



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



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## ABSTRACT

Understanding the drivers of technology adoption remains an important organizational problem. Our research focused on a personality trait that is relevant to the adoption of technological innovation: personal innovativeness in IT (PIIT). We examined the causal pathways by which this trait affects behavioral intention by testing three alternative models based on innovation diffusion theory, the theory of planned behavior, and an integrative perspective that combines them. Data were collected from 196 hospital administrators in South Korea. The target innovation was an e-commerce purchasing system. Testing across all three models resulted in complete mediation, indicating that PIIT is a strong predictor of intended use of IT but it exerts its influence by altering the mediators. Our integrative perspective provides a more complete account of the causal mechanisms underlying the relationships as well as unique insights that cannot be obtained with a single theory driven model.

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## 1. Introduction

The acceptance of IS remains a critical issue as systems cannot generate any benefit unless they are used. A key factor that underlies user acceptance of IT has been suggested to be personality traits – individuals' predisposition to respond to stimuli across varying situations [7,18]. One such personality trait that has a history of empirical support in several research domains is *personal innovativeness*. Derived from innovation diffusion theory (IDT), personal innovativeness is an enduring trait, possessed by almost everyone. Some adapt while others innovate. Agarwal and Prasad created a metric for individual innovativeness in IT: *personal innovativeness in IT* (PIIT), defined as *willingness to try any new IT* [2]. Of even more interest is *how or by what means* does a causal effect occur? Questions about cause–effect relationships convey the notion of mediation, the process by which some variables exert influences on others through mediating variables.

Yi et al. [22] investigated the nature of the relationship between PIIT and behavioral intention to determine whether the effect of PIIT on behavioral intention would be mediated or moderated by

the innovation characteristics of *usefulness*, *ease of use*, and *compatibility*, confirming empirically that the effect was mediated by such characteristics. Their findings were significant in advancing our understanding of how PIIT is related to behavioral intention; however, their study used a limited set of innovation characteristics while, according to IDT, there are other important innovation characteristics.

Furthermore, additional unanswered questions remain. The theory of innovation diffusion rests upon social processes and presupposes that interpersonal communication influences the behavior of an individual during the adoption process. Moreover, early adopters tend to be more self-confident and less fatalistic than later adopters [14]. Such observations suggest that social and personal control factors are additional elements that could further illuminate the causal pathways from PIIT to behavioral intention. Two theoretical models incorporating those two factors are the theory of planned behavior (TPB) and the unified theory of acceptance and use of technology (UTAUT). In TPB, social factors are represented by the subjective norm construct while UTAUT uses the social influence construct to represent social factors. Personal control factors are represented by the perceived behavioral control and facilitating conditions constructs of TPB and UTAUT, respectively.

The purpose of our research was to compare and validate the efficacy of alternative theoretical perspectives in order to explain how the effect of PIIT on behavioral intention is mediated, thereby

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providing a more complete account of the role PIIT plays in affecting user acceptance of a technology. More specifically, we examined how the effect of PIIT on behavioral intention is mediated from the perspectives of IDT, TPB/UTAUT, and their integration. Doing so can help us determine which theoretical perspective provides a more complete explanation of the phenomena and whether the nature of the relationship is constant across the competing theoretical perspectives. Our research examined the mediation effects of IDT and TPB/UTAUT constructs on the PIIT. We assessed the results of those two models, and developed and tested a third model that integrates constructs from both theories.

## 2. Theoretical background

### 2.1. Innovation diffusion theory

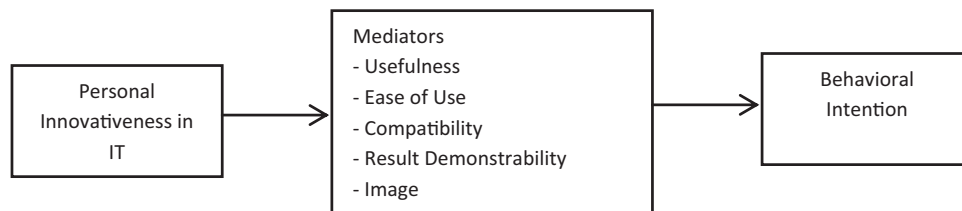
Innovation diffusion theory views the diffusion of an innovation as being determined by the dissemination of information through a social system [14]. Potential adopters use the information to form perceptions of the characteristics of the innovation, which assist in their subsequent adoption. There are five general attributes of innovations that have been shown to influence its adoption: *relative advantage* – the degree to which adopting the innovation is perceived as being better than using the prior practice; *compatibility* – the degree to which adopting the innovation is compatible with what people do; *complexity* – the degree to which an innovation is perceived as being difficult to use; *observability* – the

