An empirical test of three mediation models for the relationship between personal innovativeness and user acceptance of technology

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Understanding information technology acceptance by individual professionals: Toward an integrative view

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Abstract

Although information technology is becoming a vital part of the workplace of skilled professionals, it is unclear what factors contribute to its acceptance by them. Building upon and integrating the key findings of three closely related theoretical paradigms (the technology acceptance model, the theory of planned behavior, and innovation diffusion theory), we developed a more complete, coherent, and unified model and tested the resulting model in the context of PDA acceptance by healthcare professionals. Using LISREL, data collected from 222 physicians in the U.S. were tested against the model; it explained 57% of the physician's intention to accept an innovation, with good model fit. Our study produced useful insights into the factors that influence technology acceptance decisions by professionals and provided new ideas in the understanding of user acceptance of technology.

Keywords: Information technology; Technology acceptance; Innovation diffusion; TAM; Theory of planned behavior; Healthcare professionals; Physicians; PDA; LISREL

1. Introduction

What causes highly skilled professionals to adopt a new information technology (IT)? Is it merely the characteristics of the technology itself? Are individuals also influenced by other issues, such as their interaction through a social network, their predisposed tendency to try out a new technology, or the cognitive and situational resources required for its effective utilization? If these factors are indeed important in the acceptance decisions of professionals, are they interrelated? If so, how are they related and what are the mechanisms through which they achieve their effects on the acceptance decisions? Such questions have widespread practical as well as theoretical ramifications because the expected benefits from the investments in IT are realized only when they are adopted by their intended users and subsequently used. Undeniably, the continuing revolution in IT has moved beyond the realm of supporting managers and business users to that of enhancing and transforming the work of skilled professionals, such as lawyers and doctors. Although much research effort has been directed to understanding user acceptance of new technologies, it is relatively unknown what motivates individual professionals in making technology acceptance decisions [35].

Of the various models that information systems (IS) researchers have used to explain or predict the motivational factors underlying user acceptance of technology, the technology acceptance model (TAM) of Davis and his colleagues [17,18] is perhaps the most

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widely applied. It states that an individual's system usage is determined by behavioral intention, which is, in turn, determined by two beliefs: *perceived usefulness*, the extent to which a person believes that using the system will improve his or her job performance, and *perceived ease of use*, the extent to which a person believes that using the system will be free of effort. TAM initially included attitude, but this was later dropped due to its weak role as a mediator between the beliefs and behavioral intention.

Other dominant theoretical paradigms in understanding user acceptance of technology include the theory of planned behavior (TPB) [5,6] and innovation diffusion theory (IDT) [40]. Grounded in social psychology, TPB is a general model that has been applied in many diverse domains. The model posits that behavioral intention is a function of, in addition to attitude, *subjective norm*, the perception that other people considered important by the person think he or she should perform the behavior, and *perceived behavioral control*, the perception of internal and external resource constraints on performing the behavior. The theory has been widely applied to a diverse set of technologies in the IS context, e.g. [30,46].

Originating from sociology, IDT views innovation diffusion as a particular type of communication process in which the messages about a new idea are passed from one member to another in a social system. The theory posits that the rate of adoption is partially determined by the perceived attributes of an innovation, called innovation characteristics, and proposes several attributes potentially important across diverse innovation adoption domains. The theory has been used to study various innovations ranging from agricultural practices to high-tech products. Moore and Benbasat [37] adopted and expanded the original set of innovation characteristics proposed by IDT and refined the constructs to be applicable to the IS context. Subsequent studies have found that certain innovation characteristics, such as relative advantage, complexity, result demonstrability, and image, are more important than others in predicting user intention to use a technology. *Result demonstrability* refers to the extent to which the tangible results of using an innovation can be observable and communicable. *Image* refers to the extent to which use of an innovation is perceived as enhancing one's image or status.

Although they originated in different disciplines, TAM and IDT have similarities. If IT can be thought of as a specific innovation, both theories share the view that the adoption of a particular IT is determined by its perceived attributes. Furthermore, the constructs employed in TAM are fundamentally a subset of the perceived innovation characteristics; specifically, perceived usefulness and perceived ease of use are conceptually similar to relative advantage and complexity of IDT, respectively. Perceived usefulness and relative advantage both encapsulate the degree to which a user feels that the target technology is better than the current practice. Perceived ease of use is the opposite of complexity. Thus TAM and IDT partially reconfirm each other's findings.

Recent innovation studies have shown that another variable derived from IDT, *personal innovativeness in the domain of IT* (PIIT), the willingness of an individual to try out any new IT, plays an important role in determining the outcomes of user acceptance of technology. PIIT was initially proposed as a moderator of, but later re-conceptualized as a direct determinant of, perceived usefulness and perceived ease of use. Its relationships with other innovation characteristics, such as result demonstrability and image, or the TPB variables, such as subjective norm and perceived behavioral control, have not been investigated.

Little research has attempted to integrate the three theoretical paradigms (TAM, TPB, IDT) and to define the relationships between their key constructs in explaining or predicting user acceptance of technology. Our research aims at developing a holistic understanding of technology acceptance, particularly within the context of individual professionals, by (1) integrating the key constructs of TAM (perceived usefulness and perceived ease of use), TPB (subjective norm and perceived behavioral control), and IDT (result demonstrability, image, and PIIT) through a new model, (2) testing the model in a setting of healthcare professionals (physicians practicing in the U.S.), and (3) studying the acceptance of a technology that is widely applicable in a professional usage context.

