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The Influence of Affect, Attitude and Usefulness in the Acceptance of Healthcare Information Systems

Abstract

Grounded in current theories of affect this study examines the role positive and negative moods play on the acceptance of a specialized telemedicine system for microbiology consultation and diagnostics, referred to as telepathology. From a laboratory experiment using microbiology laboratory assistants, the notion that healthcare users' attitude is an important factor in the acceptance behavior of a healthcare information system is supported. A regression analysis of the data revealed the need to tailor the IS Technology Acceptance Model for the healthcare field. Specifically, our results show that ease of use which is thought to be a main antecedent of end-user acceptance of information technology may not be as important in the healthcare field. The results also indicated that affect is a significant antecedent of attitude and that positive affect is almost as effective in improving users' attitude toward acceptance of a healthcare information system as the perception of usefulness of the system. In addition, negative affect, while not as powerful as positive affect and usefulness, can significantly and negatively influence a user's attitude. Those interested in better understanding the adoption of IS within the healthcare industry would most benefit from our findings.

Contribution:

This paper contributes to IS research in several ways. The study provides evidence that healthcare professional's attitude has significant impact on their acceptance behavior and that ease of use, which is thought to be a main antecedent of end-user acceptance of information technology, may not be as important in the healthcare field. The results also indicate that affect is a significant antecedent of attitude and that positive affect is almost as effective in improving users' attitude toward acceptance of a healthcare information system as the perception of usefulness of the system. In addition, negative affect, while not as powerful as positive affect and usefulness, can also significantly and negatively influence users' attitude. In addition to providing support for the need to tailor the IS Technology Acceptance Model for the healthcare field this study proposes a model that can help to improve the acceptance of healthcare systems. In particular, this study shows that the inclusion of affect in the proposed model provides a more complete picture of user behavior.

It is expected that both practitioners and IS researchers will be interested in the findings of this research. The study can help practitioners, who are responsible for expanding information technology systems in their healthcare organization, better understand how influential attitude factors and affect can be when healthcare professionals are determining to accept (or not accept) a new telemedicine system. IS researchers have a proposed model that further supports the need for modifying the IS Technology Acceptance Model when applying it to healthcare and perhaps to other disciplines.

INTRODUCTION

This research examines how the acceptance of healthcare technologies (e.g. telepathalogy system) could be increased. Motivated by the importance, and yet limited amount research related to attitude in the healthcare literature (Diener, Mueller, and Fletcher 2001; Grigsby, Kaehny, Sandberg, and Schlenker 1995), an investigation is conducted to reaffirm the impact attitude has on the acceptance of an information system and to study one particular hypothesized antecedent (affect). Next a model, which identifies affect as an important antecedent of attitude, is proposed and tested. Previous research suggests that attitudes may be influenced by one's affective state (Isen 2003). Moreover, studies show that affect is an essential component of making sound rational decisions (Hanoch 2002; Bachara, Damasio, Tranel, and Damasio 1997; Damasio 1994; Bachara,

Damasio, Damasio, and Anderson 1994). Since choosing to adopt a healthcare system is a rational decision, it is likely that healthcare professionals' affect plays a role in whether they decide to adopt that system. Based on this literature, we argue that affect is an important factor that should be considered when studying attitude. By examining its influence on attitude when deciding to adopt a system, this research helps us better understand healthcare professionals' behavior and their system acceptance decision process.

BACKGROUND

The healthcare industry is one of the largest consumers of information technology in the U. S. economy. However, healthcare systems tends to be complex and inefficient (Evans and Wurster 2000) and healthcare industry often lags behind other industries in its adoption of information technologies (Abrahams, Ginsburg, and Silver 2005; Mikulich, Liu, and Steinfeldt 2001; Eder and Darter 1998). Though, this trend is poised to change because of demanding Internet-savvy consumers, spiraling health care costs, physician's interest in expanding their practices, and new healthcare related legislation. However, regardless of the potential advantages, underutilized technologies will not effectively achieve their intended purpose and the scarce medical resources supporting these systems will be wasted (Markus and Keil 1994; Mathieson 1991). Thus, user acceptance of healthcare technologies becomes a critical management issue (McGarry 2007; Perednia and Allen 1995). Examining factors that can increase the healthcare professionals' acceptance of healthcare technology can potentially provide insight into ways to improve the efficiency of healthcare practices, which in turn assists in advancing the technological

movement of the healthcare industry as a whole.

While user acceptance of a technology has been extensively studied in the information systems (IS) literature, there is evidence that healthcare systems may require new acceptance models or at a minimum may require tailoring the existing models to match their needs (Hu, Chau, Sheng, and Tam 1999). Consequently, there is a growing need for developing new theoretical models to predict the acceptance of healthcare systems (Pare, Sicotte, and Jacques 2006; Berner, Detmer, and Simborg 2005; Saleem, et al. 2005; Davidson and Chiasson 2005; Ammenwerth, Mansmann, Iller, and Eichstadter 2003; Schuster, Hall, Couse, Swayngim, and Kohatsu 2003; Hu, Chau, Sheng, and Tam 1999). Research has also shown that one of the essential reasons why telemedicine, a specialized type of healthcare information system, has yet to reach its potential is that the attitudes of healthcare professionals are not given enough consideration (Diener, Mueller, and Fletcher 2001; Grigsby, Kaehny, Sandberg, and Schlenker 1995). Two recent investigations provide evidence that healthcare professionals' attitude plays a significant role in acceptance of a healthcare information system (Pare, Sicotte, and Jacques 2006; Hu, Chau, Sheng, and Tam 1999). Thus, examining factors that can improve or diminish users' attitudes toward the acceptance of a healthcare information system is an important research stream both for theoreticians and practitioners.