degree to which the results of an innovation are observable to others; and *trialability* – the degree to which one can experiment with an innovation before making an adoption or rejection decision.

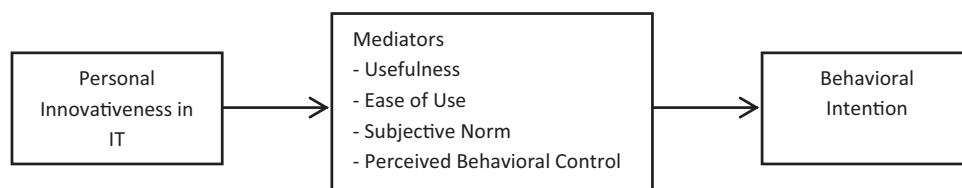
Moore and Benbasat [12] expanded upon the original set of innovation characteristics and refined them to be relevant to an IS context. Later, Yi et al. [23] found that the innovation characteristics (such as relative advantage, complexity, result demonstrability, and image) were among those characteristics found to be more important than others in predicting user intention to use an IT. *Result demonstrability* is the degree to which the tangible results of using the system can be observed and communicated. *Image* is the extent to which the use of the system is perceived as enhancing one's status in the social system.

### 2.2. Theory of planned behavior

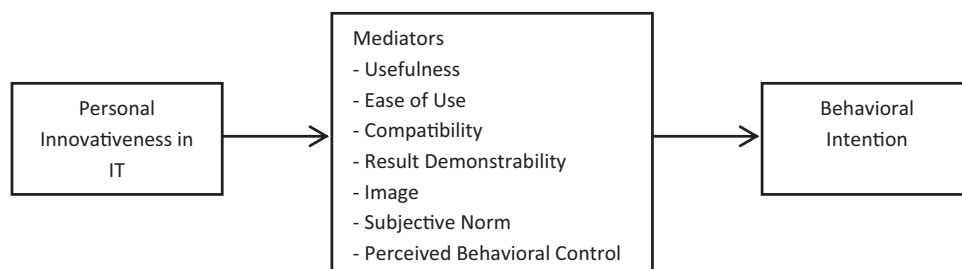
To understand the social and personal dynamics of individuals accepting or resisting a technological innovation, IS researchers have drawn heavily upon theoretical work in social psychology. One such theory is TPB, which states that a person's performance of a behavior is determined by his or her intention to perform the behavior and that behavioral intention is determined by the person's attitude, subjective norm, and perceived behavioral control of the behavior [3,10,13]. The notion of *perceived behavioral control* recognizes that there are circumstances in which a behavior might be expected to result in positive consequences (net benefits), yet not be undertaken due to a perceived lack of ability to control



Model 1 – Mediation Based on IDT



Model 2 – Mediation Based on TPB/UTAUT



Model 3 – Mediation Based on the Integrative View

Fig. 1. Alternative mediation models.

its execution. The notion of *subjective norms* reflects the perceived opinions of others, whose beliefs are important to the user.

### 2.3. Unified theory of acceptance and use of technology

UTAUT assumes that there are four factors that directly affect user acceptance and usage behavior of IT: performance expectancy, effort expectancy, social influence, and facilitating conditions [20]. Among these factors, the first two are conceptually similar to relative advantage and complexity in IDT. *Performance expectancy* refers to the extent to which an individual perceives that using the technology will result in job-related gains while *effort expectancy* refers to the extent to which an individual perceives that the technology will be easy to use. The two other constructs in UTAUT are *social influence* (which includes perceptions of how important others feel about the use of the technology) and *facilitating conditions* (which are beliefs about the availability of the necessary organizational and technological resources needed to use the technology).

