. (1999, May 15-20, 1999). *The tangled Web we wove: A taskonomy of WWW use.* Paper presented at the CHI '99, Pittsburgh.

Card, S. K., Pirolli, P., Wege, M. V. D., Morrison, J. B., Reeder, R. W., Schraedley, P. K., et al. (2001, March 31-April 4, 2001). *Information scent as a driver of Web behavior graphs: Results of a protocol analysis method for Web usability.* Paper presented at the SIGCHI'01, Seattle.

Cavender, S. (1998, 10-5-1998). Legends. *Forbes*.

Chan, F., & Khalid, H. (2003). Is talking to an automated teller machine natural and fun? *Ergonomics, 46*(13/14), 1386-1407.

Chen, H., Wigand, R. T., & Nilan, M. S. (1999). Optimal experience of Web activities. *Computers in Human Behavior, 15*, 585-608.

Chen, L., Gillenson, M. L., & Sherrell, D. L. (2004). Consumer acceptance of virtual stores: A theoretical model and critical success factors for virtual stores. *Database for Advances in Information Systems, 35*(2), 8.

Chen, Y., Lou, H., & Luo, W. (2001). Distance learning technology adoption: A motivation perspective. *Journal of Computer Information Systems, 42*(2), 38-43.

Chi, E. H. (2002). Improving web usability through visualization. *IEEE Internet Computing, 6*(2), 64-71.

Childers, T., Carr, C., Peck, J., & Carson, S. (2001). Hedonic and utilitarian motivations for online retail shopping behavior. *Journal of Retailing, 77*, 511-535.

Choi, H.-K., & Limb, J. O. (1999). *A behavioral model of Web travel.* Paper presented at the Seventh International Conference on Network Protocols, Toronto.

Chou, D. C. (2001, Fall 2001). Integrating TQM into e-commerce. *Information Systems Management, 18,* 31-40.

Chung, J., & Tan, F. (2004). Antecedents of perceived playfulness: An exploratory study on user acceptance of general information-searching websites. *Information and Management, 41*(7), 869-881.

Clore, G., & Schnall, S. (2005). The influence of affect on attitude. In D. Albarracin, B. Johnson & M. Zanna (Eds.), *The handbook of attitudes* (pp. 437-489). Mahwah, NJ: Lawrence Erlbaum Associates.

Cober, R. T., Brown, D. J., Blumental, A. J., Doverspike, D., & Levy, P. (2000). The quest for the qualified job surfer: It's time the public sector catches the wave. *Public Personnel Management, 29*(4), 479-494.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Comber, C., & Colley, A. (1997). The effects of age, gender, and computer experience upon computer attitudes. *Educational Research, 39*(2), 123-133.

Converse, P. E. (1964). The nature of belief systems in the mass public. In D. E. Apter (Ed.), *Ideology and discontent*. New York: Free Press.

Cortes, M. G. V., & Beruvides, M. G. (1996). *An analysis of middle management work in non-steady conditions.* Paper presented at the 19th Annual Conference on Computers and Industrial Engineering.

Cringely, R. X. (1998a). *Internet Timeline*. Retrieved Aug. 17, 2002, from http://www.pbs.org/opb/nerds2.0.1/timeline/index.html.

Cringely, R. X. (1998b). *The Cold War Heats Up*. Retrieved Aug. 20, 2002, from http://www.pbs.org/opb/nerds2.0.1/networking_nerds/coldwar.html.

Cukier, W., Shortt, D., & Devine, I. (2002). Gender and Information Technology: Implications of definitions. *Journal of Information Systems Education, 13*(1), 7-16.

Cutcliffe, S. H., & Post, R. C. (Eds.). (1989). *In context: History and the history of technology. Essays in honor of Melvin Kranzberg* (Vol. 1). Bethlehem: Lehigh University Press.

Czaja, S., Fisk, A., Hertzog, C., Rogers, W., Charness, N., Nair, S., et al. (2006). Factors predicting the use of technology: Findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). *Psychology and Aging, 21*(2), 333-353.

Dabholkar, P., & Bagozzi, R. (2002). An attitudinal model of technology-based self-service: Moderating effects of consumer traits and situational factors. *Journal of the Academy of Marketing Science, 30*(3), 184-201.

David, L. (2003). *Space Elevator: High hopes, lofty goals*. Retrieved Sept. 25, 2003, from http://www.space.com/businesstechnology/technology/space_elevator_030917.html.

Davidson, A., Yantis, S., Norwood, M., & Montano, D. (1985). Amount of information about the attitude object and attitude-behavior consistency. *Journal of Personality & Social Psychology, 49*(5), 1184-1198.

Davies, D. W. (2001). An historical study of the beginnings of packet switching. *Computer Journal, 44*(3), 151-162.

Davis, F. (1986). *A technology acceptance model for empirically testing new end-user information systems: Theory and results.* Doctoral dissertation, Massachusetts Institute of Technology, Cambridge, MA.

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

Davis, F. (1993). User acceptance of information technology: System characteristics, user perceptions, and behavioral impacts. *International Journal of Man-Machine Studies, 38*, 475-487.

Davis, F., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982-1003.

Delgoulet, C., & Marquié, J. C. (2002). Age differences in learning maintenance skills: A field study. *Experimental Aging Research, 28*(1), 25-37.

Deutsch, M., & Gerard, H. B. (1955). A study of normative and informational influence upon individual judgment. *Journal of Abnormal and Social Psychology, 51*, 629-636.

Diamond, E., & Bates, S. (1995). The ancient history of the Internet. *American Heritage, 46*(6), 34-37.

DOE. (1999). *Nuclear Age Timeline*. Retrieved Aug. 25, 2002, from http://www.em.doe.gov/timeline/oct1957.html.

Doll, W., & Torkzadeh, G. (1991). The measurement of end-user computing satisfaction: Theoretical and methodological issues. *MIS Quarterly, 15*(1), 5.

Doob, L. (1947). The behavior of attitudes. *Psychological Review, 54*, 135-156.

Eagly, A., & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth, TX: Harcourt Brace Jovanovich.

Eason, K. (2001). Changing perspectives on the organizational consequences of information technology. *Behaviour and Information Technology, 20*(5), 323-328.

Edison, S., & Geissler, G. (2003). Measuring attitudes towards general technology: Antecedents, hypotheses and scale development. *Journal of Targeting, Measurement, and Analysis for Marketing, 12*(2), 137–156.

Ellul, J. (1962). The Technological Order. *Technology and Culture, 3*(4), 394-421.

Evans, R. (1975). *Konrad Lorenz: The man and his ideas*. New York: Harcourt Brace Jovanovich.

Ewing, T. (1942). A study of certain factors involved in changes of opinion. *Journal of Social Psychology, 16*, 63-88.

Fang, X., Lee, S., Lee, T., & Huang, W. (2004). Critical factors affecting job offers for new MIS graduates. *Journal of Information Systems Education, 15*(2), 189-203.

Fazio, R., Powell, M., & Williams, C. (1989). The role of attitude accessibility in the attitude-to-behavior process. *Journal of Consumer Research, 16*(3), 280-288.

Fazio, R., & Williams, C. (1986). Attitude accessibility as a moderator of the attitude-perception and attitude-behavior relations: An investigation of the 1984 presidential election. *Journal of Personality and Social Psychology, 51*(3), 505-514.

Fazio, R., & Zanna, M. (1978). On the predictive validity of attitudes: The roles of direct experience and confidence. *Journal of Personality, 46*(2), 228-243.

Fazio, R. H. (1986). How do attitudes guide behavior? In R. M. Sorrentino & E. T. Higgins (Eds.), *Handbook of motivation and cognition: Foundations of social behavior* (pp. 204-243). New York, NY: Guilford Press.

Fernandes, A., & Mendes, P. (2003). Technology as culture and embodied knowledge. *European Journal of Engineering Education, 28*(2), 151-160.

Festa, P. (2001). *Present at the 'e'-creation*. Retrieved Dec. 6, 2002, from http://news.com.com/2008-1082-274161.html?legacy=cnet.

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Fishbein, M. (1967). Attitude and the prediction of behavior. In M. Fishbein (Ed.), *Readings in attitude theory and measurement* (pp. 477-492). New York: Wiley.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Flick, L. B., & Lederman, N. G. (2003). Technology: What does it mean to you? *School Science & Mathematics, 103*(7), 313-316.

Foster, M. Be alert to the signs of employee Internet addiction. *National Public Accountant*, 39-40.

Franc, R. (1999). Attitude strength and the attitude-behavior domain: Magnitude and independence of moderating effects of different strength indices. *Journal of Social Behavior & Personality, 14*(2), 177-195.

Gast, M. F., & Patinka, P. J. (1983). Imprinting the Young Employee. *Business Horizons, 26*(4), 11.

Gatiker, U. E., & Kelley, H. (1999). Morality and computers: Attitudes and differences in moral judgments. *Information Systems Research, 10*(3), 233-254.

Gillis, B. (2000, January 2000). The evolution of e-commerce. *Florist, 34,* 52-56.

Goodman, A. (1996). *Introduction to data collection and analysis*. Retrieved July 18, 2005, from http://www.deakin.edu.au/~agoodman/sci101/index.php.

Gradwell, J., & Welch, M. (2003). Technology education in Canada: A mosaic. *Canadian Journal of Science, Mathematics, and Technology Education, 3*(1), 17-35.

Graham, G. (1999). *The Internet:// A philosophical inquiry*. London: Routledge.

Graham, S., & Lowery, B. S. (2004). Priming unconscious racial stereotypes about adolescent offenders. *Law and Human Behavior, 28*(5), 483-504.

Griffith, T. L. (1996). Negotiating successful technology implementation: A motivation perspective. *Journal of Engineering and Technology Management, 13*(1), 29-53.

Griffith, T. L., Tansik, D. A., & Benson III, L. (2002). Negotiating technology implementation: An empirical investigation of a website introduction. *Group Decision and Negotiation, 11*(1), 1-22.

Griffiths, R. T. (2002, October 11, 2002). *History of the Internet, Internet for historians*. Retrieved Dec. 9, 2002, from http://www.let.leidenuniv.nl/history/ivh/frame_theorie.html.

Halliwell, T. (2002, 6-24-2002). *Is there a father of the Internet?* Retrieved Dec. 1, 2002, from http://www.learnedcounsel.com/father.htm.

Harmon, W. (1970). *An incomplete guide to the future*. New York: W. W. Norton.

Havelka, D., Beasley, F., & Broome, T. (2004). A study of computer anxiety among business students. *Mid-American Journal of Business, 19*(1), 63-70.

Heart, F., McKenzie, A., McQuillian, J., & Walden, D. (1978). *ARPANET Completion Report*. Burlington, MA: Bolt, Beranek and Newman.

Heijden, H. v. d., Verhagen, T., & Creemers, M. (2003). Understanding online purchase intentions: Contributions from technology and trust perspectives. *European Journal of Information Systems, 12*(1), 41.

Hendrickson, A., Massey, P., & Cronan, T. (1993). On the test-retest reliability of perceived usefulness and perceived ease of use scales. *MIS Quarterly, 17*, 227-230.

Hill, T., & Lewicki, P. (2006). *Statistics: Methods and applications*. Tulsa, OK: StatSoft.

Hitt, M. A. (2000). The new frontier: Transformation of management for the new millennium. *Organizational Dynamics, 28*(3), 7-17.

Holland, R., Verplanken, B., & van Knippenberg, A. (2002). On the nature of attitude-behavior relations: The strong guide, the weak follow. *European Journal of Social Psychology, 32*(6), 869-876.

Holscher, C., & Strube, G. (2000). Web search behavior of Internet experts and newbies. *Computer Networks, 33*, 337-346.

Homer, P. (2006). Relationships among ad-induced affect, beliefs, and attitudes. *Journal of Advertising, 35*(1), 35-51.

Hone, K., Graham, R., Maguire, M., Baber, C., & Johnson, G. (1998). Speech technology for automatic teller machines: An investigation of user attitude and performance. *Ergonomics, 41*(7), 962-981.

Hong, W., Thong, J., Wong, W., & Tam, K. (2002). Determinants of user acceptance of digital libraries: An emperical examination of individual differences and system characteristics. *Journal of Management Information Systems, 18*(3), 97-124.

Hopper, J. (2002, April 1, 2002). Net changes who buys, but not why. *Marketing News*.

Hovland, C. I. (1959). Reconciling conflicting results derived from experimental and survey studies of attitude change. *American Psychologist, 14*, 8-17.

Howard, G., & Smith, R. (1986). Computer anxiety in management: Myth or reality? *Communications of the Association for Computing Machinery, 29*(7), 611-615.

Howard, J. A., & Sheth, J. N. (1969). *The theory of buyer behavior*. New York: Wiley.

Hsieh, C.-t. (2001). E-commerce payment systems: Critical issues and management strategies. *Human Systems Management, 20*(2), 131-139.

Hume, D. (1739). *A treatise of human nature*. Retrieved June 28, 2004, from http://etext.library.adelaide.edu.au/h/h92t/.

Hyman, H. H., & Sheatsley, P. B. (1947). Some reasons why information campaigns fail. *Public Opinion Quarterly, 11*, 412-423.

Igbaria, M., & Chakrabarti, A. (1990). Computer anxiety and attitudes towards microcomputer use. *Behaviour and Information Technology, 9*(3), 229-241.

Igbaria, M., & Parasuraman, S. (1989). A path analytic study of individual characteristics, computer anxiety and attitudes toward microcomputers. *Journal of Management, 15*(3), 373-388.

Igbaria, M., Zinatelli, N., Cragg, P., & Cavaye, A. L. M. (1997). Personal computing acceptance factors in small firms: A structural equation model. *MIS Quarterly, 21*(3), 279-302.

Imprint. *Merriam-Webster Online Dictionary*.

International Technology Education Association. (2000). *Standards for technological literacy: Content for the study of technology*. Reston, VA.

International Technology Education Association. (2002). *ITEA/Gallup Poll: Interpreting what others think of technology teaching*. Retrieved July 7, 2004, from http://www.iteawww.org/TAA/LinkedFiles/Articles/TTTpdf/2001-02Volume61/starkweather_mayjun02.pdf.

International Telecommunication Union. (2003). *New digital access index: Gauging ICT potential around the world*. Retrieved July 6, 2004, from http://www.itu.int/ITU-D/ict/dai/material/DAI_ITUNews_e.pdf.

Internet World Stats. (2005a). *Internet usage statistics for Africa*. Retrieved June 15, 2005, from http://www.internetworldstats.com/stats1.htm.

Internet World Stats. (2005b). *Internet usage statistics for the Americas*. Retrieved June 15, 2005, from http://www.internetworldstats.com/stats2.htm.