To address these two issues (i.e., study acceptance behavior for healthcare information systems and examine factors that can influence users' attitude towards a healthcare information system) we use the Technology Acceptance Model (TAM) as our base model. TAM serves as a suitable base model for our study since it gives attitude a central role in predicting the acceptance behavior of a technology; a role that has been

shown to be significant in acceptance of healthcare information systems (Pare, Sicotte, and Jacques 2006; Hu, Chau, Sheng, and Tam 1999). We then extend TAM by examining the impact of users' affect (users' global positive and negative feelings) on their attitude towards a new healthcare information system.

A growing number of studies in cognitive psychology show that affect has a significant and marked impact on cognition and behavior (Aspinwall 1998; Forgas 2002; Fredrickson 2003; Isen 2003; Isen et al. 2003). Further research has shown that behavioral effects of one's feeling states are robust across many environments (from laboratory experiments to organizational settings such as hospitals), tasks (from solving anagrams to diagnosing cancer), and population (from undergraduate and graduate students to physicians) (Erez and Isen 2002; Estrada and Isen 1997; Estrada, Isen, and Young 1994; Kahn and Isen 1993; Isen, Rosenzweig, and Young 1991; Kraiger, Billings, and Isen 1989). The influence of affect on cognition is also supported by neuroscience (Ashby, Isen, and Turken 1999) which suggests that affective states may also influence traits and attitudes (Isen 2003). The above discussed affect theories and their supporting studies provide ample evidence that how a user feels at the time he or she is being introduced to a technology, may have a significant influence on his or her attitude towards the technology and hence influence his or her acceptance behavior. Using cognitive theories of affect, we propose an extension to TAM by arguing that users' affect plays a significant role in influencing their attitude towards a new healthcare information system.

TELEMEDICINE

Telemedicine is one of many types of healthcare information systems. Telemedicine

uses electronic information and communications technologies to provide patient healthcare services when distance separates the participants (LeRouge, Hevner, Collins, Garfield, and Law 2004; LeRrouge, Garfield, and Henver 2002; Charles 2000). Telemedicine is frequently referred to as the use of a wide array of technologies to deliver a range of medical services to persons at some distance from a health care provider (Diener, Mueller, and Fletcher 2001). Oftentimes, telemedicine systems replace face-to-face contact by employing telecommunications and computer technology as a substitute.

In this study we examined the acceptance of a telepathology system (a laboratory telemedicine system) that was designed specifically for public health medical professionals to support distance microbiology and pathology consultation, to integrate statewide laboratory-based disease surveillance, and to facilitate prompt response to public health threats (e.g., malaria, SARS, etc.) and/or bioterrorism (Fruhling 2006; Xue and Liang 2004; Devadoss and Pan 2004).

Telemedicine systems, such as the one examined in this study, are one of the most important components of the national healthcare information infrastructure and require special attention. A system that is not readily accepted by its users is less likely to be utilized effectively (Turoff, Chumer, and Van de Walle 2004; Keil, Beranek, and Konsynski 1995). Thus, the ultimate success of healthcare information systems, such as those used in laboratories, requires the acceptance of its users (Perednia and Allen 1995).

RESEARCH MODEL AND HYPOTHESES

In this section we provide a brief review of theories used in this study. Based on these theories we propose a model for the acceptance of healthcare systems and establish several hypotheses to test this model.

Technology Acceptance Model (TAM)

TAM (Davis 1989) suggests that an individual's intention to use a technology is influenced by his or her attitude towards that technology and his or her perception of its usefulness. Attitude in turn is influenced by a person's beliefs (perceptions) in how useful the technology is and how easy it is to use. In this context, attitude is measured by how much one likes or dislikes the technology that is under investigation. The perception of ease of use is measured by the degree to which using a technology is free of effort and the perception of usefulness is measured by the degree to which the technology can help to improve task performance (Figure 1).
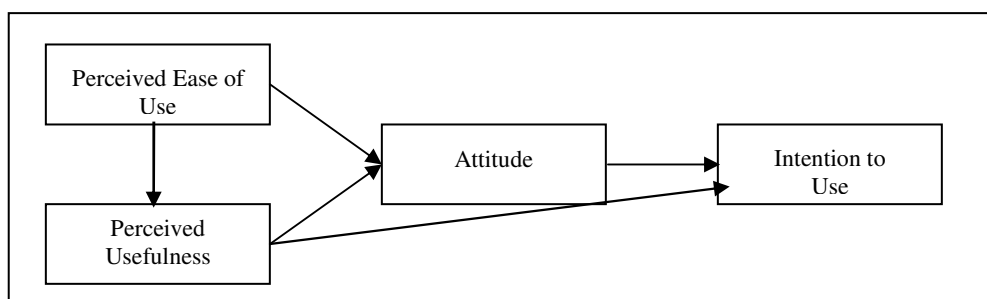

Figure 1: Technology Acceptance Model (TAM)

There is evidence that TAM may need modifications for the acceptance of healthcare systems (Hu, Chau, Sheng, and Tam 1999). Since we propose a model that extends TAM it is necessary to first test the robustness of TAM for healthcare systems. Such a test will also facilitate the determination of possible adjustments needed to modify TAM for healthcare systems. Hence we test the following hypotheses:

H1a)   Intention to use the system is influenced by users' attitude.

H1b)   Intention to use the system is influenced by users' perception of usefulness of the system.

H2)   Users' perception of usefulness is influenced by their perception of ease of use of the system.