Performance expectancy and effort expectancy are also termed *perceived usefulness* (the extent to which a person believes that using the technology will enhance his or her job performance) and *perceived ease of use* (the extent to which a person believes that using the technology will be free of effort), respectively. Similarly, social influence and facilitating conditions are analogous to the subjective norms and perceived behavioral control constructs in the TPB, respectively. Social influence and subjective norm both encapsulate the degree to which an individual user accommodates the opinions of important others [4]. Facilitating conditions and perceived behavioral control both epitomize a user's perceived lack of control over the resources required for the successful execution of the target behavior [13,16]. Thus they measure essentially the same concepts.

## 3. Research models

Prior research has established that PIIT has a direct effect on behavioral intention; however, it is better to understand *how* and *why* such effects occur. Hence, we proposed three models, as shown in Fig. 1. Model 1 posits that the innovation characteristics of IDT mediate the relationship between PIIT and behavioral intention. Model 2 theorizes that the TPB/UTAUT variables mediate the relationship. Model 3 is a model that combines both sets of variables as mediators of the effect PIIT has on behavioral intention.

### 3.1. Model 1 – mediation based on IDT

Results from the innovation diffusion and IS research suggest that the extent to which an individual is innovative directly impacts his or her perception of innovation characteristics and that early adopters are generally more educated and technically astute and have greater exposure to mass media and interpersonal communication channels than later adopters. Possessing those characteristics should allow an individual to recognize and appreciate the *usefulness* of an innovation as well as to find the innovation *easier to use*. Innovative individuals are also receptive to change, and are more likely to see the potential of a novel innovation as *compatible* with their objectives.

Yi et al.'s study on individual innovativeness examined the effectiveness of adopter and personal innovativeness in deciding to accept a technology [22]. They developed an alternative measure of individual innovativeness: *adopter innovativeness*, which is based on the innate nature of the innovative adopters, early majority, late majority, and laggards [11,14]. Their study found a significant correlation between personal innovativeness and

adopter innovativeness ( $\gamma = 0.39$  in Study 1 and  $\gamma = 0.53$  in Study 2). Further, they established PIIT to be an antecedent of *perceived usefulness* and *ease of use* as well as compatibility. They also found that usefulness and compatibility were significant determinants of *behavioral intention* while mediating the effect of PIIT.

Building upon these findings, we posited that the innovation characteristics of usefulness, ease of use, and compatibility would affect the PIIT and behavioral intention relationship in our study. We further expected that the result demonstrability and image innovation characteristics would affect the PIIT and behavioral intention relationship. Those who are early to adopt an innovation can better visualize the potential benefits of using the technology and communicate their findings to others. Lastly, innovators tend to be upwardly mobile and conscious of their social standing, and are thus likely to be particularly mindful of their image in the social network.

### 3.2. Model 2 – mediation based on TPB/UTAUT

TPB assumes that *attitude*, *subjective norm*, and *perceived behavioral control* are direct determinants of behavioral intention. UTAUT further extended prior work by arguing that perceived usefulness, perceived ease of use, subjective norm, and perceived behavioral control as direct determinants of behavioral intention.

Within the context of IT adoption, early adopters were found to exhibit greater social participation – they act as change agents and opinion leaders [6,11]. IDT suggests that early adopters are not daunted by ambiguity compared to later adopters and are more likely to be able to discern the existence of required resources and opportunities. Prior research found that highly innovative individuals were more confident when using a new technology [1,17]. Self-efficacy, self-confidence in ability to execute a course of action, has been linked to perceived behavioral control [9,13,16]. Thus, we expected that subjective norm and perceived behavioral control would mediate the relationship between PIIT and behavioral intention, in addition to usefulness and ease of use.

### 3.3. Model 3 – mediation based on the integrative view

Integrating all of the proposed mediators allowed us to explore the possibility of unifying the theories in a single model. Our examination of all of the variables in a single model also allowed us to account for variance that existed beyond the separate models. Moreover, we were able to assess the comparative strengths of alternative mediating variables, thereby setting the stage for a more accurate accounting for the relationship between PIIT and behavioral intention.

