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Unified Perspective of Technology Readiness Index (TRI) and Technology Acceptance Model (TAM) for Adoption of Digital Pills

Tabe Ekouka Elvis, Ha-Kyun Kim

Graduate School of Information Systems, Pukyong National University, Republic of Korea,

elvis.tabe@yahoo.com; kimhk@pknu.ac.kr (corresponding author)

Abstract. The Food and Drug Administration (FDA) authorized digital tablets, which are pharmaceuticals with a sensor that may notify doctors whether or not patients are taking their medication. It also allows patients greater flexibility over when monitoring begins. The approval is a significant step forward in the emerging field of digital devices meant to track drug use and alleviate the costly, long-standing problem of millions of patients not taking their prescriptions as prescribed. These are artificial aggregates that involve medicine as well as a type of electronic tracker that activates when the patient consumes the digital pills. These might be a beneficial tool for tracking and perhaps improving patient adherence to medications, as well as helping patients and their families avoid unnecessary healthcare expenses while also reducing anxiety. Digital pills may limit patient liberty, compromise privacy, or encourage inefficient use of pharmaceutical resources. The motives for conducting this study were to use a complete approach to examine the data in a quantitative analysis that reflects the substance of the study and to continue with further research, to investigate an expanded technology acceptance model framework for the adoption of digital pills in terms of technology readiness index, to provide a comprehensive analysis of the relative benefits of digital pills. The purpose of this study is to contribute to the proper usage of digital pills, by highlighting the main ethical and social challenges it raises and providing solutions. The purpose are as follows. (1) to prepare a good perception for users to accept the digital pills revolution that is changing our lives health-wise, (2) to develop, test, and validate TRI and TAM for the adoption of digital pills, (3) to strengthen the user's understanding of the digital pill's adoption and continue to use, this study's methodology is appropriate for gathering data and addressing the research questions via an online survey. The methodologies are conceptually and practically linked with previous research, with the goal of building on them while minimizing the limitations of previous work. The TRI and TAM formulated from the literature review were empirically validated from data acquired in an online survey

conducted on Amazon Mechanical Turk. In total 319, samples were gathered and 310 valid responses were analyzed after eliminating 9 invalid responses. This study used the structural equation modeling technique, which allows for simultaneous analysis. Smart PLS 3.0 and IBM SPSS version 20 were used for the analysis. Moreover, this study investigates TRI and TAM, however, the primary purpose is to examine the relationship between antecedents' TRI and Adoption intention. The results of the analyses show that optimism, innovativeness, discomfort, and Insecurity have positive impacts on perceived ease of use. The majority of the given hypotheses are supported by a satisfactory overall model fit index. The empirical findings of this study add to our understanding and explanation of the critical mechanism underlying digital pill users' adoption intention decision-making process.

Keywords: digital healthcare, digital pills, technology readiness index, technology acceptance model, amazon mechanical Turk.

1. Introduction

Digital pills are ingestible sensors linked to a tiny wearable skin sensor patch that delivers data to a connected digital device, such as a smartphone, allowing patients to exchange the information obtained by digital pills with their doctors and caretakers. Pharmaceuticals with ingestible sensors will change patient compliance. Medication or prescription compliance is also an issue for mentally ill persons; many older people struggle to keep track of their prescriptions mostly because they forget to take them (de Miguel and Morla, 2020).

Data Bridge Market Research stated that the digital pills market was estimated at USD 3.64 billion in 2021, and will project to USD 6.91 billion by 2029, registering a CAGR of 8.35 % through the estimated time 2022-2029. Expert analysis, pipeline analysis, pricing analysis, patient epidemiology, and authoritarian framework are all included in the market study produced by the Data Bridge Market Research team. They also mention that the occurrence of chronic conditions, cardiovascular disorders, and diabetes would increase the rate of digital pill adoption and have a further impact on market dynamics during the projected period of 2022-2029, the use of digital pills to track medication adherence or patient compliance is becoming more frequent (Swartz, 2018). As the use of digital pills becomes more widespread, the decision-making process will improve. This study examines the acceptance and usage of digital pills by a user in the technology readiness index (TRI) concept.