H3a)   Users' attitude is influenced by their perceptions of ease of use of the system.

H3b)   Users' attitude is influenced by their perceptions of usefulness of the system.

In this study we argue that affect can play a significant role in the acceptance of healthcare systems. Since the role of affect in rational decision making (such as decisions regarding adopting a healthcare system) is often misunderstood in the following sections we first discuss the literature that establishes affect as an essential component of making good decisions. Next, we discuss how affect can influence cognition. Finally, we explain how affect may influence the acceptance behavior, in particular the attitudes towards healthcare systems.

Affect as an Integral Part of Rationality

Affect is a psychological construct that describes one's global feelings such as moods and emotions (Fredrickson 2003; Lazarus 1991; Moore and Isen 1990). Affect and rational thinking have been shown to be intricately related. That is to say, both affect and rational thoughts are processed by the same brain structures (amygdala and the ventromedial prefrontal cortex) (Adolphs and Damasio 2001).

Abundant evidence exists which suggests that decision making without affect is at best impractical and at worst impossible (Bachara et al. 1997; Bachara et al. 1994; Damasio 1994). Studies support the fact that people with brain injuries that inhibit their emotional processing are unable to make, simple rational decisions. For example, a simple task of setting up an appointment, which should normally take a few minutes, would for such a person become an immense task of evaluating all possible variables, from different weather conditions to multiple appointment options (Bachara et al. 1997; Bachara et al. 1994; Damasio 1994). Without affect working in conjunction with their rational calculations, these individuals are unable to stop the exhaustive exploration of every imaginable alternative (Damasio 1994; Hanoch 2002; Muramatsu et al. 2005; Picard 1997). In other words, affect guides rationality by helping individuals to focus on a manageable subset of possibilities that "look right" or "feel right." These findings, suggest that including affect in those behavioral models that are based on a cognitive framework (e.g., TAM) can provide a more complete picture of their actors (Muramatsu and Hanoch 2005; Hanoch 2002; Damasio 1994).

Affect, Cognition, and Judgments

In addition to limiting the amount of possible thoughts in one's memory, affect can also influence one's cognitive content and structure, i.e., thoughts and ideas that are easily and quickly accessible in memory (Isen and Labroo 2003; Fredrickson 2003; Murray, Sujan, Hirt, and M. 1990; Isen 1984; Isen and Daubman 1984; Isen, Shalker, Clark, and Karp 1978). For example, when an individual is in a positive feeling state he or she has more ready access to positive thoughts and likewise, when an individual is in a negative feeling state he or she has more ready access to negative thoughts. (Isen and Labroo 2003; Forgas 2002; Forgas and George 2001; Forgas 1995; Isen 1984).

The above discussed effects on cognition has significant implications for decision making and their ensuing behaviors such as accepting a healthcare system. Decisions are influenced by thoughts that come to mind first or most easily (Tversky and Kahneman 1973). Because feeling states influence which thoughts are readily accessible in our memory they can impact our evaluations and decisions (Forgas 1995; Forgas 2002; Forgas et al. 2001; Isen 1984; Isen et al. 2003). According to neuropsychology research the fluctuations in dopamine levels in our brain, which are influenced by affect, are the underlying cause of such effects (Ashby, Isen, and Turken 1999). Moreover, the impact of affect on decisions has been replicated in many different contexts from simple decisions in laboratory settings to diagnosing cancer in hospitals e.g., (Isen, Labroo, and Durlach 2004; Estrada and Isen 1997; Isen, Rosenzweig, and Young 1991). Based on these studies we argue that decisions regarding acceptance of a healthcare system may be influenced by affect as well. In particular, as explained in the next section, we argue that affect influences acceptance through its effect on attitude.

Attitude and Affect

Literature suggests that attitudes may be influenced by affect (Isen 2003). This is because dopamine receptors in brain can change in response to stimuli such as one's affective states. In this section we explain how positive and negative affect may influence attitude towards a healthcare system.

Attitude towards an object refers to one's cognitive evaluation of that object (George and Jones 1996). As discussed earlier, affect guides our reasoning by helping us to focus on a manageable set of thoughts (Hanoch 2002). Affect also influence things that we think about (Forgas 2002; Isen 1984) which in turn influence our judgments (Tversky and Kahneman 1973). Because people in a positive affective state have access to more positive thoughts in their memory they tend to focus more on the favorable aspects of stimulus and/or positive outcomes of a situation (Isen and Shalker 1982; Forest, Clark, Mills, and Isen 1979; Isen, Shalker, Clark, and Karp 1978; Schiffenbauer 1974; Feather 1966). People in a negative affective state, who have access to more negative thoughts on the other hand, tend to focus on those aspects of stimuli that are not as favorable, thus they tend to be more critical of the stimuli and/or situations (Forgas 2002; Forgas, Bower, and Moylan 1990). It is then likely that healthcare users in a positive mood focus more on helpful and beneficial aspects of a new healthcare systems. Similarly, it is likely that healthcare professionals who are in a negative mood focus more on those aspects of the system that are not so favorable. Since such thoughts influence cognitive evaluations and since attitude toward a technology refers to one's cognitive evaluation of that system we predict the following:

H4a)   Users' positive affect influences their attitude towards the system positively.

H4b)   Users' negative affect influences their attitude towards the system negatively.