The target technology, a PDA (personal digital assistant), is sized to fit in the palm of one's hand or in a pocket. Physicians can use one for keeping track of tasks, meetings, call schedules, and contact information. Supporting clinical practice, a PDA can store medical pharmacy information, case logs, and care documentation. Many hospitals are implementing wireless PDA networks to improve physician access to medical records. A number of web sites offer free software for primary care physicians and commercial software is available for its users. Although the healthcare industry was relatively slow in adopting IT, physicians are increasingly viewing computers and PDAs as tools that significantly improve the quality of their work practice and patient care [24].

Our work has implications for the professional population as well as for managers responsible for making decisions about the implementation of a new IT: individuals with a wide variety of backgrounds must exploit those technologies for professional and organizational gains. Moreover, professionals may be primary users of IT in some organizations. Therefore, creating the conditions under which IT will be embraced by those professionals is increasingly important to effectively leveraging user acceptance of technology. Understanding the determinants of professional users' intention to use a new IT from an integrative perspective of three related and robust theoretical paradigms will help IT practitioners identify the essential building blocks of those conditions in which acceptance of technology can be more effectively promoted and facilitated.

2. Research model and hypotheses

The research model is shown in Fig. 1. Table 1 contains a review of prior research that used an integrative approach involving more than one of the three streams (TAM, TPB, and IDT) of research. In a recent critical review of TAM, Legris et al. [31] concluded that TAM should be integrated into a more inclusive model incorporating variables related to both human and social change processes as well as the adoption of an innovation. However, there are no studies, as far as we know, that have attempted to integrate the three research streams. Venkatesh et al. [54] proposed a unified model primarily based on TAM and TPB. The model included a single variable from IDT (perceived voluntariness) but did not include any innovation characteristics other than the TAM variables of perceived usefulness and perceived ease of use. Venkatesh and Davis [53] proposed an extended model of TAM, TAM2, which included subjective norm, result demonstrability, and image. However, TAM2 examined their effects only on perceived usefulness, instead of incorporating them into the nomological network of TAM. Our model integrates the key variables of TAM (perceived usefulness and perceived ease of use), TPB (subjective norm and perceived behavioral control), and IDT (result demonstrability, image, and PIIT), and proposes various relationships not examined by prior studies.

We choose *behavioral intention*, a person's subjective probability to perform a specified behavior, as the dependent variable for theoretical and practical reasons. According to Ajzen and Fishbein [7], intention has a major influence on behavior in mediating the effect of other determinants on behavior. Also, given that our study utilized a survey-based cross sectional design, using intention instead of usage avoids the potential problem of retrospective analysis [19]. Finally,

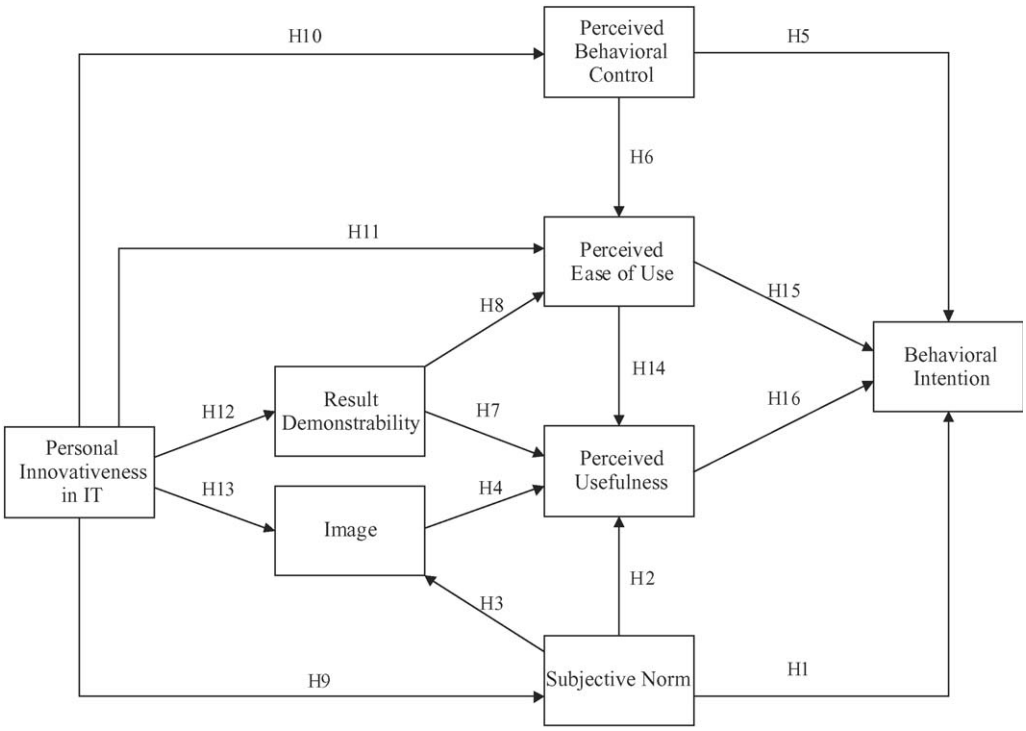

Fig. 1. Research model.