The study's main goal is to validate the model of digital pill technology acceptance. In addition, it also focuses on digital pills with characteristics that allow users to feel hopeful about taking them and build a good attitude toward using them in the future. First, this study looked at the Technology Readiness Index for digital pills (Optimism, Innovativeness, Discomfort, and Insecurity), as well as the relative benefits of utilizing digital pills. The relative and relevant advantages among the Technology Readiness Index components were then analyzed, and the research looked into the effects of digital pill users as well as the relative benefits of adoption. The Technology Acceptance Model framework was established to examine the effects. The research framework is one of the most extensively utilized consumer behavior research frameworks for examining how consumers make a purchase and utilize decisions. The TAM variables were the mediators in the serial relationships between (TRI) antecedents to adoption.

2. Literature Review

2.1. Technology readiness index (TRI)

When it comes to using technology, people have different perspectives (Rosen and Michelle, 1995). The (TRI) is a methodology for assessing overall technological readiness. People differ in their personality qualities, and as a result, their views on various areas of technology vary as well. Each trait's relative strength shows

someone's responsiveness to technology. As a result, TRI reflects some attitudes with reference to technology, although it is not a measure of a person's ability to use it. It categorizes users into four groups based on their dominant personality, with two elements acting as motivators for new technology adoption and the other two acting as inhibitors. These elements are optimism, innovativeness, discomfort, and insecurity. Optimism and innovativeness are motivators for TRI, but discomfort and insecurity are inhibitors (Parasuraman and Charles, 2015).

2.2. Optimism

Optimism is defined as "the predisposition to assume that one would generally have positive versus poor life outcomes." Optimists utilize coping strategies that are more active mechanisms than pessimists, which are effective in reaching optimistic outcomes (Scheier and Carver, 1992). It has an inverse relationship with emotional suffering, fear, and apprehension about negative experiences, as well as apparent risk and control. Optimism's impacts can be explained in two ways: first, through a greater appreciation and self-esteem for one's effort and social surroundings, which generates defensive effects rather than feeling threatened or challenged, and second, through the achievement of behaviors aimed at gaining authority rather than unsatisfactory work conditions, which are not seen as inevitable by optimistic people (Desrumaux et al., 2015).

2.3. Innovativeness

Home users' tendency to adopt innovative technologies varies, and in the realm of technology, innovativeness is defined as a person's readiness to explore new technology More innovative persons are thought to have a smaller amount of complex belief sets regarding new technologies, which are considered a trait reasonably stable descriptor of an individual (Turan, et al., 2015). A high level of personal innovation when it comes to technology generally leads to a superior level of adoption; people with a high level of innovativeness believe that if they don't try out new technology, they would miss out on some benefits. They have a favorable sense of its overall utility. Early adopters use new technology even if their perspective worth is unknown and profit is not immediately apparent (Lin and Filieri, 2015).

2.4. Insecurity

Fear of technology and worries about its capacity to perform efficiently, while related to discomfort, focuses on specific aspects of technology-based transactions rather than a general lack of technological comfort. The following examples demonstrate the many sorts of ideas that lead to insecurity. I would never do business with a company that can only be accessed over the internet. Never be sure if the information you give or sent through the Internet reaches the appropriate location. Because of their inherent dread of technology, people avoid using computers. People's distrust of new technologies may be one of the reasons for this (Purba, 2015).

2.5. Discomfort

Discomfort refers to the tension that an individual feel as a result of his or her incapacity to adapt to the advent of new technologies healthily. People who seem to have a high level of discomfort have a sense of being out of control and overwhelmed by technology. This might be enhanced by providing more detailed feedback and increasing the simplicity of usage. People who seem to have an elevated level of discomfort consider technology to be complex and therefore more complicated to use. In general, a high level of personal discomfort with technology leads to the poorer perception of technology's use Walczuch et al., 2007).