Jahng, J., Jain, H., & Ramamurthy, K. (2001). The impact of electronic commerce environment on user behavior: The case of a complex product. *e-Service Journal*, 41-53.

Jiang, J. J., Hsu, M. K., Klein, G., & Lin, B. (2000). E-commerce user behavior model: An emperical study. *Human Systems Management, 19*, 265-276.

Johnson, S. E. (2003). Behavioral safety theory. *Professional Safety, 48*(10), 39-44.

Joseph, D. (2000, September 7, 2000). *Guide to e-commerce*. Retrieved Oct. 3, 2002, from http://www.ilr.cornell.edu/library/reference/guides/ecommerce/.

Kahane, L. (2001). *Regression basics*. Thousand Oaks, CA: Sage.

Kai-ming Au, A., & Enderwick, P. (2000). A cognitive model on attitude towards technology adoption. *Journal of Managerial Psychology, 15*(4), 266-282.

Kanter, R. M. (2001). The ten deadly mistakes of wanna-dots. *Harvard Business Review*, 91-100.

Kaplan, K. (1972). On the ambivalence-indifference problem in attitude theory and measurement: A suggested modification of the semantic differential technique. *Psychological Bulletin, 77*, 361-372.

Katz, D. (1960). The functional approach to the study of attitudes. *The Public Opinion Quarterly, 24*(2), 163-204.

Kelman, H. C. (1961). Processes of opinion change. *Public Opinion Quarterly, 25*(1), 57-78.

Kelsey, D. (2001). Most young people go online for health info. *The Washington Post*.

Kennedy, K. N., & Deeter-Schmelz, D. R. (2001). Descriptive and predictive analyses of industrial buyers' use of online information for purchasing. *Journal of Personal Selling and Sales Management, 21*(4), 279-290.

Khalid, H. (2001). Towards affective collaborative design. In M. Smith, G. Salvendy, D. Harris & R. Koubek (Eds.), *Usability evaluation and interface design, Proceedings of HCI International 2001* (Vol. 1, pp. 370-374). Mahwah, NJ: Lawrence Erlbaum.

Kickul, J., & Gundry, L. K. (2001). Breaking through boundaries for organizational innovation: New managerial roles and practices in e-commerce firms. *Journal of Management, 27*, 347-361.

King, C., & Scheleur, S. (2003). *United States Department of Commerce News*. Retrieved Apr. 2, 2003, from http://www.census.gov/mrts/www/current.html.

King, R. (2001). The 7 habits of highly persistent dotcoms. *Business 2.0, 2*(9), 87-93.

Kleijnen, M., Wetzels, M., & de Ruyter, K. (2004). Consumer acceptance of wireless finance. *Journal of Financial Services Marketing, 8*(3), 206.

Kleinrock, L. (1961). *Information Flow in Large Communication Nets.* Ph.D. Proposal, Massatchusetts Institute of Technology, Cambridge.

Kocharekar, R. (2001, Spring 2001). K-commerce: Knowledge-based commerce architecture with convergence of e-commerce and knowledge management. *Information Systems Management, 18,* 30-36.

Koelling, C. P., & Beruvides, M. G. (1994). Management of technology issues in research and development work analysis. In T. M. Khalil & B. A. Bayraktar (Eds.), *Management of Technology* (Vol. 4, pp. 1381-1388): Institute of Industrial Engineers.

Kotov, A. (1999). *The Internet as a medium for software engineering experiements.* Paper presented at the ICSE '99, Los Angeles.

Koufaris, M. (2001). System design and consumer behavior in electronic commerce. *Dissertation Abstracts International Section A: Humanities & Social Sciences, 61*(9-A), 3661.

Koufaris, M. (2002). Applying the Technology Acceptance Model and flow theory to online consumer behavior. *Information Systems Research, 13*(2), 205-223.

Krafft-Ebing, R. V. (1950). *Psychopathica Sexualis*. New York: Pioneer Publications.

Kranzberg, M. (1981). Technology's the answer but that's not the question. *Mechanical Engineering, 103*(9), 38-41.

Kranzberg, M. (1986). Technology and history: Kranzberg's laws. *Technology and Culture, 27*(3), 544-560.

Kranzberg, M. (1991). Science-technology-society: It's as simple as XYZ! *Theory Into Practice, 30*(4), 234-241.

Kranzberg, M. (1993a). Dynamic process: Technological change and engineering education. *ASEE Prism, 2*(5), 20-24.

Kranzberg, M. (1993b). Educating the whole engineer. *ASEE Prism, 3*(3), 26-31.

Kranzberg, M. (Ed.). (1959). *1848: A turning point?* Boston, MA: D. C. Heath and Company.

Kranzberg, M. (Ed.). (1980). *Ethics in an age of pervasive technology*. Boulder, CO: Westview Press.

Kranzberg, M., & Davenport, W. H. (Eds.). (1972). *Technology and culture*. New York: Schocken Books.

Kranzberg, M., & Pursell Jr., C. (Eds.). (1967a). *The emergence of moden industrial society: Earliest times to 1900* (Vol. 1). New York: Oxford University Press.

Kranzberg, M., & Pursell Jr., C. (Eds.). (1967b). *Technology in the twentieth century* (Vol. 2). New York: Oxford University Press.

Krech, D., Crutchfield, R. S., & Ballachey, E. L. (1962). *Individual in society: A textbook of social psychology*. New York, NY: McGraw-Hill.

Krosnick, J. (1988). The role of attitude importance in social evaluation: A study of policy preferences, presidential candidate evaluations, and voting behavior. *Journal of Personality and Social Psychology, 55*(2), 196-210.

Krosnick, J. (1990). Government policy and citizen passion: A study of issue publics in contemporary America. *Political Behavior, 12*, 59-92.

Krosnick, J. (1999). Survey research. *Annual Review of Psychology, 50*, 537-567.

Krosnick, J., & Petty, R. (1995). Attitude strength: An overview. In R. E. Petty & J. A. Krosnick (Eds.), *Attitude strength: Antecedents and consequences*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Kuhn, T. S. (1970). *The structure of scientific revolutions*. Chicago: Chicago University Press.

Kwak, H., Fox, R. J., & Zinkhan, G. M. (2002). What products can be successfully promoted and sold via the Internet? *Journal of Advertising Research*.

Lais, S. (2002). How to stop web shopper flight. *Computerworld, 36*(25), 44-45.

Lancieri, L. (1999). *Description of Internet user behavior.* Paper presented at the IEEE International Joint Conference on Neural Networks.

Langston, C., & Sykes, W. (1997). Beliefs and the big five: Cognitive bases of broad individual differences in personality. *Journal of Research in Personality, 31*(2), 141.

LaPiere. (1934). Attitudes versus actions. *Social Forces, 13*, 230-237.

Lardner, J. (1999). The world's first nethead. *U.S. News and World Report, 127*(25), 67.

Leamnson, R. N. (2002). It's never too late: Developing cognitive skills for lifelong learning. *Interactive Learning Environments, 10*(2), 93-103.

Leedy, P., & Ormrod, J. (2005). *Practical research: Planning and design* (8th ed.). Upper Saddle River, NJ: Pearson.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management, 40*(3), 191-204.

Licklider, J. C. R. (1960). Man-computer symbiosis. *IRE Transactions on Human Factors in Electronics, HFE-1*, 4-11.

Licklider, J. C. R., & Taylor, R. W. (1968). The computer as a communication device. *Science and Technology, April 1968*.

Lin, I.-Y., Huang, X.-M., & Chen, M.-S. (1999, November 9-11, 1999). *Capturing user access patterns in the Web for data mining.* Paper presented at the 11th IEEE International Conference on Tools with Artificial Intellegence, Chicago.

Ling, J., & Van Schaik, P. (2004). The effects of link format and screen location on visual search of web pages. *Ergonomics, 47*(8), 907-921.

Liu, C.-c., Day, W.-w., Sun, S.-w., & Wang, G. (2002). User behavior and the "globalness" of Internet: From a Taiwan users' perspective. *Journal of Computer-Mediated Communication, 7*(2).

Locke, J. (1689). *An essay concerning human understanding*. Retrieved June 28, 2004, from http://etext.library.adelaide.edu.au/l/l81u/.

Lorenz, K. (1963). *On aggression*. San Diego: Harcourt Brace.

Loureiro, P., Carneiro, F., & Sachsida, A. (2004). Race and gender discrimination in the labor market: An urban and rural sector analysis for Brazil. *Journal of Economic Studies, 31*(2), 129-143.

Luarn, P., & Lin, H. (2005). Toward an understanding of the behavioral intention to use mobile banking. *Computers in Human Behavior, 21*(6), 873-891.

Lynch, P. D. (2001). The global Internet shopper: Evidence from shopping tasks in twelve countries. *Journal of Advertising Research, 41*(3), 15-23.

Ma, Q., & Liu, L. (2004a). The Technology Acceptance Model: A Meta-Analysis of Empirical Findings. *Journal of Organizational and End User Computing, 16*(1), 59-72.

Ma, Q., & Liu, L. (2004b). The Technology Acceptance Model: A meta-analysis of empirical findings. *Journal of Organizational and End User Computing, 16*(1), 59.

Malatesta, G. (2001, 8-22-2001). Conformity rules in cyberspace. *The Australian,* p. 40.

Malinowski, A., & Wilamowski, B. (2001). *Internet technology as a tool for solving engineering problems.* Paper presented at the IECON'01: The 27th Annual Conference of the IEEE Industrial Electronics Society, Denver, CO.

Manasian, D. (2003). Digital dilemmas. *Economist, 366*(8308), 3-5.

Maney, K. (2005, July 26). A very different future is calling - on billions of cell phones. *USA Today*.

Manning, H., McCarthy, J. C., & Souza, R. K. (1998). *Why most web sites fail* (white paper). Cambridge, MA: Forrester Research.

Martocchio, J. (1994). Effects of conceptions of ability on anxiety, self-efficacy, and learning in training. *Journal of Applied Psychology, 79*(6), 819-825.

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research, 2*, 173-191.

McCloskey, D. (2004). Evaluating electronic commerce acceptance with the technology acceptance model. *Journal of Computer Information Systems, 44*(2), 49.

McCoy, S., Everard, A., & Jones, B. (2005). An examination of the technology acceptance model in Uruguay and the US: A focus on culture. *Journal of Global Information Technology Management, 8*(2), 27.

McCullagh, P., & Nelder, J. (1983). *Generalized linear models*. New York: Chapman and Hall.

McFarland, D., & Hamilton, D. (2006). Adding contextual specificity to the technology acceptance model. *Computers in Human Behavior, 22*(3), 427-447.

McGuire, W. J. (1968). Personality and susceptibility to social influence. In E. F. Borgatta & W. W. Lambert (Eds.), *Handbook of personality theory and research* (pp. 1130-1187). Chicago: Rand McNally.

McKnight, D. H., & Chervany, N. L. (2002). What trust means in e-commerce customer relationships: An interdisciplinary conceptual typology. *International Journal of Electronic Commerce, 6*(2), 35-59.

Melone, N. P. (1990). A theoretical assessment of the user-satisfaction construct. *Management Science, 36*(1), 76-91.

Miles, J., & Shevlin, M. (2001). *Applying regression and correlation: A guide for students and researchers*. London: Sage.

Milne, J. L. (1999). Chief financial officers often 'surf' in spare time. *Canadian Manager, Summer 1999*.

Miyazaki, A. D., & Fernandez, A. (2001). Consumer perceptions of privacy and security risks for online shopping. *The Journal of Consumer Affairs, 35*(1), 27-44.

Morris, M. G. (1997). A longitudinal examination of information technology acceptance: The influence of system experience on user perceptions and behavior. *Dissertation Abstracts International, 57*(7), 3125.

Morrow, P., Prell, E., & McElroy, J. (1986). Attitudinal and behavioral correlates of computer anxiety. *Psychological Reports, 59*(3), 1199-1204.

MSN Encarta. (2004). *Tabula Rasa*.

Mueller, D. J. (1986). *Measuring social attitudes: A handbook for researchers and practitioners*. New York: Teachers College Press.

Nauts. (2000, Feb. 15, 2000). *Sputnik Satellites and Launch Vehicles*. Retrieved Sept. 1, 2002, from http://nauts.com/vehicles/50s/sputnik.html.

Nidditch, P. H. (Ed.). (1975). *An essay concerning human understanding*. Oxford: Oxford University Press.

NIST/SEMATECH. (2006). *e-Handbook of Statistical Methods*. Retrieved Sept. 25, 2006, from http://www.itl.nist.gov/div898/handbook/.

Norman, D. (2002). Emotion and design: Attractive things work better. *Interactions, 9*(4), 36-42.

Olson, M. A., & Fazio, R. H. (2001). Implicit attitude formation through classical conditioning. *Psychological Science, 12*(5), 413-417.

Omachonu, V. K., & Beruvides, M. G. (1989a). *Improving hospital productivity: Patient-, unit-, and hospital-based measures.* Paper presented at the 1989 International Industrial Engineering Conference and Societies' Manufacturing and Productivity Symposium.

Omachonu, V. K., & Beruvides, M. G. (1989b). *White collar/knowledge work productivity monitoring for interdependent functions with no measurable output.* Paper presented at the 1989 International Industrial Engineering Conference and Societies' Manufacturing and Productivity Symposium.

O'Neill, E. T., Lavoie, B. F., & Bennett, R. (2003). *Trends in the evolution of the public web: 1998-2002*. Retrieved Apr. 18, 2005, from http://www.dlib.org/dlib/april03/lavoie/04lavoie.html.

Osgood, C. E., Suci, G. J., & Tannenbaum, P. H. (1957). *The measurement of meaning*. Urbana, IL: University of Illinois Press.

Owens, J. (2001, 3-5-2001). What women want online. *Adweek Eastern Edition, 42,* 32.

Pannabecker, J. R. (1991). Technological Impacts and Determinism in Technology Education: Alternate metaphors from social constructivism. *Journal of Technology Education, 3*(1), 43-54.

Parasuraman, S., & Igbaria, M. (1990). An examination of gender differences in the determinants of computer anxiety and attitudes toward microcomputers among managers. *International Journal of Man-Machine Studies, 32*(3), 327-340.

Park, C. W., & Lessig, V. P. (1977). Students and housewives: Differences in susceptibility to reference group influence. *Journal of Consumer Research, 4*(2), 102-110.

Perlman, G. (2002). Achieving universal usability by designing for change. *IEEE Internet Computing, 6*(2), 46-55.

Petrina, S. (1992). Questioning the Language that We Use:A reaction to Pannabecker's critique of the technological impact metaphor. *Journal of Technology Education, 4*(1), 54-61.