It is important to note that there is ample evidence that the impact of affect on cognition depends on the context and thus is not due simple response bias and/or careless evaluations (Isen 2003; Erez and Isen 2002). For example, despite their readily access to positive thoughts, people in a positive affective state do not evaluate negative stimuli as positive (Isen 2003; Erez and Isen 2002). Hence our model will not apply to systems that are poorly designed (e.g., positive affect will not improve the attitudes of the healthcare professionals if the system is inadequate). Our theoretical model is presented in Figure 2. In the following section, we provide the methodology used to verify this model, report the results of our experiment, and discuss the implication of our results.
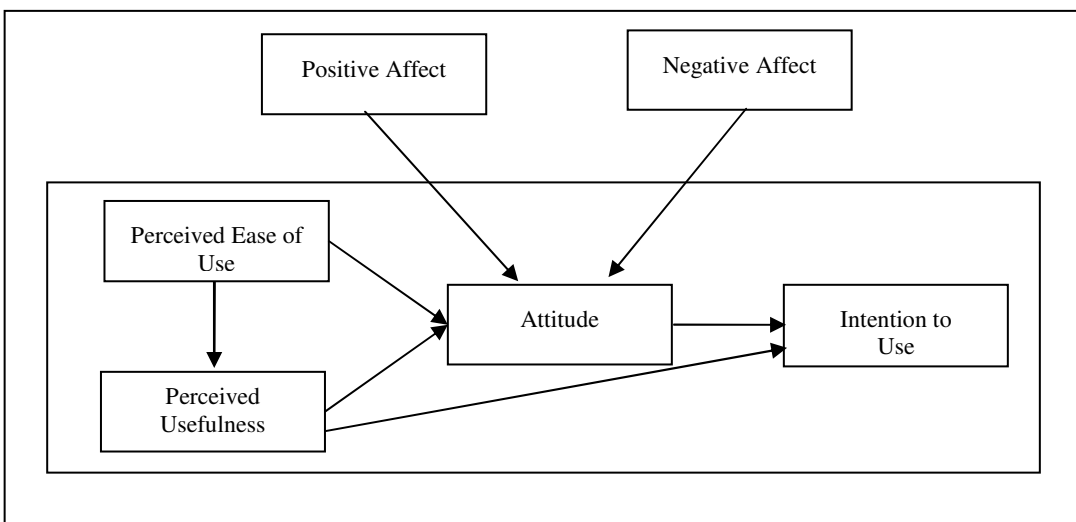

Figure 2: Research Model

METHOD

To test our expanded model which includes affect, we used a laboratory experiment. Lab experiments are an effective method of isolating and controlling variables so that the desired relationships can be examined (Staw and Barsade 1993). For example, through a laboratory experiment we were able to exclude possible confounding task effects such as the type of hardware used to complete the task or conditions under which the task was performed. Literature suggests that task can influence acceptance behavior (Goodhue 1995). Since one objective of this study was to examine acceptance behavior for healthcare information systems, it was essential to exclude any possible task related confounding effects. The laboratory experiment provided the necessary environment for controlling such possible task effects.

Laboratory Telemedicine System

The laboratory telemedicine system examined in this study is an interactive computerized public healthcare telemedicine system for remote consultation of suspicious microbiology specimens among the hub State Public Health Laboratory (SPHL) and its remote laboratories. The application follows Health Insurance Portability and Accountability Act (HIPAA) guidelines and utilizes a secure web-based network topology so that the SPHL is connected to its geographically dispersed remote microbiology laboratories. The laboratory telemedicine system in this study is deployed in three Midwest states at 25 laboratories.

When a suspicious microbiology specimen is encountered at a remote microbiology laboratory, the telemedicine system utilizes a digital camera to capture macroscopic images

of culture plates and/or a microscope interface to capture microscopic images. The images, along with specimen laboratory data, can be sent as a message to a SPHL expert with routine, urgent, or emergency priorities. A corresponding pager also notifies the expert. Next, the expert logs into the telemedicine system and consults with the remote microbiology laboratorian by viewing the digital specimen images, analyzing the attached laboratory data and communicating via the system.

Task

Using the laboratory telemedicine system, laboratory medical professionals can share knowledge (diagnostics and consultation) of suspicious and/or unknown agents. To do so, laboratorians prepare the specimen following various microbiology protocols and then examine the results using the human eye and microscopes. Using the laboratory telemedicine system, laboratorians can capture and store macroscopic and microscopic images. Communications among laboratories are referred to as messages or notifications. All messages and images are encrypted and are only available on designated hardware using specially developed software. They often reference previous images or notifications that are stored by the system and communicate with other laboratories via the system. In a case when the specimen is unknown or is possibly a harmful agent they can enlist the help of SPHL experts. If necessary, a SPHL expert can concurrently, remotely view the specimen.

In this study we asked the participants to complete tasks that are typical in public health laboratories using the telemedicine system. The first task required the participants to

communicate with a SPHL expert. Subjects had to access a message that was sent by the SPHL expert and then reply to it using the system. This message included an attached image and descriptive laboratory data on the attributes of the specimen. The second task required subjects to analyze a specimen at a laboratory in a different location. Subjects had to use the system to remotely access a camera that was capturing a macroscopic image of a specimen. For this task subjects had to remotely manipulate the camera (e.g., zoom and pan) so that they were able to analyze the macroscopic image of the specimen. Next, the participants were asked to compare their analysis of the specimen to past incidents. This task required subjects to access information that presented a listing of past alert messages and images that were captured. This included viewing various images and messages at different laboratory locations.

Participants

Thirty nine (28 women and 11 men) microbiology laboratory assistants, whose ages ranged from 21 to 46, were invited to participate in this research. Laboratory telemedicine systems, such as the one used in this study, are in early stages of development. For example, currently the telemedicine system used in our study is available only in 25 laboratories[1]. The sample size in this study is roughly half of the total population of the current users of this system.