2.6. Technology acceptance model (TAM)

The perceived ease of use explains the variation in perceived usefulness. When a user perceives that using technology would be simple, despite the fact that TAM has altered over time, it consistently explains around 40% of the variation in usage intentions (Venkatesh et al, 2012). TAM factors are used to forecast user acceptance of the Internet of Things. TAM was originally designed to forecast ICT system utilization. User acceptance can also be predicted using the variables (Gao and Bai, 2014). TAM has shown to be a reliable model in previous studies, and it uses two crucial elements to explain user acceptance.

2.7. Perceived usefulness

A user feels that utilizing technology improves his or her job routine, which reflects perceptions of performance utilize contingency, which is closely linked to both extrinsic motivation and instrumental (Chen, 2014). Understanding the user's position and perceived usefulness is a factor in smart technology acceptance. Prior TAM research provides important insight into the role of perceived usefulness and perceived ease of use as direct experience grows. The role of perceived usefulness as a strong driver of the user's intention over time is supported through a large organization of research.

2.8. Perceived ease of use

Perceived ease of use is among the most important predictors of behavioral intention, adoption, and continuous intention to use technology. The user believes that using technology will be simple; the direct result of perceived ease of use may be a trigger for increasing usage and the likelihood of user acceptance. It has been established that perceived ease of use influences adoption in two directions, one a straight effect on adoption and an indirect effect on adoption via perceived usefulness, the straight effect suggests that perceived ease of use might be a potential method to enhance the likelihood of user acceptance and adoption (Bagozzi, 2007).

2.9. Adoption

The adoption intention refers to how a user would adopt and continue to utilize the technology in the future (Venkatesh, 2000). According to TAM philosophy, adoption

or intention to use will predict a user's positive or negative valuation of using technology. The primary dependent variable for this research study was based on TAM Adoption.

3. Research Methodology

This study's findings are focused on the evaluation of data from a survey distributed via Amazon Mechanical Turk (MTurk). The approaches used in this study are appropriate for gathering, analyzing, and answering the study's questions. Moreover, the study's techniques are theoretically and practically aligned and the study's subject was approached using a quantitative methodology.

The study model and accompanying hypotheses were developed using information acquired from a literature survey and examination of different technical systems. Table 1 below states the variable's operational definitions used in this study.

Table 1: The operational definition of constructs

Variable	Operational Definition	Reference
Optimism	A positive attitude toward technology Believing in the ability of technology to give people in their daily lives, more control, flexibility, and efficiency.	Desrumaux et al., 2015
Innovativeness	Having required control and being overwhelmed.	Lin and Filieri, 2015
Insecurity	For security and privacy considerations, distrust technology.	Walczuch et al., 2007
Discomfort	Having desire for control and a feeling of being overburdened.	Walczuch et al., 2007
Perceived Usefulness	A user believes that taking digital pills will be effortless.	Chen, 2014
Perceived Ease of Use	A person feels that using digital pills will improve his or her health.	Gao and Bai, 2014
Adoption	An extent to believe that they would adopt and continue to use digital pills.	Venkatesh, 2000

3.1. Characteristics of respondents

The outcomes of this study center on evaluating data acquired through Amazon's Mechanical Turk, an online survey service. Amazon Mechanical Turk (MTurk) has recently gained traction in social science experimentation and survey research. MTurk is a one-stop marketplace for getting works done, bringing people and resources together to facilitate task completion, labor recruiting, data collection, and compensation. According to MTurk, the marketplace has a huge and diversified workforce of more than 100,000 individuals from more than 100 countries that execute thousands of tasks on a daily basis.

Users can sign up as task requesters (task authors) or workers on MTurk (paid for the task completers). Requesters can also use technological scripts or simple

templates to build and submit nearly any type of activity that can be completed by other workers at a computer (e.g., writing, experiments, surveys, etc.) or connect workers to an external online survey platform (e.g. SurveyMonkey, and Google form).