Petty, R. E., & Cacioppo, J. T. (1981). *Attitudes and persuasion: Classic and contemporary approaches*. Dubuque, IA: Wm. C. Brown.

Phan, D. D. (2001, Fall 2001). E-business management strategies: A business-to-business case study. *Information Systems Management, 18,* 61-70.

Pinch, T. J., & Bijker, W. E. (1987). The social construction of facts and artifacts: Or how the sociology of science and the sociology of technology might benefit each other. In W. E. Bijker, T. P. Hughes & T. J. Pinch (Eds.), *The Social Construction of Technological Systems* (pp. 17-50). Cambridge, MA: MIT Press.

Pomerantz, E., Chaiken, S., & Tordesillas, R. (1995). Attitude strength and resistance processes. *Journal of Personality and Social Psychology, 69*(3), 408-419.

Postel, J., Kleinrock, L., Cerf, V., & Boehm, B. (1989). *Act One - The Poems* (Request for comments): Computer Science Department, UCLA.

Price, S. (2000). *Audacious & Outrageous: Space elevators*. Retrieved Sept. 15, 2003, from http://science.nasa.gov/headlines/y2000/ast07sep_1.htm.

Priester, J. R., Nayakankuppam, D., Fleming, M. A., & Godek, J. (2004). The A2SC2 model: The influence of attitudes and attitude strength on consideration and choice. *Journal of Consumer Research, 30*(4).

Project, T. H. o. C. (2001, July 30, 2001). *Donald W. Davies CBE, FRS*. Retrieved Nov. 20, 2002, from http://www.thocp.net/biographies/davies_donald.htm.

Prunty, J. (2001). Implementing behavior-based profitability to achieve e-commerce success. *Bank Accounting and Finance, 15*(1), 67-72.

Rabin, S. (2001). Providing a high-performing commerce site, *Information Systems Management* (Vol. 18, pp. 40-52).

Raden, D. (1985). Strength-related attitude dimensions. *Social Psychology Quarterly, 48*(4), 312-330.

Raghavan, R., & Solpietro, C. (2005). *TTU human subjects policies and procedures*. Retrieved Dec. 7, 2005, from http://www.ors.ttu.edu/NEWORS/NewHome/Policies_Procedures/TTU_IRB_Policies_procedures.html#V.%20%20Levels%20of%20Review.

Reis, S. M. (2002). Social and emotional issues faced by gifted girls in elementary and secondary school. *SENG Newsletter, 2*(3), 1-5.

Richardson, T. (2002). *Govt unveils plans for eDemocracy*. Retrieved July 5, 2004, from http://www.theregister.co.uk/2002/07/16/govt_unveils_plans_for_edemocracy/.

Riemenschneider, C. K., & McKinney, V. R. (2001-2002). Assessing belief differences in small business adopters and non-adopters of web-based e-commerce. *Journal of Computer Information Systems, Winter 2001-2002*, 101-107.

Robey, D. (1979). User attitudes and management information system use. *Academy of Management Journal, 22*(3), 527.

Rogers, W., Cabrera, E., Walker, N., Gilbert, D., & Fisk, A. (1996). A survey of automatic teller machine usage by older adults: A structured interview approach. *Human Factors, 38*(1), 156-166.

Ropeik, D., & Gray, G. (2003). Cell phones and driving: How risky? *Consumers' Research, 86,* 14-16.

Rothaermela, F. T., & Sugiyamab, S. (2001). Virtual Internet communities and commercial success: Individual and community-level theory grounded in the atypical case of TimeZone.com. *Journal of Management, 27*(3), 297-313.

Rousseau, J. J. (1762). *Emile, ou de l'education*. Retrieved Oct. 21, 2003, from http://projects.ilt.columbia.edu/pedagogies/Rousseau/Contents2.html.

Sample, J., & Warland, R. (1973). Attitude and prediction of behavior. *Social Forces, Vol. 51*(3), 292-304.

Sapir, E. (1929). The status of linguistics as a science. *Language, 5*, 207-214.

Sarnoff, I. (1960). Psychoanalytic theory and social attitudes. *Public Opinion Quarterly, 24*, 251-279.

Sax, L. (2005). *Why Gender Matters*. New York: Doubleday.

Schoen, J. (2003). *Online voting offers alternative*. Retrieved July 5, 2004, from http://www.af.mil/stories/story.asp?storyID=123006092.

Schuman, H., & Johnson, M. P. (1976). Attitudes and behavior. *Annual Review of Psychology, 2*, 161-207.

Scott, C., & Rockwell, S. (1997). The effect of communication, writing, and technology apprehension on likelihood to use new communication technologies. *Communication Education, 46*(1), 44-62.

Segaller, S. (1998). *Nerds 2.0.1: A brief history of the Internet*. New York: TV Books.

Segars, A., & Grover, V. (1993). Re-examining perceived ease of use and usefulness: A confirmatory factor analysis. *MIS Quarterly, 17*, 517-525.

Shaeffer, E., Krosnick, J., Langer, G., & Merkle, D. (2005). Comparing the quality of data obtained by minimally balanced and fully balanced attitude questions. *Public Opinion Quarterly, 69*(3), 417-428.

Shaffer, D., & Johnson, R. (1980). Effects of occupational choice and sex-role preferences on attractiveness of competent men and women. *Journal of Personality, 48*(4), 505-519.

Shashaani, L. (1994). Gender differences in computer experience and its influence on computer attitudes. *Journal of Educational Computing Research, 11*(4), 347-367.

Sherif, C., Kelly, M., Rodgers, H., Sarup, G., Jr., & Tittler, B. (1973). Personal involvement, social judgment, and action. *Journal of Personality and Social Psychology, Vol. 27*(3), 311-328.

Sherif, M., & Cantril, H. (1947). *The psychology of ego-involvements: Social attitudes and identifications*. New York: Wiley.

Sherman, S. J., & Fazio, R. H. (1983). Parallels between attitudes and traits as predictors of behavior. *Journal of Personality, 51*(3), 308-345.

Shih, H.-P. (2004). Extended technology acceptance model of Internet utilization behavior. *Information and Management, 41*(6), 719-729.

Shim, S., Eastlick, M. A., Lotz, S. L., & Warrington, P. (2001). An online prepurchase intentions model: The role of intention to search. *Journal of Retailing, 77*, 397-416.

Simonson, M., Maurer, M., Montag-Torardi, M., & Whitaker, M. (1987). Development of a standardized test of computer literacy and a computer anxiety index. *Journal of Educational Computing Research, 3*(2), 231-247.

Sivacek, J., & Crano, W. (1982). Vested interest as a moderator of attitude-behavior consistency. *Journal of Personality and Social Psychology, 43*(2), 210-221.

Sjöberg , L., & Fromm, J. (2001). Information technology risks as seen by the public. *Risk Analysis, 21*(3), 427-442.

Smith, A. (1975). *Power of the mind*. New York: Ballantine Books.

Smith, M. B., Bruner, J. S., & White, R. W. (1956). *Opinions and personality*. New York, NY: Wiley.

Sosbe, T. (2000). *Paying off nicely: CertMag's 2003 salary survey*. Retrieved June 13, 2005, from http://www.certmag.com/articles/templates/cmag_feature.asp?articleid=523&zoneid=9.

Spacey, R., Goulding, A., & Murray, I. (2004). Exploring the attitudes of public library staff to the Internet using the TAM. *Journal of Documentation, 60*(5), 550.

Staniec, J. (2004). The effects of race, sex, and expected returns on the choice of college major. *Eastern Economic Journal, 30*(4), 549-562.

Stevenson, D. (2000). *Internet Classics Archive*. Retrieved Dec. 4, 2004, from http://classics.mit.edu/Aristotle/soul.html.

Stewart, W. (1997). *How The Net Was Invented*. Retrieved Oct. 30, 2002, from http://livinginternet.com/.

Stinchcombe, A. (1965). Social structure and organizations. In J. March (Ed.), *Handbook of organizations* (pp. 142-193). Chicago: Rand McNally.

Stine, J. K., & Tarr, J. A. (1998). At the Intersection of Histories: Technology and the environment. *Technology and Culture, 39*(4), 601-640.

Stokes, D. E. (1997). *Pasteur's quadrant: Basic science and technological innovation*. Washington, D.C.: Brookings.

Stone, M. (2001, 7-10-2001). E-shopping must be made less technical. *The Washington Post*.

Straub, D. W., Keil, M., & Brenner, W. H. (1997). Testing the technology acceptance model across cultures: A three country study. *Information & Management, 33*(1), 1-11.

Subramanian, G. (1994). A replication of perceived usefulness and perceived ease of use measurement. *Decision Sciences, 25*(5/6), 863-873.

Sumanth, D. J., Omachonu, V. K., & Beruvides, M. G. (1990). A review of the state-of-the-art research on white-collar/knowledge-worker productivity. *International Journal of Technology Management, 5*(3), 337-355.

Szajna, B. (1994). Software evaluation and choice: Predictive evaluation of the Technology Acceptance Instrument. *MIS Quarterly, 18*(3), 319-324.

Szajna, B. (1996). Empirical evaluation of the revised technology acceptance model. *Management Science, 42*(1), 85-92.

Tan, X., Yen, D., & Fang, H. (2002). Internet integrated customer relationship management. *Journal of Computer Information Systems, Spring 2002*, 77-86.

Tapp, A. (2004). The loyalty of football fans: We'll support you evermore? *Journal of Database Marketing and Customer Strategy Management, 11*(3), 203-215.

Taylor, R. W. (1990). *In memoriam: J. C. R. Licklider; 1915-1990*. Palo Alto, CA: Digital - Systems Research Center.

Taylor, S., & Todd, P. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research, 6*, 144-176.

Technology. *Merriam-Webster Online Dictionary*.

Technology. *The American Heritage Dictionary of the English Language, Fourth Edition*.

Technology. *Webster's Revised Unabridged Dictionary*.

Terry, W. (2000). *Learning and Memory; Basic principles, processes, and procedures*. Needham Heights, MA: Allyn and Bacon.

Thompson, M., Zanna, M., & Griffin, D. (1995). Let's not be indifferent about (attitudinal) ambivalence. In R. Petty & J. Krosnick (Eds.), *Attitude strength: Antecedents and consequences* (pp. 361-386). Mahwah, NJ: Lawrence Erlbaum Associates.

Thurstone, L. L. (1931). The measurement of attitudes. *Journal of Abnormal and Social Psychology, 26*, 249-269.

Thurstone, L. L., & Chave, E. J. (1929). *The measurement of attitude*. Chicago, IL: University of Chicago Press.

Todman, J., & Monaghan, E. (1994). Qualitative differences in computer experience, computer anxiety, and students' use of computers: A path model. *Computers in Human Behavior, 10*(4), 529-539.

U.S. Census Bureau. (2001). *Back to school*. Retrieved June 14, 2005, from http://www.census.gov/Press-Release/www/releases/archives/facts_for_features_special_editions/000784.html.

Veiga, J. F., Floyd, S., & Dechant, K. (2001). Towards modelling the effects of national culture on IT implementation and acceptance. *Journal of Information Technology, 16*(3), 145-158.

Venkatesh, V. (1999). Creation of favorable user perceptions: Exploring the role of intrinsic motivation. *MIS Quarterly, 23*(2), 239.

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research, 11*(4), 342-365.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186.

Venkatesh, V., Morris, M., & Ackerman, P. (2000). A longitudinal field investigation of gender differences in individual technology adoption decision-making processes. *Organizational Behavior and Human Decision Processes, 83*(1), 33-60.

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478.

Volk, F. A. (2002). Internet users' attitudes and e-commerce behaviors. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 62*(9-B), 4278.

Von Hecker, U. (2004). Disambiguating a mental model: Influence of social context. *Psychological Record, 54*(1), 27-43.

Von Meier, A. (1999). Occupational cultures as a challenge to technological innovation. *IEEE Transactions on Engineering Management, 46*(1), 101-114.

Walstrom, K. A., & Duffy, T. J. (2003). Implications regarding computer technology attitudes of new employees. *Information Systems Management, 20*(2), 26-31.

Wang, Y., Wang, Y., Lin, H., & Tang, T. (2003). Determinants of user acceptance of Internet banking: An empirical study. *International Journal of Service Industry Management, 14*(5), 501.

Wasson, C. R. (1979). Consumer choice processes: Search, or automatic response? *Journal of the Academy of Marketing Science, 7*(4), 360-373.

Webster, J., & Martocchio, J. (1992). Microcomputer playfulness: Development of a measure with workplace implications. *MIS Quarterly, 16*(2), 201-226.

Webster, J. G., & Lin, S.-F. (2002). The Internet audience: Web use as mass behavior. *Journal of Broadcasting and Electronic Media, 46*(1), 1-12.

Webster's Revised Unabridged Dictionary. (1998). Springfield, MA: C. & G. Merriam Co.

Weigel, R., & Newman, L. (1976). Increasing attitude-behavior correspondence by broadening the scope of the behavioral measure. *Journal of Personality and Social Psychology, 33*, 793-802.

Weinberg, B. D. (2001). The three faces of e, commerce: Insight into online consumer behavior through the interpretation of an Internet consumer's experiences. *Advances in Consumer Research, 28*(1), 218-222.

Weiss, M. J. (2001). Online America. *American Demographics*, 53-60.

Westrum, R., & Adamski, A. J. (1999). Organizational factors associated with safety and mission success in aviation environments. In D. J. Garland, J. A. Wise & V. D. Hopkin (Eds.), *Handbook of aviation human factors*. Mahwah, NJ: Lawrence Erlbaum Associates.

Whorf, B. (1956). In J. Carroll (Ed.), *Language, thought, and reality: Selected writings of Benjamin Lee Whorf*. Cambridge, MA: MIT Press.

Wicker, A. W. (1969). Attitudes versus actions: The relationship of verbal and overt behavioral responses to attitude objects. *Journal of Social Issues, 25*, 41-78.

Williams, G. (2002, September). Innovative model. *Entrepreneur magazine*. Retrieved Jan. 17, 2005, from http://www.entrepreneur.com/startingabusiness/inventing/article54604.html.

Wood, W. (2000). Attitude change: Persuasion and social influence. *Annual Review of Psychology, 51*, 539-570.

Yang, H., & Yoo, Y. (2004). It's all about attitude: Revisiting the technology acceptance model. *Decision Support Systems, 38*(1), 19-31.

Yarbrough, W. V., Koelling, C. P., & Beruvides, M. G. (1993). White collar work: A classification of clerical endeavors. In Sumanth, Edosomwan, Poupart & Sink (Eds.), *Productivity and Quality Management Frontiers* (Vol. 4, pp. 12-21): Institute of Industrial Engineers.