To ensure a realistic and relevant context for this study, participants were recruited

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[1] There are systems available at the State level between SPHLS and CDC, however, within a state this is the only laboratory telemedicine system that connects remote laboratories as far as we know. Consequently, to date, such systems have still few actual users.

from the medical center of a major university in a Midwestern state where the system was being deployed and where participants were likely to have the option to work with the system in the near future if they so chose. All of the participants were actively involved in various rotations at laboratories. Therefore, they had a high level of familiarity on the current operations of a microbiology laboratory. None of the participants had any prior experience with the telemedicine system used in this study, hence, these individuals provided a suitable pool of subjects for studying the acceptance of a new system.

Procedure

The experiment was conducted in a laboratory setting. On the experiment day each participant was provided a computer, login, and password. After arrival subjects were given a 15 minute overview of the system. Then, the participants were asked to fill out a demographic survey which collected information regarding their age, gender, work, and computer experience. After completing the demographic survey subjects completed the PANAS survey, which was used to capture their feeling state before starting to work with the system (see Affect Measurement section). Next, the participants were asked to perform several tasks using the telemedicine system (see Task section). After completing the required tasks subjects were asked to fill out the TAM survey. The subjects were thanked for their participation and the research session concluded. The entire experiment did not exceed one hour.

TAM Measurements

To measure TAM constructs, i.e., attitude, ease of use, perceived usefulness, and intention to use, we used scales from previous research (Venkatesh, Morris, Davis, and Davis 2003) which has been validated in many prior studies (McCoy, Galletta, and King 2007; Hwang 2005; Brown, Massey, Montoya-Weiss, and Burkman 2002; Taylor and Todd 1995; Davis 1989; Davis, Bagozzi, and Warshaw 1989). The results of our reliability test (Table 1), confirmed the strong relationship among these items found in previous research. We provide more detailed explanation of these results (Table 1) in the Analysis section of the paper.

To provide a context that validated the acceptance construct measured as intention to use, we informed subjects that the laboratory telemedicine system that they were about to use, was currently being used in approximately 25 laboratories in Midwestern states. Subjects were also informed that either the same or a similar system was expected to be used in many more laboratories across the country. Consequently, it was very likely that subjects would use either the same telemedicine system or a similar system in their work place in the near future. Therefore, the system used in our study provided an appropriate context for examining the acceptance of a new laboratory telemedicine system.

Affect Measurements

One can experience a wide range of feelings, in other words, one can have many specific affective states (e.g., sadness, fear, happiness, joy, etc.). These feeling states are typically categorized into more general groups such as positive and negative affect (Schwartz and Clore 1988; Clark and Isen 1982; Osgood and Suci 1955). To measure users' affect we used the Positive and Negative Affect Schedule (PANAS) (Watson, Clark,

and Tellegen 1988), which has been used in many prior studies (e.g., George 1995; Cropanzano, James, and Konovsky 1993; Webster and Martocchio 1992). PANAS is a survey that asks users to rate on a five-point scale (with 1 denoting "strongly disagree", 3 denoting "neutral", and 5 "strongly agree") how each of the items of the survey describes how they feel at the time they fill out the survey. Half of the items in PANAS are used to measure positive affect (e.g., interested, excited, active) and the other half negative affect (e.g., distressed, upset, irritable). The bivariate nature of the scales in PANAS suggests that 1) positive and negative affect can coexist (i.e., are not mutually exclusive) and that 2) positive and negative affect are not necessarily the opposite ends of the same continuum (Larsen, Hemenover, Norris, and Cacioppo 2003).

Our test of reliability showed a strong relationship among the PANAS items on the survey for both positive and negative items. (see Table 1) Consistent with prior research (Elsbach and Barr 1999; Kraiger, Billings, and Isen 1989) composite affect scores were calculated for each subject. To calculate a composite score for the positive affect, the ratings for the positive items on the survey were averaged. Similarly, the negative items on the survey were averaged to create a single negative affect score for each subject.

ANALYSIS

Though the scales used in this study were validated in many prior studies (McCoy, Galletta, and King 2007; Hwang 2005; Brown, Massey, Montoya-Weiss, and Burkman 2002; Taylor and Todd 1995; Davis 1989; Davis, Bagozzi, and Warshaw 1989), we tested and confirmed the reliability and validity of all items. Reliability refers to the precision of

an instrument (Kerlinger 1992) and is often tested by calculating Cronbach's alpha (α) for each construct. As shown in Table 1, all reliabilities (α) were well above the minimum required value of 0.70 (ranging from .84 to .96) (Chin 1998; Nunally 1978).

Validity refers to how closely the items of construct measure that construct (Kerlinger 1992). Validity is shown by demonstrating that each indicator (the diagonal elements) has a loading of 0.70 on its underlying construct and that this loading is higher than any other of its loadings on other constructs (Barclay, Higgins, and Thompson 1995; Fornell and Larcker 1981). As shown in Table 1, the loadings on constructs ranged from 0.72 to 0.93. These loadings were also higher than the cross-loadings between constructs.