Table 1
Review of prior integrative studies on technology acceptance

Prior studies	Theory basis	Subjects (innovation)	Findings
Agarwal and Karahanna [1]	IDT [40], TAM [17,18], Flow Theory [16], Social Cognitive Theory [10]	Undergraduate students (World Wide Web)	The authors found that cognitive absorption is a proximal antecedent of perceived usefulness and perceived ease of use. Further, personal innovativeness and playfulness were found to be important determinants of cognitive absorption
Agarwal and Prasad [2]	IDT, TAM	MBA students (World Wide Web)	In examining the effects of individuals' perceptions about the characteristics of the target technology on two acceptance outcomes (i.e., current use and future use intentions), the authors found the specific characteristics that are relevant for each outcome are different. Specifically, the results show that the innovation characteristics of visibility, compatibility, trialability and voluntariness are relevant in explaining current usage, while the only relevant innovation characteristics for future use intention are relative advantage and results demonstrability
Agarwal and Prasad [3]	IDT, TAM	MBA students (World Wide Web)	Proposed and developed an operational measure for the construct of personal innovativeness in IT. In addition, the authors theorized that PIIT would exhibit a moderating influence on the relationship between three salient perceptions (relative advantage, ease of use and compatibility) and behavioral intention. Significant moderation was observed only for compatibility
Chau and Hu [12]	TAM, TPB [5,6]	Physician (Telemedicine technology)	The authors compared TAM, TPB and a decomposed TPB. The overall results suggested that TAM was better than TPB, and the decomposed TPB was not substantially better than TAM, in explaining the variance in behavioral intention
Chen et al. [15]	IDT, TAM	Online consumers	Assessing the validity of existing theories in a new domain, this study combined TAM and IDT in order to examine consumer behavior in the virtual store context. Findings reveal that consumer acceptance and use of virtual stores can be predicted reasonably well from their intention, which is determined by their attitude towards using virtual stores. Further, compatibility, usefulness, and ease of use are the primary determinants of consumer attitude towards using virtual stores and both compatibility and ease of use influence usefulness of virtual stores
Karahanna et al. [28]	IDT, TAM	Financial end-users ranging from clerical to executive (Windows 3.1)	The authors combined TAM and the diffusion of innovation perspective in order to examine pre-adoption and post-adoption beliefs and attitudes. They found that potential adopter intention to adopt is solely determined by normative pressures, whereas user intention is solely determined by attitude. Further, potential adopters base their attitude on a rich set of innovation characteristics (i.e., usefulness, ease of use, result demonstrability, visibility, and trialability) while users' attitude is only based on instrumentality beliefs of the usefulness and perceptions of image enhancements
Lewis et al. [32]	IDT, TAM, Social Cognitive Theory, Social Information Processing Theory [21,42]	Full-time faculty members at a large public university (World Wide Web)	Arguing that individuals beliefs about IT use is influenced by the individual, institutional, and social contexts in which individuals interact with IT, the authors proposed a broad framework and examined the simultaneous effects of those influences on perceptions of usefulness and ease of use. Results suggest that top management commitment to new technology and personal innovativeness each positively influences usefulness and ease of use beliefs, self-efficacy positively influences only ease of use, while the social influences emanating from informal circles, departmental peers, professional peers, supervisors and senior leaders, have no significant effect on either usefulness or ease of use perceptions. Perceptions of usefulness were not influenced by those of ease of use

Table 1 (*Continued*)

Prior studies	Theory basis	Subjects (innovation)	Findings
Mathieson [34]	TAM, TPB	Undergraduate students (Spreadsheet software)	Compared TAM and TPB and found that both models predicted intention to use an IS fairly well. Results suggested that while TAM was better able to predict attitude than TPB, and might be easier to use because of its parsimonious structure, TPB is richer in providing insight into the factors that influence an individual's behavior toward an IT
Riemenschneider et al. [39]	TAM, TPB	Small business executives (World Wide Web)	A series of models that utilized TAM and TPB to varying degrees were analyzed in terms of model fit. Specifically, models consisting of TAM and TPB were analyzed separately in addition to models ranging from a loose to a tight integration of the two theories. The authors found progressive improvements in fit as the TPB and TAM theories became more integrated, thus revealing the conceptual overlap of TAM and TPB and highlighting the advantages of integrating the two theories
Taylor and Todd [46]	TAM, TPB	Undergraduate and MBA students (Computing Resource Center)	Incorporating social influences and behavioral control into TAM, the authors investigated the role of prior experience. Results showed that experienced users placed more weight on perceived behavioral control, and behavioral intention fully mediated the relationship between perceived behavioral control and behavior. For inexperienced users, perceived behavioral control had less of an impact on intention, but had a significant influence on behavior. The relative influence of subjective norm on behavioral intention was not significantly different between the two groups
Taylor and Todd [47]	TAM, TPB	Undergraduate and MBA students (Computing Resource Center)	The authors compared TAM, TPB, a decomposed version of TPB. Results showed that decomposing the belief structures in TPB provided a moderate increase in the explanation of behavior intention, compared with TAM and TPB, although it is considerably less parsimonious than TAM
Venkatesh et al. [54]	IDT, TAM, TPB, TRA [20], Social Cognitive Theory, Motivational Model [49], Model of PC Utilization [48]	Subjects represented all levels of the organizational hierarchy from four organizations (the innovations were proprietary systems supporting the functional areas of product development, sales, business account management and accounting)	The authors evaluated eight prominent models of individual acceptance of technology in terms of their similarities and differences. A Unified Theory of Acceptance and Use of Technology (UTAUT) was then formulated based on the various models' conceptual as well as empirical similarities. Determinants of behavioral intention included performance expectancy, effort expectancy, social influence while behavioral intention and facilitating conditions determined actual use behavior. Moderators of UTAUT were gender, age, experience and voluntariness of use. An empirical test of UTAUT revealed it was able to account for 70% of the variance in usage intention, substantially exceeding that of any of the original eight models and their extensions
Wu and Wang [55]	IDT, TAM	Customers from four major private wireless telecommunication-service providers, two leading domestic banks, and two well-known securities investment companies in Taiwan	The authors integrated innovation diffusion theory, perceived risk, and cost into TAM in order to investigate what determines user mobile commerce acceptance. Findings indicated that all variables except perceived ease of use significantly affected the users' behavioral intention

even though the target technology in our study, PDA, is now more commonly used, it is still considered an emerging technology. Thus, the choice of intention over actual usage as a dependent variable was desirable, allowing a timely investigation of physician's acceptance when a growing number of healthcare organizations are adopting and using PDAs.