Yi, M., & Hwang, Y. (2003). Predicting the use of web-based information systems: Self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model. *International Journal of Human-Computer Studies, 59*(4), 431-449.

Young, A., Cole, J., & Denton, D. (2003). Enhancing our technological literacy. *World & I, 18*(3), 140-147.

Yu, J. L. C.-S., Liu, C., & Yao, J. E. (2003). Technology acceptance model for wireless Internet. *Internet Research, 13*(3), 206.

Zajonc, R. B., & Markus, H. (1982). Affective and cognitive factors in preferences. *Journal of Consumer Research, 9*(2), 123-131.

Zakon, R. H. (2002). *Hobbes' Internet Timeline v5.6*. Retrieved Aug. 17, 2002, from http://www.zakon.org/robert/internet/timeline/.

Zhang, P., & Li, N. (2005). The importance of affective quality. *Communications of the Association for Computing Machinery, 48*(9), 105-108.

Zhang, P., & von Dran, G. (2000). Satisfiers and dissatisfiers: A two-factor model for website design and evaluation. *Journal of American Association for Information Science, 51*(14), 1253–1268.

Zhang, P., von Dran, G., Blake, P., & Pipithsuksunt, V. (2001). Important design features in different web site domains. *e-Service Journal, 1*(1), 77-91.

Zhang, P., von Dran, G., Small, R., & Barcellos, S. (1999, January 5–8). *Websites that satisfy users: A theoretic framework for Web user interface design and evaluation.* Paper presented at the Hawaii International Conference on Systems Science (HICSS 32), Hawaii.

Zhang, P., von Dran, G., Small, R., & Barcellos, S. (2000, January 2–6). *A Two-Factor Theory for Website Design.* Paper presented at the Hawaii International Conference on Systems Science (HICSS 33), Hawaii.

Zhifang, Z. (2002). Linguistic relativity and cultural communication. *Educational Philosophy & Theory, 34*(2), 161-170.

Zoonen, L. v. (2001). Feminist Internet studies. *Feminist Media Studies, 1*(1).

APPENDIX A
PILOT STUDY

1. Introduction

A study was conducted in the United States and Egypt in order to evaluate attitudes of Internet users and to examine issues that could be faced when conducting the technology imprint model (TIM) experiment. The purpose of testing in both countries was to explore cultural differences between both populations regarding Internet attitudes and behavior as well as perceptions regarding the Internet's usefulness, ease of use, significance, and likeability. Similar samples in both countries were chosen to participate in the study. Most participants were either undergraduate or graduate college students or business professionals in positions ranging from support staff to junior and middle management. Similar distributions of gender and age were also considered in the study.

Participants in the study were asked to complete a questionnaire consisting of two parts. Demographic data was collected in the first part (Q1), while the second part (Q2) collected data about Internet attitudes and perceptions (see Appendix A). Q1 consisted of 18 questionnaire items covering the subject's background: age, gender, ethnicity, primary language, countries of birth and residence, employment, income, Internet usage frequency, and so forth. All Q1 items had multiple-choice, categorical (some ordinal, some nominal) responses. Q2 consisted of 63 items and measured four variables representing attitudes toward the Internet. These are the dependent variables and they will later be discussed in detail.

Technology imprints are believed to exist in positive or negative forms toward technologies in general. In simple terms, they are strong attitudes characterized by their irreversibility and generality across all items considered technological attitude objects (Beruvides and Besheer, 2004). Three main interacting groups of factors are believed to play a significant role in determining the existence and behavior of imprints: personal experience, cognitive factors, and cultural elements. Certain measurables in Q1 are combined to form two of these groups (personal experience and culture). The third group, cognitive factors, consists of the dependent variables measured in Q2. The components of each group are discussed below.

Personal experience is a group of factors that describe the user's personal characteristics and history as well as experience with technology. This category includes age, gender, education, income, and number of years of previous Internet experience. These are all independent variables obtained from the responses in Q1.

As will be shown later, users were classified into one of three cultural/background categories based on their primary language, ethnicity, place of birth, country of residence, and how long they have been living there. The resulting classification represents the culture group. Although one variable is used in the analysis, in reality it is derived from the many variables mentioned above, all of which are independent and obtained from Q1.

The third and last category, cognitive factors, is based on the results obtained in the Q2 responses. These are the dependent variables and the most important measurables in the model. They are perceived usefulness, perceived ease of use, perceived significance, and likeability as reported by participants.

2. Dependent Variables

The 63 questions in the attitude questionnaire (Q2) were in 5-point Likert scale format (1=strongly disagree, 3=neutral, 5=strongly agree). As mentioned above, there were four dependent variables in this study and they were all represented in Q2 (perceived usefulness, perceived ease of use, perceived significance, and likeability). Two of them were directly adapted from Davis's (1986) technology acceptance model (TAM): perceived usefulness and perceived ease of use. Davis's original TAM measures the perceived usefulness and ease of use of any technology chosen by the researcher. TAM is not restricted to any specific technology; rather it states that the questionnaire items can be customized to measure the factors for any object qualifying as *a technology*. In this study, the Internet was chosen as the technology toward which attitudes are investigated.

The other two constructs, developed specifically for use in the pilot study, are perceived significance and likeability. The questionnaire items of these variables were designed based on the original items in TAM as well as general questionnaire design guidelines (Burgess, 2001). The questionnaire was translated into Arabic and verified by

Arabic-speaking instructors at Texas Tech University whose first language is Arabic. Questionnaires in both English and Arabic were made available to subjects in Egypt.

3. Independent Variables

It was natural to investigate age, an independent variable, since the Internet has developed quite suddenly within the last decade. Some of today's Internet users were not even born when the Internet became mainstream in the mid 1990s, while others had already retired. Many Internet users fall somewhere between those two categories. A user's understanding, expectations, and ambitions can vary dramatically among an elementary school student, a college student, and a university professor. It is not difficult to see how the user's age when first exposed to the Internet (whether that was last year or 15 years ago) has the potential to play an important role in shaping his or her attitude toward the Internet today.

Ordinal age data collected in the questionnaires allowed the subjects to choose one of four age groups: 25 or under, 26-40, 41-55, or 56 or older. This categorization was chosen in order to classify users according to their age in 1995 when the Internet became widely available: the first category, 25 or under, would have been at the age of high school students or younger; the second, 26-40, college students or in the early stages of their careers; the third, 41-55, in intermediate stages of their careers; and the last group, 56 and older, in advanced stages of their careers and possibly even retired.

Gender was considered in the study not because it was expected to have a significant effect, but to answer the question of whether or not it does (Venkatesh et al., 2000). There is an abundance of literature regarding gender differences in education, employment, career choice, and technology acceptance (Arvey and Campion, 1982; Athey and Hautaluoma, 1994; Cukier et al., 2002; Fang et al., 2004; Loureiro et al., 2004; Shaffer and Johnson, 1980; Staniec, 2004; Venkatesh et al., 2000). Many of these studies argue that males are more technically and scientifically inclined than females and are more likely to be mathematicians, scientists, or engineers. The factors often investigated as being the cause of these gender differences include parental and social influences, stereotypes, and cultural pressures (Reis, 2002). While the reasons for gender differences, innate or learned, are the cause of extensive and sometimes sensitive debate, it is

generally agreed that they can, and often do, exist (Sax, 2005). It is an objective of this research to detect any gender differences in attitudes toward technology, and eventually in technology imprints. For this reason, gender was included as an independent variable.

Language is an important variable to consider since computers and the Internet cater mainly to the English speaker. In a recent study of Internet statistics and demographics, it was determined that approximately 75 percent of all websites use English as the primary language (O'Neill et al., 2003). Therefore, if a user's primary language is not English, or he or she doesn't speak English at all, they could be at a disadvantage. This could affect their attitude toward the Internet.

The theory of linguistic determinism argues that an individual's behavior is defined, shaped, and controlled to a large degree by his or her language because of the restrictions imposed by vocabulary (Whorf, 1956; Zhifang, 2002). This concept, developed by Edward Sapir and Benjamin Whorf , is often referred to as the Sapir-Whorf hypothesis or the Whorfian hypothesis. Sapir states that:

> "Human beings do not live in the objective world alone, nor alone in the world of social activity as ordinarily understood, but are very much at the mercy of the particular language which has become the medium of expression for their society. It is quite an illusion to imagine that one adjusts to reality essentially without the use of language and that language is merely an incidental means of solving specific problems of communication or reflection. The fact of the matter is that the 'real world' is to a large extent unconsciously built upon the language habits of the group. No two languages are ever sufficiently similar to be considered as representing the same social reality. The worlds in which different societies live are distinct worlds, not merely the same world with different labels attached…We see and hear and otherwise experience very largely as we do because the language habits of our community predispose certain choices of interpretation" (Sapir, 1929).

For these reasons, it is important to include language in the analysis. This data is nominal with four possible responses: Arabic, English, Spanish, or other. The language in which the questionnaire was filled out was also considered since it is an indication of the user's language of preference when interacting with media.

Education and income are independent factors expected to have an effect on attitudes toward technology. Spending more years in an academic environment suggests more exposure to up-to-date computer facilities and some computer training. Similarly,

higher income suggests more exposure to up-to-date computer equipment. These two factors are likely to be correlated with the last factor in this group, Internet experience. This is particularly true among Egyptian subjects where Internet penetration was only 4.3% nationwide (Internet World Stats, 2005a) versus the U.S. where 67.8% of the population had some form of Internet access (Internet World Stats, 2005b). For ease of calculation and analysis, income was grouped into three classifications: under $50,000, $50,000 and over, and would rather not say. The cutoff income figure of $50,000 was chosen because of its centrality.

4. Methodology

A total of 117 subjects were tested. Seventy seven questionnaires were filled out in Egypt: 45 in English and 32 in Arabic. Forty questionnaires were filled out in the U.S., all of which were in English.

The first step in preparing the data for analysis was to omit responses from participants who had never used the Internet. It was decided that a person with no prior Internet experience is not qualified to judge its usefulness, significance, or other characteristics. Therefore, the questionnaires of all participants who indicated no previous Internet experience were automatically rejected before any further consideration or analysis. It should be noted that all rejected questionnaires were filled out in Egypt. All 40 U.S. participants had some prior Internet experience.

For the remaining responses, a classification system was used to separate participants with an Egyptian background, participants with an American background, and participants with a third, unspecified background. It was accomplished by carefully studying the responses. Participants whose responses indicated they are currently living in the same country in which they were born, and that they had lived in that country all their lives, were automatically added to the group representing that country. Participants who were living in a country other than that in which they were born and had been living there less than 10 years were automatically added to the mixed background group. Others were manually classified on an individual, case-by-case basis after considering other responses like primary language, ethnicity, age, etc. The background classification was meant to indicate whether the individual is more likely to be immersed in Egyptian,

American, or some other culture. It does not necessarily mean the person is a citizen of that country or was born there. The 10-year cutoff point was chosen since the public Internet was approximately 10 years old when the study was conducted. Therefore, if an individual has been living in a certain country for that whole period, he or she is likely to have been influenced by that environment regarding the Internet.

After eliminating participants whose responses indicated no Internet experience, the total number of qualifying questionnaires became 103. The number of qualifying questionnaires filled out in English was 85. Eighteen qualifying questionnaires were filled out in Arabic, all of which were completed in Egypt. Forty-five of the 85 English questionnaires were completed in Egypt, while 40 were completed in the U.S. By location, a total of 63 qualifying questionnaires were completed in Egypt and 40 in the U.S.

As previously mentioned, several variables were classified in a smaller number of categories than the original questionnaires, which was also done to simplify the calculations and add more contrast to the results. These variables are education, in which bachelor or less/master or higher was used as the cutoff point; cultural group, which was dependent on several other variables (primary language, ethnicity, place of birth, country of residence, and how long the individual has been living there); and income, in which under $50,000/above $50,000 was used as the cutoff point.

Initial data analysis indicated a significant effect of having a bachelor's degree compared with other educational levels. Based on those preliminary results, the bachelor's degree was decided upon to be used as a cutoff point in creating two educational groups. All responses were categorized into bachelor's degree or lower or master's degree or higher. The $50,000 salary cutoff was chosen because of its simplicity as well as being approximately the average salary in the U.S. in many fields (American Federation of Teachers, 2003; Business Week Online, 2000; Sosbe, 2000; U.S. Census Bureau, 2001).

In the Arabic questionnaires, income was presented in Egyptian pounds not U.S. dollars. These responses had to be converted to their equivalent dollar amount to maintain consistency throughout the data. However, this was not enough to equate and reliably compare the salaries from both countries. That is because the value of the dollar is much

higher in Egypt than it is in the U.S. An annual salary of $10,000 in Egypt is a great privilege and is sufficient to maintain a very comfortable and somewhat luxurious lifestyle. Therefore, it was decided not to use income in the analysis.

In the preliminary analysis, it was found that the residential area in which the user lived was significant in determining their dependent variable responses. This seems to be of no value as most of the U.S. respondents live in a small city, which some classified as being rural. Meanwhile, most Egyptians classified themselves as residents of urban or suburban areas. The problem with this classification system is that the rural area as classified by the American respondents probably provides easier access to computers and more high-tech facilities than the urban and suburban areas reported by Egyptians. Consequently, users from rural areas had more favorable attitudes toward the Internet than those from urban areas. Therefore, the lack of reliability renders this variable useless. For this reason, it was not used in the analysis.

Of the 63 attitude measurement items in Q2, 10 were negatively oriented. During the pre-analysis data review, the answers to those questions were reversed in order to maintain consistency in the answering structure. Each of the four dependent variables was represented in Q2 by 14 Likert-style items. For practical reasons, the average response of each group of items was calculated and used in the analysis.

It was determined that the appropriate independent variables to be used in the model are age, gender, Internet use, culture group, education group, and questionnaire language, which is the language in which the questionnaire was printed and filled out. Internet use refers to the extent of the subject's prior Internet experience in years. Income was not used due to the discrepancy between the equivalent incomes in Egypt and the U.S. Absolute monetary value would be a misrepresentation of the subject's actual standard of living because of the different economies of the two countries.

A 6-way factorial multivariate analysis of variance was conducted in SPSS that included all the main effects as well as all 2-way interactions. No interactions higher than 2-way were included in order to maintain parsimony in the study. An alpha of 0.05 was chosen. After an initial analysis, it was determined that age and gender had no significant effects. In order to simplify the model, those two variables were removed. The model was

reduced to main effects of the remaining four independent variables as well as the 2-way interaction education group x Internet use.