The sample collection for this study was completed using Amazon's Mechanical Turk (MTurk). As a result, 310 valid responses were analyzed out of 319 samples. All the participants of this survey were from the United States.

Table 2: Characteristics of respondents.

Characteristics		Responses	Percentage
Gender	Male	200	63.7%
	Female	110	36.3%
	Total	310	100%
Marital status	Single	177	57.0%
	Married	133	43.0%
	Total	310	100%
	20-29 years	22	7.1%
	30-39 years	174	56.6%
	40-49 years	85	27.4%
	50-59 years	21	6.8%
	60 years or more	8	2.1%
	Total	310	100%
Educational level	High school	18	6.0%
	Finished school	7	1.8%
	College / University	100	32.5%
	Graduate	157	51.1%
	Graduate school	28	8.6%
	Total	310	100%

3.2. Research model

The study's major goals are to look at how the TAM variables act as mediators in links between antecedents and adoption. As a result, the initial step in this research will be to look at the causal linkages between the Technology Readiness Index for digital pills. Second, it will look at how the Technology Acceptance Model would be used to mediate interactions.

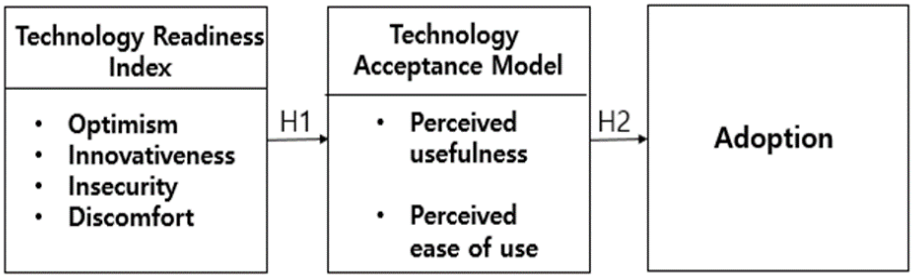

Fig. 1: Research Model

3.3. Research hypothesis

Optimism: Optimists are less inclined to dwell on unpleasant occurrences and, as a result, are more willing to tackle technology. They are less inclined to be escapists more willing to accept their situation. Optimists are eager to experiment with technology. Optimism that creates more positive attitudes, will aid in the development of more positive attitudes towards technology (Desrumaux et al., 2015). Because one is less concerned about possible bad repercussions, an optimist regards technology as being more beneficial and easier to utilize, People with high degrees of optimism and innovation are at ease with technology and require little proof of its effectiveness. The hypotheses are based on these findings.

Hypothesis 1: Optimists impact Perceived Usefulness positively.

Hypothesis 2: Optimists significantly impact Perceived Ease of Use.

Innovativeness: A high level of personal innovation when it comes to technology generally leads to a better perception of a technology's utility in particular. Personal innovativeness is examined as a predictor of technological acceptance in this study (Walczuch et al., 2007). Therefore, the following hypotheses are set.

Hypothesis 3: Innovativeness has a significant impact on Perceived Usefulness.

Hypothesis 4: Innovativeness has a significant impact on Perceived Ease of Use.

Insecurity: As a result of their inherent fear of technology, people avoid using computers. People's distrust of new technologies could be one of the reasons for this. Thus, we believe that people who feel insecure will have a lower perception of a technology's usefulness (Walczuch et al., 2007). The following hypotheses have been established.

Hypothesis 5: Insecurity will have a significant impact on Perceived Usefulness.

Hypothesis 6: Insecurity will impact Perceived Ease of Use positively.

Discomfort: people with discomfort feel like they do not have control over technology. This could be improved by providing more detailed feedback and making the system easier to use (Walczuch et al., 2007). People who experience discomfort

assume technology is more complicated and thus difficult to use. The following hypotheses are based on these findings.