Several recent studies using TAM suggested the exclusion of attitude from the model. For instance, TAM2 dropped attitude because it had been found to only partially mediate the effects of perceived usefulness and perceived ease of use on behavioral intention. TAM without the attitude construct has been applied and tested in several other investigations, including

Saade and Bahli [41] and Venkatesh [50]. We therefore decided to exclude attitude from our model.

2.1. Subjective norm

Much research in psychology theorizes subjective norm (also called social norm) to be an important determinant of intention. While TAM does not include subjective norm, the theory of reasoned action (TRA) identifies attitude and subjective norm as two sole determinants of behavioral intention [20]. TPB, an update of TRA, also included subjective norm, which epitomizes perception of what important others feel about adopting an innovation. Although it can be expected to be important in determining technology acceptance and usage based on TRA and TPB, empirical evidence supporting its role has been mixed [28,34]. Given the strong theoretical basis, we included the construct in our model in the context of professionals.

Bandura [9] suggested that one learns and uses behaviors based upon what one sees in social groupings. Observed behaviors of others influence the observer to emulate those behaviors. Social norms and interpersonal communication networks play significant roles in affecting adoption decision, according to IDT. We expected that social influence would be particularly important in our context. Due to specialization and professionalism in the practice of medicine, physicians tend to hold the opinions and suggestions of their peers in high regard. Even when not inclined to do so, they may still choose to follow a process if well perceived referents think they should. This compliance effect, which is different from the identification or internalization effect [29], suggests a direct path from subjective norm to intention. At the same time, the opinions of important referents could be the basis for a person's feelings about the utility of the technology. This internalization effect means that, if a superior or peer says that a particular innovation might be useful, the suggestion could affect the individual's perception of the usefulness of the innovation. Consequently, we proposed:

H1. Subjective norm will have a positive effect on behavioral intention.

H2. Subjective norm will have a positive effect on perceived usefulness.

2.2. Image

In order to create or preserve a positive image within a social group, individuals often respond to social influences. TAM2 theorized that subjective norm achieved its effect on perceived usefulness partially by altering image. Although physicians generally enjoy a high level of prestige and autonomy, they tend to be cognizant of the image they project as it relates to their professional status and their interactions within their social network. This identification effect is captured in our model by the path from subjective norm to image and that from image to perceived usefulness. An individual may believe that a system is useful because the system enhances their image and social status. Consequently, we proposed:

H3. Subjective norm will have a positive effect on image.

H4. Image will have a positive effect on perceived usefulness.

2.3. Perceived behavioral control

Perceived behavioral control is an individual's belief about the "presence or absence of requisite resources and opportunities" [8] necessary to perform the behavior. TPB extended TRA by including perceived behavioral control to account for the availability of cognitive and situational resources needed to perform a behavior, theorizing perceived behavioral control as a determinant of intention as well as behavior. Furthermore, prior IS research suggested that perceived behavioral control might be a determinant of perceived ease of use. Venkatesh [51] found that both internal and external control were strong determinants of perceived ease of use. By definition, perceived behavioral control reflects user perceptions of internal and external constraints. Considering physicians' learning capability and the conditions that are generally available to support their work, we expected that a physician's perceptions of internal and external controls would be considerable and this could lead to greater perception of ease of use as well as intentions to use a particular innovation. Hence we proposed:

H5. Perceived behavioral control will have a positive effect on behavioral intention.

H6. Perceived behavioral control will have a positive effect on perceived ease of use.

2.4. Result demonstrability

Potential adopters can better understand the advantages of using a new technology and its implications for their job when tangible results of the technology are directly apparent, suggesting a positive relationship

between result demonstrability and the perception of usefulness. Further, we theorized that result demonstrability would positively influence perceived ease of use. The extent to which an individual perceived the results of using an innovation to be demonstrable partially reflects confidence in using the system and achieving desired results, which is, by definition, the concept of self-efficacy [10,33]. This is also consistent with the view of attribution theory [23], which posits that people are more likely to make internal attributions when the event outcome is positive. Individuals may partially attribute the observed positive results from the use of the system to their own ability in successfully carrying out the required activity. Prior research has found that self-efficacy is a significant determinant of perceived ease of use [52,56]. Therefore, we hypothesized:

H7. Result demonstrability will have a positive effect on perceived usefulness.

H8. Result demonstrability will have a positive effect on perceived ease of use.

2.5. Personal innovativeness in IT

Some individuals are more willing to take a risk by trying out an innovation, whereas others are hesitant to change their practice. According to IDT, people react differently due to their differences in *innovativeness*, a predisposed tendency toward adopting an innovation. Based on this, the theory separates adopters into one of five categories: innovators, early adopters, early majority, late majority, and laggards. Agarwal and Prasad [3] adapted the concept to the domain of IT and proposed a new instrument to measure personal innovativeness in IT (PIIT), which describes the extent to which the individual has an innate propensity toward adopting a new IT.