5. Results

Using Pillai's trace, the results of the analysis yielded significant main effects of culture group, $F(8,186) = 2.40$, $p = 0.02$, education group, $F(4,92) = 4.65$, $p = 0.01$, Internet use, $F(8,186) = 2.88$, $p = 0.01$, and questionnaire language, $F(4,92) = 4.79$, $p = 0.01$, and a significant interaction effect for education group x Internet use, $F(4,92) = 6.70$, $p = 0.01$).

In between-subjects tests, culture group had a significant effect on perceived usefulness, $F = 5.11$, $p = 0.01$. Contrast tests showed that Americans ($N = 32$, $M = 4.24$, $SD = 0.58$) rated perceived usefulness higher than Egyptians ($N = 50$, $M = 3.75$, $SD = 0.82$), $p = 0.03$, and higher than the mixed-culture group ($N = 21$, $M = 3.751$, $SD = 0.896$), $p = 0.01$ (see Figure 1).

Similarly, education group had a significant effect on perceived usefulness, $F = 4.01$, $p = 0.05$, and perceived ease of use, $F = 5.00$, $p = 0.03$. The master's or higher group ($N = 19$, $M = 3.99$, $SD = 0.98$) rated perceived usefulness, $p = 0.05$, higher than bachelor's or lower ($N = 84$, $M = 3.88$, $SD = 0.76$). Additionally, master's or higher ($M = 3.86$, $SD = 0.82$) rated perceived ease of use, $p = 0.03$, higher than bachelor's or lower ($M = 3.81$, $SD = 0.59$) (see Figure 2 and Figure 3).

Internet use had a significant effect on perceived usefulness, $F = 5.23$, $p = 0.01$. Those who had used the Internet four or more years at the time of the experiment ($N = 86$, $M = 3.96$, $SD = 0.80$) rated perceived usefulness, $p = 0.01$, higher than those who had used it 1-3 years ($N = 15$, $M = 3.69$, $SD = 0.79$) and higher (although not significantly), $p = 0.27$, than those who had used the Internet less than a year ($N = 2$, $M = 3.14$, $SD = 0.81$) (see Figure 4).

Questionnaire language had significant effects on perceived ease of use, $F = 8.47$, $p = 0.01$. Those who filled out the questionnaire in Arabic ($N = 18$, $M = 3.26$, $SD = 0.32$) Found the Internet more difficult to use than those who filled out the English version ($N = 85$, $M = 3.94$, $SD = 0.63$). The effect of questionnaire language on perceived significance, $F = 7.65$, $p = 0.01$, was also significant with Arabic questionnaire subjects

(N = 18, M = 3.54, SD = 0.37) found the Internet less significant than English questionnaire subjects (N = 85, M = 4.20, SD = 0.67). Also, there was a significant effect on likeability, F = 5.44, p = 0.02, with Arabic questionnaire subjects (N = 18, M = 3.20, SD = 0.29) finding the Internet less likeable than English questionnaire subjects (N = 85, M = 3.70, SD = 0.66) (see Figure 5, Figure 6, and Figure 7).

The interaction effect, education group x Internet use, had significant effects on perceived usefulness, F = 12.69, p = 0.01, and perceived ease of use, F = 4.92, p = 0.03. The descriptive statistics showing the interaction relationships can be seen in Figure 8, Figure 9, Figure 10, and Figure 11.

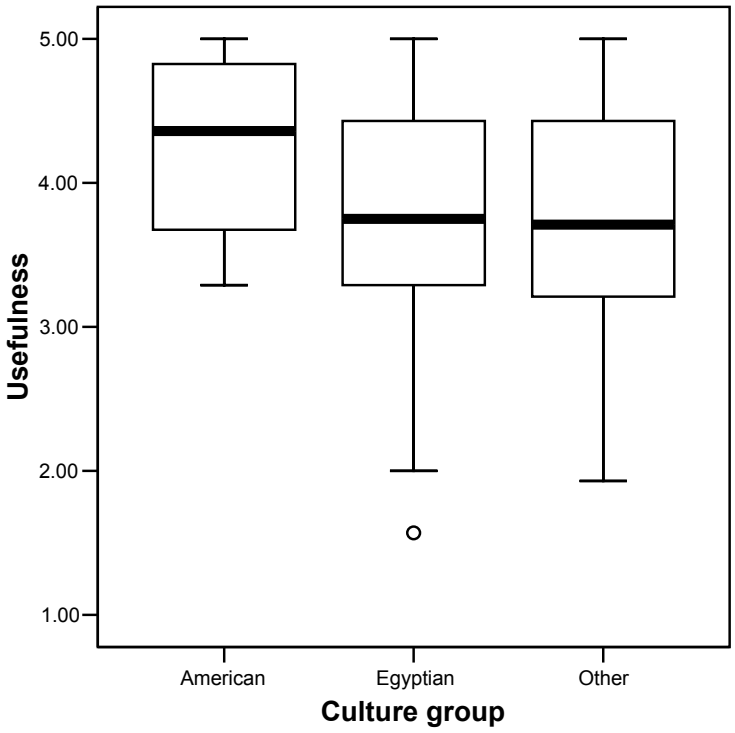

Figure 1. Effect of culture group on perceived usefulness.

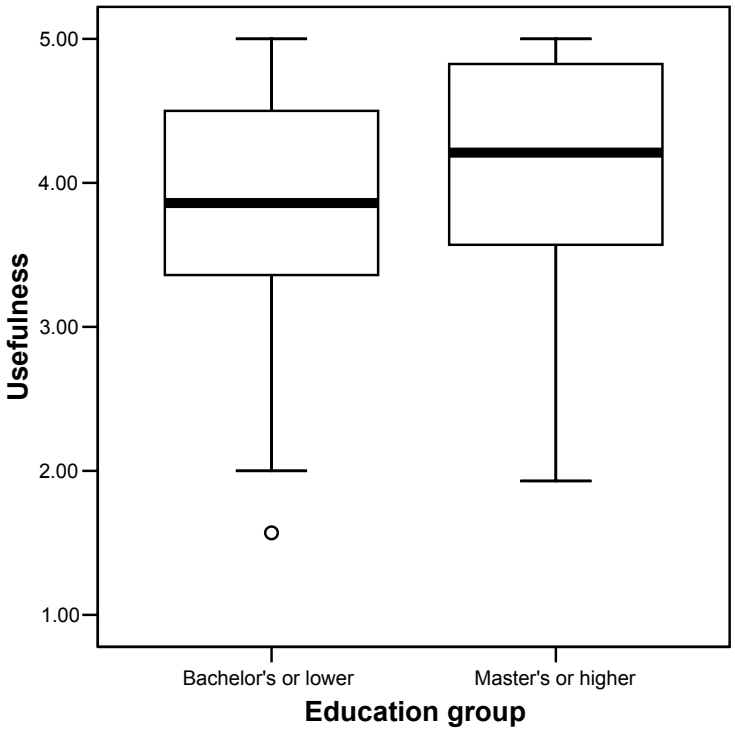

Figure 2. Effect of education group on perceived usefulness.

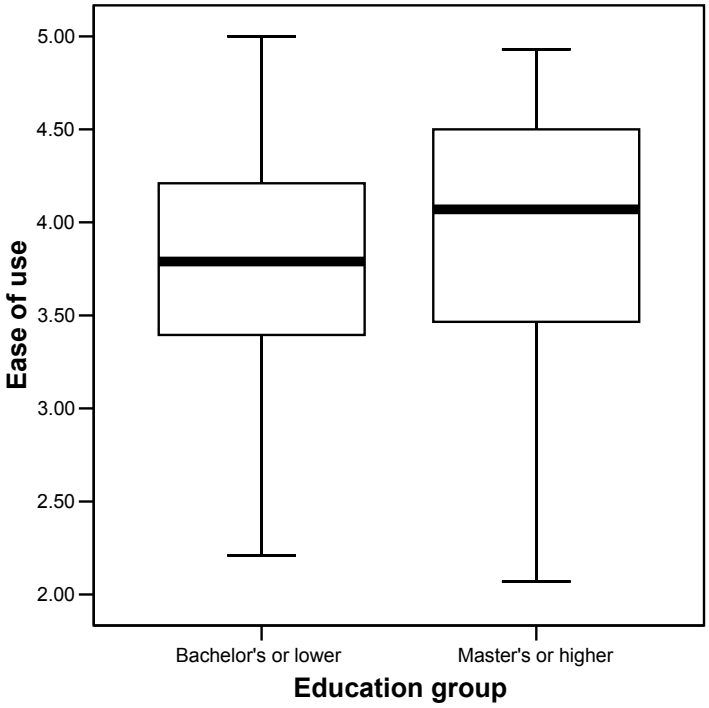

Figure 3. Effect of education group on perceived ease of use.

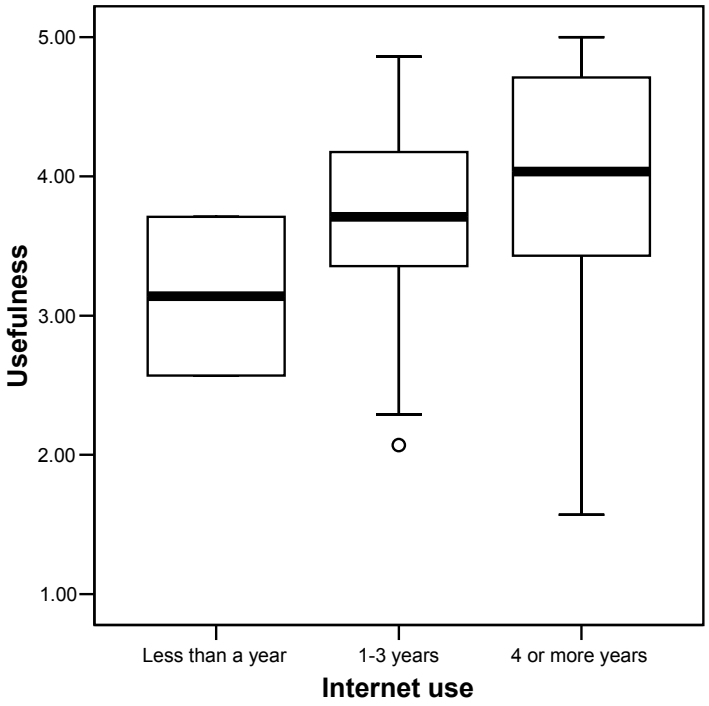

Figure 4. Effect of Internet use on perceived usefulness.

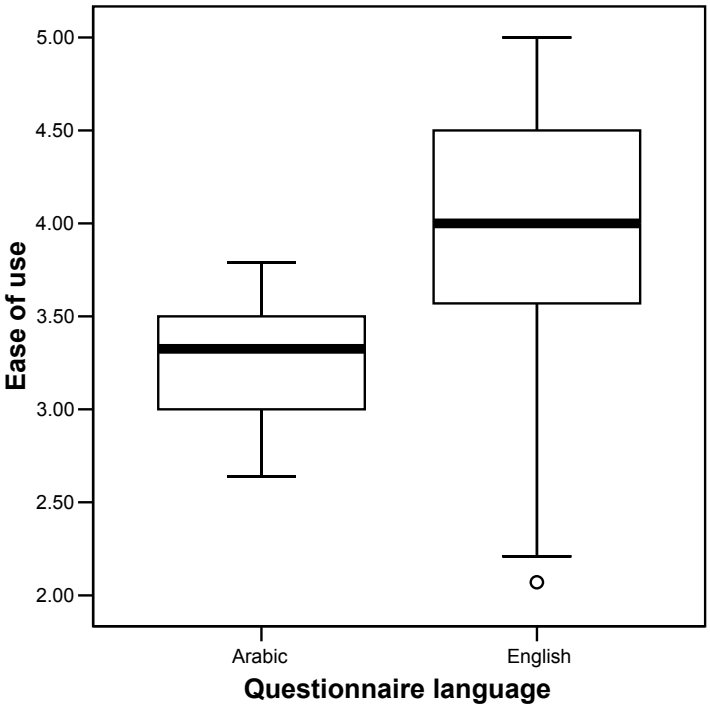

Figure 5. Effect of questionnaire language on perceived ease of use.

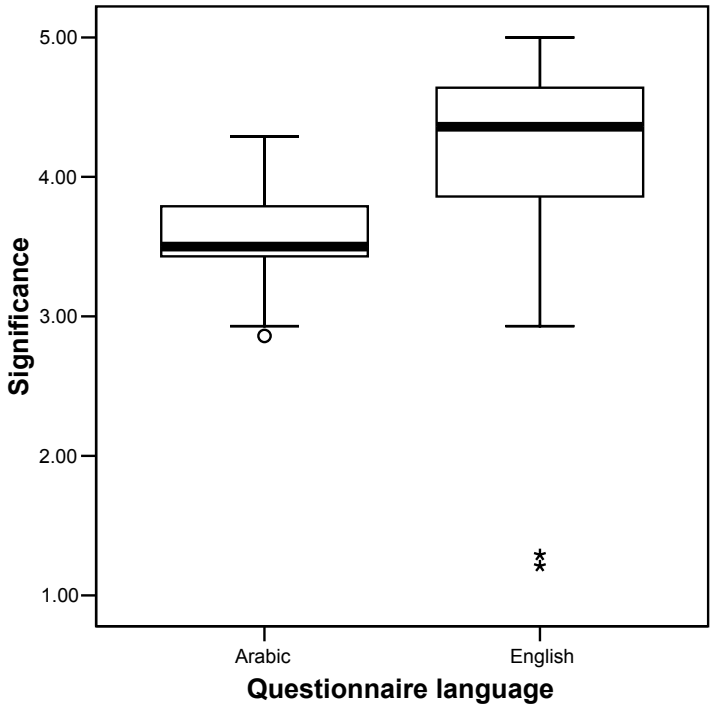

Figure 6. Effect of questionnaire language on perceived significance.

