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INDIVIDUAL'S INTENTION TO USE SELF DIAGNOSTIC MEDICAL SUPPORT SYSTEMS

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ABSTRACT

In this paper, we consider adding the construct of trust to the Unified Theory of Acceptance and Use of Technology (UTAUT) model in the context of individual use of self-diagnosis medical support systems. We believe that these are important factors in an individual and personal setting. By the adding the concepts of knowledge-based trust, system-based trust, and belief-based trust to the UTAUT model we will be able to increase our understanding of individuals intention to use medical expert systems such as self-diagnosis medical systems. We feel that our conceptual model will have implications for medical system providers and government agencies as well as future academic researchers studying individual use of technology within a global/national context.

Keywords

Trusts, Unified Theory of Acceptance and Use of Technology (UTAUT), Self Diagnosis Medical Support Systems

INTRODUCTION

In 2004 President Bush outlined a plan to ensure that most Americans would have electronic health records by the year 2014. As a nation we spend over $1.6 trillion on health care and there are still serious concerns about preventable errors, health care quality, and poor communication among doctors, hospitals, and many other health care providers involved in the process. Although, the President's Health Information Technology Plan addresses longstanding problems of preventable errors, uneven quality, and rising costs in the nation's health care system, we believe that it will not be solved solely by implementing a paperless system. There seem to be serious issues with physician adoption of electronic medical records (EMR) due to perceived limited return on investments of EMR, EMR business process alignment, quality of care, required increase effort, financial resource constraints, and time constraints (Hennington & Janz, 2008). According to White House reports, recent studies have found that as much as $300 billion is spent each year on health care that does not improve patient outcomes. This includes treatment that is unnecessary, inappropriate, inefficient, or ineffective. We posit that there might be an opportunity to reduce this expenditure by better educating the general population about non-prescriptive means to resolve minor medical occurrences as well as limit the number of unwarranted visits to medical professionals which may result in unnecessary, inappropriate, inefficient, or ineffective treatment methods.

An Expert Support System (ESS) such as a Medical Diagnostic Support System (MDSS) (Miller, 1994; Sheng, 2000) is an evolving technology capable of increasing diagnostic decision accuracy by augmenting the natural capabilities of human diagnosticians in the complex process of medical diagnosis (West et al. 2003). A recent study finds that the physician's diagnostic performance can be strongly influenced by the quality of information produced by a diagnostic decision support system (Berner et al., 1999). These types of MDSS have been available for sometime for medical professionals however only in recent years has the technology been made available to individual users through web applications. Self Diagnostic Medical Support Systems (SDMSS) such as WebMD, Dr. Koops, or WorldDoc are Web based applications that allow individual users to educate and inform themselves about individual medical concerns and thereby help them make better individual health care decisions, which may reduce these unnecessary medical costs. These Web based systems allow the individual user to enter symptom information into an interactive algorithmic process between the user and the SDMSS with the system then providing several alternatives to the user. This process is not meant to eliminate the need for health care professionals; it is meant to provide quality health care information to the user to support them in their health care decisions. Nonetheless, many individuals are still hesitant to use the software for self-diagnostic purposes because of various reasons, such as lack of trust, limited access to technology, limited knowledge about the technology, and limited knowledge about the medical and health care domain. Trust is at the core of many economic transactions (Gefen et al, 2003). Individual acceptance of SDMSS seems to be a critical factor in increasing the general education level on health care and the knowledge of medical options available to individuals. An understanding of the various determinates of SDMSS use is important in order to improve acceptance of this technology. We believe that our study provides some insight into human trust behavior in the medical/healthcare context.