There is a lack of empirical evidence that addresses the link between personal innovativeness and social influence. IDT, in describing differences in communication behavior among earlier and later adopters, noted that earlier adopters exhibited greater social participation and were more highly interconnected (i.e., linked to others) through interpersonal networks. Also, earlier adopters had more change agent contact and greater exposure to interpersonal communication channels. Within the context of IT adoption, Brancheau and Wetherbe [11] found that, relative to later adopters, earlier adopters were involved in significantly more interpersonal communication and were more active advice-seekers and advice-givers. Hence, earlier adopters are likely to shape others' opinions about adoption of a technology and also be responsive to them as they are engaged in the advice-seeking and advice-giving capacity more frequently and actively than later adopters. Therefore, we hypothesized:

H9. PIIT will have a positive effect on subjective norm.

The effect of PIIT on perceived behavioral control is unknown. IDT argues that earlier adopters are less fatalistic than later adopters, where fatalism can be described as the extent to which an individual perceives a lack of ability to control his or her future. IDT further suggests that highly innovative individuals are more favorably inclined towards trying out new ideas and changes and possess greater ability to deal with uncertainty and risk. Agarwal et al. [4] theorized that self-perceptions of efficacy in the task domain of computing were strongly influenced by the extent to which individuals believe they were personally innovative with respect to IT. Taylor and Todd [47] viewed self-efficacy as a determinant of perceived behavioral control. Therefore, we hypothesized:

H10. PIIT will have a positive effect on perceived behavioral control.

According to IDT, earlier adopters are more technically competent than others and are respected by their peers for their first-hand knowledge of an innovation. Thus, given their technical competencies, earlier adopters should consider the complexity of the technology less troublesome than later adopters, suggesting a direct influence on the perceptions of ease of use. Providing empirical evidence, Lewis et al. [32] found that PIIT was a significant determinant of perceived ease of use. Extending prior findings, we theorized a direct effect of PIIT on result demonstrability. Innovators and early adopters find it easier to imagine, understand, and appreciate the benefits of an innovation [36]. They typically have the ability to envision the potential benefits and advantages associated with an innovation in its early stage of diffusion. Thus, earlier adopters should feel more confident about the tangible results of using the innovative technology and in communicating those results to others. Finally, we expected PIIT to positively influence image. Earlier adopters are well aware of the importance of their adoption decisions in earning the esteem of others and maintaining a central position in the communication networks of the social system. Thus, earlier adopters are likely to highly value the positive image that they derive from the use of the technology. Consequently, we hypothesized:

H11. PIIT will have a positive effect on perceived ease of use.

H12. PIIT will have a positive effect on result demonstrability.

H13. PIIT will have a positive effect on image.

2.6. Perceived usefulness and perceived ease of use

Over the last decade, substantial empirical evidence has accumulated to support TAM. TAM2 theorized that behavioral intention to use a new system would be determined by perceived usefulness and perceived ease of use, while perceived usefulness would be determined by perceived ease of use. Consistently, we tested the relationships between the variables proposed by TAM2 in a professional acceptance setting with the following hypotheses:

H14. Perceived ease of use will have a positive effect on perceived usefulness.

H15. Perceived ease of use will have a positive effect on behavioral intention.

H16. Perceived usefulness will have a positive effect on behavioral intention.

We did not hypothesize a direct effect of PIIT on perceived usefulness over and above the theorized mediators in the model. We expected its effect on perceived usefulness to be fully mediated by the intervening variables in the model.

3. Methodology

3.1. Study context and sample

A field study was conducted to test the model. The subjects were resident and faculty physicians in seven family practice residency programs located in an eastern state of the U.S. Of the 301 questionnaires delivered, 224 were returned for a response rate of 74.4%. Two returned questionnaires were discarded because of missing responses. Thus, the total sample size was 222. The average age of the respondents was 35.6, ranging from 24 to 76. Sixty-five percent of the respondents were male. Ninety-two (41%) family medicine faculty or residents reported using a PDA, which was mostly used in outpatient clinic and hospital settings. The usage of a PDA for their work was mostly voluntary (94.2%).

3.2. Operationalization of research variables

Items used in the questionnaire to operationalize the constructs in the model were adapted from prior research with changes in wording appropriate for PDAs in the targeted healthcare context. All of the items (see Appendix A) were measured on a seven-point Likert scale ranging from −3 (strongly disagree) to +3 (strongly agree). In addition to the study variables, the survey included questions about whether the respondent currently used a PDA, when they used it (outpatient clinic, at the hospital, while studying, while dictating/writing notes, and other), and whether its use was mandatory or voluntary. Finally, the survey included demographic questions about age, gender, and job status (faculty or resident).

4. Results

4.1. Psychometric properties of measures

In the initial test of internal consistency reliability, one PIIT item and one result demonstrability item were found to be unreliable: each had less than 20% correlations with its item-to-total variance. These two items were the only reverse-scored ones on the survey instrument, suggesting that the direction of the wording may have caused the problem. Dropping those two items resulted in Cronbach's alpha values of 0.86 and 0.85 for PIIT and result demonstrability, respectively. Cronbach's alpha values were 0.90 for image, 0.95 for subjective norm, 0.79 for perceived behavioral control, 0.94 for perceived ease of use, 0.97 for perceived usefulness, and 0.97 for behavioral intention. The reliabilities of all measures surpassed 0.70 criteria recommended for applied research [38].