## 4. Methodology

### 4.1. Study context and sample

At the time of data collection, the use of e-commerce systems in the Korean healthcare field was a critical issue. Although a few of the major hospitals had contracted with two major private e-purchasing system companies (Care Camp and EZ Medico) and the Korean government purchasing system (Korea Public Procurement Services), most hospitals had problems obtaining those contracts due to their cost or the lack of the needed IT infrastructure. The Korean Hospital Association had produced a list of hospitals waiting to obtain an e-commerce system. In general, hospital IT management in Korea was recognizing the importance of e-purchasing systems in helping to improve management efficiency and reduced costs. As a result, it was important to identify and understand the factors that drove the adoption of an e-commerce

system. Thus, our study sample consisted of purchase officers employed in a major hospital.

The hospitals were selected from the roster of the Korean Hospital Association, which contained a total of 320 hospitals. 196 hospitals had more than 300 beds and calls were made to each hospital to identify the administrators in charge of e-purchasing. A total of 419 persons from 118 hospitals were identified. Questionnaires were mailed to them and a follow-up call was made after 4 days to verify that the questionnaires had been received and to ask for a prompt response. After one week, 114 questionnaires from 51 hospitals had been returned. A follow-up call was made two weeks later and 137 questionnaires from 67 hospitals were subsequently received, resulting in a total of 251 responses, representing a response rate of 59.9%.

The average age of the study's participants was 38 years with 10.8 years of experience. Seventy-two percent of the respondents possessed an education beyond junior college. To assess the possibility of response bias, we examined early and late respondents using the chi-square test of significance. Factors examined included: the type of hospital (i.e., national/local public/private/university foundation), cooperation type of hospital (i.e., medical/special/social cooperation), geographic location (i.e., which of Korea's six regions), the number of beds in the hospital, the number of departments in the hospital, and the number of years in business. We found no significant difference in any of them, indicating that there was no response bias in the data between the early and late respondents and that non-response bias was unlikely.

#### 4.2. Research variables

Items used in the survey questionnaire were adapted from prior research with minor wording changes to reflect our study context

(an e-commerce purchasing system). Because the modifications to the items were trivial, we decided to proceed without revalidating the scales. Perceived usefulness, perceived ease of use, and compatibility were measured by items adapted from [22] and the rest were from [23]. A complete list of the items are presented in Appendix A. Items were measured by adopting a five-point Likert scale ranging from –2 (strongly disagree) to +2 (strongly agree). Demographic questions such as gender, age, and level of education were included. The survey instrument was created in English and underwent a double translation process for verification purposes (the English language version was reviewed for content validity and translated to Korean; a separate group then translated the Korean version to English). There were no semantic differences between the first and the second English versions of the instrument. The Korean version of the questionnaire items was subsequently pilot tested for reliability and validity.

## 5. Results

### 5.1. Psychometric properties of measures

In the initial test of psychometric properties of measures, one result demonstrability item was deemed unreliable; it was the only reverse-scored item on the survey instrument, suggesting that the direction of the wording may have caused a problem. Dropping that item resulted in a Cronbach's alpha value of 0.71 for the construct. The remaining constructs were all satisfactory, surpassing the generally accepted 0.70 criteria [21].

Convergent and discriminant validity of the measures were assessed using principal components analysis with Varimax rotation (see Table 1). One subjective norm item cross-loaded on image. Examination of the wording suggested that it might tap into the

