The Influence of Framing Effects on Perceived Ease of Use, Perceived Usefulness, and Behavioral Intention in Information Technology Systems

Jon C. Autrey

THE INFLUENCE OF FRAMING EFFECTS ON PERCEIVED EASE OF USE, PERCEIVED USEFULNESS, AND BEHAVIORAL INTENTION IN INFORMATION TECHNOLOGY SYSTEMS

THESIS

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AFIT/GIR/ENV/01M-01

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Abstract

Every year the Department of Defense spends millions of dollars on the purchase of new computer equipment. There is some question as to the necessity of the amount of this spending. Brynjolfsson (1993) and Landauer (1996) state that it appears that as the order of magnitude of information technology (IT) has increased in both numbers and processing power, the actual increase in the level of productivity, as a whole, has not. Unfortunately, in a time when Air Force budgets are shrinking and the United States military is called on by the taxpayers they serve to do more with less, funding for this IT is often not available.

This thesis looks at the use of information framing to influence users' perceptions of information technology using the Technology Acceptance Model (TAM). TAM does this by measuring users' perceived ease of use, perceived usefulness, and behavioral intention toward a computer. An experiment was conducted by framing information about the technology level of two computers. Users' perceptions about using those systems were then collected using the TAM construct measuring instruments. The results of this study suggest that these perceptions about computer technology have more impact on users' actual use of an IT system than the actual technology level that is present in a computer. This indicates that the aggressive product replacement cycles for computers currently used by Air Force units could be reexamined to extend the useful life of existing systems. The savings realized could then be applied to other critical Air Force mission needs.

THE INFLUENCE OF FRAMING EFFECTS ON PERCEIVED EASE OF USE, PERCEIVED USEFULNESS, AND BEHAVIORAL INTENTION IN INFORMATION TECHNOLOGY SYSTEMS

I. Introduction

Introductory Overview

Every year the Department of Defense spends millions of dollars on the purchase of new computer equipment. There is some question as to the necessity of the amount of this spending. Brynjolfsson (1993) and Landauer (1996) state that it appears that as the order of magnitude of information technology (IT) has increased in both numbers and processing power, the actual increase in the level of productivity, as a whole, has not. Brynjolfsson's (1993) Productivity Paradox and Landauer's (1996) Productivity Puzzle address this very phenomenon. As Nobel Laureate Robert Solow put it, "We see computers everywhere except in the productivity statistics" (Brynjolfsson, 1993:67).

As the demand for more information technology systems grows, it must be funded. Unfortunately, in a time when Air Force budgets are shrinking and the United States military is called on by the taxpayers they serve to do more with less, this funding is often not available. Air Force Materiel Command (AFMC), responsible for the procurement and maintenance of Air Force weapons systems, in fiscal year (FY) 1999 alone, spent millions of dollars to purchase personal computers and the associated software and hardware to run them.

Theoretical Overview

Brynjolfsson (1993) and Landauer (1996) and their research into the "productivity paradox" lay the groundwork for a solution to reducing this spending. In simple terms, if upgrading information technology provides little increase in productivity, then there is little reason to upgrade at all. The ability to obtain productivity gains without putting a new personal computer on a worker's desk would seem to be beneficial. The majority of productivity measures, however, seem to be focused on the macro level (firm or industry) as opposed to the micro level (individual user) (Cron and Sobol, 1983; Baily and Gordon, 1988; Brynjolfsson, 1993; Brynjolfsson and Hitt, 1993; Thomas and Baron, 1994; Brynjolfsson and Hitt, 1996; Landauer, 1996). For the individual user, performance is an appropriate and useful measurement (Lucas and Spitler, 1999).

Festinger's (1957) cognitive dissonance theory says that when a user has two cognitive structures or ideas that contradict one another, they will change one of the cognitive structures to resolve this difference. The theory says that users' perceptions tend to migrate toward their expectations.

> "For the user of an IS [Information System], cognitive dissonance theory suggests that those with high expectations of their performance using the IS should perform better than those with low expectations of their performance." (Szajna and Scamell, 1993:495)

This concept can be applied to information technology systems such as personal computers. If a user has expectations that their performance will be higher on a newer system, then their performance should be higher on any system that they believe is newer, regardless of whether it was a better system or not. Davis and others (1989a, 1989b) suggest one alternative on how this can be measured.

Davis' Technology Acceptance Model (TAM) tells us that a user's behavioral intention to use a system and therefore actual system use is dependent on their belief in the perceived usefulness (U) and perceived ease of use (EOU) of that system (Figure 1).

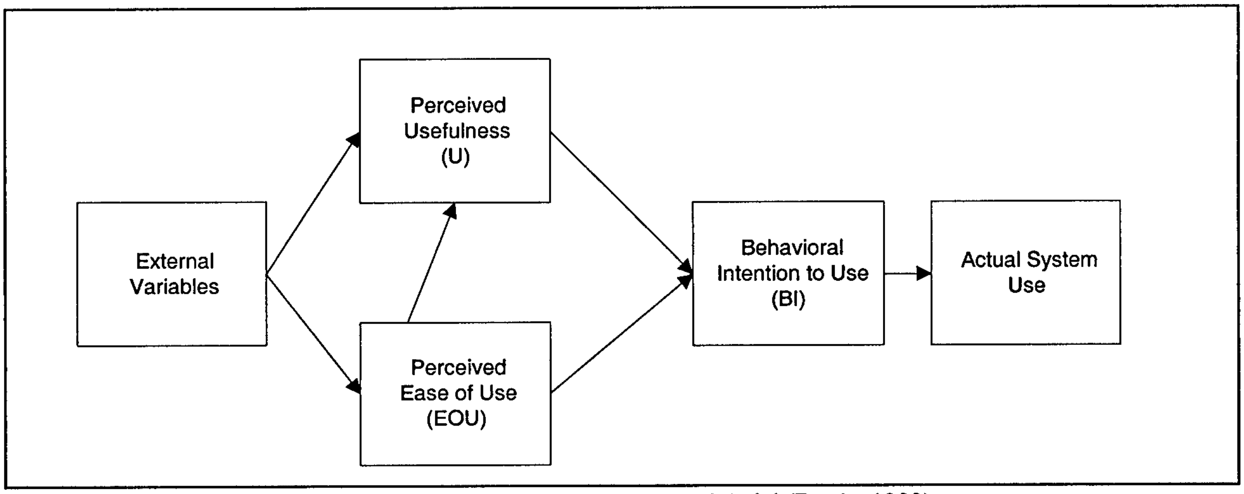

Figure 1. The Technology Acceptance Model (Davis, 1989)

If the user can be made to believe that the system they are using is a high-quality one, their actual system use will benefit from this belief. Since TAM posits that users' behavioral intention to use a system, and therefore system use, is mediated by their belief in the perceived usefulness and perceived ease of use of that system, changing their perceptions about that system would influence their use of that system. Using TAM to measure a user's perceived usefulness and ease of use for these systems would therefore help determine their actual use. Since actual use is determined by these values, the information system with the higher rated usefulness and ease of use will be the more used system. From cognitive dissonance theory, we expect that even if the system used is not a newer system, if the user is told that it is, they will perceive it to be more useful. By framing the technology level of the computer in this way and therefore influencing the user's perceptions, the actual level of technology present in a computer system should have minimal effect on their actions. It is the user's perceptions that affect their system use, and therefore it should also influence their performance. A user's perceptions can be influenced using framing effects, which frame an item in a positive or negative light (Levin and others, 1998).

The Research Question

The question this thesis will address is whether capabilities of an information technology system itself, or simply the perceptions of that system's capabilities, are the driving factor in increased system use. As theorized, increased system use can be obtained through simply framing the technology level of the computer and not through new and expensive IT purchases. This can be shown if similar perceived ease of use, perceived usefulness, and behavioral intention (BI) scores are obtained from groups that have had similar information frames presented to them, even if they are using vastly different levels of computer technology. The perceived ease of use, perceived usefulness, and behavioral intention scores should be greater for those told they are using a newer, better system.

Thesis Organization

The remainder of this thesis will explore this theory in more detail. Chapter 2 will review the pertinent literature as introduced in the theoretical overview above and conclude with the introduction of the formal hypotheses. Chapter 3 will discuss the methodology used to test the hypotheses stated in chapter 2. The results and analysis of the experimentation can be found in chapter 4. Finally, chapter 5 will discuss these results and potential areas for improvement and further research.

II. Literature Review and Theory Development

The Productivity Paradox

For many years, the question of whether information technology (IT) or computers have or have not increased productivity has been debated. There are numerous papers which make arguments whether the paradox exists or not, or whether more spending on IT leads to more profits (e.g. see Cron and Sobol, 1983; Baily and Gordon, 1988; Brynjolfsson, 1993; Brynjolfsson and Hitt, 1993; Thomas and Baron, 1994; Brynjolfsson and Hitt, 1996; Landauer, 1996). Brynjolfsson and Yang (1996) summarize several of the trends that have led to this discussion. The price of computing was dropping by half every 2-3 years at the time of their study. Information technology purchases account for over 10% of United States companies' capital investments (Brynjolfsson and Yang 1996). Even with this surge in IT investments, white-collar productivity has remained stagnant for 20 years. Loveman (1988), as reported by Brynjolfsson (1993), found in a study of data from sixty manufacturing business units that IT investments had made no productivity contributions whatsoever. Brynjolfsson (1993) reports similar results from studies conducted in the services sector. This paradox of why dramatic IT investments are not leading to productivity increases is not only limited to capital investments. Scacchi (1995) reported that similar problems exist in the area of software productivity.

The question of whether increases in IT capital expenditures have led to increased productivity is still open. The reasons for the paradox have been postulated by many.

Brynjolfsson (1993) gives four reasons why this perceived paradox might exist. Mismeasurement of the inputs and outputs used to determine the productivity statistics is one potential reason. Lags in the time it takes IT to show results on profits, and redistribution of profits that might otherwise show IT as good for the individual firm, if not the industry, are two other possible explanations. Finally, mismanagement of IT through intentionally or unintentionally wasteful management practices also offers a potential explanation. In addition to Brynjolfsson's comprehensive work, other possibilities exist as well. Thomas and Baron (1994) put forth the idea that in the public sector, productivity has an entirely different meaning than increased profitability. This makes accurate comparisons with private sector firms almost impossible. The productivity paradox has not gone away in recent years either. McKim (2000) speaks about problems with productivity measurements as recently as January of 2000.

The productivity paradox aside, there is still the question of whether use of information technology actually increases the productivity of the individual worker. As alluded to in the first chapter, the majority of studies into productivity take a macro view of the productivity concept (Cron and Sobol, 1983; Baily and Gordon, 1988; Brynjolfsson, 1993; Brynjolfsson and Hitt, 1993; Thomas and Baron, 1994; Brynjolfsson and Hitt, 1996; Landauer, 1996). They view the productivity statistics for the firm, or even the entire industry, by way of a simple formula: outputs divided by inputs (Thomas and Baron, 1994) or as the output or values created by IT (Brynjolfsson, 1993). A different way to view productivity that is on the micro level is required to see the gains of an individual worker. Since the productivity measures are based at a macro level, a different way to view individual worker productivity is through their performance.

Performance measurement of an individual worker in information technology can be relatively straightforward. In general, when a person is presented with an information system that will help increase their system use in their work, the more that system is used to do that work, the better the implications on their performance. Increasing the worker's system use is therefore dependent on changing their behavior to use that system, which may not be an easy task. Human behaviors are complex and mediated by many things, as discussed in the following sections.