In this paper, we develop a model that helps investigate the determinants of individual use of self-diagnostic medical software. First, we looked at applying the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al. 2003) to the novel setting of Self Diagnostic Medical Support Systems processes. User acceptance is one of the most comprehensive streams of Information Systems research, and UTAUT integrates eight theories of individual acceptance into one comprehensive model (Hennington & Janz, 2007). As such, it provides a useful lens through which to view what is currently taking place in the healthcare industry regarding Self Diagnostic Medical Support Systems adoption. The UTAUT model allows us to examine technology acceptance behavior in organizational settings (Hennington & Janz, 2007). This view offers rich analysis of the factors both contributing to and acting as barriers to SDMSS adoption. Researching SDMSS use is different from typical research applications of UTAUT because it is an individual's private matter which is not directly related to business performance. Thus, individual trust in the system structure, medical knowledge, and individual beliefs may be important considerations to include in the UTAUT model. This research can assist the medical community by providing theoretical foundations that can help in the explanation and prediction of SDMSS adoption, which may be beneficial to the goal of educating users about health care and medical options.

The structure of the remainder of this paper follows. In the next section of this paper we review the theoretical background of technology acceptance and usability models and determinates of trust, proposed in the literature. The third section will discuss our conceptual model design that we use to view the acceptance and use of SDMSS by individual users. We conclude with a discussion of these results, and implications to guide the ensemble formation strategy for a MDSS.

THEORETICAL BACKGROUND

There has been limited research concerning the acceptance and usability of SMDSS though many variations of technology acceptance and usability have been proposed in information systems research (Davis, 1989; Venkatesh et al., 2003) A review of these studies suggests that the most important determinant of individual intention to use technology is the perception of how well technology will help perform a required task. Also important is the expectation of learning and being able to use the technology successfully. The core component in many of these research models is build upon the fundamentals of the TAM model or UTAUT model. In this section we look at are the theoretical foundations and evolution of these various models.

A well-known model that researchers have utilized to explain individual intentions is the Theory of Reasoned Action (TRA). The TRA model proposes that individual behavior is determined by behavioral intentions to perform the behavior, and that behavioral intentions are jointly determined by individual attitudes and subjective norms regarding a behavior (Hung-Pin Shih, 2004). Based on this understanding of the belief–attitude–intention–behavior relationship, Davis (1986) proposed the Technology Acceptance Model (TAM) for explaining and predicting user acceptance of an information system (IS). A focal point of TAM is the identification of two key beliefs: perceived usefulness and perceived ease of use. Davis (1989) defined perceived usefulness as ''the degree to which a person believes that using a particular system would enhance his or her job performance,'' and defined perceived ease of use as, ''the degree to which a person believes that using a particular system would be free of effort.'' According to its theoretical stipulations (Davis, 1993), system usage is determined by individual behavioral intentions to use an IS; these are jointly determined by individual attitudes toward IS use and perceived usefulness (Hung-Pin Shih, 2004).

Information technology (IT) acceptance research has yielded many competing models, each with different sets of acceptance and use determinants. Venkatesh et al. (2003) considered the following competing theoretical models: Theory of Reasoned Action (Fishbein and Ajzen, 1975), Technology Acceptance Model (Davis, 1989), Motivational Model (Davis et al., 1992), Theory of Planned Behavior (Ajzen, 1991), a combination of Technology Acceptance and Theory of Planned Behavior models (Taylor and Todd, 1995), Model of PC Utilization (Thompson et al., 1991), Innovation Diffusion Theory (Rogers 1995), and Social Cognitive Theory (Compeau and Higgins, 1995). From this review a Unified Theory of Acceptance and Use of Technology (UTAUT) was formulated, with four core determinants of intention and usage, and up to four moderators of key relationships. The core determinants asserted to impact behavioral intentions to use technology are performance expectancy, effort expectancy, and social influence. The fourth determinant facilitating conditions is asserted to impact directly on use behavior (Hennington & Janz, 2007). UTAUT has been considered to be a useful tool to evaluate the likelihood for the success of implementation of new technologies (Venkatesh et al., 2003).