**Table 1**  
Factor structure matrix of loadings and cross-loadings.

Scale items	1	2	3	4	5	6	7	8
1. Personal innovativeness in IT								
(a) If I heard about	0.18	<b>0.81</b>	0.11	0.18	0.17	0.09	0.04	0.04
(b) Among my peers	0.13	<b>0.81</b>	0.06	0.04	0.03	0.16	0.07	0.23
(c) I like to experiment	0.12	<b>0.85</b>	0.09	0.17	0.17	0.15	0.10	0.02
2. Perceived usefulness								
(a) Overall, I find	0.31	0.22	0.20	<b>0.78</b>	0.14	0.19	0.06	0.08
(b) Using the e-commerce system	0.23	0.17	0.23	<b>0.79</b>	0.17	0.13	0.07	0.07
(c) Purchasing products through	0.04	0.08	0.21	<b>0.73</b>	0.07	0.14	0.21	0.32
3. Perceived ease of use								
(a) It is easy to	0.12	0.19	<b>0.77</b>	0.11	–0.02	0.19	0.18	0.11
(b) It is easy for me	0.18	0.04	<b>0.85</b>	0.15	0.18	0.11	0.02	0.10
(c) The e-commerce system is easy	0.12	0.04	<b>0.83</b>	0.26	0.15	0.07	0.03	0.01
4. Compatibility								
(a) Using the e-commerce system is	0.18	0.20	0.19	0.21	0.35	<b>0.72</b>	0.14	–0.00
(b) Using the e-commerce system fits well	0.25	0.18	0.11	0.11	0.25	<b>0.75</b>	0.19	0.29
(c) Using the e-commerce system fits into	0.24	0.19	0.22	0.23	0.19	<b>0.73</b>	0.08	0.23
5. Result demonstrability								
(a) I have no difficulty	0.15	0.19	0.04	0.16	0.10	0.32	0.22	<b>0.72</b>
(b) The results of using	0.26	0.14	0.25	0.34	0.25	0.09	0.11	<b>0.68</b>
6. Image								
(a) People in my work setting	0.09	0.10	0.12	0.15	0.17	0.07	<b>0.85</b>	0.11
(b) Using the e-commerce system	0.12	0.07	0.06	0.07	0.05	0.17	<b>0.87</b>	0.11
7. Subjective norm								
(a) At work, my colleagues	<b>0.78</b>	0.16	0.22	0.21	0.20	0.17	0.16	0.12
(b) At work, my superiors	<b>0.82</b>	0.19	0.10	0.15	0.24	0.22	0.07	0.15
(c) At work, my subordinates	<b>0.84</b>	0.18	0.19	0.19	0.20	0.18	0.09	0.11
8. Perceived behavioral control								
(a) I am able to use	0.25	0.06	0.10	0.09	<b>0.81</b>	0.28	0.12	0.01
(b) I have IT resources	0.27	0.24	0.24	0.08	<b>0.71</b>	0.15	0.03	0.25
(c) In my work, using	0.19	0.23	0.07	0.30	<b>0.68</b>	0.26	0.23	0.16

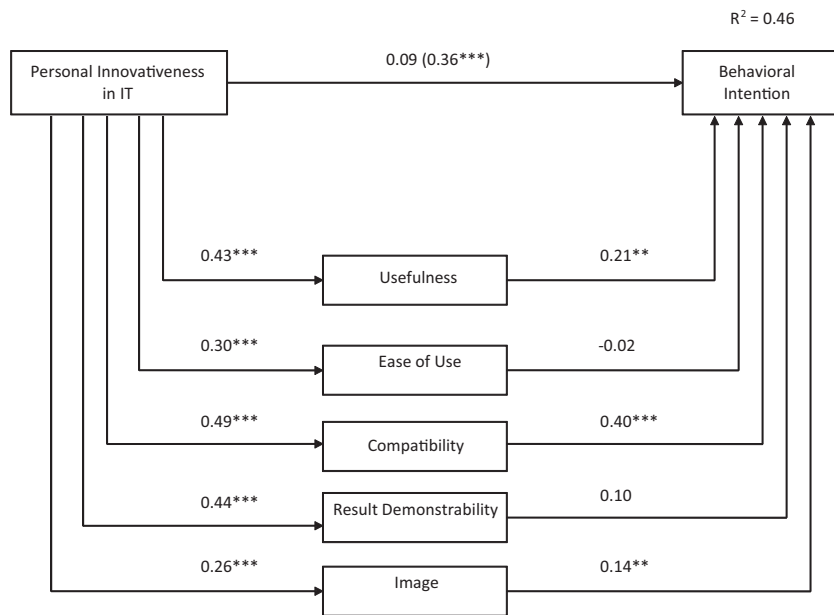


Fig. 2. Mediation results based on IDT.

notion of image (people whose opinions I value prefer me to use the e-commerce system in my work); as a result, that item was also dropped. All items loaded high on their target construct (0.70 or more) except for one result demonstrability item (0.68) and one perceived behavioral control item (0.68). Given those items were very close to the recommended criteria (0.70), had been previously validated, and their reliability was satisfactory, the items were retained. All cross-loadings were less than 0.40. Overall, the results indicate strong convergent and discriminant validity.