Cognitive Theory and Performance Expectancy

The theory of cognitive dissonance (Festinger, 1957) posits that people have a need for cognitive consistency. If a person has two ideas that are not consistent with one another, then dissonance occurs. A person in this state will then adjust one of their ideas until it is in agreement with the other. Szanja and Scamell (1993) explain in one example how performance is one such area where cognitive dissonance can occur. If actual performance tends to be less than what the user expected that performance to be, then a negative disconfirmation exists. The opposite is true when actual performance exceeds expected performance (positive disconfirmation). This disconfirmation causes dissonance to occur in the user and their perceptions of the system they are using will migrate toward their expectations of that system.

Other work in the area of cognitive consistency was done by Aronson and Carlsmith (1962; Carlsmith and Aronson, 1963). They suggest that the state of dissonance is less between two inconsistent cognitions, but more a difference in a cognition about the behavior and a cognition about the individual themselves, which the term "self-relevant performance expectancy" (Aronson and Carlsmith, 1962:178). Events or behaviors that agree with this expectancy allow cognitive consistency. Those behaviors that do not agree form dissonance. Thus, when one's expectations are not met, a person will adjust their performance to be more in line with their expectations, similar to Festinger (1957). This theory translates to the information technology world and computers as well. Szanja and Scamell (1993) predicted that this would affect the performance of information system users. They suggested that cognitive dissonance would make those subjects with high expectations of performance perform better than those subjects with low expectations of performance. In the end, they found that user's satisfaction scores indeed differed for those with differing expectations. This research proved useful in applying cognitive dissonance theory to measure performance in the information technology arena.

Framing Effects

Levin and others (1998) explain information framing as the way stimuli are manipulated in such a way that the manipulation (labeling, etc.) influences their evaluation. Framing effects are primarily referenced in the literature as valence effects where "the frame casts the same critical information in either a positive or negative light" (Levin and others, 1998:150). Valence framing has its foundations in prospect theory as developed by Kahneman and Tversky (Kahneman and Tversky, 1979; Tversky and Kahneman, 1981).

There is much disagreement in the literature as to how positive versus negative frames impact user's decisions, but Levin and others (1998) argue in their taxonomy of framing effect studies that there are actually multiple types of framing manipulations (Table 1). Risky choice framing is framing in the traditional sense. It is the one most directly based on prospect theory, where the options involve various risk levels. Goal framing is the type where the ultimate goal is what is being framed. Finally, in attribute framing, it is some characteristic of an item that is framed. A classic example of this would be a glass of water that can either be positively framed as half full or negatively framed as half empty, but in both cases actually are describing the same glass of water. When previous framing research is categorized into these three classes, the information frame's effects become more predictable (Levin and others, 1998).

Table 1. Framing Effect Classifications (Levin and others 1998)

Frame Type	What is Framed	What is Affected
Risky Choice	Options with different risk levels	Risk Preference
Attribute	Object/event attributes or characteristics	Item Evaluation
Goal	Consequences or implied goal of behavior	Impact of Persuasion

Attribute framing (Figure 2) has been used with success in numerous studies. It is the simplest type of framing since only one item (attribute) is framed. Examples of items framed range from quality of ground beef (Levin, 1987; Johnson, 1987; Levin and Gaeth, 1988), cheating on tests (Levin and others 1988), and auditor evaluations (Schneider and others, 1993) to more serious areas such as arms race security deficits (Kramer, 1989) and surgical decisions (Wilson and others, 1987). Among the findings of these studies was a consistent trend: in all such cases of attribute framing, a positive frame has a greater impact than a negative frame. This has been termed a "valence-consistent shift" (Levin and others, 1998). Using framing effects "often has a substantial influence on the processing of ... information" (Levin and others, 1998:164). This is consistent with cognitive dissonance (Festinger, 1957), which finds that even in the face of contradictory evidence, people tend to shift their beliefs and performance toward their expectations. Their expectations of a product are influenced by what they are told about it through the information frame.

Since attribute framing is focused on item evaluation, it can clearly be useful in computer or information technology studies such as this one, where rating favorability or functionality of these items. In fact, Russo and others (1996) found that positive framing of one item when one compared to similar ones can lead to considerable positive distortion of an objects characteristics.

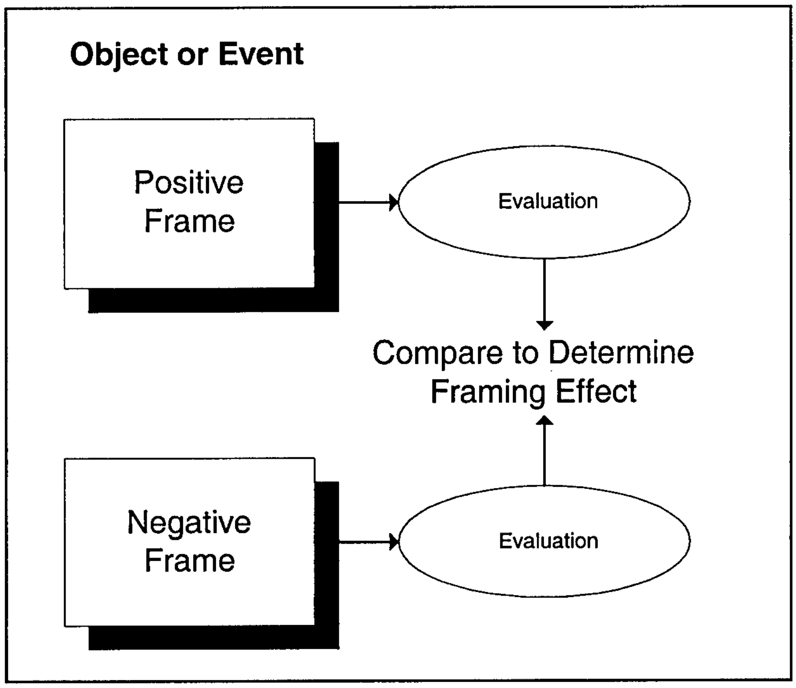

Figure 2. Attribute Framing Model (Levin and Others, 1998)

Related Behavioral Theory

If the ultimate desired goal is to increase a worker's performance levels through increased use of the information technology systems at their disposal, a way to predict this behavior is necessary. The Technology Acceptance Model (TAM) (Davis, 1989; Davis and others, 1989) presents an effective way to do so. This widely cited model predicts actual system use by measuring users' perceptions toward that system. While TAM was ultimately selected for this research effort, several related behavioral models and theories do exist.

The Theory of Reasoned Action. The Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980) is a model used to predict people's behavior based on the attitudes and beliefs of that person (Figure 3). It says that behavioral intention, and subsequently actual behavior, is subject to two factors. One is the attitude toward the behavior, or whether the attitude is favorable or unfavorable to that person. The second is subjective norm, which is the social factors pressuring a person to do or not do a behavior. TRA has been used and discussed in numerous studies and papers (e.g. see Bagozzi, 1981; Saltzer 1981; Warshaw, 1980; Warshaw and Davis, 1984, 1985; Sheppard and others, 1988).

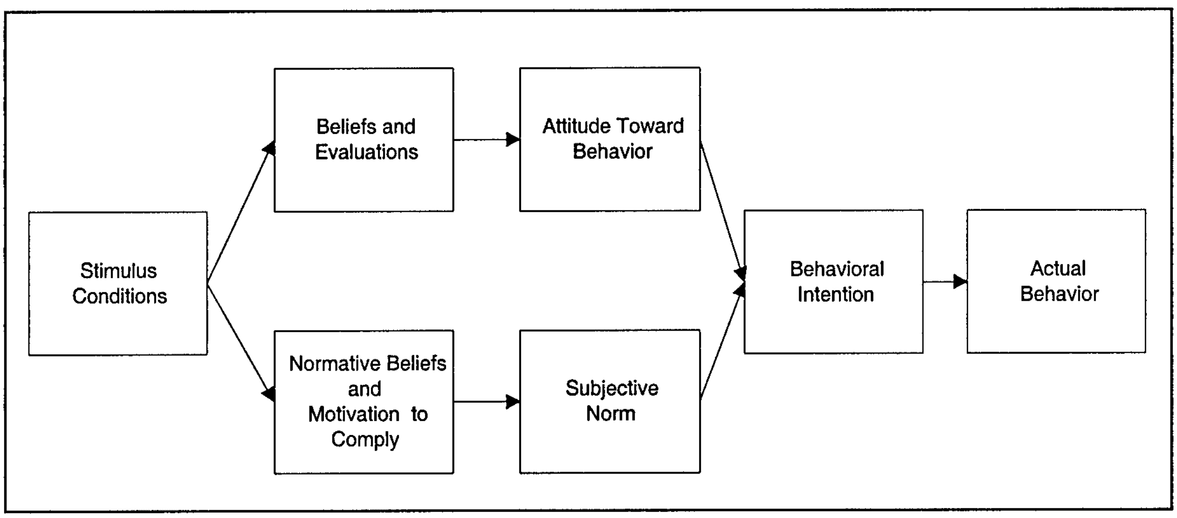

Figure 3. Theory of Reasoned Action (Fishbein and Ajzen, 1975)

While TRA has been shown to be a good model for predicting behavior, there are issues that must be addressed before it can be used in research. The prominent beliefs that are associated with a particular behavior must first be identified before using the model (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980). In addition, there is some question as to the direct or indirect effects of subjective norm on behavior. Davis (1989), Yeaman (1988), and Mathieson (1991) all found that subjective norm had no significant effect on intentions. However, Taylor and Todd (1995) have found that it does have a significant effect, while Venkatesh and Morris (2000) found that subjective norm has an effect only for females over the short term. Despite these questions, TRA's significance is clear, as it forms the basis for the Technology Acceptance Model ultimately used in this study.

The Theory of Planned Behavior. The Theory of Planned Behavior (TPB) was adapted from the Theory of Reasoned Action by Ajzen (1985). In addition to attitude and subjective norm, it adds the construct of perceived behavioral control (Figure 4). Perceived behavioral control is a person's belief in the availability of assets needed to complete the behavior (Taylor and Todd, 1995). This allows the extension of TRA to situations where there may be impediments to behavioral performance. Studies have been competed comparing TPB to the Technology Acceptance Model and have found that both are useful in predicting behavior (Mathieson, 1991; Taylor and Todd, 1995), however Mathieson (1991) found that TAM was better from an empirical point of view for predicting intention to use.