The extensive literature on trust has consistently found the conceptualization of the trust construct to be difficult to quantify with a single definition due to various theoretical and operational aspects and many researchers have acknowledged this viewpoint (McKnight et al., 1998; Shapiro, 1987; Gefen et al., 2003). Trust is crucial in transactional, buyer-seller relationships, especially those containing an element of risk including interacting with web based systems (Reichheld and

Schefter, 2000). Risk is the potential that the trusting party will experience negative outcomes, if the other party proves untrustworthy (March and Shapira, 1987). By trusting, people reduce their perceived social complexity through a belief that may, at times be irrational, and that rules out the risk of undesirable but possible behaviors on the part of the trusted party (Luhmann, 1979). Trust is based on social judgments such as assessment of the other party's benevolence, competence (Currall, 1992). Belief-based trust is an expectation that benevolence exists in others such that they will not behave opportunistically by taking advantage of a situation (Cody-Allen & Kishore, 2006). Gefen et al (2003) state, "that it is one's belief that the other party will behave in dependable ethical and socially appropriate manner and that trust deals with the belief that the trusted party will fulfill its commitments despite the trusting party's dependence and vulnerability." Knowledge-based trust antecedents such as familiarity with the web based medical support system vendors suggest that trust develops over time with the accumulation of trust relevant knowledge resulting from experience with the other party (Homes, 1991; Lewicki & Bunker, 1995). Thus the development of trust among individual parties requires time and an interaction history (McKnight et al., 1998). System-based trust is conceived to be an individual's perception of a system's ability to meet an individual's requirements. This will lead the individual to believe that the system can be trusted to perform the specific action the user wishes it to perform (Cody-Allen & Kishore, 2006).

PROPOSED RESEARCH CONCEPTUAL MODEL

Very little research to date has examined the effects of trust on an individual's intention to use technology. Those that have examined trust influence on user acceptance have either used the TAM model or have considered trust as having a direct effect on intention to use technology within the UTAUT model. From this brief review, we focused on three main constructs of trust, knowledge-based trust (Gefen et al, 2003), system-based trust, and belief-based trust (Cody-Allen & Kishore, 2006; McLoad & Pippen, 2008) and their moderating effect on performance expectancy, effort expectancy, and social influence. We propose that in the self-diagnostic medical support systems domain, the three of the four core determinants of intention and usage of the UTAUT model: performance expectancy, effort expectancy, and social influence are moderated by knowledge-based trust, system-based trust, and belief-based trust.

P1: An individual's knowledge-based trust towards a SDMSS will have a moderating effect on effort expectancy and thus on the individual's intention to use the SDMSS

P2: An individual's system-based trust towards a SDMSS will have a moderating effect on performance expectancy and thus on the individual's intention to use the SDMSS.

P3: An individual's belief-based trust towards a SDMSS will have a moderating effect on social influence and thus on the individual's intention to use the SDMSS

This study applies the Unified Theory of Acceptance and Use of Technology (UTAUT) to the phenomenon of individual user adoption of SDMSS. UTAUT integrates eight theories of individual acceptance into one comprehensive model designed to assist in understanding what factors either enable or hinder technology adoption and use. As such, it provides a useful lens through which to view what is currently taking place in the healthcare industry regarding user adoption. Defined below are the core determinates of behavioral intentions as proposed by Venkatesh et al (2003) in their conception of the UTAUT model. Additionally, our trust construct definitions of knowledge-based trust, system-based trust, and belief-based trust, which we propose as moderators on the core determinates user intention, are discussed below. (See figure 1)

The first core determinant of behavior intentions, performance expectancy, is defined by Venkatesh et al. (2003) as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance". The underpinning constructs for this determinate are: perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations (Hennington & Janz, 2007). Perceived usefulness, which is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Venkatesh et al., 2003). Extrinsic motivation is defined as "the perception that users will want to perform an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions" (Venkatesh et al., 2003). Job-fit is defined as "how the capabilities of a system enhance an individual's job performance" (Venkatesh et al., 2003). Relative advantage is defined as "the degree to which an innovation is perceived as being better than its precursor" (Venkatesh et al., 2003).