Mediation results are summarized in Figs. 2–4, where the values in parentheses correspond to the effects of PIIT on behavioral intention prior to controlling for its indirect effects through the indicated mediator variables, and the respective levels of significance are: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . The results show that PIIT has a significant direct effect on behavioral intention ( $\beta = 0.36$ ,  $p < 0.001$ ), supporting the first condition of the mediational analysis. PIIT has significant effects on all of the

presumed mediators, supporting the second condition of the analysis. In each model, in the presence of the presumed mediators, the previously significant relationship was no longer significant with the path coefficient now decreased to almost zero, clearly indicating full mediation [5,8]. When the non-significant mediators were dropped from each model and each model was re-run, the significant relationships between the retained mediators and the dependent variables previously observed and the non-significant (almost zero) effect of PIIT on behavioral intention did not change, fully supporting the mediational analysis. Collinearity diagnostics were examined while running each of the models. The largest variance inflation factor of each model was less than 3, showing that multicollinearity was not a problem.

To substantiate our findings of full mediation, a Sobel test [15] was further conducted. This involved computing the ratio of the mediator path to its estimated standard error. A  $p$ -value for this ratio is computed in reference to the standard normal distribution;

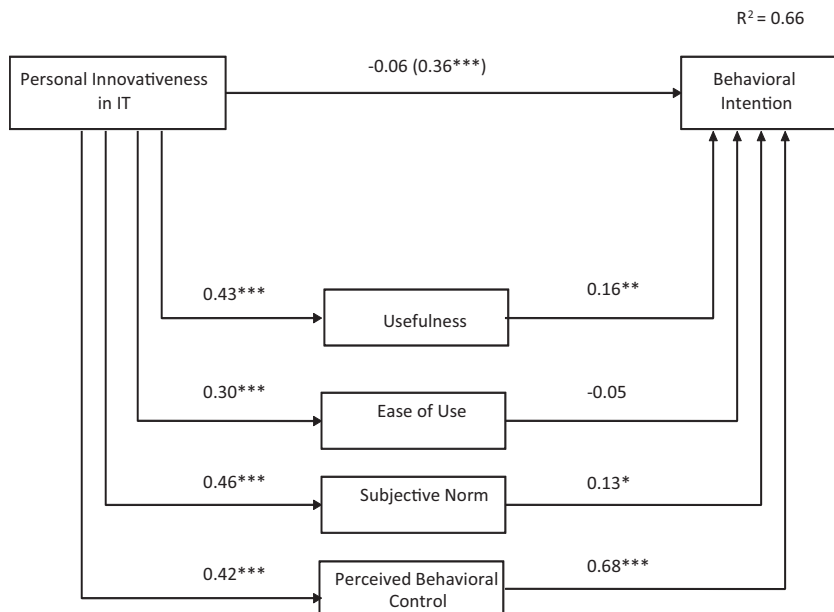


Fig. 3. Mediation results based on TPB/UTAUT.