Table 1: Descriptive Statistics, Reliability Coefficients, & Interconstruct Correlations

	α	Mean	SD	BIU	A	PU	PEOU	POSA	NEGA
BIU	0.92	4.90	1.52	**0.93**					
A	0.96	5.09	1.20	0.64	**0.86**				
PU	0.96	4.77	1.43	0.71	0.50	**0.93**			
PEOU	0.84	5.21	1.31	0.44	0.07	0.56	**0.83**		
POSA	0.89	5.39	0.82	0.21	0.47	-0.08	-0.09	**0.72**	
NEGA	0.93	3.92	0.90	-0.26	-0.48	-0.08	-0.12	-0.35	**0.74**

α – Cronbach Alpha, SD – Standard Deviation, BIU – Behavioral Intention to Use, A – Attitude, PU – Perceived Usefulness, PEOU – Perceived Ease of Use, POSA – PANAS Positive Affect, NEGA – PANAS Negative affect ,

RESULTS

The hypotheses of this study were tested through a series of linear regressions following statistical practices of past research (e.g., Pare, Sicotte, and Jacques 2006). The first three hypotheses of this study examine whether TAM's predictions are applicable to our healthcare information system. These hypotheses assert that intention to use is influenced by usefulness and attitude, usefulness is influenced by ease of use, and attitude is influenced by both ease of use and usefulness.

The results of our analysis show a strong explanatory power for the combined effects of attitude and usefulness on acceptance. That is, 61% (R^2=0.61) of variance in intention to use is explained by users' attitude and their belief that the system is useful. These results found that attitude and usefulness have a large effect size (f^2 = 1.54) on intention to use. Effect size refers to "the degree to which the phenomenon is present in the population" (Cohen 1988, p. 9) and is considered large if its value exceeds 0.33 (Cohen 1988, p. 143). Thus, these results not only support H1a and H1b, but also show that usefulness and attitude have a substantial effect on acceptance.

Our regression analysis also indicates that 31% (R^2= 0.31) of the variance in usefulness is explained by ease of use. The significant path shown between ease of use and usefulness supports H2.

Contrary to TAM's prediction that both ease of use and usefulness are antecedents of attitude, our result showed only a significant path between usefulness and attitude but not between ease of use and attitude. These results support H3b but not H3a.

Next we tested our extended model by examining the impact of positive and negative affect on attitude. Our results showed that 60% of variance in attitude (R^2=0.60) is explained by usefulness, positive affect, and negative affect. In addition, these results found that usefulness and affect together have a large effect size (f^2=1.50) on attitude (Cohen 1988). The standard coefficient for positive affect (β=0.43) is very close to standard coefficient for usefulness (β=0.50) indicating that positive affect is almost as effective as usefulness in improving users' attitude. While the standard coefficient for negative affect (β=-0.29) is not as large as usefulness and positive affect, these results show that negative

affect can significantly reduce one's attitude. By demonstrating that positive affect influenced attitude positively and negative affect influenced attitude negatively, these results supported H4 and H5. Table 2 and Figure 3 display these results.

Table 2: Linear Regression Results

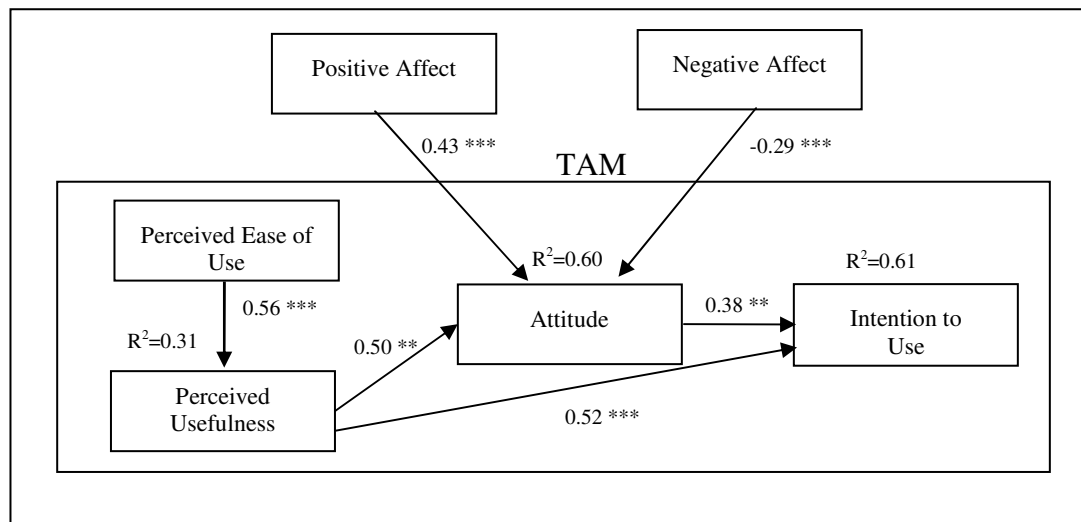| Dependent Variable	Independent Variable	Parameter Estimate	Standard Error	Standardized Coefficient	t-Value	P
Intention to use	Intercept	-0.2	0.72		-0.2	0.120
	Perceived usefulness***			0.52	4.3	0.000
	Attitude**			0.38	3.1	0.003
	Overall model F = 28.0; p < 0.001; R^2 = 0.61; adjusted R2 = 0.59					
Attitude toward the system	Intercept	1.3	1.4		0.9	0.353
	Perceived usefulness**			0.50	4.6	0.002
	Positive affect***			0.43	3.6	0.000
	Negative affect***			-0.29	-2.5	0.000
	Overall model F = 6.3; p < 0.05; R^2 = 0.60; adjusted R2 = 0.56					
Perceived usefulness	Intercept	1.6	0.8		2.0	0.054
	Perceived ease of use***			0.56	4.1	0.000
	Overall model F = 16.9; p < 0.001; R^2 = 0.31; adjusted R2 = 0.30					

*p < 0.05; ** p < 0.01; ***p < 0.001

Figure 3: Results for research model. Standard β values represent path coefficients; * p<0.05; ** p<0.01; *** p=0.000

Subsequently, we tested whether our extension to TAM (Figure 2), including both positive and negative affect along with perceived usefulness, did in fact improve the

original model (Figure 1). As recommended (Cardy and Selvarajant 2006; Hair, Anderson,

Tatham, and Black 1998) three regression models testing the antecedents to attitude were

compared. The first included only perceived usefulness as a predictor of attitude. The

second included both perceived usefulness and positive affect only. Finally, the last model

included all three factors, perceived usefulness, as well as positive and negative affect.