The Technology Acceptance Model

Although the Theory of Reasoned Action and the Theory of Planned Behavior are useful tools for predicting behavior, the work of Davis (1989) and Davis and others (1989) has produced a model that is better for predicting behavior with information technology such as computers. The Technology Acceptance Model's (Figure 1, page 3) key purpose is "to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions" (Davis and others, 1989b). Since its inception, the

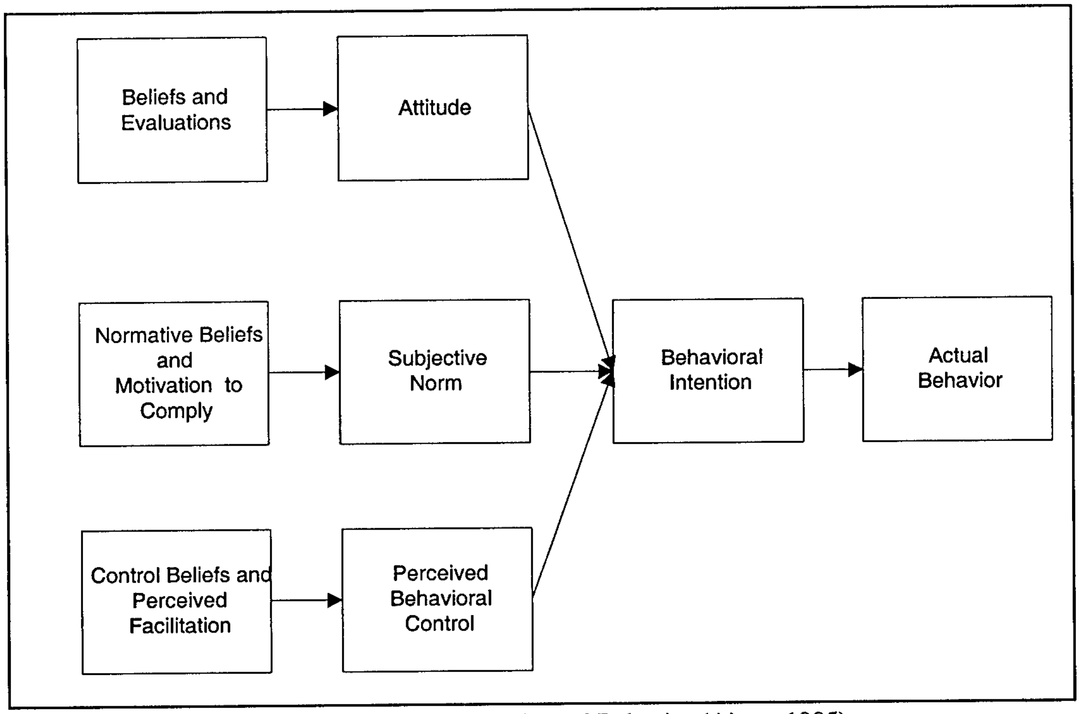

Figure 4. Theory of Planned Behavior (Ajzen, 1985)

Technology Acceptance Model has been used with success in numerous studies (e.g. see Davis, 1989, 1993; Davis and others, 1989; Venkatesh and Davis, 1996, 2000; Szajna, 1996; Jackson and others, 1997; Lucas and Spitler, 1999; Venkatesh and Morris, 2000).

To predict behavioral intention and ultimately system usage, TAM relies on the relationship of two key constructs, perceived ease of use and perceived usefulness. Perceived usefulness is defined at "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989:320). A system perceived as useful would be one that a user believes would have a "positive use-performance relationship" (Davis, 1989:320). Perceived ease of use is defined as "the degree to which a person believes a particular system would be free from effort" (Davis, 1989:320). Given two systems, a user will rate the one he or she believes is easier to use as having a higher perceived ease of use score. In addition to their direct effect on behavioral intention, perceived ease of use has been found to have influence on perceived usefulness as well. Any factors not explicitly included in the model itself are deemed external variables. Their effect on behavioral intention and systems usage is mediated via the perceived ease of use and perceived usefulness constructs. Analysis of data used in previous TAM studies has shown that usefulness has a significant impact on behavioral intention and consequently system usage (Davis and others, 1989a, 1989b; Mathieson, 1991; Taylor and Todd, 1995). It is important to note that a construct called attitude toward using was originally included in the model that influenced behavioral intention. Subsequent research (Szajna, 1996; Venkatesh and Davis, 1996, 2000; Venkatesh and Morris, 2000) has shown that this construct is not required and that perceived ease of use and perceived usefulness affect behavioral intention directly when attitude is removed from the model.

The behavioral intention, perceived ease of use, and perceived usefulness constructs all have scales developed by Davis and others (Davis, 1989; Davis and others, 1989) for use in TAM. These scales have proven to have a high degree of reliability in previous studies. The Technology Acceptance Model is at its heart a simple model, but one with its foundations firmly grounded in the psychological literature. Its ability to predict system usage at little cost makes it a valuable tool in information technology research. It is for these reasons that TAM was selected as the baseline model for this research effort.

Theory Synthesis and Hypotheses

Using the Technology Acceptance Model and its measurements of perceived ease of use, perceived usefulness, and behavioral intention as a baseline, the following hypotheses can be developed. TAM (Davis, 1989) suggests that perceived ease of use and perceived usefulness are the drivers of behavioral intention and consequently actual system use. From the original model, we have the following hypotheses annotated in Figure 5.

> ***H1**: Perceived ease of use will have a significant positive influence on perceived usefulness.*
>
> ***H2**: Perceived ease of use will have a significant positive influence on behavioral intention.*
>
> ***H3**: Perceived usefulness will have a significant positive influence on behavioral intention.*

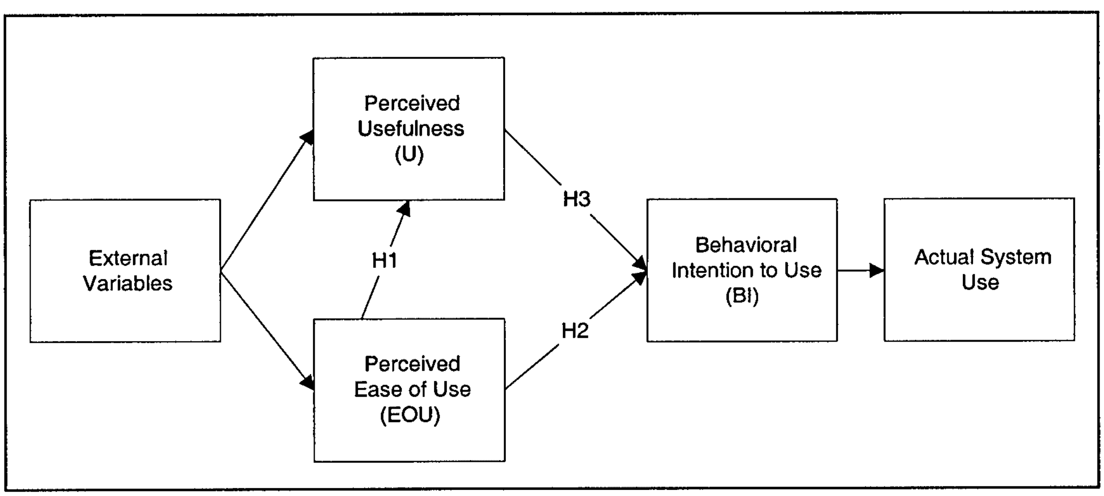

Figure 5. Technology Acceptance Model with Hypotheses (Davis, 1989)

Given Festinger's (1957) cognitive dissonance theory and how it affects people's beliefs and performance, and given the above hypotheses on how TAM's (Davis, 1989a) perceived of use, perceived usefulness and behavioral intention all drive actual system use, additional theories are suggested. If a user's expectations about the technology level of a computer are framed to be different from the actual technology level of that computer, their system use and the beliefs (ease of use, usefulness and intention ratings) that affect performance in that system will also be influenced, regardless of how that computer system actually performs. From Festinger's (1957) cognitive dissonance theory, we know that people's performance and beliefs adjust to meet their expectations, even in the face of contradictory evidence. Framing effects (Levin and others, 1998) suggest that if they are told the system is poor one, and it regardless performs at a level better than the user expected for that system, cognitive dissonance will occur (positive disconfirmation). They will then alter their performance to be in line with their framed expectations. Similarly, if they are told the system is a good one and it performs at a lower level than expected, they will adjust their performance to be in line with their expectations here as well. Russo and others (1996) discuss how for a positive frame these effects will be even greater. This suggests the following.

> ***H4a**: Positively or negatively framing the technology level of a computer will have a significant main effect on a user's perceived usefulness ratings for that system.*

> ***H4b**: Positively or negatively framing the technology level of a computer will have a significant main effect on a user's perceived ease of use ratings for that system.*

TAM suggests that the effects of behavioral intention are completely mediated by perceived usefulness and perceived ease of use. Therefore, the following hypothesis is also suggested.

> ***H4c:*** *Positively or negatively framing the technology level of a computer will have a significant main effect on a user's behavioral intention ratings for that system.*

Confirmation or disconfirmation of these hypotheses is sought via the methodology covered in the next chapter.

III. Methodology

Research Design

The above theory can be supported using a laboratory experiment, diagrammed as follows:

		Actual System Level	
		Low	High
System Level Told to User	Low	A	B
	High	C	D

Figure 6. Experimental Design

The above design was selected because it is a true, between-subjects experiment due to the randomization of subjects into the groups. By using a true experiment, a significant level of control over internal validity during the experiment can be accomplished. The actual experimental design was completed using the steps that follow in the below paragraphs.

User Selection

The first step in the experimental design was to determine the desired number of experimental subjects that will take part in the study. In this case, time and budgetary constraints limited the population that was being measured to all Air Force Institute of

Technology (AFIT) students. Because there was little probability that all AFIT students could, or would, participate as research subjects, the sampling frame would be limited to those students who volunteered to be research subjects. Larger sample sizes more accurately provide an estimate of the population being measured (Law of Large Numbers), and that the larger the sample size, the more normally distributed the sampling distribution (Central Limit Theorem). Based on this information, an initial attempt was made to obtain a sample size for each group of at least thirty (Dooley, 1999; McClane, 1998).

Subjects for the experiment were graduate students attending the Air Force Institute of Technology during the 1999/2000 school year. The student body of 389 Masters and Ph. D. students was asked to take part in a 30-45 minute experiment that involved using a computer and completing some short questionnaires. Ninety-nine students volunteered for a response rate of 25.4%. Although the sampling frame consisted almost entirely of military personnel, the wide variety of backgrounds, career fields, and other demographics help support the generalizability of this research. Detailed demographic breakouts of the research subjects can be found in Appendix A.

Once the initial number of desired participants was decided, they were divided randomly into the four treatments. Using Microsoft Excel 97, a list consisting of four sets of thirty entries was generated. Using Excel's analysis tools, a uniform distribution of numbers from zero to one was generated. This list was then placed next to the list of the treatments and used to sort the groups randomly to determine the experimental order. Therefore, the first participant in the experiment was assigned to either group A, B, C, or

D depending on which value is shown first in the list. The second subject was placed in the second group listed, and so on until all participants had been assigned. Of the ninety-nine subjects who actually participated, each was allowed to sign up for a 45-minute time block of their own choosing to help ensure an additional level of randomness in the experimental order.

Experimental Workspace

Once the order of the participants was determined, the actual experimental room was established. An office area was isolated from any external variables that might cause influence on the subject participating in the experiment, such as other students, faculty, etc. This created an environment that was consistent between the four groups and was enough to avoid any potential group threats between them. In the room, a desk was used to hold two computers. One computer was an older Zenith Pentium computer rated at a speed of 133 MHz. The second was a Dell Pentium-II rated at a speed of 350 MHz. An identical 17" monitor was shared by both computers. All cabling from the two systems was hidden from the user's view. The experimental area was set up in such a way that unbeknownst to the user, either computer could be attached to the monitor while giving the impression that it was the other that was connected. To avoid the potential bias that can be introduced by the audio and visual cues taken from the computers, the computers were modified to correct for them. Modern computers have indicator lights that show hard drive usage. These lights were disconnected. This eliminated the subjects being able to look at the computer and realize that they may not be using the one that they were told. The problem of hard drive noise was controlled through the placement of the computers. By placing the computers next to one another and far enough from the user to be visible, but not individually heard, this potential bias was removed. Further visual clues were established by ensuring the power light was showing on both the system that the user was told they were using and the other one as well. This way the appearance was given that the user was using the machine that they were told they were using.