The convergent and discriminant validity of the measures were assessed using principal components analysis with varimax rotation. In general, convergent and discriminant validity are considered to be satisfactorily when measurement items load high on their respective constructs (0.70 or more) and low on other constructs (0.40 or less). As shown in Table 2, seven factors were extracted and all but one were satisfactorily high on their respective constructs. The one exception was a perceived behavioral control item, whose loading was 0.66, which is below than, though close to, 0.70. Given that the item was validated before, its loading score was close to the criteria, and the construct reliability was high, it was retained. No items loaded higher on any other construct than the one it was intended to measure. The cross-loading scores were all lower than 0.4. Thus, the measure exhibits strong convergent and discriminant validity. The construct validity assessment was supplemented by an analysis using LISREL. This showed that the constructs was supported – all of the

Table 2
Factor structure matrix of loadings and cross-loadings

Scale items	1	2	3	4	5	6	7
1. Personal innovativeness in IT							
a. If I heard about	0.15	0.09	0.16	0.07	0.84	0.19	0.10
b. Among my peers	0.18	0.02	0.19	0.12	0.84	0.06	0.16
c. I like to experiment	0.11	0.12	0.33	−0.04	0.80	0.09	0.12
2. Result demonstrability							
a. I have no difficulty	0.23	0.03	0.19	0.06	0.18	0.10	0.87
b. The results of using a PDA	0.27	0.21	0.27	0.09	0.21	0.17	0.78
3. Image							
a. Have more prestige	0.16	0.20	0.04	0.88	0.11	−0.02	−0.08
b. Have a high profile	0.17	0.27	0.03	0.87	0.03	0.04	0.03
c. Using a PDA is a status symbol	0.03	0.19	0.01	0.87	0.01	0.01	0.11
4. Subjective norm							
a. People whose opinions	0.17	0.89	0.11	0.14	0.05	−0.01	0.08
b. My colleagues who are important	0.16	0.92	0.08	0.18	0.05	0.06	−0.01
c. My superiors think that	0.16	0.90	0.05	0.21	0.08	−0.00	0.06
d. My subordinates think that	0.12	0.85	0.15	0.20	0.08	0.04	0.10
5. Perceived behavioral control							
a. I am able to use	0.32	0.19	0.23	0.06	0.21	0.70	0.06
b. I have the resources	0.08	0.11	0.54	0.01	0.15	0.66	0.12
c. Using a PDA in my work	0.14	−0.14	0.25	−0.03	0.08	0.81	0.12
6. Perceived ease of use							
a. My interaction with a PDA	0.37	0.16	0.74	0.05	0.23	0.24	0.18
b. I believe that it is easy to get	0.29	0.07	0.83	0.03	0.19	0.25	0.14
c. It is easy for me to remember	0.28	0.09	0.81	−0.01	0.22	0.16	0.11
d. Overall, I believe that a PDA is	0.19	0.16	0.80	0.07	0.25	0.22	0.17
7. Perceived usefulness							
a. Using a PDA improves	0.86	0.22	0.21	0.18	0.16	0.13	0.15
b. Using a PDA enhances	0.89	0.19	0.23	0.14	0.12	0.13	0.14
c. Using a PDA enables	0.78	0.18	0.39	0.09	0.16	0.21	0.19
d. Overall, I find using a PDA useful	0.86	0.18	0.26	0.11	0.15	0.13	0.16

Principal components analysis with varimax rotation was performed.

coefficients for the measure were significant ($t > 2.0$). Discriminant validity was also confirmed by employing the guidelines of Segars [43]. All of the modification indices in the Lambda X matrix were well below the critical threshold of 5, meaning that adding a path from any measurement item to any other latent variable, other than the one to which it was assigned, would not cause a significant change in the overall χ^2-statistic. Thus no cross-loading of any measurement item on any other construct but its own is significant, demonstrating strong convergent and discriminant validity.

Table 3
LISREL standardized correlation matrix

Latent construct	1	2	3	4	5	6	7	8
1. Personal innovativeness in IT	–							
2. Result demonstrability	0.55	–						
3. Image	0.20	0.11	–					
4. Subjective norm	0.27	0.15	0.48	–				
5. Perceived behavioral control	0.54	0.30	0.11	0.15	–			
6. Perceived ease of use	0.64	0.51	0.13	0.18	0.77	–		
7. Perceived usefulness	0.48	0.50	0.33	0.35	0.45	0.60	–	
8. Behavioral intention	0.44	0.37	0.30	0.42	0.49	0.53	0.71	–

4.2. Measurement model testing

The model was tested using LISREL. Table 3 contains the correlation matrix generated by it. The fit indices (see Table 4) are within accepted thresholds, except for GFI, which is slightly lower than the commonly cited threshold. The χ^2 to degrees of freedom ratio at 1.97, AGFI at 0.80, NNFI at 0.94, CFI at 0.95, and RMSR at 0.08 are all within the accepted thresholds as suggested in the literature [22,44]. The RMSEA, another fit indicator that has gained acceptance for structural equation models is at 0.06. Hu and Bentler [25] argue for a cutoff around 0.06 while Jarvenpaa et al. [27] assert that it should be at or below 0.08. Only the GFI at 0.84 was somewhat below the 0.90 benchmark. While GFI can be brought up to 0.90 by dropping items, we decided not to pursue that route in the interest of content validity. Overall, the fit indices indicated that the model fit the data well.

Fig. 2 shows the standardized LISREL path coefficients with their respective significance levels. All the proposed hypotheses were supported except for H13 and H15. The path between PIIT and image (H13; $\gamma = 0.07$, $t = 1.01$, ns) and the path between perceived ease of use and behavioral intention (H15; $\beta = -0.01$, $t = -0.10$, ns) were found non-significant. The model explained substantial variance in perceived ease of use ($R^2 = 0.70$), perceived usefulness ($R^2 = 0.49$), and behavioral intention ($R^2 = 0.57$), and modest variance

Table 4
Model fit indices

Fit index	Recommended value	Observed value
χ^2/degrees of freedom	≤3.00	1.97
GFI	≥0.90	0.84
AGFI	≥0.80	0.80
NNFI	≥0.90	0.94
CFI	≥0.90	0.95
RMSR	≤0.10	0.08
RMSEA	≤0.06 or ≤0.08	0.06

GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; NNFI = non-normed fit index; CFI = comparative fit index; RMSR = root mean square residual; RMSEA = root mean square error of approximation.