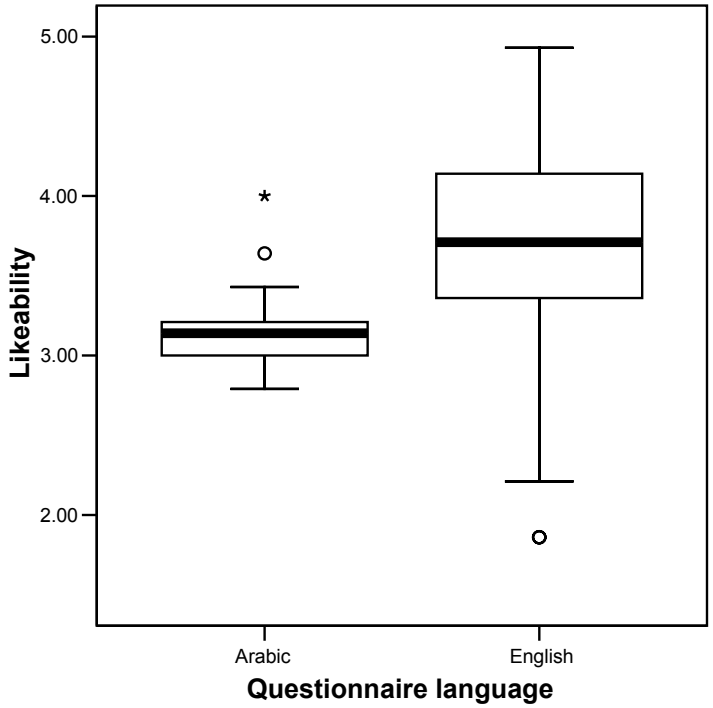

Figure 7. Effect of questionnaire language on likeability.

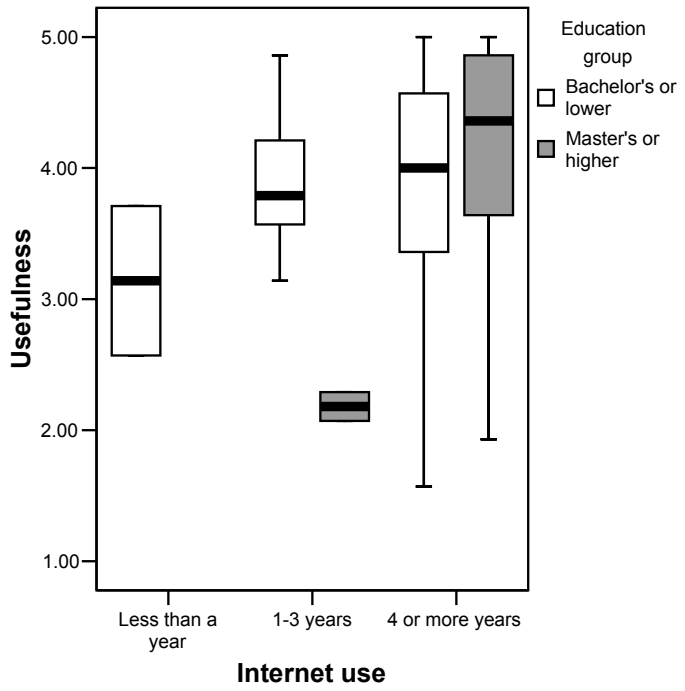

Figure 8. Internet use x education group interaction effect on perceived usefulness.

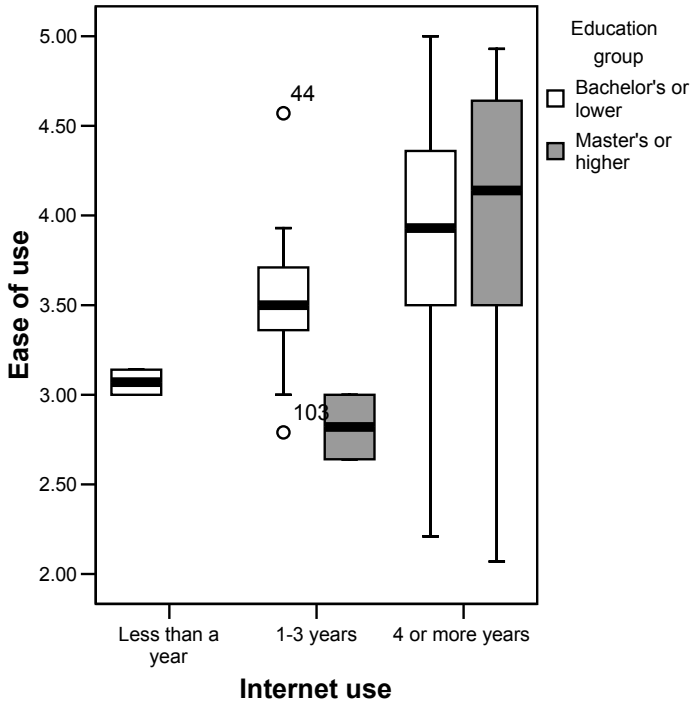

Figure 9. Internet use x education group interaction effect on perceived ease of use.

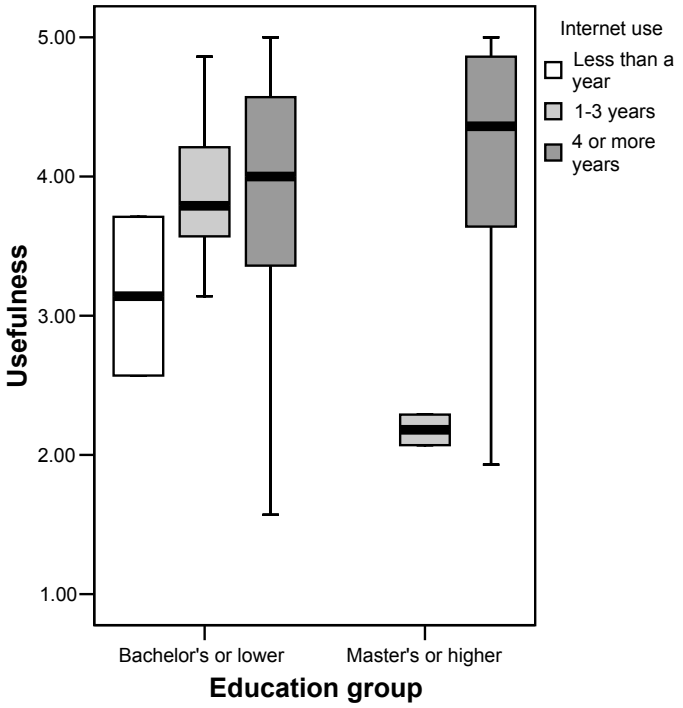

Figure 10. Education group x Internet use interaction effect on perceived usefulness.

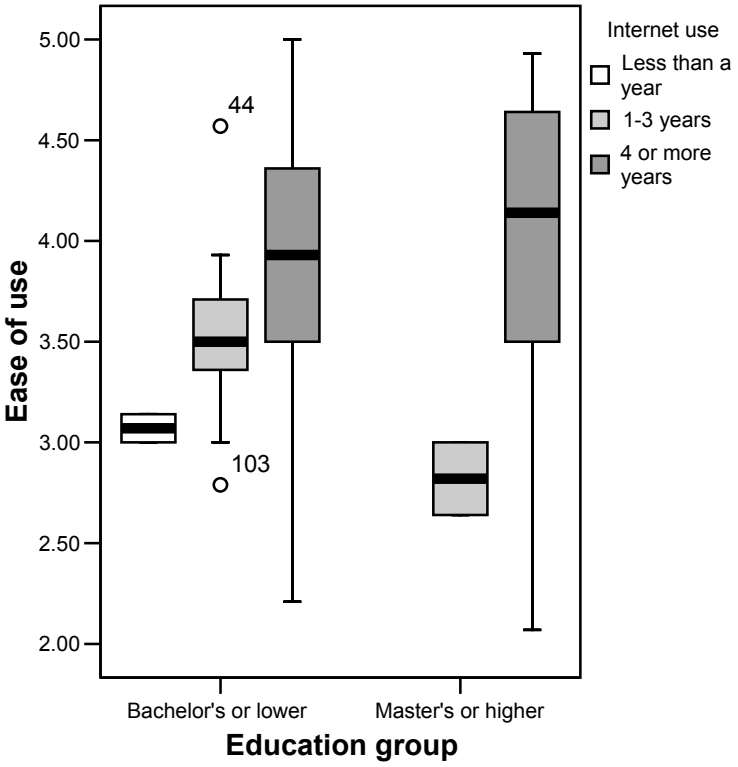

Figure 11. Education group x Internet use interaction effect on perceived ease of use.

6. Discussion

With the high degree of reliance on the Internet found in many organizations and among individuals today, it is important to realize that attitudes toward the Internet are not always the same among different groups of people. Understanding some of the factors that create those differences contributes even more to the value of this knowledge. The pilot study showed that American users generally found the Internet significantly more useful than their Egyptian and non-American, non-Egyptian counterparts and easier to use than Egyptians. In addition, those who filled out the questionnaire in Arabic had significantly more negative views of the Internet with regards to ease-of-use, significance, and likeability.

It would have been more informative and accurate to collect exact data (rather than categorized) then classify subjects into their respective groups, if needed. This would be relevant for independent variables such as age, Internet use, years spent in current country of residence, and so on. Exact data will be collected in future experiments. Nevertheless, given the available data, valuable knowledge was gained from this study.

Because of high levels of significance exhibited by questionnaire language in the pilot study, it is worthwhile to further investigate subjects who fill out the Arabic version of the questionnaire in future experimentation. Choosing an Arabic questionnaire may have some significant implications. It is possible that a subject who chooses an Arabic questionnaire could find the Internet less likeable or useful than a subject who chooses an English questionnaire. This is a particularly interesting concept, considering that the primary language used in the vast majority of Internet websites is English. Until this day, for example, no Arabic search engines exist.

While services such as Yahoo and Google can search for Arabic terms, they are not primarily Arabic language websites, and are not designed for the Arabic speaker. In fact, there are several complexities that have yet to be resolved before effective Arabic search engines can be developed. One such problem is that of diacriticals that are used as pronunciation aids in Arabic. They are markings that are placed above or below letters to

indicate certain accents or vowel-like sounds. What emphasizes this problem is that these marks are not always used. Many books and almost all daily, weekly, and monthly publications are printed without diacriticals. Some websites use them, some do not. That is because Arabic readers generally do not need them unless they encounter new words or words that are very difficult to pronounce, both of which are highly unlikely due to the derivative nature of Arabic. The context in which the words are used is usually sufficient to deduce the correct word and its pronunciation. However, since not all websites use them, effective online searches become very difficult. For example, without the use of diacriticals, the Arabic words for *Qur'an* and *marriage* are identical. Therefore, searching for that word would yield many unwanted results. At the same time, a search using diacriticals would severely limit the results.

Similarly, Arabic e-commerce, e-banking, weather forecasts, employment services, traffic reports, and other such functionalities that are considered fairly common in the English Internet are much less available and user-friendly than their English counterparts. In order to better explain this, several questions must be answered. Listed below are some questions that should be included (after proper wording and formatting) in the Arabic version of the questionnaire if this experiment is to be repeated.

- What is the subject's ratio of Arabic to English Internet usage?
- Do subjects who prefer filling out Arabic questionnaires also use mostly Arabic Internet applications/websites?
- Are subjects who choose Arabic questionnaires familiar with English Internet terminology such as *browser*, *email*, *window*, *click*, *save*, and so on, or do they only know the Arabic terminology?
- Does the subject think there are differences between Arabic and English websites? If so, which language does the subject think the Internet favors, if any?
- Would the subject use the Internet more frequently or for more complex tasks if they were more familiar with English Internet terminology or if Arabic websites were more developed?

7. Conclusion

While technology imprints were not measured in the pilot study, attitudinal differences between Egyptian and American users regarding Internet use were detected. Generally, Egyptians rated the Internet less favorably than Americans. The data showed that extreme values, or potential imprint subjects, as expected, are arranged in a pattern among the two groups. Negatively biased responses were found mainly in Egypt while positively biased responses were found mainly in the U.S. Therefore, it is expected to find the majority of negatively imprinted individuals in Egypt and positively imprinted individuals in the U.S. in future research.

8. Implications of the Study

Valuable knowledge was gained by conducting the pilot study. However, it was not intended to determine whether technology imprints exist. It demonstrated the robustness of the technology acceptance model (TAM) measures, perceived usefulness (PU) and perceived ease of use (PEOU), on several occasions. It did not show a similarly strong effect for perceived significance (PS) and likeability (L), although hints of their importance appeared a few times. For this reason, the main experiment will test PU and PEOU along with a modified L and a new imprint variable (I). the experiment will address the effect of I on the frequency of use (FOU) of the technology, rather than attempt to find the variables leading to imprints.

Demographic data will be collected in a questionnaire similar to that used in the pilot study. The number of items on the demographic questionnaire will be reduced as many of them turned out to be of little, if any, importance (e.g. marital status, number of children under 16 in household, classification of residential area, etc.). Modifications will also be made to the attitude questionnaire. In the pilot study, users responded to constructs measuring only attitudes toward the Internet. The pilot study showed that some extreme attitudes toward the Internet existed, which will be the focus of the main experiment.

In order to justify classifying extreme responses as potential technology imprinted individuals, it must be proven that their behavior and attitude will extend beyond the limits of the Internet platform and exhibit the same patterns in another technology. Users

must also demonstrate some form of irreversibility in their responses. The attitude questionnaire will, therefore, be repeated among users for two different technologies. The Internet will still be used as one of the technologies. In addition, ATMs will be used as the other technological object. An exploratory technology, mobile phone imaging, will also be included. The responses will be tested for cross-platform extreme values and cross-platform behavioral similarities in general.