Experimental Procedure

All subjects were observed by a single experimenter at a time convenient to both. To avoid possible problems of experimenter expectancy, each subject was read a script that contained the details of the experiment in which he or she was participating. The answers to any questions asked by the subjects were carefully recorded to unsure that future subjects would be give the same answer. The experiment was given to a single subject at one time. As each subject arrived, he or she was first asked to fill out a consent form (Appendix B). This form stated that the subject agreed to participate in the experiment and that they would not divulge any aspects of their participation to others so that potential contamination could be avoided. The subjects were then asked to take a short questionnaire concerning their opinions on information technology (computers). This consisted of eight questions measuring perceived ease of use and perceived usefulness taken from Davis (1989). The purpose of this questionnaire was originally designed to test the framing effect of the high-end vs. low-end systems during the pilot study and was not to be used during the experiment. It was decided that it would be useful to collect this data for the full experiment as well to allow for comparison of pre- and post-test user perceptions. These constructs were measured using a 7-point Likert scale ranging from "Strongly Agree" to "Strongly Disagree" with a midpoint labeled "Neutral." Davis (1989a) found that this measurement had a high degree of convergent and discriminant validity. In the sample of all 99 respondents, the scales were found to be highly reliable with a Chronbach alpha coefficient of .95 for perceived ease of use and .90 for perceived usefulness. The pre-questionnaire can be found in Appendix C.

Once this was done, the subject was given a pre-printed booklet with the purpose of the experiment given. This was a cover story about the effects of information technology on the workforce so that no bias was introduced into the constructs that are actually being measured (perceived ease of use, usefulness, and behavioral intention). These statements were the same for each treatment, with one exception. Users in group A and C were told that the computer they were using was an older Pentium-133 while users in group B and D were told that their system was a newer Pentium-III system. Subjects in groups B and C used the opposite machine than the one they had been told they were using (see Figure 6 on page 19 for treatment group layout). The subjects were seated in front of the system and asked to read over the instructions on the first page. Once the subject indicated that they understood the instructions and were ready to continue, they were given permission to turn to the next page in their booklet and begin the tasks. The tasks consisted of using various Microsoft Office products on whichever system they were assigned. The purpose was to have the subject use the computer system that they believed they were using so that they would be able to answer questions about their use of that system later. The first task involved correcting grammatical and spelling errors in a Microsoft Word document. Word is a word processing program for use with Microsoft Windows or Macintosh based systems. The next task simulated sending an electronic mail (e-mail) message to using Microsoft Outlook. Outlook is the e-mail program that is part of the Microsoft Office suite of programs. The third task had the subject complete a simple accounting problem using Microsoft Excel, the office suite's spreadsheet program. This task used an accounting problems simplified from Mathieson (1991). The subject also used Excel to generate a set of random numbers. Finally, the subjects used Microsoft Binder to group all of the files used together within a single file. While each subject accomplished the tasks, the facilitator took notes at random intervals to try to dissuade the subjects from forming an alternate theory about the purpose of the experiment. In addition, the overall time it took for the user to complete all of the tasks was also recorded for each subject. A sample task booklet can be found in Appendix D.

Upon completion of the computer tasks, subjects were given a questionnaire to fill out regarding their perceptions of using the computer. The questions used were taken from work on the Technology Acceptance Model (Davis, 1989a). These constructs were again measured using a 7-point Likert scale ranging from "Strongly Agree" to "Strongly Disagree" with a midpoint labeled "Neutral." In the sample of all 99 respondents, the Chronbach alpha coefficient was .90 for perceived ease of use, .97 for perceived usefulness, and .95 for behavioral intention. These questions were found to have a high degree of reliability in measuring the desired constructs. The results of this empirical data collected were used to lend support to the stated theory. Additional demographic information was gathered to allow for the conducting of additional analysis based on the responses (e.g. male vs. female). The results of these questionnaires were tabulated in a Microsoft Excel spreadsheet that designated each user with a control number to protect their anonymity. The post-questionnaire can be found in Appendix E.

Pre-Pilot Study

Before the actual experiment was run on subjects, it was necessary to ensure the tasks in the experimental booklet were error-free and could be followed by the subjects without difficulty. A pre-pilot study was run using one subject to go through the experimental booklet and accomplish the tasks. Upon completion of the tasks, it was determined that the level of intensity required of the computer during the experiment was minimal. It was at this point that the Microsoft Excel random number generation task was added as well as the Microsoft Binder manipulation. These activities were more processor and hard disk intensive and more accurately depicted tasks that might be accomplished in an office environment. These tasks were incorporated into the experimental booklets.

Pilot Test

Since the level of manipulation of the independent variable called for in the above design is centered only on the subjects being told the level of technology of the system they are using, a potential problem arose. This level of manipulation may not have been enough to reflect the intended causal construct. The original manipulation presented was to frame the level of the computer to be used as either a Pentium computer or a Pentium-III on the assumption that most users would see a difference between the two. Therefore, this information about the computer's attributes was framed through a "story-like context" (Levin and others, 1988:521) in the experimental subjects test booklets. To serve as a check for this potential problem, a pilot test using the above design was first run on a small sample of subjects to test the level of manipulation. During follow-up debriefings when informed of the purpose of the study, subjects identified that the subtler frame of either Pentium or Pentium-III was insufficient. Additional pilot studies were then run. In addition to the original frame stating the type of computer, supplementary material was added about how the Pentium computer was "older" and "purchased three years ago." The Pentium-II computer was listed as "newer" and "purchased within the last year." In addition, the task booklet of subjects in treatment A and B was modified on the cover to list their group and "low-end system" while those in treatments C and D had their booklets modified to show them using the "high-end system." The subjects taking part in the revised pilot test were then debriefed to help determine potential flaws in the study and further refine the experiment. Exit interviews and analysis of the pilot data indicated that the new manipulations were more effective. While there was not a significant difference in the responses between those subjects in the high-end and low-end framed groups, there appeared to be enough of a difference to proceed with the experiment using the new information frame. Mean perceived usefulness was marginally increased between pre- and post-tests for those told they were using the high-end system and marginally decreased for those told they were using the low-end system, whereas it only changed in one case using the original frame (Table 2). Perceived ease of use also decreased for those given the low-end information frame. The lack of significance in the pilot study data can most likely be attributed to the low number of participants in the pilot study. Subjects for the pilot were volunteers from the Air Force Institute of Technology's Information Resource Management (IRM) program. IRM students have a background in the development and application of information technology systems. Using students who are familiar with the implications of the use of information technology allowed them to serve as subject matter experts whose inputs, comments, and suggestions benefited the overall study.

Table 2. Pilot Study Usefulness Results

Groups Compared	Frame	Pre-test Usefulness	Post-test Usefulness
Low-end framed	Original	5.5	5.5
	Final	4.75	4.5
High-end framed	Original	5	5.25
	Final	4.5	4.75

During the pilot study it was determined that one of the files used during the manipulation of files with Microsoft Binder was too large for the computer systems to easily handle. When the subjects attempted to add the file to their Binder projects, an error would occur and a warning message stating that the file was already in use would appear. This message appeared if the user became impatient while the file was loading and attempted to utilize the mouse or keyboard. Those that waited for the file to load before attempting any actions on the computer had no problems. As error messages would not be welcomed during the actual experiment, this file was removed and replaced with a smaller file of the same name. The problem did not re-occur during the remaining pilot studies or in subsequent pre-experiment testing.

Experimental Execution

Actual experimentation went generally as planned. Two days before the subject's time slot, an e-mail reminder was sent showing the time and place of the experiment. The experimenter then met each subject at the agreed upon time in the office set up for the research. If a subject did not arrive within 10 minutes of his or her time slot, they were considered a no-show. No-shows were sent an e-mail offering to reschedule their time. Those that were a no-show twice were not asked to reschedule their participation in the experiment. Users who asked about the purpose of the experiment beforehand were offered a generic explanation that the experiment covered information technology in the workforce with a promise of the full details upon completion of the experiment. After the experiment, those who asked were informed of the true nature of the research.

One potential problem did arise during the experiments. Although the problem with Microsoft Binder had seemed to be eliminated after the pilot study, it began to re-appear during the actual experiment. To compensate for the error, all subjects who received the error and asked about it were given the statement "Binder is proving to be a somewhat finicky program. Even on the high-end machine it sometimes has problems with large files." They were then told to click the ignore option button on the error message. This explanation was sufficient for all such users.

IV. Results and Analysis

Scale Internal Consistency Assessment

To lend added credence to the Chronbach Alpha reliability assessment of scale items, additional steps were completed. Pearson correlations were assessed on the pre- and post-test questionnaire items. As summarized in Table 3, the pre-test constructs of perceive ease of use and perceived usefulness were somewhat correlated. The post-test results showed that this was no loner in evidence, but behavioral intention was found to be highly correlated with perceived usefulness.

Table 3. Construct Correlation Matrix

Construct		Pre-test		Post-test		
		EOU	U	EOU	U	BI
Pre-test	EOU	1.000				
	U	.608*	1.000			
Post-test	EOU			1.000		
	U			.239**	1.000	
	BI			.265*	.880*	1.000

* p < .01
** p < .05

Task Completion Times

To insure consistency of tasks across treatment groups, task completion times (Table 4) were analyzed for statistically significant differences. Cursory examinations of

Table 4. Task Completion Time Descriptive Statistics

Treatment Group	System Told	Actual System	N	Mean (minutes)	Standard Deviation	Standard Error Mean	Distribution Normal
A	Low	Low	22	22.227	5.042	1.075	Yes
B	Low	High	23	19.609	3.394	0.708	Yes
C	High	Low	27	22.815	5.609	1.080	Yes*
D	High	High	27	19.444	4.917	0.946	Yes

* Upon removal of outlier

the completion times by group showed similar but noticeable differences in the means for each treatment. Analysis of Variance (ANOVA) was appropriate for comparing task completion times across the four treatment groups and between groups with similar information frames. Comparisons between all four treatments groups found that those who used the high-end computer had statistically significant shorter times to complete the task booklet ($p = .024$). This difference was unexpected, as the tasks called for were not deemed so machine dependent as to cause a difference in times between groups using the two different computers. When all those who were told they were using the high-end system were compared to those told they were using the low-end system, mean times for the two groups were nearly identical and showed no significant difference ($p = .813$).

Upon finding significance in the difference in times taken to complete the tasks, additional analysis was conducted. Assuming a similar task, the time it takes to complete the task should normally distributed within the individual groups throughout the sampling frame. Any non-normal samples in the distribution of the times would be a possible indication that a problem may have existed in the task sets. Shapiro-Wilk tests for normality were conducted on the times for all four treatment groups. To assist in analysis, groups were labeled according to their treatment (Table 4). Groups A, B and D were distributed normally, however group C was not. Analysis of the times for group C showed an outlier taking 45 minutes to complete the tasks given. Removing this data point and re-running the Shapiro-Wilk test showed the distribution of the remaining times to be normal. The normality of the completion times within the groups lends credence to the consistency of the tasks. Potential reasons for the differences in overall mean times will be further discussed in chapter 5.

Regression Analysis

Testing for hypotheses 1-3 was completed by conducting a series of regression analyses on the experimental data, similar to previous research on the technology acceptance model (Davis, 1993; Venkatesh and Davis, 1996, 2000; Morris and Dillon, 1997). Regression is a powerful tool for use in predicting outcomes and is useful in determining effect of variables on one another. From Figure 5 on page 16, we have three variables related to the first hypotheses. Values for perceived ease of use (EOU), perceived usefulness (U), and behavioral intention (BI) were taken from the post-task questionnaire Likert scales.