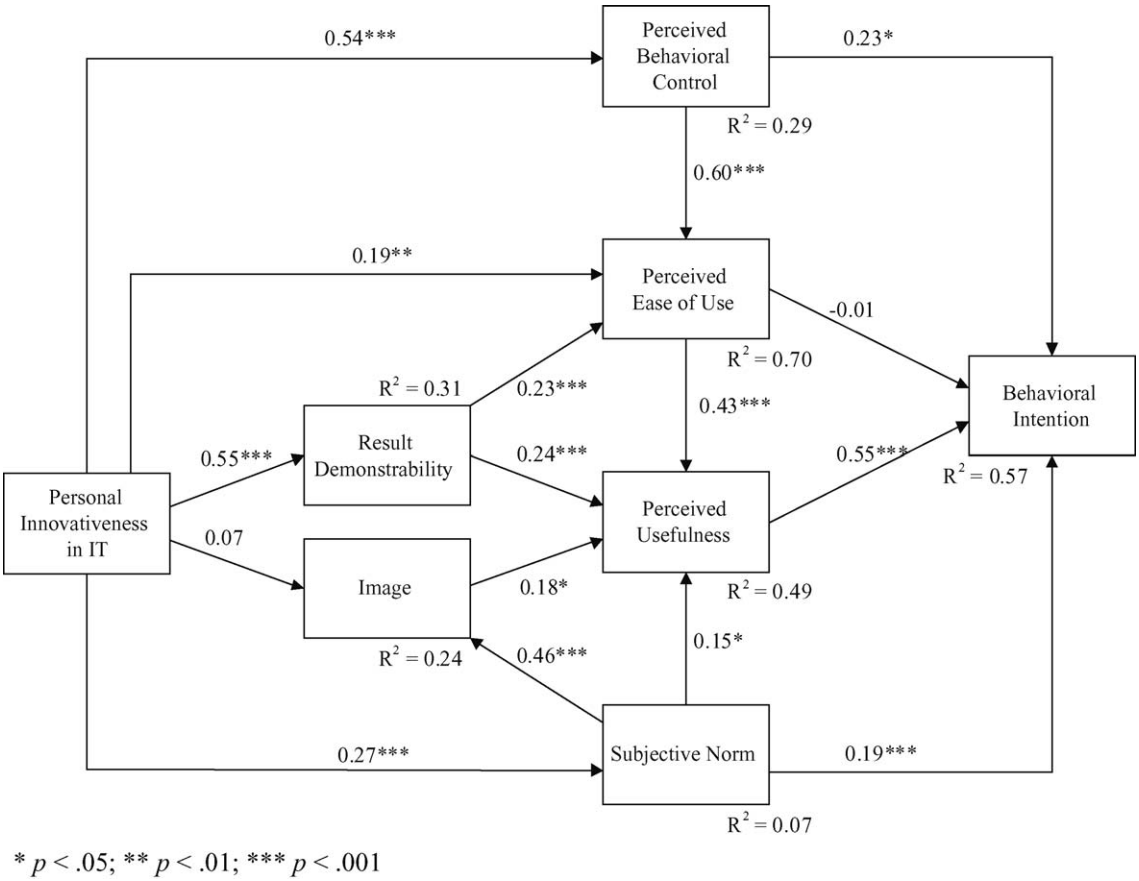

Fig. 2. LISREL test of research model.

in perceived behavioral control ($R^2 = 0.29$), result demonstrability ($R^2 = 0.31$), and image ($R^2 = 0.24$). There was no direct effect of PIIT on perceived usefulness ($\gamma = -0.01$, $t = -0.09$, ns) over and above the mediators in the model.

5. Discussion

5.1. Summary of findings

The objective of our study was to integrate the three streams of research and define the relationships between their key constructs in explaining and predicting technology acceptance by professionals. Fourteen of the sixteen hypotheses were supported. The model has been found to meet or exceed all recommended fit criteria except for GFI, suggesting adequate model fit. The model explains 57% of physician's intention to accept an innovation. Collectively, the model successfully related the three streams of research and identified the factors that determine the physicians' intention to accept this new technology.

Within the context of individual professionals, Chau and Hu [12–14] empirically examined the acceptance of telemedicine technology by physicians in Hong Kong. When juxtaposed with those studies, our study provides some new insights into technology acceptance by physicians, despite the cultural and technological differences. First, consistent with Chau and Hu, perceived usefulness was found to be the most significant determinant of physician's intention to accept a technology. Second, the path from perceived ease of use to behavioral intention was not significant in our study. Chau and Hu did not examine the direct link between perceived ease of use and behavioral intention, but they reported a non-significant effect of perceived ease of use on behavioral intention via attitude. Given the high level of cognitive ability and learning capacity coupled with the general availability of support staff, physicians may still intend to adopt a new technology despite perception of its complexity. Third, in contrast to Chau and Hu, we found a significant effect of perceived ease of use on perceived usefulness, suggesting that a reduction in effort is a significant component of the utility an individual professional derives from the use of an innovation such as a PDA. Fourth, Chau and Hu found that perceived behavioral control had a significant effect, but subjective norm had a non-significant effect, on behavioral intention. We found that both subjective norm and perceived behavioral control had significant effects on behavioral intention. The path coefficients were similar, indicating comparable magnitude of effects on the acceptance decision. Finally, the models employed in the Chau and Hu studies explained 43% of the variance in behavioral intention at most. Our model outperforms those models in accounting for behavioral intention.