Hypothesis 7: Discomfort impacts Perceived Usefulness positively.

Hypothesis 8: Discomfort impacts Perceived Ease of Use positively.

Perceived Usefulness: TAM remained an important driver of long-term user intention (Jeong et al., 2016). According to related psychology research, the TAM variables are also major factors of intention; perceived usefulness is assessed by a user's level of extrinsic motivation and result in anticipation. As a result, it is proposed that perceived usefulness influences the variables of the relative advantage of digital lifestyle patterns. Previous research in a comparable environment has found a link between perceived usefulness and adoption. Thus, this study model hypothesizes that these two constructs have a positive association.

Hypothesis 9: Perceived Usefulness will affect Adoption in a positive way.

Perceived Ease of Use: Perceived ease of use has been demonstrated to influence adoption through two pathways, direct effect and an indirect effect via perceived usefulness to adoption (Walczuch et al., 2007). According to the direct effect, perceived ease of use can be a mechanism for increasing the adoption of digital pills indefinitely. In this study, the more a user believes a digital pill is ease to use, the more likely he or she believes it will be valuable to them. As a result, this research effort hypothesizes a positive association between TAM variables. Adoption is the primary dependent variable. This study intends to comprehend the motivational factors of consumers' adoption and intention.

Hypothesis 10: Perceived Ease of Use significantly impact Perceived Usefulness.

Hypothesis 11: Perceived Ease of Use will significantly impact Adoption.

4. Results and Discussion

4.1. Analysis method

The structural equation modeling analysis is a powerful analytical method that combines multivariate statistical techniques. The SEM analysis method is an effective approach to testing a model; it is one of the most successful methods for explaining cause and effect relationships of variables in various hypotheses connected to statistical models with a theoretical underpinning (Tacq, 2011). The model was tested using the data collected for the study. Smart PLS 3.0 and IBM SPSS version 20.0 were used in this study. Table 3 shows reliability and internal consistency. Table 4 shows correlation and discriminant validity.

Table 3: Reliability and internal consistency.

Variable		Factor Loading	Composite Reliability	AVE	Cronbach's σ
Optimism	OP1	0.896	0.914	0.779	0.858
	OP2	0.857			
	OP3	0.895			
Innovativeness	INN1	0.842	0.894	0.678	0.842
	INN2	0.806			
	INN3	0.812			
	INN4	0.833			
Insecurity	INS1	0.724	0.845	0.578	0.756
	INS2	0.756			
	INS3	0.777			
	INS4	0.782			
Discomfort	DIS1	0.812	0.846	0.647	0.727
	DIS2	0.817			
	DIS3	0.783			
Perceived usefulness	PU1	0.753	0.871	0.629	0.803
	PU2	0.796			
	PU3	0.785			
	PU4	0. 835			
Perceived ease of use	PEOU1	0.784	0.861	0.608	0.785
	PEOU2	0.791			
	PEOU3	0.742			
	PEOU4	0.801			
Adoption	AD1	0.842	0.897	0.684	0.846
	AD2	0.815			
	AD3	0.805			
	AD4	0.845			

Table 4: Correlation and discriminant validity.

Variable	AVE	1	2	3	4	5	6	7
OP	0.779	0.883						
INN	0.678	0.771	0.823					
INS	0.578	0.495	0.571	0.760				
DIS	0.647	0.434	0.549	0.696	0.804			
PU	0.629	0.579	0.668	0.622	0.699	0.793		
PEOU	0.608	0.311	0.452	0.664	0.675	0.622	0.780	
AD	0.684	0.332	0.523	0.607	0.751	0.707	0.707	0.827

4.2. Test hypothesis and discussion

Because structural equation modeling allows for simultaneous analysis of all interactions while combining multiple regression and factor analysis, it was chosen

for this research. Simultaneous study of both observable and latent variables, as well as model fit statistics, are all possible using this statistical technique. Smart PLS 3.0 was used to verify the structural model. The path coefficients and coefficients of determination (R^2) between the factors in the study model are shown.