Table 5. Summary Regression Data

Relationship	Hypothesis	Adjusted R^2	B	Standard Error (B)	β	*t*	p
U = EOU	1	.047					
EOU			.424	.175	.239	2.426	.017**
BI = EOU + U		.777					
EOU	2		.115	.099	.057	1.158	.250
U	3		.975	.056	.866	17.461	.000*

* $p < .001$ ** $p < .05$

Analysis of hypothesis 1 involved regressing perceived ease of use on perceived usefulness (U = EOU). Significance was found for this value ($\beta = .239$, $p < .05$) so hypothesis 1 was supported.

Hypotheses 2 and 3 both have the dependent variable of behavioral intention (BI = EOU + U). Perceived usefulness and perceived ease of use were used with this variable in a regression model to determine their influence. Perceived usefulness was found to have a significant effect on behavioral intention ($\beta = .866$, $p < .001$), thus supporting hypotheses 3, however, contrary to indications from previous research on TAM, support was not found for hypothesis 2.

Summary statistics for the regression analysis can be found in Table 5 and Figure 7. As indicated, the results of the regression analysis show support for two of the first three stated hypotheses. Adjusted R^2 and significant β values for usefulness in the behavioral intention model were quite high, explaining almost 78 percent of the variance.

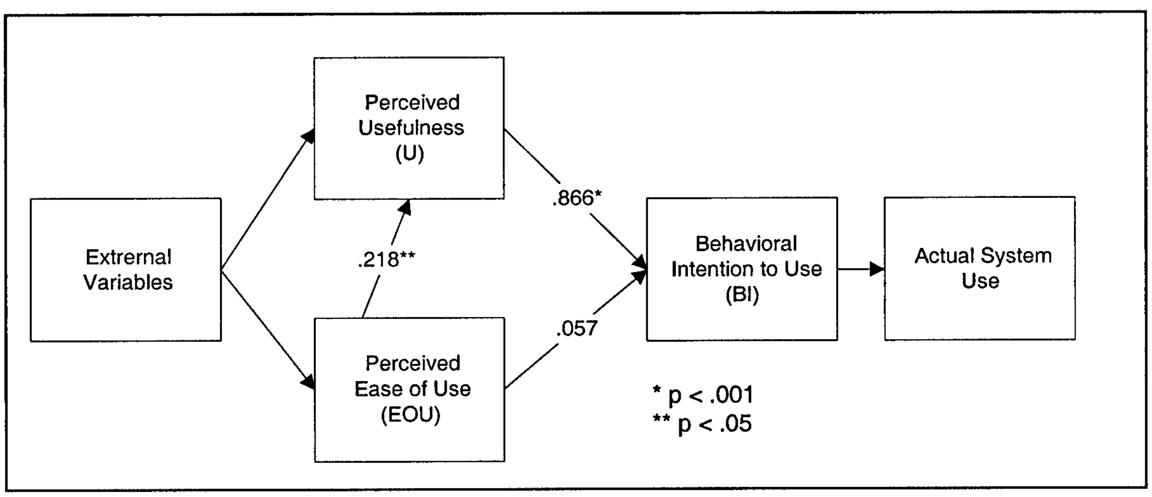

Figure 7. Technology Acceptance Model with Hypotheses Results

Analysis of Variance

Analysis of Variance was used to determine if there is a statistically significant difference between the multiple sets of perceived ease of use, perceived usefulness, and behavioral intention data. Since hypotheses 4a-4c deal with differences between groups of subjects given different information frames, and groups of subjects using the same type of PC, this tool was selected to determine support for these hypotheses. Summary descriptive statistics for this data are presented in Table 6, broken down by construct and treatment group

Table 6. Construct Descriptive Statistics by Treatment

Treatment Group	System Told	Actual System	N	EOU		U		BI	
				Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
A	Low	Low	22	6.18	1.150	4.56	2.047	3.93	2.162
B	Low	High	23	6.12	.451	4.98	1.680	4.70	1.756
C	High	Low	27	6.19	1.057	6.08	1.065	6.30	1.021
D	High	High	27	6.30	.826	6.27	.857	6.54	.553

A series of 2×2 ANOVAs was run using perceived ease of use, perceived usefulness, and behavioral intention as the dependent variables and system level told to user and actual system level as the independent variables. The results (Table 7) indicated that the predicted main effect of system level told to the user for perceived usefulness ($F(1, 95) = 23.369$, $p < .001$) and behavioral intention ($F(1, 95) = 51.262$, $p < .001$) was present (H4a, H4c). Support was not found for hypothesis 4b ($F(1, 95) = .239$, $p = .626$). No main effects were found in the interactions. Marginal support was found for the effect of actual system level on behavioral intention, but not at the traditional level of $p < .05$ ($F(1,95) = 2.924$, $p = .091$).

Table 7. Summary ANOVA Data

Analysis	df	Mean Square	F	p
Ease of Use Overall				
System Told (ST)	1	.199	.239	.626
System Actual (SA)	1	.015	.018	.895
(ST) × (SA)	1	.184	.221	.639
Error	95	.832		
Usefulness Overall				
System Told (ST)	1	48.674	23.369	.000*
System Actual (SA)	1	2.258	1.079	.302
(ST) × (SA)	1	.342	.164	.687
Error	95	2.092		
Behavioral Intention Overall				
System Told (ST)	1	108.519	51.262	.000*
System Actual (SA)	1	6.191	2.924	.091**
(ST) × (SA)	1	1.679	.793	.375
Error	95	2.117		

* $p < .001$
** $p < .1$

To further examine the possible significance of actual system use on behavioral intention, an additional analysis step was completed. A series of oneway ANOVAs was run comparing individual treatments across the system told (system users were told they were using) and system actual (actual system they were using) levels. Actual system used was not found to have a significant effect on behavioral intention during this analysis, as was originally expected. Significant effects for the remaining individual comparisons were consistent with those of the 2 × 2 ANOVAs and the results can be found in Table 8. Further discussion on the impact of the information frame can be found in chapter 5.

Table 12. Summary Oneway ANOVA Data

Hypothesis	Variable	Levels Compared	Groups Compared	MS	F	p
H4a	U	Told Low/ Told High	A/C	28.248	11.300	.002**
			B/D	20.676	12.218	.001**
			All Low/ All High	48.364	23.319	.000*
H4b	EOU	Told Low/ Told High	A/C	.000	.000	.992
			B/D	.388	.837	.365
			All Low/ All High	.202	.247	.620
H4c	BI	Told Low/ Told High	A/C	67.774	25.426	.000*
			B/D	42.112	26.656	.000*
			All Low/ All High	107.673	50.104	.000*
H4a	U	Actual Low/ Actual High	A/B	1.997	.058	.454
			C/D	.463	.185	.485
			All Low/ All High	1.899	.744	.391
H4b	EOU	Actual Low/ Actual High	A/B	.004	.572	.811
			C/D	.167	.495	.669
			All Low/ All High	.024	.030	.864
H4c	BI	Actual Low/ Actual High	A/B	6.560	1.699	.199
			C/D	.782	1.159	.287
			All Low/ All High	5.130	1.600	.209

* $p < .001$
** $p < .01$

Data Analysis Summary

Overall, results showed support for a majority of the hypotheses suggested. These results are summarized in Table 9. Those that were not supported all surrounded the perceived ease of use construct. Several possibilities exist as to why this may have

Table 9. Summary Hypotheses Results

Hypothesis	Description	Hypothesized	Result
H1	EOU → U	Significant effect	Supported
H2	EOU → BI	Significant effect	Not Supported
H3	U → BI	Significant effect	Supported
H4a	U for different information frame	Main effect	Supported
H4b	EOU for different information frame	Main effect	Not Supported
H4c	BI for different information frame	Main effect	Supported

occurred, and these will be presented in the next chapter. Also worthy of discussion is the significant effect of perceived usefulness. Previous studies have found the perceived usefulness-behavioral intention link to be strong, but not to the level of explaining 78 percent of the variance as was found in this study. Possible reasons for this can be found in the chapter 5 discussions as well.

V. Discussion

Results

While results of this research supported the majority of the hypotheses, the lack of significance surrounding perceived ease of use (H3, H4b) was perplexing. Much work on the Technology Acceptance Model has found that perceived ease of use can have significant direct effect on behavioral intention (e.g. see Davis, 1989, 1993; Davis and others, 1989; Venkatesh and Davis, 1996, 2000; Venkatesh and Morris, 2000). This direct effect was not found in this study. One possible reason for this was the effects of perceived ease of use were mediated via the perceived usefulness construct. Szajna (1996) found that a revised TAM that removed the direct link between perceived ease of use and behavioral intention was also an effective predictor of system usage. The perceived ease of use-behavioral intention link has also been found to be consistently weaker than the perceived usefulness-behavioral intention link (e.g. see Davis, 1989, 1993; Davis and others, 1989; Venkatesh and Davis, 1996, 2000; Venkatesh and Morris, 2000).

In this case, another possibility also exists. The primary information frame given to the subjects in this experiment was the technology level of the computer. Davis' (1989) definition of perceived ease of use is the degree to which a "system will be free from effort" (Davis, 1989:320). Given the remarkable consistency and minimal variance (.81) in the perceived ease of use measurements, it is quite possible that subjects in this experiment found no difference in how easy it would be to use a Pentium or Pentium-III based computer. Although the perceived ease of use-perceived usefulness link was found to be significant, the adjusted R^2 was only .047, signifying little effect on perceived usefulness.

The lack of significance in perceived ease of use can also be partially explained by the strength of perceived usefulness. With an R^2 of .777 and a β of .866, it is clear that in this case, where the framed technology level of a computer was introduced as an external variable, that perceived usefulness is the key factor in determining behavioral intention and therefore actual system use. The strength of the perceived usefulness construct also helps explain other areas as well. In determining the reliability of the scales used, factor analysis seemed to indicate that only two variables were being measured with the second questionnaire and not the expected three. Perceived usefulness and behavioral intention were loading on the same factor (Table 12, Appendix G). Once the regression analysis was completed, the potential reason for this loading became apparent. Because of the treatment frames given, a factor analysis found these variables to be highly correlated and thus measuring the same construct. With perceived usefulness accounting for such a significant amount of the variance in behavioral intention, the reason that only two factors were found is explained.

As indicated, perceived usefulness was expected to play an important role in determining behavioral intention, but not as significant an effect as was found. The strength of this variable's effect can most likely be attributed to the influence of the framing effect. Perceived usefulness relates to how likely the subjects think the computer they are using will be useful to them in the future. In this study (as discussed below in the limitations), the sampling frame was limited to those persons available, which coincidentally contained subjects that were educated at the Bachelors and Masters level and were everyday users of computers. People familiar with computers generally understand the rate at which information technology is advancing and how a Pentium-133 computer is three-year-old technology. Because they are familiar with the tasks required by a computer today, they would generally not believe an older computer would be useful to them. Therefore, those who were told they were using the older computer consistently indicated a low perceived usefulness for that computer, while those told they were using the newer computer rated it higher. The same trend was true for behavioral intention. People who had the low-end framed computer rated their intention to use that computer as low. A sample less familiar with the current trends in computer processing power, or not exposed to higher end machines through work or studies, may have been less likely to uniformly assess the low-end framed computer as less useful and less likely to use. This may have shown the perceived usefulness-behavioral intention link more consistent with previous TAM research. However, this result does indicate the strength of an information frame regarding computer technology level on a subject group familiar with computing trends, as might be expected in today's military or business workforce. Because such a sample would be most likely be familiar with current information technology trends, the effect of the information frame should be much greater.

As described in Chapter 4, an additional check on the consistency of the tasks was completed. The mean difference in times between those subjects who used the high-end computer and those who used the low-end computer was approximately three minutes.