Comparing the R^2 change statistics across models, it was clear that all models were

acceptable (all F changes were significant), but the last model (Figure 3) (including all

three factors) possessed the most explanatory power (.60) (see Table 3).

Table 3 : Regression Model Comparison

Dependent Variable	Independent Variable(s)	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics		
					R^2 change	F Change	Sig. F Change
Attitude	Perceived usefulness	0.24	0.22	1.06	0.24	11.56	0.002
Attitude	Perceived usefulness positive affect	0.52	0.50	0.85	0.28	20.62	0.000
Attitude	Perceived usefulness positive affect negative affect	0.60	0.56	0.80	0.07	6.27	0.017

In order to ensure that there were no issues due to multicolinearity with the data we

calculated tolerance and variance inflation factor (VIF) values for our data. The tolerance

values were all within 0.9 to 1.0 range which is well above the suggested lower limit of

0.10 and the VIF value were all close to 1.0 , which was below the acceptable threshold of

10 (Hair, Anderson, Tatham, and Black 1998). We also used a SPSS macro (with N=1000 replication) to estimate bootstrapped confidence limits for the regression coefficients perceived usefulness, positive affect, and negative affect. As shown in Table 4 the confidence intervals for the regression sample closely agree with the confidence intervals reported in the bootstrapping analysis. These results indicate that our results from the initial sample are supported.

Table 4: Confidence Intervals for coefficients PUSE, positive, and negative affect

	Regression	Bootstrap
Perceived usefulness	(.23 .61)	(.30 .69)
Positive affect	(.27 .96)	(.22 .98)
Negative affect	(-.71 -.07)	(-.67 -.09)

Table 5 presents a summary of the findings from our hypotheses testing.

Table 5: Summary of Hypotheses and Results

H1a)	Intention to use the system is influenced by users' attitude.	Supported
H1b)	Intention to use the system is influenced by users' perception of usefulness of the system.	Supported
H2)	Users' perception of usefulness is influenced by their perception of ease of use of the system.	Supported
H3a)	Users' attitude is influenced by their perceptions of ease of use of the system.	Not supported
H3b)	Users' attitude is influenced by their perceptions of usefulness of the system.	Supported
H4a)	Users' positive affect influence their attitude toward the system positively.	Supported
H4b)	Users' negative affect influence their attitude toward the system negatively	Supported

DISCUSSION

As hypothesized, we found users' attitude towards a healthcare information system has an important role in their acceptance behavior. This further supports the choice of TAM as the base model in our study. Moreover, the results suggest that affect is an effective antecedent of attitude. Specifically, our results indicate that users' positive affect and their perception of usefulness of the system have almost the same influence on their attitudes toward the system, which in turn has a significant influence on their acceptance behavior. As predicted by our model, it was confirmed that users' positive affect influences their attitude positively and their negative affect influences their attitude negatively. These findings are consistent with previous healthcare acceptance studies (Pare, Sicotte, and Jacques 2006; Hu, Chau, Sheng, and Tam 1999) and affect theories (Isen and Labroo 2003; Forgas 2002, 1995; Isen 1984) and validate our proposed extension to TAM.

Our study extends both IS acceptance and affect theories. While decision makers experience a sequence of affective and cognitive processes (Hanoch 2002), affect is rarely included in IS behavioral models. In particular, as our results show, including affect in studies that examine attitudes (such as healthcare acceptance studies) can provide a better explanation of users' behavior. As for affect studies, our results show the robustness of affect theories in the IS acceptance context.

As TAM predicts, the results show that perceived usefulness has an impact both on users' attitude and their intention to use the system. Similar to a prior study examining the acceptance of a healthcare information system by physicians (Hu, Chau, Sheng, and Tam 1999), our results did not find a significant relationship between the system's ease of use

and the users' attitude. While these results contradict TAM's prediction, they provide additional evidence for the difference in acceptance of healthcare information systems versus traditional IS systems. Tasks completed by healthcare information systems, such as the one used in this study, are inherently different from the tasks that are completed by traditional IS systems (Singh, Dalal, and Spears 2005; Chau 1996a; Chau 1996b; Taylor and Todd 1995; Mathieson 1991; Igbaria and Chakrabarti 1990; Davis 1989). Hence, consistent with literature that highlights the importance of task type on acceptance behavior (Lee, Kozar, and Larsen 2003; Goodhue 1995; Keil, Beranek, and Konsynski 1995) our results provide further support for the need to develop acceptance models specific to healthcare information systems (Hu, Chau, Sheng, and Tam 1999). In addition, IT practitioners can also learn from this study that the usefulness of a healthcare information system needs to be a high priority when developing a new healthcare information system and that including potential users in the requirements definition is essential.

Another possible explanation for the lack of influence of ease of use on attitude in our model is that certain user characteristics may influence the acceptance behavior. Similar to our results, (Hu, Chau, Sheng, and Tam 1999) found that physician's perception of usefulness is not influenced by their perception of ease of use. To explain their results they argue that as pragmatic users, physicians have to be convinced that a technology is helpful before they adopt it. Public health decisions, by definition, require pragmatic decision makers. Likewise, it is then only natural for trained laboratory assistants to highly value the usefulness of a healthcare information system, and thus, intend to adopt a system only if they are convinced that the system is helpful.