Effort expectancy is defined as the "degree of ease associated with the use of the system" (Venkatesh et al. 2003). Its foundational constructs are perceived ease of use, complexity and ease of use (Hennington & Janz, 2007). Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Venkatesh et al., 2003). Complexity is defined as "the degree to which an innovation is perceived as relatively difficult to understand and

use" (Venkatesh et al., 2003). Ease of use is defined as "the degree to which an innovation is perceived as being difficult to use" (Venkatesh et al., 2003).

Social influence is defined as "the degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh et al., 2003). Its foundational constructs include subjective norm, social factors and image. (Hennington & Janz, 2007) Subjective norm is defined as "the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Venkatesh et al., 2003). Social factors are defined as "the individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (Venkatesh et al., 2003). Image is defined as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (Venkatesh et al., 2003)

Facilitating conditions are the variables asserted to have a direct impact on system usage. They are defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (Venkatesh et al., 2003). Foundational constructs for this facet of the UTAUT model include perceived behavioral control, facilitating conditions, and compatibility (Hennington & Janz, 2007). Perceived behavioral control's definition is that "reflects perceptions of internal and external constraints on behavior and encompasses self efficacy, resource facilitating conditions, and technology facilitating conditions" (Venkatesh et al., 2003). Facilitating conditions are "objective factors in the environment that observers agree make an act easy to do, including the provision of computer support" (Venkatesh et al., 2003). Compatibility is defined as "the degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters" (Venkatesh et al., 2003).

Behavioral intention is asserted to have a direct impact upon individuals' actual use of a given technology. This construct originates in the Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975) and is defined as "a measure of the strength of one's intention to perform a specified behavior" (Davis et al., 1989). Davis (1986) introduced the behavioral intention construct to the MIS discipline via his Technology Acceptance Model (TAM), an adaptation of TRA designed specifically for the information systems context (Hennington & Janz, 2007).

We define knowledge-based trust as trust that develops over time with the accumulation of trust relevant knowledge resulting from experience (Homes 1991; Lewicki & Bunker 1995). In such cases an individual's familiarity with SDMSS would lead to development of trust among individuals with increased time and an interaction history. We considered an individual's experience and perceived expertise related to computers and health care and medical knowledge, because an individual's computer and medical domain expertise may affect their intention to use SDMSS. The level of an individual's medical domain knowledge would have a positive relation on knowledge-based trust. To our knowledge, no prior literature has focused on computer and medical domain experience and how these affect SDMSS use. Additionally, knowledge-based trust acts as a moderator on the performance expectancy determinant.

We define system-based trust as an individual's perception of a system's ability to meet an their requirements and will lead that individual to believe that the system can be trusted to perform specific tasks (Cody-Allen & Kishore, 2006). System structural assurances or system safeguards refer to an individual's assessment of user legal recourse, guarantees, explicit privacy policy statements and regulations that exist in a specific context (McKnight et al. 1998; Shapiro 1987). An individual's computer experience will have a positive relation on system-based trust. Additionally, system-based trust acts as a moderator on effort expectancy.

We define belief-based trust as an expectation that benevolence exists in others such that they will not behave opportunistically by taking advantage of the situation (Cody-Allen & Kishore 2006). Gefen et al (2003) state the trust, "is one's belief that the other party will behave in dependable ethical and socially appropriate manner and that trust deals with the belief that the trusted party will fulfill its commitments despite the trusting party's dependence and vulnerability." Belief-based trust acts as a moderator on social influence determinate and user's intention to use a SDMSS.