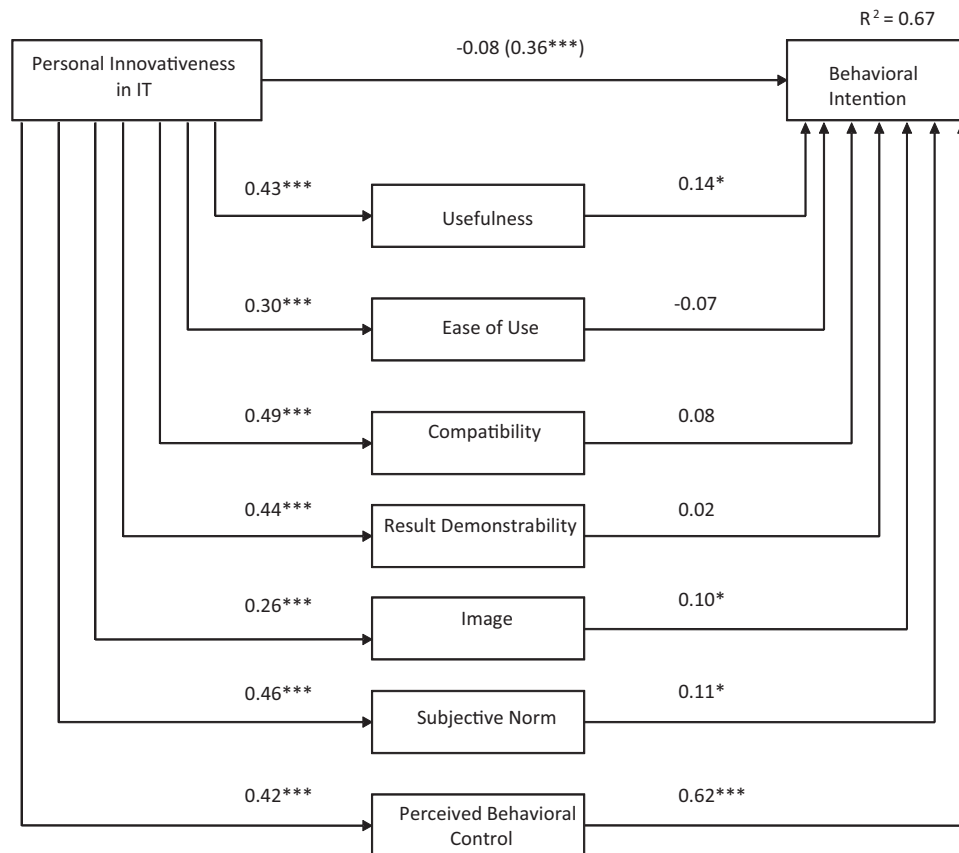


Fig. 4. Mediation results based on the integrative view.

significance supports the hypothesis of mediation. Results are presented in Table 2.

## 6. Discussion

The objective of our study was to examine how PIIT exerts an effect on user acceptance of technology via alternative sets of

mediating variables. Results indicated a strong and positive relationship between PIIT and each of the mediators, providing evidence of its important role as an antecedent to the mediating variables. The results showed no significant (almost zero) effect of PIIT on behavioral intention in the presence of the theorized mediators, indicating full mediation in all models, without exception.

The IDT mediation model explained the least amount of variance in behavioral intention with 46% while the results of the TPB/UTAUT mediation model and the integrated model were close with 66% and 67% of variance explained, respectively. The IDT model indicated a non-significant effect of perceived ease of use and result demonstrability while only perceived ease of use was non-significant in the TPB/UTAUT model. The integrated model showed that perceived ease of use, compatibility, and result demonstrability were not important in explaining how PIIT exerts its influence on behavioral intention whereas perceived usefulness, image, subjective norm and perceived behavioral control were important. Overall, our integrated model provided the most complete understanding of the causal pathways through which PIIT achieves its influence on behavioral intention. Our overall findings indicate that PIIT is a determinant of a technology acceptance decision achieving its effect indirectly through innovation characteristics, social influence, and personal control perception.

## 7. Limitations

Our study has some limitations. They mainly occur because there are other characteristics that may be important in the adoption and diffusion of innovations (e.g., cost, communicability, divisibility, profitability, trialability, and visibility). Further, our

**Table 2**  
Sobel normal theory test results.

Indirect effects of PIIT on behavioral intention through proposed mediators				
	Effect	Std. error	Z-value	p-value
IDT model				
Total	0.39	0.05	7.59	0.00
Usefulness	0.10	0.03	2.91	0.00
Ease of use	-0.06	0.02	-0.27	0.79
Compatibility	0.21	0.04	4.97	0.00
Result demonstrability	0.04	0.03	1.37	0.17
Image	0.04	0.02	2.29	0.02
TPB/UTAUT model				
Total	0.47	0.06	8.24	0.00
Usefulness	0.08	0.03	3.05	0.00
Ease of use	-0.02	0.02	-1.15	0.25
Subjective norm	0.07	0.03	2.45	0.01
Perceived behavioral control	0.34	0.05	6.96	0.00
Integrated model				
Total	0.48	0.06	8.39	0.00
Usefulness	0.06	0.03	2.48	0.01
Ease of use	-0.02	0.02	-1.42	0.15
Compatibility	0.04	0.03	1.39	0.16
Result demonstrability	0.00	0.03	0.04	0.97
Image	0.03	0.01	2.13	0.03
Subjective norm	0.06	0.03	2.06	0.04
Perceived behavioral control	0.31	0.05	6.64	0.00