9. Questionnaires Used in the Pilot Study

Questionnaire #1:

1. What is your age?

□ 25 or under
□ 26-40
□ 41-55
□ 56 or older

2. What is your gender?

□ Male
□ Female

3. What is your primary language?

□ Arabic
□ English
□ Spanish
□ Other _____

4. What is the highest level of education you have completed?

□ Grammar school
□ High school or equivalent
□ Vocational/technical school (2-year)
□ Some college
□ Bachelor's degree
□ Master's degree
□ Doctoral degree
□ Professional degree (MD, JD, etc.)
□ Other _____

5. How would you classify yourself?
□ Arab
□ Asian/Pacific Islander
□ Black
□ Caucasian
□ Hispanic
□ Indigenous or Aboriginal
□ Latino
□ Multiracial
□ Would rather not say
□ Other _____

6. What is your current marital status?
□ Divorced
□ Living with a partner
□ Married
□ Separated
□ Single
□ Widowed
□ Would rather not say

7. Where do you currently reside?
□ Egypt
□ United States
□ Other _____

8. How long have you been living there?
□ Less than 9 years
□ 10-40 years
□ More than 40 years
□ All my life

9. Where were you born?
□ Egypt
□ United States
□ Other _____

10. What is your current household income in U.S. dollars?
□ Under $9,999
□ $10,000 - $19,999
□ $20,000 - $29,999
□ $30,000 - $39,999
□ $40,000 - $49,999
□ $50,000 - $74,999
□ $75,000 - $99,999
□ $100,000 - $150,000
□ Over $150,000
□ Would rather not say

11. Which of the following best describes the area you live in?
□ Urban
□ Suburban
□ Rural

12. How many children under 16 live in your household?
□ None
□ 1
□ 2-3
□ 4 or more

13. Which of the following categories best describes your primary area of employment (regardless of your actual position)?
□ Homemaker
□ Retired
□ Student
□ Unemployed
□ Agriculture
□ Arts
□ Broadcasting
□ Education
□ Construction
□ Finance and insurance
□ Government and public administration
□ Health care and social assistance
□ Hotel and food services
□ Information
□ Legal services
□ Manufacturing
□ Military
□ Mining
□ Processing
□ Publishing
□ Real estate
□ Religious
□ Retail
□ Scientific or technical services
□ Software
□ Telecommunications
□ Transportation and warehousing
□ Utilities
□ Wholesale
□ Other _____

14. Which of the following best describes your role in industry?
□ Upper management
□ Middle management
□ Junior management
□ Administrative staff
□ Support staff
□ Student
□ Trained professional
□ Skilled laborer
□ Consultant
□ Temporary employee
□ Researcher
□ Self-employed
□ Other _____

15. The organization you work for is in which of the following?
□ Public sector
□ Private sector
□ Not-for-profit
□ Don't know
□ Other _____

16. How long have you been using the Internet?
□ Never used it
□ Less than a year
□ 1-3 years
□ 4 or more years

17. How frequently do you access the Internet from the following places?

	Daily	Weekly	Monthly	Less than once a month	Never
Home	□	□	□	□	□
Work	□	□	□	□	□
School	□	□	□	□	□
Public terminal	□	□	□	□	□
Other	□	□	□	□	□

18. Who pays for your Internet access?
□ Self/spouse
□ Parents
□ Work
□ School
□ Don't know
□ Other _____

Questionnaire #2:

		Strongly disagree		Neutral		Strongly agree
1	I like to use the Internet.	1	2	3	4	5
2	Using the Internet improves the quality of the work I do.	1	2	3	4	5
3	Using the Internet at work or school makes my work more pleasant.	1	2	3	4	5
4	The Internet addresses my job-related needs.	1	2	3	4	5
5	The Internet enables me to finish tasks more quickly.	1	2	3	4	5
6	Using the Internet is enjoyable rather than being a burden.	1	2	3	4	5
7	It is important to encourage students to use the Internet.	1	2	3	4	5
8	It is fun to use the Internet.	1	2	3	4	5
9	Using the Internet makes it easier to do my job.	1	2	3	4	5
10	When new websites are launched, I like to be among the first to see them.	1	2	3	4	5
11	People at work or school expect me to use the Internet.	1	2	3	4	5
12	When I have access to the Internet, I usually use it.	1	2	3	4	5
13	Using the Internet enhances my effectiveness on the job.	1	2	3	4	5

14	The Internet is rigid and inflexible to interact with.	1	2	3	4	5
15	It is easy for me to remember how to perform tasks using the Internet.	1	2	3	4	5
16	People who don't have email addresses are old-fashioned.	1	2	3	4	5
17	I often use the Internet for leisure.	1	2	3	4	5
18	I rely on the Internet to communicate with friends and family.	1	2	3	4	5
19	The Internet often behaves in unexpected ways.	1	2	3	4	5
20	Using the Internet increases my productivity.	1	2	3	4	5
21	There is no need to go to a store as long as I can buy the same product online.	1	2	3	4	5
22	In the future, the Internet will be more important to individuals than it is today.	1	2	3	4	5
23	It is easy to use the Internet to find helpful guidance in performing tasks.	1	2	3	4	5
24	In a business environment, it is important to teach every employee to use the Internet regardless of their rank.	1	2	3	4	5
25	The Internet is the backbone of many of today's business organizations.	1	2	3	4	5
26	Overall, I find the Internet useful in my job.	1	2	3	4	5
27	The Internet improves the quality of life of those who use it.	1	2	3	4	5
28	Most companies need the Internet to succeed.	1	2	3	4	5

29	I often spend my spare time browsing the Internet.	1	2	3	4	5
30	The Internet allows me to accomplish more work than would otherwise be possible	1	2	3	4	5
31	I frequently make errors when using the Internet.	1	2	3	4	5
32	Interacting with the Internet requires a lot of mental effort.	1	2	3	4	5
33	In the future, the Internet will be more important to businesses than it is today.	1	2	3	4	5
34	I like to use the Internet to watch videos or listen to music.	1	2	3	4	5
35	Overall, I find using the Internet a pleasant experience.	1	2	3	4	5
36	The influence of the Internet will increase over time.	1	2	3	4	5
37	I find it easy to recover from errors that occurred while I was using the Internet.	1	2	3	4	5
38	I only use the Internet when I have to.	1	2	3	4	5
39	Overall, I find the Internet easy to use.	1	2	3	4	5
40	Using the Internet gives me greater control over my work.	1	2	3	4	5
41	Using the Internet is one of my favorite pastimes.	1	2	3	4	5
42	Using the Internet saves me time.	1	2	3	4	5
43	Using the Internet is stressful.	1	2	3	4	5

44	Overall, I find the Internet an important tool that everyone should learn.	1	2	3	4	5
45	Without the Internet, my job would be more difficult to perform.	1	2	3	4	5
46	The Internet is a main part of my daily life.	1	2	3	4	5
47	The Internet supports critical aspects of my job.	1	2	3	4	5
48	It is necessary to have Internet-equipped computers in any academic institution.	1	2	3	4	5
49	I always use the most up-to-date versions of software.	1	2	3	4	5
50	I often become confused when I use the Internet.	1	2	3	4	5
51	I find it cumbersome to use the Internet.	1	2	3	4	5
52	I would rather use the Internet than the library for research.	1	2	3	4	5
53	I find it easy to use the Internet to accomplish what I set out to do.	1	2	3	4	5
54	Interacting with the Internet is often frustrating.	1	2	3	4	5
55	I need to seek help often when using the Internet.	1	2	3	4	5
56	The future of communications is in the Internet.	1	2	3	4	5
57	Most of my colleagues and friends use the Internet.	1	2	3	4	5
58	The Internet is a good entertainment tool.	1	2	3	4	5

59	Without Internet knowledge and skills, employers will be less likely to hire me.	1	2	3	4	5
60	My interaction with the Internet is easy for me to understand.	1	2	3	4	5
61	Without the Internet, it would be harder to get things done.	1	2	3	4	5
62	Using the Internet improves my job performance.	1	2	3	4	5
63	Using the Internet reduces the time I spend on unproductive activities.	1	2	3	4	5

10. Pilot Study References

American Federation of Teachers. (2003). *2003 survey and analysis of teacher salary trends*. Retrieved Jun 15, 2005, from http://www.aft.org/salary/2003/download/2003Table1.pdf

Arvey, R., & Campion, J. (1982). The employment interview: A summary and review of recent research. *Personal Psychology, 35*, 281-322.

Athey, T., & Hautaluoma, J. (1994). Effects of applicant over-education, job status, and job gender stereotype on employment decisions. *Journal of Social Psychology, 134*(4), 439-452.

Beruvides, M., & Besheer, H. (2004). *Technology imprint: A systematic analysis on the impact and filtering effects of technology on user perception.* Paper presented at the ASEM Annual Conference, Washington, D.C.

Burgess, T. F. (2001). *A general introduction to the design of questionnaires for survey research*. Retrieved Nov 28, 2004, from http://www.leeds.ac.uk/iss/documentation/top/top2.pdf

Business Week Online. (2000). *Salary survey 2000*. Retrieved Jun 14, 2005, from http://www.businessweek.com/smallbiz/salary/sb_naverage.htm

Cukier, W., Shortt, D., & Devine, I. (2002). Gender and Information Technology: Implications of definitions. *Journal of Information Systems Education, 13*(1), 7-16.

Fang, X., Lee, S., Lee, T., & Huang, W. (2004). Critical factors affecting job offers for new MIS graduates. *Journal of Information Systems Education, 15*(2), 189-203.

Internet World Stats. (2005a). *Internet usage statistics for Africa*. Retrieved Jun 15, 2005, from http://www.internetworldstats.com/stats1.htm

Internet World Stats. (2005b). *Internet usage statistics for the Americas*. Retrieved Jun 15, 2005, from http://www.internetworldstats.com/stats2.htm

Loureiro, P., Carneiro, F., & Sachsida, A. (2004). Race and gender discrimination in the labor market: An urban and rural sector analysis for Brazil. *Journal of Economic Studies, 31*(2), 129-143.

O'Neill, E. T., Lavoie, B. F., & Bennett, R. (2003). *Trends in the evolution of the public web: 1998-2002*. Retrieved April 18, 2005, from http://www.dlib.org/dlib/april03/lavoie/04lavoie.html

Reis, S. M. (2002). Social and emotional issues faced by gifted girls in elementary and secondary school. *SENG Newsletter, 2*(3), 1-5.

Sapir, E. (1929). The status of linguistics as a science. *Language, 5*, 207-214.

Sax, L. (2005). *Why Gender Matters*. New York: Doubleday.

Shaffer, D., & Johnson, R. (1980). Effects of occupational choice and sex-role preferences on attractiveness of competent men and women. *Journal of Personality, 48*(4), 505-519.

Sosbe, T. (2000). *Paying off nicely: CertMag's 2003 salary survey*. Retrieved Jun 13, 2005, from http://www.certmag.com/articles/templates/cmag_feature.asp?articleid=523&zoneid=9

Staniec, J. (2004). The effects of race, sex, and expected returns on the choice of college major. *Eastern Economic Journal, 30*(4), 549-562.

U.S. Census Bureau. (2001). *Back to school*. Retrieved Jun 14, 2005, from http://www.census.gov/Press-Release/www/releases/archives/facts_for_features_special_editions/000784.html

Venkatesh, V., Morris, M., & Ackerman, P. (2000). A longitudinal field investigation of gender differences in individual technology adoption decision-making processes. *Organizational Behavior and Human Decision Processes, 83*(1), 33-60.

Whorf, B. (1956). In J. Carroll (Ed.), *Language, thought, and reality: Selected writings of Benjamin Lee Whorf*. Cambridge, MA: MIT Press.

Zhifang, Z. (2002). Linguistic relativity and cultural communication. *Educational Philosophy & Theory, 34*(2), 161-170.

APPENDIX B
DEFINITIONS

Attitude (A) within the context of the theory of reasoned action (TRA):
A person's location on a bipolar evaluative or affective dimension with respect to some object, action, or event (Fishbein and Ajzen, 1975).

An individual's positive or negative feelings (evaluative affect) about performing the target behavior (Davis et al., 1989).

Attitude strength (S):
The extent to which an attitude manifests durability or impactfulness or both (Krosnick and Petty, 1995).

Behavioral intention (BI):
The intention to perform a specific behavior (Davis et al., 1993).

A person's subjective probability that he will perform some behavior (Fishbein and Ajzen, 1975).

Intention:
A person's location on a subjective probability dimension involving a relation between himself and some action (Fishbein and Ajzen, 1975).

Likeability (L):
The degree to which a person has an affective deviation from indifference toward or against a specific technology.

Negative technology imprint:

An acquired predisposition stronger than any attitude, harder to change than any attitude, and negatively biasing behavior toward technology-related target objects, as a result of the technology's external characteristics and one's own experiences

Perceived ease of use (PEOU):

The degree to which a person believes that using a particular technology would be free of effort (Davis, 1989).

Perceived usefulness (PU):

The degree to which a person believes that using a particular technology would enhance his or her job performance (Davis, 1989).

Polarity:

The orientation of bias of an attitude toward or against a particular technology.

Subjective norm (SN):

A person's perception that most people who are important to him think he should or should not perform the behavior in question (Fishbein and Ajzen, 1975).

APPENDIX C

TAM AND TAM2

Original technology acceptance model (TAM) (Davis, 1989):

Perceived usefulness (PU):

1. Without the system, my job would be more difficult to perform.
2. Using the system gives me greater control over my work.
3. Using the system improves my job performance.
4. The system addresses my job-related needs.
5. Using the system saves me time.
6. The system enables me to finish tasks more quickly.
7. The system supports critical aspects of my job.
8. The system allows me to accomplish more work than would otherwise be possible.
9. Using the system reduces the time I spend on unproductive activities.
10. Using the system enhances my effectiveness on the job.
11. Using the system improves the quality of the work I do.
12. Using the system increases my productivity.
13. Using the system makes it easier to do my job.
14. Overall, I find the system useful in my job.

Perceived ease-of-use (PEOU):

15. I often become confused when I use the system.
16. I frequently make errors when using the system.
17. Interacting with the system is often frustrating.
18. I need to seek help often when using the system.
19. Interacting with the system requires a lot of mental effort.
20. I find it easy to recover from errors that occurred while I was using the system.
21. The system is rigid and inflexible to interact with.
22. I find it easy to use the system to accomplish what I set out to do.
23. The system often behaves in unexpected ways.
24. I find it cumbersome to use the system.

25. My interaction with the system is easy for me to understand.

26. It is easy for me to remember how to perform tasks using the system.

27. It is easy to use the system to find helpful guidance in performing tasks.

28. Overall, I find the system easy to use.

Modified technology acceptance model (TAM2) (Davis, 1989):

Perceived usefulness (PU):

1. Using the system in my job would enable me to accomplish tasks more quickly.
2. Using the system would improve my job performance.
3. Using the system in my job would increase my productivity.
4. Using the system would enhance my effectiveness on the job.
5. Using the system would make it easier to do my job.
6. I would find the system useful in my job.

Perceived ease-of-use (PEOU):

7. Learning to operate the system would be easy for me.
8. I would find it easy to get the system to do what I want it to do.
9. My interaction with the system would be clear and understandable.
10. I would find the system to be flexible to interact with.
11. It would be easy for me to become skillful at using the system.
12. I would find the system easy to use.

Modified technology acceptance model (TAM2) (Davis et al., 1989):

Perceived usefulness (PU):

1. Using the system would improve my job performance.
2. Using the system in my job would increase my productivity.
3. Using the system would enhance my effectiveness on the job.
4. I would find the system useful in my job.