The results of this study have important implications. The large effect size found for the combined effect of attitude and perceived usefulness on intention to use show that paying attention to these two factors is particularly important in the adoption of healthcare information systems. The effect size of affect and usefulness on attitude was also large. Therefore, we contend that usefulness has both direct and indirect (through attitude) significant impact on intention to use. For practitioners, this may mean that providing training sessions that clearly demonstrate the usefulness of a healthcare information system may be a critical success factor in increasing the likelihood of its adoption.

In addition, the results indicated that affect not only is a predictor of attitude but it can be almost as influential as usefulness in forming users' attitudes toward a healthcare information system. For example, as shown in Figure 3, the effect of positive affect on attitude shown as path coefficient (.43) is only slightly smaller than the effect of perceived usefulness on attitude (.50).

Compared to positive affect (.43) and usefulness (.50), negative affect had a smaller effect on attitude (-.29). Nevertheless, our results demonstrate that the effect of negative affect on users' attitude was in the correct direction (negative) and significant. These results suggest that paying attention to users' affect when introducing a new technology can be another success factor in the adoption of a new healthcare information system. Since the results indicate that positive and negative affect increase users' positive and negative attitude respectively, organizations may benefit from reducing negative affect and fostering positive affect when introducing a new healthcare information system. Positive affect can be successfully induced in an organization with simple methods such as providing

comfortable settings and a pleasant work environment (Isen and Baron 1991). Consequently, providing such amenities as refreshments, comfortable chairs, and proper lighting, may help improve users' positive affect during initial training of a healthcare information system. Organizations can also foster positive affect by facilitating a positive organizational climate (Fredrickson 2003; Baron, Rea, and Daniels 1992; Isen and Baron 1991). Positive affect can act as an "emotional currency" (Aspinwall 1998). Thus, by facilitating positive affect, not only will organizations likely increase positive feelings but they will also help users to better cope with or alleviate their negative feelings. Negative feelings (affect), as our results show, can influence users' attitudes toward the system negatively.

Previous research reports that individuals' baseline affect tends to be positive (Elsbach and Barr 1999; Isen 1993). This was supported in this research where subjects entered the study with a higher average positive affect score (5.38) than negative affect score (4.11). Thus, organizations may merely need to sustain the positive affect of their employees, rather than trying to induce it. An implication from our study is, when possible avoid introducing a new healthcare information systems during high stress times, which is likely to increase individuals' levels of negative affect. This is particularly important since the more salient affect category has the most influence on one's cognitive processes (Bower 1991; Ellis and Ashbrook 1988).

The results also provide additional support for engaging users in early development stages of a system. There is evidence that being familiar with the process of using a particular system and being actively involved in building a model, can improve users'

affect (Kahai, Solieri, and Felo 1998). In other words, these findings together with the results of this study suggest that involving users in development of a system is not only another way to foster positive affect in an organization but also another method to improve users' attitude toward the system. This is because users who were involved in the development of a system are more likely to experience positive affect when the system is being introduced.

In summary, the results of this study have significant theoretical and practical implications for both researchers and the practitioners in the healthcare field. The results provide additional support that attitude is a key factor in acceptance behavior of a healthcare information system. By confirming the findings of a previous healthcare acceptance study our research provides additional support that the well-grounded IS technology acceptance model may need to be tailored to fit healthcare information systems. By establishing affect as an antecedent of attitude our study extends both TAM and affect literature. Our results show that paying attention to users' affect can be almost as effective as paying attention to how useful the system is in forming their attitudes. In other words, our results not only establish affect as an antecedent of attitude but they also found that affect is a powerful determinant of attitude.

LIMITATIONS AND FUTURE RESEARCH

As with any laboratory experiment study, the generalizability of our results is limited to the task and the experimental setting. We attempted to reduce threats to

generalizability by using an actual healthcare information system which is already in use in many public health microbiology laboratories and by employing typical tasks that are performed in such laboratories. Nevertheless, future research examining different healthcare information systems using different user populations is needed to increase the confidence in the generalizability of these results. Studying mandatory versus voluntary usage of this or other telemedicine systems may add to the richness of this area of study. While currently the system usage is voluntary its usage may become mandatory, thus requiring further examination of acceptance under a mandatory usage policy. In addition, a longitudinal follow-up study would further deepen our knowledge on acceptance of such healthcare systems. Furthermore, investigating if the extended model further explains user acceptance among different types of systems such as decision support systems and group decision support systems (Barkhi 2005) would also strengthen the findings of this research on importance of affect.

CONCLUSIONS

The results of our study showed affect as a key determinant of user's attitude towards adoption of a new healthcare information system. By developing a model that predicts the adoption behavior of a laboratory healthcare information system, this study not only provides a direction for further theory building in healthcare research but also suggests that including affect in healthcare research may potentially be very productive in theory development. Moreover, our results contribute to the affect literature since they show the robustness of affect theories in a new context (acceptance of a healthcare information

system). By showing affect as an antecedent of attitude our results also contribute to the IS acceptance literature.

From a practical point of view, the results of this study suggest that managerial interventions such as user involvement in system development and target trainings to provide information regarding usefulness of a healthcare information system can potentially be effective in improving its acceptance. Moreover, this study shows how users' affective states may be advantageous or disadvantageous in their acceptance of a new healthcare information system. Managers, armed with this additional information may be better prepared to introduce such systems.

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