We included new variables and relationships in the model. As theorized, we found that perceived behavioral control influences behavioral intention indirectly through perceived ease of use and perceived usefulness. Subjective norm influenced perceived usefulness directly and indirectly via image. Thus both internalization and identification processes are in play in the physician's acceptance of technology. User perceptions of result demonstrability was a significant determinant of both perceived usefulness and perceived ease of use, indicating that when an innovation generates job relevant results that are readily discernable, perceptions of usefulness and ease of use are considerably affected.

We proposed and confirmed a significant role of PIIT in determining the antecedents of physician's intention to use a technology. It had a significant effect on perceived ease of use, result demonstrability, subjective norm, and perceived behavioral control. Our study extended prior findings by theorizing and confirming an antecedent role of PIIT for subjective norm, perceived behavioral control, and result demonstrability as well as perceived ease of use. Inconsistent with the hypothesis, PIIT did not have a significant effect on image, suggesting that more innovative people do not necessarily more highly value the image they derive from the use of a new technology. Because physicians are already esteemed by others by virtue of their profession, earlier adopters might not highly value the positive image associated with the use of a technology as might otherwise be expected. In sum, our study findings indicate that PIIT is a distal determinant of professional user acceptance of technology, achieving its influence indirectly through mediators such as result demonstrability, perceived ease of use, subjective norm, and perceived behavioral control.

5.2. Limitations

Given that measures of all constructs were collected at the same point in time, causality can only be inferred. The findings and implications are based on a single-study design that examined a particular technology involving a specific user group, professionally and geographically. However, the technology chosen for our study is widely applicable to professionals beyond our study setting. Actual usage of the innovation was not

measured; instead, usage intentions were assessed. Because the data were gathered at a single point in time and not longitudinally, measuring usage would unavoidably involve retrospective analysis. Abundant empirical evidence does suggest a sufficiently strong causal link between intention and behavior [26,45].

5.3. Implications for practical use

Our research has important implications. As IT continues to pervade the workplace, one key advantage of understanding the determinants of user intention is the opportunity that it presents for organizational intervention. It is important to develop training interventions and implementation strategies that illustrate and disseminate the potential advantages associated with the target technology as evident by the most significant effect of usefulness on usage intention. Further, our research has shown that subjective norm and perceived behavioral control perceptions contribute to physicians' intention to use a technology. Exploiting a social network to enhance the subjective norm and augmenting the control perceptions through adequate resources and skill training should be actively pursued to facilitate technology acceptance. Our results also indicate that a technology can be more successfully implemented if its tangible results are readily apparent or if the technology contributes to enhancing the image of the user.

Our study highlights the importance of an individual's propensity to experiment with IT and how it is manifested in technology acceptance behavior through several key beliefs and perceptions. Given that PIIT emerged as an important individual difference variable, it is crucial to identify those individuals who possess a propensity to experiment with new information technologies and actively involve them when introducing a new technological innovation. Highly innovative people are likely to consider a technology as more favorable, its tangible results more demonstrable, the situational and cognitive resources required for the use of the technology less constrained, and the opinions of others' more important. It is therefore crucial to contact them first to try out a new technology and then have them serve as change agents and opinions leaders for successful diffusion of the technology.

6. Conclusion

IT is becoming an integral part of the work of professionals, making the examination of factors critical to technology acceptance by them essential for its success. Our research has produced insights into factors that influence technology acceptance by professionals, extending the existing literature by proposing a novel and coherent perspective to integrate three streams of research and to assess its empirical applicability to individual professionals who are becoming increasingly dependent on IT. By taking an integrative approach, we can develop a rich understanding of the mechanisms underlying technology acceptance. The factors that have been identified as important here should be actively managed and manipulated to fully realize the expected benefits from the investment in IT.

Appendix A. Questionnaire items

Personal innovativeness in IT
- If I heard about a new information technology, I would look for ways to experiment with it
- Among my peers, I am usually the first to try out new information technologies
- In general, I am hesitant to try out new information technologies (Dropped)
- I like to experiment with new information technologies

Result demonstrability
- I have no difficulty telling others about the results of using a PDA
- The results of using a PDA are apparent to me
- I would have difficulty telling others about the results of using a PDA (Dropped)

Image
- People in my practice setting who use a PDA have more prestige than those who do not
- People in my practice setting who use a PDA have a high profile
- Using a PDA is a status symbol in my practice setting

Subjective norm
- People whose opinions I value prefer me to use a PDA in my work
- At work, my colleagues who are important to me think that I should use a PDA
- At work, my superiors think that I should use a PDA
- At work, my subordinates think that I should use a PDA

Perceived behavioral control
- I am able to use a PDA in my work
- I have the resources to use a PDA in my work
- Using a PDA in my work is wise

Perceived ease of use
- My interaction with a PDA is clear and understandable
- I believe that it is easy to get a PDA to do what I want it to do
- It is easy for me to remember how to perform tasks using a PDA
- Overall, I believe that a PDA is easy to use

Perceived usefulness
- Using a PDA improves my job performance
- Using a PDA enhances my effectiveness on the job
- Using a PDA enables me to accomplish tasks more quickly
- Overall, I find using a PDA useful in my job

Behavioral intention
- I intend to use (or continue to use) a PDA in my work
- I anticipate that I will use (or continue to use) a PDA in my work
- I intend to apply (or continue to apply) a PDA to improve my work

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