Perceived ease-of-use (PEOU):

5. Learning to operate the system would be easy for me.

6. I would find it easy to get the system to do what I want it to do.

7. It would be easy for me to become skillful at using the system.

8. I would find the system easy to use.

Extended technology acceptance model (TAM2) (Venkatesh and Davis, 2000):

Intention to use:

1. Assuming I have access to the system, I intend to use it.

2. Given that I have access to the system, I predict that I would use it.

Perceived usefulness (PU):

3. Using the system improves my performance in my job.

4. Using the system in my job increases my productivity.

5. Using the system enhances my effectiveness in my job.

6. I find the system to be useful in my job.

Perceived ease-of-use (PEOU):

7. My interaction with the system is clear and understandable.

8. Interacting with the system does not requires a lot of my mental effort.

9. I find the system to be easy to use.

10. I find it easy to get the system to do what I want it to do.

Subjective norm:

11. People who influence my behavior think that I should use the system.

12. People who are important to me think that I should use the system.

Voluntariness:

13. My use of the system is voluntary.

14. My supervisor does not require me to use the system.

15. Although it might be helpful, using the system is certainly not compulsory in my job.

Image:

16. People in my organization who use the system have more prestige than those who do not.
17. People in my organization who use the system have a high profile.
18. Having the system is a status symbol in my organization.

Job relevance:

19. In my job, usage of the system is important.
20. In my job, usage of the system is relevant.

Output quality:

21. The quality of the output that I get from the system is high.
22. I have no problem with the quality of the system's output.

Result demonstrability:

23. I have no difficulty telling others about the results of using the system.
24. I believe I could communicate to others the consequences of using the system.
25. The results of using the system are apparent to me.
26. I would have difficulty explaining why using the system may or may not be beneficial.

APPENDIX D
INTRODUCTION TO THE EXPERIMENT

Thank you for being here. The experiment you are about to participate in is part of my work toward a Ph.D. degree in industrial engineering at Texas Tech. Participation in this experiment is completely voluntary. If you do not want to participate, you may leave now. If you feel uncomfortable answering any specific question, you may skip it. If at any time during testing you decide you do not wish to complete the questionnaire, please exit the room without disturbing others. You will not be asked to provide your name. Any answers you provide will be kept completely confidential and anonymous. The questionnaires will be kept in a safe place at all times and will be destroyed after the research has been completed. No physical activity is involved in this experiment. You will only be asked to fill out a questionnaire. It should take about 30 to 45 minutes to complete the session.

Parts of the questionnaire will collect demographic data. You will be asked to provide information such as your age, gender, income, and education level. In the remainder of the questionnaire, you will answer questions about your experience with computers, the Internet, mobile phones, and ATM machines.

The purpose of the questionnaires is not to judge you on your knowledge or skills. The answers you provide will be combined with answers from hundreds of other respondents. Your responses, as well as everyone else's, will be data points in a huge database. The data will be treated collectively and not individually. No one person's answers will stand out. The best thing you can do to help me run a successful experiment is to answer honestly and accurately, and try to remember that you are not being scored on how much you know. A scientific theory will be developed based on your responses. Inaccurate responses will result in a flawed theory.

Again, thank you for being here and agreeing to participate.

APPENDIX E
COMPLETE QUESTIONNAIRE (NOT RANDOMIZED)

Demographics

1. What is your age? _____

2. What is your gender?
a. Male
b. Female

3. What is your primary language?
a. English
b. Spanish
c. Other _____

4. What is the highest level of education you have completed?
a. Grammar school
b. High school or equivalent
c. Some college
d. Bachelor's degree
e. Master's degree
f. Doctoral degree
g. Professional degree (MD, JD, etc.)
h. Other _____

5. What is your current annual income? _____

6. Which of the following best describes your role in your organization?
a. Upper management
b. Middle management
c. Junior management
d. Administrative/support staff
e. Student
f. Trained professional
g. Skilled laborer
h. Consultant
i. Researcher
j. Self-employed
k. Retired
l. Homemaker
m. Other _____

Computer experience

7. How many years have you been using computers? If you have never used one, write "0."
_____

8. How would you rate your computer experience level?
a. No experience
b. Beginner
c. Average
d. Advanced
e. Expert

Computer FOU

9. How often do you use computers?

a. Not at all
b. Less than once a week
c. About once a week
d. 2 or 3 times a week
e. 4 to 6 times a week
f. About once a day
g. More than once a day

10. Rate your computer use on the following scale.

Infrequent [1 2 3 4 5 6 7] Frequent

Internet experience

11. How many years have you been using the Internet? If you have never used it, write "0."

_____

12. How would you rate your Internet experience level?

a. No experience
b. Beginner
c. Average
d. Advanced
e. Expert

Internet FOU

13. How often do you use the Internet?

a. Not at all
b. Less than once a week
c. About once a week
d. 2 or 3 times a week
e. 4 to 6 times a week
f. About once a day
g. More than once a day

14. Rate your Internet use on the following scale.

Infrequent [1 2 3 4 5 6 7] Frequent

ATM experience

15. How many years have you been using automatic teller machines (ATMs)? If you have never used one, write "0." _____

16. How would you rate your ATM experience level?

a. No experience
b. Beginner
c. Average
d. Advanced
e. Expert

ATM FOU

17. How often do you use ATMs?
a. Not at all
b. Less than once a month
c. About once a month
d. 2 or 3 times a month
e. 4 to 6 times a month
f. About once a week
g. More than once a week

18. Rate your ATM use on the following scale.
Infrequent [1 2 3 4 5 6 7] Frequent

Mobile phone imaging experience

19. How many years have you been using a mobile phone to take pictures? If you have never used one for that purpose, write "0." _____

20. How would you rate your experience level using mobile phones to take pictures?
a. No experience
b. Beginner
c. Average
d. Advanced
e. Expert

Mobile phone imaging FOU

21. How often do you use mobile phones to take pictures?
a. Not at all
b. Less than once a month
c. About once a month
d. 2 or 3 times a month
e. 4 to 6 times a month
f. About once a week
g. More than once a week

22. Rate your use of mobile phones for taking pictures on the following scale.
Infrequent [1 2 3 4 5 6 7] Frequent

Internet PU

23. Using the Internet improves my performance (compared with not using it to complete the same task).	Strongly disagree	1	2	3	4	5	Strongly agree
24. Using the Internet increases my productivity.	Strongly disagree	1	2	3	4	5	Strongly agree
25. Using the Internet enhances my effectiveness.	Strongly disagree	1	2	3	4	5	Strongly agree
26. I find the Internet to be useful.	Strongly disagree	1	2	3	4	5	Strongly agree

Internet PEOU

27. My interaction with the Internet is clear and understandable.	Strongly disagree	1	2	3	4	5	Strongly agree
28. Interacting with the Internet does not require a lot of my mental effort.	Strongly disagree	1	2	3	4	5	Strongly agree
29. I find the Internet to be easy to use.	Strongly disagree	1	2	3	4	5	Strongly agree
30. I find it easy to get the Internet to do what I want it to do.	Strongly disagree	1	2	3	4	5	Strongly agree

Internet SN

31. People who influence my behavior think that I should use the Internet.	Strongly disagree	1	2	3	4	5	Strongly agree
32. People who are important to me think that I should use the Internet.	Strongly disagree	1	2	3	4	5	Strongly agree

Internet L

33. I like the Internet.	Strongly disagree	1	2	3	4	5	Strongly agree
34. I find the Internet appealing.	Strongly disagree	1	2	3	4	5	Strongly agree

Internet S

35. There is no need to use the Internet if an alternative is available.	Strongly disagree	1	2	3	4	5	Strongly agree
36. I can't imagine ever changing my mind about the Internet.	Strongly disagree	1	2	3	4	5	Strongly agree
37. How likely are you to change your opinion about the Internet?	Very unlikely	1	2	3	4	5	Very likely
38. How certain are you about your attitude toward the Internet?	Very uncertain	1	2	3	4	5	Very certain
39. If I received information that is contrary to my opinions toward the Internet, I would at all costs keep my opinions.	Strongly disagree	1	2	3	4	5	Strongly agree
40. I try to avoid using the Internet.	Strongly disagree	1	2	3	4	5	Strongly agree
41. I will rarely use the Internet.	Strongly disagree	1	2	3	4	5	Strongly agree

ATM PU

42. Using ATMs improves my performance (compared with not using them to complete the same task).	Strongly disagree	1	2	3	4	5	Strongly agree
43. Using ATMs increases my productivity.	Strongly disagree	1	2	3	4	5	Strongly agree

44. Using ATMs enhances my effectiveness.	Strongly disagree	1	2	3	4	5	Strongly agree
45. I find ATMs to be useful.	Strongly disagree	1	2	3	4	5	Strongly agree

ATM PEOU

46. My interaction with ATMs is clear and understandable.	Strongly disagree	1	2	3	4	5	Strongly agree
47. Interacting with ATMs does not require a lot of my mental effort.	Strongly disagree	1	2	3	4	5	Strongly agree
48. I find ATMs to be easy to use.	Strongly disagree	1	2	3	4	5	Strongly agree
49. I find it easy to get ATMs to do what I want them to do.	Strongly disagree	1	2	3	4	5	Strongly agree

ATM SN

50. People who influence my behavior think that I should use ATMs.	Strongly disagree	1	2	3	4	5	Strongly agree
51. People who are important to me think that I should use ATMs.	Strongly disagree	1	2	3	4	5	Strongly agree

ATM L

52. I like ATMs.	Strongly disagree	1	2	3	4	5	Strongly agree
53. I find ATMs appealing.	Strongly disagree	1	2	3	4	5	Strongly agree

ATM S

54. There is no need to use ATMs if an alternative is available.	Strongly disagree	1	2	3	4	5	Strongly agree
55. I can't imagine ever changing my mind about ATMs.	Strongly disagree	1	2	3	4	5	Strongly agree
56. How likely are you to change your opinion about ATMs?	Very unlikely	1	2	3	4	5	Very likely
57. How certain are you about your attitude toward ATMs?	Very uncertain	1	2	3	4	5	Very certain
58. If I received information that is contrary to my opinions toward ATMs, I would at all costs keep my opinions.	Strongly disagree	1	2	3	4	5	Strongly agree
59. I try to avoid using ATMs.	Strongly disagree	1	2	3	4	5	Strongly agree
60. I will rarely use ATMs.	Strongly disagree	1	2	3	4	5	Strongly agree

Mobile phone imaging PU

61. Using a mobile phone to take pictures improves my performance (compared with not using them to complete the same task).	Strongly disagree	1	2	3	4	5	Strongly agree
62. Using a mobile phone to take pictures increases my productivity.	Strongly disagree	1	2	3	4	5	Strongly agree
63. Using a mobile phone to take pictures enhances my effectiveness.	Strongly disagree	1	2	3	4	5	Strongly agree
64. I find using a mobile phone to take pictures to be useful.	Strongly disagree	1	2	3	4	5	Strongly agree

Mobile phone imaging PEOU

65. Taking pictures with a mobile phone is clear and understandable.	Strongly disagree	1	2	3	4	5	Strongly agree
66. Taking pictures with a mobile phone does not require a lot of my mental effort.	Strongly disagree	1	2	3	4	5	Strongly agree
67. I find taking pictures with a mobile phone to be easy to use.	Strongly disagree	1	2	3	4	5	Strongly agree
68. I find it easy to use a mobile phone to take pictures.	Strongly disagree	1	2	3	4	5	Strongly agree

Mobile phone imaging SN

69. People who influence my behavior think that I should use a mobile phone to take pictures.	Strongly disagree	1	2	3	4	5	Strongly agree
70. People who are important to me think that I should use a mobile phone to take pictures.	Strongly disagree	1	2	3	4	5	Strongly agree

Mobile phone imaging L

71. I like taking pictures with mobile phones.	Strongly disagree	1	2	3	4	5	Strongly agree
72. I find mobile phones with a built-in camera appealing.	Strongly disagree	1	2	3	4	5	Strongly agree

Mobile phone imaging S

73. There is no need to take pictures with a mobile phone if an alternative is available.	Strongly disagree	1	2	3	4	5	Strongly agree
74. I can't imagine ever changing my mind about taking pictures with a mobile phone.	Strongly disagree	1	2	3	4	5	Strongly agree
75. How likely are you to change your opinion about taking pictures with a mobile phone?	Very unlikely	1	2	3	4	5	Very likely

76. How certain are you about your attitude toward taking pictures with a mobile phone?	Very uncertain	1	2	3	4	5	Very certain
77. If I received information that is contrary to my opinions toward taking pictures with a mobile phone, I would at all costs keep my opinions.	Strongly disagree	1	2	3	4	5	Strongly agree
78. I try to avoid taking pictures with a mobile phone.	Strongly disagree	1	2	3	4	5	Strongly agree
79. I will rarely take pictures with a mobile phone.	Strongly disagree	1	2	3	4	5	Strongly agree

Perceived importance

80. Computers are important to me.	Strongly disagree	1	2	3	4	5	Strongly agree
81. The Internet is important to me.	Strongly disagree	1	2	3	4	5	Strongly agree
82. ATMs are important to me.	Strongly disagree	1	2	3	4	5	Strongly agree
83. Taking pictures with my mobile phone is important to me.	Strongly disagree	1	2	3	4	5	Strongly agree

APPENDIX F

EQUATIONS

Theory of reasoned action (TRA) (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975):

$$BI = A + SN$$

$$A = \sum b_i e_i$$

$$SN = \sum nb_i mc_i$$

BI ≡ behavioral intention

A ≡ attitude

SN ≡ subjective norm

b_i ≡ salient beliefs about the consequences of performing a behavior

e_i ≡ evaluation of the consequences of performing a behavior

nb_i ≡ normative beliefs (perceived expectations of specific referent individuals or groups)

mc_i ≡ motivation to comply with these normative expectations

Technology acceptance model (TAM) (Davis, 1989):

$$BI = PU + PEOU$$

$$PU = PEOU + \text{External variables}$$

$$PEOU = \text{External variables}$$

BI ≡ behavioral intention

PU ≡ perceived usefulness

PEOU ≡ perceived ease of use

External variables ≡ object properties such as menus, icons, mice, and touch screens

Technology imprint model (TIM):

$$FOU = PU + PEOU + I$$

$$I = L + S$$

$$FOU = PU + PEOU + L + S$$

FOU ≡ frequency of use

PU ≡ perceived usefulness

PEOU ≡ perceived ease of use

I ≡ imprint variable

L ≡ likeability

S ≡ attitude strength

TIM with coefficients and error terms:

$$FOU = \beta_1 I + \beta_2 PU + \beta_3 PEOU + \varepsilon_1$$

$$FOU = \beta_4 L + \beta_5 S + \beta_2 PU + \beta_3 PEOU + \varepsilon_2$$

β_1, β_2, β_3, β_4, and β_5 ≡ coefficients

ε_1 and ε_2 ≡ error terms

TIM exploratory equations:

$$FOU = PU + PEOU + SN + I$$

$$FOU = PU + PEOU + SN + L + S$$

FOU ≡ frequency of use

PU ≡ perceived usefulness

PEOU ≡ perceived ease of use

SN ≡ subjective norm

I ≡ imprint variable

L ≡ likeability

S ≡ attitude strength