research design was cross-sectional in nature; thus, the degree to which causality can be inferred from the findings is limited. Lastly, the intention to use the innovation, rather than actual usage, was assessed in our study. However, the reliance on behavioral intention as a predictor of actual behavior underlies much socio-behavioral research, and a strong causal link between behavioral intention and actual behavior has been demonstrated in prior research (e.g., [19,20]).

## 8. Implications

Our results showed that PIIT is an important antecedent of key innovation characteristics and behavioral intention, thereby providing an extension of the extant IDT and TPB/UTAUT models. The effect of PIIT on behavioral intention was fully mediated across the alternative models, indicating that PIIT is a determinant of behavioral intention. Further, the results highlight the importance of user perceptions of usefulness, image, subjective norm, and perceived behavioral control in determining behavioral intention as well as mediating the effect of PIIT on behavioral intention.

From a practical perspective, our results revealed the important role of personal innovativeness in influencing both user perceptions of innovation characteristics and the associated personal control and social influence aspects that characterize the innovation adoption process. When introducing a novel technology into the organization, managers could identify those individuals most likely to be enthusiastic and readily embrace a new technology by measuring their PIIT and then provide them with an early exposure to it. They could then serve as opinion leaders and help others feel confident to try, facilitating the subsequent diffusion of the technology through the organization. For most members of a social system, the innovation decision depends heavily on that of the other group members. This suggests that the rate at which an innovation is adopted involves social persuasion and interpersonal communication factors in addition to users' beliefs toward the innovation. Therefore, management's efforts should be more specifically directed toward utilizing the additional knowledge of the consequential behavior of innovative individuals beyond their perceptions of innovation characteristics.

## 9. Conclusion

Our research focused on a personality trait that has been receiving attention recently – personal innovativeness in IT. We examined the causal pathways by which it affects behavioral intention by testing the mediating effects based on two alternate theories (IDT and TPB/UTAUT) and tested the plausibility of integrating constructs from both theories. Results indicated a full mediation effect across the alternative models. The integrated perspective performed better than either IDT or TPB/UTAUT and highlighted the most important predictors of user acceptance of an e-commerce system for streamlining the process and procedures of hospitals. Personal innovativeness had a significant effect on each of these predictors, showing that involving highly innovative people throughout the adoption process is one of the most important success factors in the implementation of a technology.

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## Appendix A. Survey 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.

I like to experiment with new information technologies.

### Perceived usefulness

Overall, I find using e-commerce system useful.

Using the e-commerce system enhances my effectiveness to saving my working time.

Purchasing products through e-commerce system has more advantage than disadvantage.

### Perceived ease of use

It is easy to get the e-commerce system to do what I want it to do.

It is easy for me to learn how to perform tasks using the e-commerce system

The e-commerce system is easy to order products.

### Compatibility

Using the e-commerce system is compatible with all aspects of my work.

Using the e-commerce system fits well with the way I like to work.

Using the e-commerce system fits into my work style.

### Result demonstrability

I have no difficulty telling others about the results of using the e-commerce system

The results of using e-commerce system are apparent to me.

### Image

People in my work setting who use e-commerce system have a high profile.

Using the e-commerce system is a status symbol in my work settings.

### Subjective norm

At work, my colleagues who are important to me think that I should use the e-commerce system.

At work, my superiors think that I should use the e-commerce system.

At work, my subordinates think that I should use the e-commerce system.

### Perceived behavioral control

I am able to use the e-commerce system in my work.

I have IT resources to use the e-commerce system in my work.

In my work, using e-commerce system is entirely my control.

### Behavioral intention

I intend to use (or continue to use) the e-commerce system in my work.

I anticipate that I will use (or continue to use) e-commerce system in my work.

I intend to apply (or continue to apply) the e-commerce system to improve my work.

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