Proposed Methodology for Testing Model

In order to understand the relationship among individual variables within the proposed model and to evaluate if the corresponding explanatory power of the associated structural model is improved, i.e. a higher R^2, we will utilize a structural equation modeling (SEM) approach (Dow et al. 2008). Structural Equations can be used to examine the relationships among the variable items. This type of procedure allows us to assess the integrity of our measured variables as well as evaluate the degree to which the observed relations among our trust variables fit within the proposed extended UTAUT model. By

parceling of our items within the SEM approach we can minimize the effects of nuisance factors. Additionally, in order to minimize any possibility of introducing errors into our measures we will follow Sethi and King (1991) approach of utilizing measurement scales for this study which were previously validated instruments when available otherwise existing literature will be exhausted in the creation of scales for the proposed trust constructs. As a check for measurement validity, each item will be screened using internal consistency and confirmatory factor analysis (CFA).
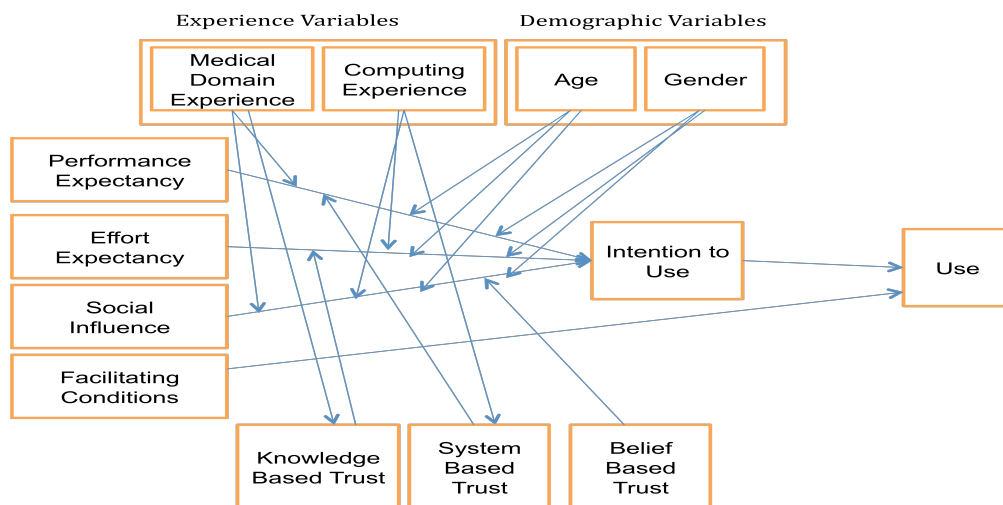

Figure 1

Contribution

In this paper we considered the influences that trust contributes to the understanding of an individual's behavioral intention to use a SDMSS as a moderator within the UTAUT model. The use of the UTAUT model as a theoretical lens to evaluate individual intentions toward use of SDMSS could potentially assist the government and healthcare technology companies to improve development and awareness of their medical software applications. This process has a duel benefit of reducing national healthcare cost and providing opportunities for increased opportunities for medical technology companies. First, we discussed the theoretical aspects of TAM and UTAUT and the contributing factors they have on understanding an individual's intention to use SDMSS. Secondly, we considered the implications of trust within the UTAUT model through three antecedents; knowledge-based trust, system-based trust, belief-based trust. Finally we proposed a new model based on UTAUT. A lesson from this paper is that firms should consider these three aspects of the trust construct during their application development stage and try to include social/community awareness about their technology throughout their development lifecycle. It is through exploitation of these social/community opportunities that a firm achieves a certain amount of legitimacy, which leads to future opportunities.

This papers contribution is mutually beneficial to both the healthcare and information systems communities, as UTAUT offers valuable practical insight to the healthcare industry in explaining why SDMSS technology has not been more widely adopted as well as what prescriptions may facilitate future adoption, while offering the information system community the opportunity to strengthen existing theory through an illustration of its application.

CONCLUSIONS AND FUTURE RESEARCH

Future research considerations would be to further examine the constructs of knowledge-based trust, system-based trust, and belief-based trust by developing measurement scales to be utilized in the testing of an individual's intention to use a SDMSS. Furthermore the findings from such a survey could provide new insight on various theoretical relationships and additional constructs related to system trust, knowledge trust, belief trust, experience, effort expectancy, performance expectancy and social influence with regard to the Unified Theory of Acceptance and Use of Technology model. For government officials the results might assist them in developing additional incentives beyond those earmarked for EMR to increase our population's healthcare/medical knowledge as a means to reduce healthcare costs.

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