While this was not a large time difference, it was enough to be statistically significant ($p < .05$). This difference in times can most likely be attributed to differences in the actual computers themselves. The Pentium computer was approximately three years old and had components from that era. In addition to the slower central processing unit, hard drive speeds were slower, as well as system bus speeds. Because of this, the time it took to open or save documents while performing the tasks would have taken additional time to complete. The variance of times for those using the low-end system was also greater than that of those using the high-end system. These factors could easily account for the statistical difference in the two groups. While there was an actual difference in the time it actually took the subjects to complete the tasks, this difference was marginal. The users' perceptions of the machine they were using were clearly influenced by the information frame given.

Results from the ANOVA showed significant main effects for the information frame given on users' perceived usefulness and behavioral intention. From TAM, behavioral intention is mediated via the perceived ease of use and perceived usefulness constructs. Because the results of the regression analysis showed perceived usefulness accounted for a significant amount of the variance of behavioral intention, it is not surprising that the effect was present in both constructs. Most likely, the main effect indicated was due to the mediating effect of perceived usefulness as predicted by TAM. This does not discount the effect on perceived usefulness.

Levin (1987) found that information framed in a positive manner has a larger impact than information framed in a negative manner. This trend was also present in this study. The difference in mean perceived usefulness and behavioral intention scores for subjects that were given the negative information frame (that the faster computer they were using was actually the slower one) was less than that for those subjects given the positive information frame (that the slower computer they were using was actually the faster one) when compared with a control group (information frame matching actual computer used). This is in line with valence-consistent shift as discussed by Levin and others (1998). Levin and others (1998) also discuss why attribute framing effects such as the one used in this study have such a significant effect. When information is framed, a subject is drawn to "what makes the single object of the manipulation seem more or less worthwhile" (Levin and others, 1998:178). In the case of information technology, describing a computer system as "older" and "low-end" draws the user to all of the negative possibilities linked with that type of computer, while "newer" and "high-end' focuses attention on the positive aspects. This view helps explain the significance of the framing effect in this study. Users clearly believed that an older computer was less useful to them than a newer one.

Limitations

It is important to note some of the limitations that were part of this research effort. One major limitation consisted of the composition of the sampling frame used in the study. Subjects chosen for the study consisted of 99 percent military members. The other 1 percent was composed of civilians who work for the Department of Defense. While most military members are consistent with their civilian counterparts, some differences in the population are apparent. In this study, for example, the military members were all part of the officer corps. A military officer must have a degree. This level of education is not consistent with that of the population as a whole, however it is comparable to today's business workforce. The variety of military specialties held by these officers also helps distinguish them as a diverse group for study.

Additional limitations surrounding the population sampled were that it was entirely composed of students working toward a Masters or Ph. D. The higher education level of these subjects compared to a randomly selected sample chosen from the general population may have affected the results of the study as well. Also related to the sampling frame was the gender of the subjects involved. The perceived ease of use construct was found to have no direct effect on behavioral intention in this study. Recent research on TAM has shown that this link is stronger for women than it is for men (Venkatesh and Morris, 2000). One possible reason for the weak perceived ease of use-behavioral intention link found in this study could be due to the limited number of females in the sample. Overall, females composed only 6.1 percent of the subjects. This is related to the military nature of the sample, as women make up a smaller percentage of the armed forces than their male counterparts do. Overall, the sample size was less than thirty subjects for each treatment. While this is an arbitrary number associated with the Law of Large Numbers and there is no requirement to reach it, having a larger number of subjects would have perhaps helped the power of the significance tests in those categories found non-significant.

One additional area of concern is the universal acceptance of Festinger's (1957) Cognitive Dissonance Theory. While support has been found for this theory, others do not agree with Festinger's idea of dissonance occurring. This study, through the use of the information frame, showed support for this dissonance occurring; however, those who do not believe Cognitive Dissonance Theory may dispute the underlying cause.

A final limitation that may have affected the results could have been the tasks completed by the subjects. The task booklet consisted of relatively simple tasks that might be found in an office environment. If the tasks had been more complex or more highly taxing on the computer systems used, some users may have seen past the framing effect given and rated the system based more on the actual level of technology, and not their information frame.

Implications for the Air Force

Limitations aside, the results of this study show potential if applied to Air Force use. Each year countless new computer systems are purchased by the Air Force. While some of these are specialized systems for scientific or engineering research, many are for office automation tasks. This research has shown that users believe what they are told about such an information system and not what their own experience with the system has shown them. This thesis confirms the results found in other studies on the effect of attribute framing on users' perceptions and behavior. These studies have consistently shown that framing information in a positive or negative light has an impact on users' actions or decisions (e.g. see Levin, 1987; Johnson, 1987; Wilson and others, 1987; Levin and Gaeth, 1988; Levin and others 1988; Kramer, 1989; Schneider and others, 1993). The effect of such an information frame has implications for the Air Force.

Given the findings of this research, it is practical to re-examine the product upgrade cycle for new system purchases. Currently AFMC is examining just such a product replacement cycle. This research used a computer system three years old, and for office automation task such as word processing or electronic mail, that system was rated at the same level of usefulness as a newer system, provided the users were told it was a newer system. If the Air Force were to take the approach of framing older computers in a positive light, users should be willing to continue using them for longer periods without replacement. This would allow newer personal computer purchases to be allocated to those areas where they are truly needed. This concept could easily be introduced to Air Force personnel through initial training or in conjunction with computer awareness training that is already given to members on an annual basis.

Recommendations for Further Research

The research conducted in this study was primarily focused on the TAM constructs and the effect of the framing of information technology on those constructs. The results of the research suggest further areas that may be of interest to study.

In the course of this study, a significant amount of demographic information was collected, as summarized in Appendix A. Further analysis of this collected data could be completed to show effects of the framed technology level, as determined by such demographics as years of military service or military specialty.

The limitations of this study primarily centered on the population available from which to draw a sample. While the diversity of the specialty fields of the military subjects used helps the generalizabiliy of this research, it would be useful to compare the results with a study conducted using a sample more representative of the general population. Having a larger sample with varying levels of education, career fields, and technology experience would be helpful in this comparison.

Concluding Remarks

The Technology Acceptance Model is a powerful tool used in the prediction of behaviors as related to information technology systems. Combined with an information frame on the technology level of a computer, it shows how that frame can have a significant effect on users' perceptions. The cost of purchasing new information technology equipment continues to be a significant portion of capital investment in the Untied States (Lucas and Spitler, 1999). If, as this research shows, users' perceptions about computers play a more significant role in system use than the actual level of the computer they are using, this level of IT funding should be revisited.

Appendix A: Subject Demographic Information

Table 10. Demographic Information: Overview

Number of Subjects per Treatment		
Treatment	Number Subjects	Percent Total
A	22	22.2%
B	23	23.3%
C	27	27.3%
D	27	27.3%
Total	99	100%

Education Level Completed		
Education Level	Number Subjects	Percent Total
Bachelors Degree	79	79.8%
Masters Degree	20	20.2%

Education Level Working Toward		
Education Level	Number Subjects	Percent Total
Masters Degree	90	90.9%
Ph. D.	8	8.1%
No Response	1	1.0%

Gender of Participants		
Gender	Number Subjects	Percent Total
Male	93	93.9%
Female	6	6.1%

Computer Use for Work		
Hours per Week	Number Subjects	Percent Total
0-6	8	8.1%
7-12	16	16.2%
13-18	16	16.2%
19-24	22	22.2%
24-30	12	12.1%
Over 30	25	25.3%

Computer Use for Other		
Hours per Week	Number Subjects	Percent Total
0-6	39	39.4%
7-12	38	38.4%
13-18	12	12.1%
19-24	4	4.0%
24-30	5	5.1%
Over 30	1	1.0%

Table 11. Demographic Information: Military Specific Information

Military Service		
Response	Number Subjects	Percent Total
Yes	98	99.0%
No	1	1.0%
Years Military Service		
Years	Number Subjects	Percent Total
0-4	32	32.7%
5-9	33	33.7%
10-14	19	19.4%
Over 15	14	14.3%
Rank of Participants		
Rank	Number Subjects	Percent Total
O1-O3	93	94.9%
O4-O6	5	5.1%
Years in Specialty		
Years	Number Subjects	Percent Total
0-4	52	53.1%
5-9	34	34.7%
10-14	8	8.2%
Over 15	4	4.1%

Military Specialty		
Specialty	Number Subjects	Percent Total
Acquisition	2	2.0%
Aircraft Maintenance	4	4.1%
Civil Engineer	6	6.1%
Communications and Information	18	18.4%
Contracting	7	7.1%
Cost Analysis	2	2.0%
Engineer	22	22.4
Financial Management	9	9.2%
Infantry	1	1.0%
Scientist	10	10.2%
Space and Missile Operations	2	2.0%
Supply	5	5.1%
Transportation	4	4.1%
Weather	5	5.1%
Invalid Response	1	1.0%

Appendix B: Sample Informed Consent Form

Informed Consent Form

Study Overview

Welcome to the experiment. The following is a general description of the study and a reminder of your rights as a potential subject. As in any study, your participation is completely voluntary. If now, or at any point during the study, you decide that you do not want to continue participating, please let the experimenter know and you will be dismissed without penalty. Also, please remember that your name will not be associated with any of the information that you provide during the study. All of the information you provide is absolutely anonymous and confidential.

In this study, you will be asked to perform a series of tasks. You will also be asked to complete a questionnaire during the study. You will receive more specific instructions later in the study. If you have any questions or concerns at this time please inform the experimenter.

For further information

The Air Force Institute of Technology faculty members responsible for conducting this research are Maj Michael Morris, Maj Mark Ward, and Maj David Biros. They would be happy to address any of your questions or concerns regarding this study. Maj Morris is the primary advisor and can be reached at 255-3636 ext 4578.

If you would like to participate in this study, please sign in the space provided. Your signature indicates that you are aware of each of the following: 1) the general procedure to be used in this study, 2) your right to discontinue participation at any time, and 3) the steps taken to insure confidentiality of the data you will provide during the study.

Printed Name: ______________________

Signature:___________________________ Date:__________________

Appendix C: Sample Pre-Questionnaire

Subject Number ____

Circle the answer that you feel is most appropriate regarding your agreement with the statement.

1. I find a computer easy to use.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

2. Using a computer would increase my productivity in my job or studies.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

3. I would find a computer useful in my job or studies.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

4. Using a computer would improve my performance in my job or studies.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

5. Using a computer would enhance my effectiveness in my job or studies.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

6. I find it easy to get a computer to do what I want it to do.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

7. Learning to operate a computer is easy for me.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

8. It is easy for me to become skillful at using a computer.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

Appendix D: Sample Experimental Task Booklet

THE ROLE OF INFORMATION TECHNOLOGY
IN THE WORKFORCE

Research Group A
(Low-End System)

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

Thank you once again for participating in this experiment. Your total participation time should be approximately 30 minutes.

On the following pages, you will find a series of tasks to accomplish using the computer provided. For this scenario, the computer you will be using is an older Pentium 133Mhz system. This system was purchased off the Air Force Desktop V contract three years ago in 1997. Once you have completed the tasks provided, you will be given a short questionnaire to fill out.

Throughout this experiment booklet you will find certain visual clues to help you along. Whenever you see a word in *Italics*, it means that that there is a corresponding icon on the desktop with that name. If a word is partially underlined, such as File, this means that you should choose that menu item to accomplish a task. These visual clues are for the benefit of those participants who are not familiar with the particular program to accomplish a task. Depending on your level of computer expertise, you may not require this added help.

As a reminder, you are free to end your participation in this experiment at any time. Just let the facilitator know and you will be dismissed without prejudice. If you have any questions or problems develop during the experiment let the facilitator know. Due to the nature of experimental design, the facilitator may not be able to answer questions directly relating to the experimental content.

Please do not discuss this experiment or its contents with anyone who has not participated in it as this will potentially bias the results of their participation. If you have no questions at this time, please let the facilitator know you are ready to begin.

STOP – Do not go on to the next page until you are instructed to do so

Task 1

On the computer in front of you will find a shortcut to start *Microsoft Word.* If you are not familiar with this program, Word is a word processing program for use with the Microsoft Windows operating system. Start Word by double clicking on the icon provided. Once in Word, you will find that a file has already been opened. This file contains numerous typographical and grammatical errors. Using the spelling and grammar checking built into the Word program (Select Tools, then Spelling and Grammar) correct the document. Some of the errors highlighted will actually be correct, but Word has incorrectly shown that they are wrong, or the correct answer is not among those listed and must be filled in manually. You can use the help function built into the spelling and grammar checker for those items for which you are undecided to insure that you get the correct solution. This is often useful in correcting grammatical problems and can be access through the button with a picture of a question mark surrounded by a speech balloon. Once you have completed the corrections, save the file (Select File, then Save), exit the program, and move on to the next task.

Task 2

The next task you are going to accomplish is to send an electronic mail message. On the desktop you will find an icon labeled *Microsoft Outlook.* Double-click on this icon to load the program. Since the computer you are using is not connected to the network, we will be simulating sending a message by using Outlook's message posting feature.

To do this, select the option to create a new post (File, New, Post in This Folder). Then post the following message:

> Subject: Experimental Work
>
> I am working on Task 2 of the experimental booklet. I enjoy working on experimental tasks. If I get the opportunity, I hope to do more in the future.

Run the spell checker to insure that you have no errors in the typed text (Select Tools, then Spelling...).

When done, click on the Post button to post the message and exit Outlook (File, Exit). This completes the second task.

Task 3

The third task will be to do some calculations using the spreadsheet package installed on the computer, which in this case is Microsoft Excel. Double-click the *Microsoft Excel* icon on the desktop to load the program. Once the program starts, you will find that a worksheet entitled "Work in Progress" has already been opened. This is the file that you will be working with.

You are working for a small manufacturing firm and have been asked by the boss to provide the following information in a summary chart. You have been given the following information from which a partial chart has already been built with the information from 1990 ("Work in Progress"). Your goal is to complete the table's missing data using the information below. If you need assistance in how to complete a required calculation, it can be obtained by clicking Help, then Microsoft Excel Help.

1. Sales are expected to grow by 6% for 1990 and 1991, and by 4% in 1992 and 1993.
2. Direct costs are expected to remain at 43% of sales from 1990 and 1991. In the beginning of 1992, a new machine will be installed. It will cost $900,000 and reduce direct costs to 32% of sales from that point forward. The full cost will be allocated in 1992.
3. Overhead was $0.8M in 1989 and is expected to grow at its historical rate of 5% per year.
4. Taxes are 25% of gross profit.
5. Gross profit is equal to income minus expenses, net profit is profit after taxes.

Once you have completed the spreadsheet, save the file (Select File, then Save), then open a new worksheet (Select File, then New..., then OK). Task 3 then continues on the next page.

Task 3 (Continued)

Often today current personal computers are used for more advanced tasks such as simulation and modeling that required specialized workstations in the past. One small part that is often associated with this is the generation of random numbers. You are going to accomplish this now.

Open the data analysis tools on the worksheet you just created (Select Tools, then Data Analysis…). Scroll down the list and highlight Random Number Generation, then click the OK button. In the boxes shown, fill in the following information, then click OK again:

Number of Variables:	10
Number of Random Numbers:	3000
Distribution:	Normal
Output Range:	A1

The bottom of the screen will show "Calculating Random Number Generation…" while it is working.

Once the number set has been generated, save the file so that the number set does not need to be generated again (Select File, then Save As…, give it a name and click the OK button). Exit the program, and move on to the next task.

Task 4

The final task is to bind our two files that we have worked on together. On the desktop you will find an Icon labeled *Microsoft Binder.* Double-click on this file to start the program.

Microsoft Binder is a program used to link related documents together in an easy to use package. Add the PowerPoint file entitled "Bldg 640 Comm Upgrade.ppt" by using the Section menu (Choose Section, then Add from File…). Then add the two files you worked on earlier to the binder. The document's names were "Information Operations.doc" and "Work in Progress.xls"

Once you have completed the additions, save the file (Select File, then Save Binder), exit the program, and let the facilitator know you are finished.

STOP – Do not continue until you are instructed to do so

Appendix E: Sample Post-Questionnaire

Questionnaire

Now that you have completed the experiment, please take a few minutes to complete the following questions. All of the demographic information on the first section is being collected to help analyze trends and groupings among the experimental subjects. It cannot and will not be used to identify you individually in any way. Fill in the appropriate information or circle the applicable data range.

The remaining pages of questions relate to your participation in the study you just completed. As you answer them, consider using a Pentium 133Mhz computer like the one you just used for various purposes. These can range from everyday office automation to more intensive tasks such as simulation and modeling. The tasks you have completed today have been an example of some of these areas. The majority focused on office automation tasks and task three's random number generation gave some indication of how such a system might be used in other areas. Circle the answer that you feel is most appropriate regarding your agreement with the statement.

1. What is your age?

2. Are you male or female?

   Male Female

3. Are you in the military? (If no, go to question 8)

   Yes No

4. How many years have you been in the military?

   0 - 4 5 - 9 10 - 14 Over 15

5. What is your rank?

   E1 - E3 E4 - E6 E7 - E9 O1 - O3 O4 - O6

6. What is your primary AFSC?

7. How long have you been in this career field (years)?

   0 - 4 5 - 9 10 - 14 Over 15

8. What is the highest level of education you have completed?

High School   Associates Degree   Bachelors Degree   Masters Degree   Ph.D.

9. Are you currently working toward a higher level of education, and if so what level?

Associates Degree   Bachelors Degree   Masters Degree   Ph.D.

10. How many hours a week do you use a computer for work or study?

0 – 6   7 – 12   13 – 18   19 – 24   24 – 30   Over 30

11. How many hours a week do you use a computer for non-work or non-study activities?

0 – 6   7 – 12   13 – 18   19 – 24   24 – 30   Over 30

1. Learning to operate a Pentium 133Mhz computer such as this one would be easy for me.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

2. I am comfortable using Microsoft Outlook.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

3. I would use a Pentium 133Mhz computer such as this one frequently in my job or studies over the next year

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

4. Using a Pentium 133Mhz computer such as this one would increase my productivity in my job or studies.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

5. I am comfortable using Microsoft Excel.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

6. I would use a Pentium 133Mhz computer such as this one in my job or studies over the next year

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

7. I would find it easy to get a Pentium 133Mhz computer such as this one to do what I want it to do.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

8. I am comfortable using Microsoft Windows.

1 Strongly Agree	**2** Agree	**3** Slightly Agree	**4** Neutral	**5** Slightly Disagree	**6** Disagree	**7** Strongly Disagree

9. I think Information Technology will help me perform my job.

1 Strongly Agree	2 Agree	3 Slightly Agree	4 Neutral	5 Slightly Disagree	6 Disagree	7 Strongly Disagree

10. Using a Pentium 133Mhz computer such as this one would enhance my effectiveness in my job or studies.

1 Strongly Agree	2 Agree	3 Slightly Agree	4 Neutral	5 Slightly Disagree	6 Disagree	7 Strongly Disagree

11. Using a Pentium 133Mhz computer such as this one would improve my performance in my job or studies.

1 Strongly Agree	2 Agree	3 Slightly Agree	4 Neutral	5 Slightly Disagree	6 Disagree	7 Strongly Disagree

12. It would be easy for me to become skillful at using a Pentium 133Mhz computer such as this one.

1 Strongly Agree	2 Agree	3 Slightly Agree	4 Neutral	5 Slightly Disagree	6 Disagree	7 Strongly Disagree

13. I would find a Pentium 133Mhz computer such as this one easy to use.

1 Strongly Agree	2 Agree	3 Slightly Agree	4 Neutral	5 Slightly Disagree	6 Disagree	7 Strongly Disagree

14. I would find a Pentium 133Mhz computer such as this one useful in my job or studies.

1 Strongly Agree	2 Agree	3 Slightly Agree	4 Neutral	5 Slightly Disagree	6 Disagree	7 Strongly Disagree

15. I found the tasks easy to follow.

1 Strongly Agree	2 Agree	3 Slightly Agree	4 Neutral	5 Slightly Disagree	6 Disagree	7 Strongly Disagree

16. I am comfortable using Microsoft Word.

1 Strongly Agree	2 Agree	3 Slightly Agree	4 Neutral	5 Slightly Disagree	6 Disagree	7 Strongly Disagree

Appendix F: Experiment Script

Thank you for participating in this experiment on information technology in the workforce. Today you have been placed into the group that will be using a high-end/low-end computer system. Your total participation time should be no more than approximately 30 minutes.

On the desk in front of you, you will find several documents. On the top of this pile you will find an informed consent form. The purpose of this form is to explain your rights and expectations as an experimental subject. Please read this form and sign at the bottom.

I'll take that form now.

Please remember that you are free to end your participation in this experiment at any time. Just let me know and you will be dismissed without prejudice. If you have any questions or problems develop during the experiment let me know. Due to the nature of the experiment, I will not be able to answer questions directly relating to the experimental content.

In the "Pre Task" manila envelope, you will find a short questionnaire. Please take a moment and fill it out now.

I'll take that from you.

(User completes pre-survey)

In the manila envelope labeled "Task" in front of you, you will find the scenario you will be working on today. Please take it out now. Open to the first page and read over the instructions. Let me know when you are ready to continue.

If you understand the instructions and have no questions, you may now begin the scenario.

<Start timer>

(User completes computer tasks)

<Stop timer>

Now that you have completed the scenario, open the "Questionnaire" envelope and remove the questionnaire enclosed. Please take a few minutes to read the instructions and complete it now.

(User completes questionnaire)

Please do not discuss this experiment or its contents with anyone who has not participated in it as this will potentially bias the results of their participation. Thank you again for your help.

Appendix G: Factor Analysis Results

Table 12. Questionnaire Factor Analysis Results

Pre-test			Post-test		
Question #	Factor 1	Factor 2	Question #	Factor 1	Factor 2
EOU1	.836	-.287	EOU1	.270	.885
EOU2	.832	-.405	EOU2	.555	.581
EOU3	.855	-.423	EOU3	.372	.876
EOU4	.871	-.390	EOU4	.463	.803
U1	.717	.494	U1	.909	-.271
U2	.788	.416	U2	.916	-.250
U3	.827	.307	U3	.914	-.246
U4	.741	.475	U4	.929	-.204
			BI1	.886	-.156
			BI2	.918	-.252

Bibliography

Adams, Dennis A., R. Ryan Nelson and Peter A. Todd. "Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication," *MIS Quarterly, 16*: 227-247 (June 1992).

Ajzen, Icek and Martin Fishbein. *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Pretence-Hall, 1980.

Ajzen, Icek. "From Intentions to Actions: A Theory of Planned Behavior," in *Action Control: From Cognition to Behavior.* Ed. J. Kuhl and J. Beckerman. New York: Springer Verlag, 1985.

Ajzen, Icek and Thomas J. Madden. "Prediction of Goal-Directed Behavior: Attitudes, Intentions, and Perceived Behavioral Control," *Journal of Experimental Social Psychology, 22*: 453-474 (1986).

Aronson, Elliot and J. Merrill Carlsmith. "Performance Expectancy as a Determinant of Actual Performance," *Journal of Abnormal and Social Psychology, 65*: 178-182 (March 1962).

Bagozzi, Richard P. "Attitudes, Intentions and Behavior: A Test of Some Key Hypotheses," *Journal of Personality and Social Psychology, 41*: 607-627 (1981).

Baily, Martin N. and Robert J. Gordon. "The Productivity Slowdown, Measurement Issues, and the Explosion of Computer Power," in *Brookings Papers on Economic Activity, 2.* Ed. W. C. Brainard and G. L. Perry. Washington DC: The Brookings Institution, 1988.

Bandura, Albert. "Self-Efficacy: Toward a Unifying Theory of Behavioral Change," *Psychological Review, 84*: 191-215 (1977)

Bettman, James R. and Mita Sujan. "Effects of Framing on Evaluation of Comparable and Noncomparable Alternatives by Expert and Novice Consumers," *Journal of Consumer Research, 14*: 141-154 (September 1987).

Brewer, Marilynn B. and Roderick M Kramer. "Choice Behavior in Social Dilemmas: Effects of Social Identity, Group Size and Decision Framing," *Journal of Personality and Social Psychology, 50*: 543-549 (1986).

Brynjolfsson, Erik. "The Productivity Paradox of Information Technology," *Communications of the ACM, 36*: 67-77 (December 1993).

Brynjolfsson, Erik and Lorin Hitt. "Is Information Systems Spending Productive? New Evidence and New Results," *Proceedings of the Fourteenth International Conference on Information Systems.* 47-64. Orlando: ACM, 1993.

Brynjolfsson, Erik and Shinkyu Yang. "Information Technology and Productivity: A Review of the Literature," *Advances in Computers, 43*: 179-214 (February 1996).

Carlsmith, J. Merrill and Elliot Aronson. "Some Hedonic Consequences of the Confirmation and Disconfirmation of Expectancies," *Journal of Abnormal and Social Psychology, 66*: 151-160 (February 1963).

Cron, William L. and Marion G. Sobol. "The Relationship Between Computerizations and Performance: A Strategy for Maximizing the Economic Benefits of Computerization," *Information and Management, 6*: 171-181 (1983).

Davis, Fred D. "Perceived Usefulness, Perceived Ease of Use, and User acceptance of Information Technology," *MIS Quarterly, 13*: 319-340 (September 1989).

Davis, Fred D., Richard P. Bagozzi and Paul R. Warshaw. "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models," *Management Science, 35*: 982-1002 (August 1989).

Davis, Fred D. "User Acceptance of Information Technology: System Characteristics, User Perceptions and Behavioral Impacts," *International Journal of Man-Machine Studies, 38*: 475-487 (1993).

Dillon, Andrew and Charles Watson. "User Analysis in HCI: the Historical Lesson from Individual Differences Research," *International Journal of Human-Computer Studies, 45*: 619-637 (1996).

Dooley, David. *Social Research Methods* (Third Edition). New Jersey: Prentice-Hall, Inc, 1999.

Festinger, L.A. *A Theory of Cognitive Dissonance.* New York: Row Peterson, 1957.

Fishbein, Martin and Icek Ajzen. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.* Reading MA: Addison-Wesley, 1975.

Fleishman, John A. "The Effects of Decision Framing and Others' Behaviors on Cooperation in a Social Dilemma," *Journal of Conflict Resolution, 32*: 162-180 (March 1988).

Harris, Monica J. "Controversy and Cumulation: Meta-anlaysis and research on Interpersonal Expectancy Effects," *Personality and Social Psychology Bulletin, 17*: 316-322 (June 1991).

Hirschheim, R. and M. Newman. "Information Systems and User Resistance: Theory and Practice," *The Computer Journal, 31*: 398-408 (1988).

Igbaria, M., T. Guimaraes and G. B. Davis. "Testing the Determinants of Microcomputer Usage via a Structural Equation Model," *Journal of Management Information Systems, 11*: 87-114 (1995).

Jackson, Cynthia M., Simeon Chow and Robert A. Leitch. "Toward and Understanding of the Behavioral Intention to Use and Information System," *Decision Sciences, 28*: 357-389 (Spring 1997).

Johnson, Richard D. "Making Judgements When Information is Missing: Inferences, Biases, and Framing Effects," *Acta Psycologica, 66*: 69-82 (1987).

Kahneman, Daniel and Amos Tversky. "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica, 47*: 263-291 (March 1979).

Kramer, Roderick M. "Windows of Vulnerability or Cognitive Illusions? Cognitive Processes and the Nuclear Arms Race," *Journal of Experimental Social Psychology, 25*: 79-100 (1989).

Landaur, Thomas K. *The Trouble with Computers: Usefulness, Usability, and Productivity*. Cambridge: MIT Press, 1996.

Levin, Irwin P., R. D. Johnson, C. P. Russo, and P. J. Deldin. "Framing Effects in Judgment Tasks with Varying Amounts of Information," *Organizational Behavior & Human Decision Processes, 37*: 362-377 (1985).

Levin, Irwin P. "Associative Effects of Information Framing," *Bulletin of the Psychonomic Society, 25*: 85-86 (1987)

Levin, Irwin P., Sara K. Schnittjer and Shannon L. Thee. "Information Framing Effects in Social and Personal Decisions," *Journal of Experimental Social Psychology, 24:* 520-529 (1988b).

Levin, Irwin P., Sandra L. Schneider and Gary J. Gaeth. "All Frames Are Not Created Equal: A Typology and Critical Analysis of Framing Effects," *Organizational Behavior and Human Decision Processes, 76*: 149-188 (November 1998).

Lucas, Henry C., Jr. and V. K. Spitler. "Technology Use and Performance: A Field Study of Broker Workstations," *Decision Sciences, 30*: 291-311 (Spring 1999).

Mathieson, Kieran. "Predicating User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior," *Information Systems Research, 2*: 173-191 (1991).

Morris, Michael G. and Andrew Dillon. "How User Perceptions Influence Software Use," *IEEE Software, 14*: 58-65 (July/August 1997).

McClave, James T., P. George Benson and Terry Sincich. *Statistics for Business and Economics* (Seventh Edition). New Jersey: Prentice-Hall, Inc, 1998.

McKim, Robert. "Rethink Productivity Measurement to Reflect the Computer Age," *Target Marketing, 23*: 38-39 (January 2000).

Quinn, James Brian and Martin N. Baily. "Information Technology: The Key to Service Performance," *Brookings Review, 12*: 36-42 (Summer 1994).

Russo, J. E., V. H. Medvec and M. G. Meloy. "The Distortion of Information During Decisions," *Organizational Behavior and Human Decision Processes, 66*: 102-110 (1996).

Saltzer, E. "Cognitive Moderators of the Relationship Between behavioral Intentions and Behavior," *Journal of Personality and Social Psychology, 41*: 260-271 (1981).

Scacchi, Walt. "Understanding Software Productivity," *Advances in Software Engineering and Knowledge Engineering, 4*: 37-70 (December 1995).

Schneider, S. L., G.L. Holstrum and R.E. Marden. "Framing Effects and Audit Decision Making: Control Environments Evaluation," Presented as the annual meeting of the Society for Judgments and Decision Making, Washington, DC. November 1993.

Sheppard, B.H., J. Hartwick and P. R. Warshaw. "The Theory or Reasoned Action: A Meta-analysis of Past Research with Recommendations for Modification and Future Research," *Journal of Consumer Research, 15*: 325-343 (1988).

Straub, Detmar, Moez Limayem and Elena Karahanna-Evaristo. "Measuring System Usage: Implications for IS Theory Testing," *Management Science, 41*: 1328-1342 (August 1995).

Szajna, Bernadette and Richard W. Scamell. "The Effects of Information System User Expectations on Their Performance and Perceptions," *MIS Quarterly*: 493-514 (December 1993).

Szajna, Bernadette. "Empirical Evaluation of the Revised Technology Acceptance Model," *Management Science, 42*: 85-92 (January 1996).

Taylor, Shirley and Peter A. Todd. "Understanding Information Technology Usage: A Test of Competing Models," *Information Systems Research, 6*: 144-176 (1995).

Thomas, Beverly E. and John P. Baron. *Evaluating Knowledge Worker Productivity: Literature Review*. United States Army Construction Engineering Research Laboratories Interim Report FF-94/27. June 1994.

Tversky, Amos and Daniel Kahneman. "The Framing of Decisions and the Psychology of Choice," *Science, 211*: 453-458 (1981).

Venkatesh, Viswanath and Fred D. Davis. "A Model of the Antecedents of Perceived Ease of Use: Development and Test," *Decision Sciences, 27*: 451-481 (Summer 1996).

Venkatesh, Viswanath and Fred D. Davis. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," *Management Science, 46*: 186-204 (February 2000).

Venkatesh, Viswanath and Michael G. Morris. "Why Don't Men Ever Stop to Ask for Directions? Gender, Social Influence, and Their Role in Technology Acceptance and User Behavior," *MIS Quarterly, 24*: 115-139 (March 2000).

Warshaw, Paul R. "Predicting Purchase and Other Behaviors from General and Contextually Specific Intentions," *Journal of Marketing Research, 17*: 26-33 (1980).

Warshaw, Paul R. and Fred D. Davis. "Self-Understanding and the Accuracy of Behavioral Expectations," *Personality and Social Psychology Bulletin, 10*: 111-118 (1984).

Warshaw, Paul R. and Fred D. Davis "Disentangling Behavioral Intention and Behavirioral Expectation," *Journal of Experimental Social Psychology, 21*: 213-228 (1985).

Wilson, D.K., R. M. Kaplan and L. J. Schneiderman. "Framing of Decisions and Selections of Alternative in Health Care," *Social Behavior, 2*: 51-59 (1987).

Vita

Captain Jon C. Autrey was born in Texarkana, Texas. Captain Autrey's father worked for the Department of the Army, so the family moved quite often in his early years. His formative years were spent in Virginia where he graduated from Colonial Heights High School in 1991. Earning an Air Force ROTC scholarship, he entered the University of Missouri - Rolla where he received a Bachelor of Science Degree in Computer Science in May of 1996. Captain Autrey was commissioned through AFROTC detachment 442 commensurate with earning his degree.

His first assignment was to the 93d Computer Systems Squadron (CSS) at Robins Air Force Base, Georgia where he supported the Joint Surveillance Target Attack Radar System (JSTARS) mission. While stationed at Robins, Captain Autrey deployed as the lead communications officer on two occasions to support exercises and real world contingencies, to include Operation ALLIED FORCE in 1999. In August of 1999, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will be assigned to the 4th Space Operations Squadron located at Schriever Air Force Base, Colorado.

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14. ABSTRACT

Every year the Department of Defense spends millions of dollars on the purchase of new computer equipment. There is some question as to the necessity of the amount of this spending. This thesis looks at the use of information framing to influence users' perceptions of information technology using the Technology Acceptance Model (TAM). TAM does this by measuring users' perceived ease of use, perceived usefulness, and behavioral intention toward a computer. An experiment was conducted by framing information about the technology level of two computers. Users' perceptions about using those systems were then collected using the TAM construct measuring instruments. The results of this study suggest that these perceptions about computer technology have more impact on users' actual use of an IT system than the actual technology level that is present in a computer. This indicates that the aggressive product replacement cycles for computers currently used by Air Force units could be reexamined to extend the useful life of existing systems. The savings realized could then be applied to other critical Air Force mission needs.

15. SUBJECT TERMS
Information Framing; Cognitive Dissonance; Technology Acceptance Model; Information Technology; Personal Computer

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