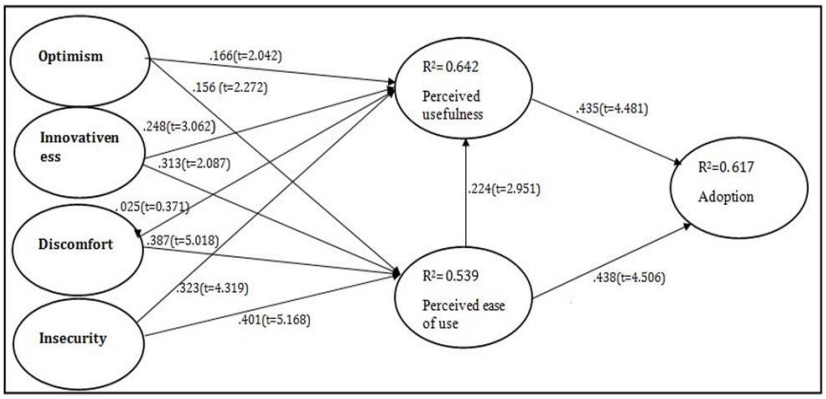

Fig. 2: Result of model.

The results in table 6 determine that the Optimism construct impact Perceived usefulness positively (β=0.166, t=2.042, p=0.042) and also impact Perceived ease of use positively (β=0.156, t=2.272, p=0.024), thereby confirming the hypothesis H1 and H2.The Innovativeness variable has a positive effect on Perceived usefulness (β=0.248, t=3.062, p=0.000) which support hypothesis H3 and positive effect on Perceived ease of use (β=0.131, t=2.087, p=0.037) that supports H4 hypothesis respectively. The Insecurity construct has an insignificant relationship with Perceived usefulness that is hypothesis H5 and the value is (β=0.025, t=0.371, p=0.711) and have a positive estimate with Perceived ease of use which is hypothesis H6 and the value is (β= 0.387, t=5.018, p=0.000). The analysis result shows that the Discomfort variable has a positive impact on Perceived usefulness (β=0.323, t=4.319, p=0.000) and Perceived ease of use (β=0.401, t=5.168, p=0.000). This confirms the positivity of the H7 and H8 hypotheses. Perceived usefulness with value (β=0.435, t=4.481, p=0.000) positively impact adoption H9. Perceived ease of use with value (β= 0.224, t=2.951, p=0.000) positively impact Perceived usefulness H10 and on continuous intention H11 with the value (β= 0.438, t=5.506, p=0.000).

Table 5: Hypothesis testing of model

Paths	Path Coefficient	t-value	p	Hypothesis Results
H1: Optimism → Perceived usefulness	0.166	2.042	.042	Supported
H2: Optimism → Perceived Ease of Use	0.156	2.272	.024	Supported
H3: Innovativeness → Perceived Usefulness	0.248	3.062	***	Supported

H4: Innovativeness → Perceived Ease of Use	0.131	2.087	.037	Supported
H5: Insecurity → Perceived Usefulness	0.025	0.371	.711	Not Supported
H6: Insecurity → Perceived Ease of Use	0.387	5.018	***	Supported
H7: Discomfort → Perceived Usefulness	0.323	4.319	***	Supported
H8: Discomfort → Perceived Ease of Use	0.401	5.168	***	Supported
H9: Perceived Usefulness → Adoption	0.435	4.481	***	Supported
H10: Perceived Ease of Use → Perceived Usefulness	0.224	2.951	***	Supported
H11: Perceived Ease of Use → Adoption	0.438	4.506	***	Supported

****Probability level p< 0.001*

5. Conclusions

This study aims to examine a number of causal relationships ranging from the relative advantages of digital pills to technology readiness index (TRI) patterns to digital pill adoption via TAM. The findings demonstrate the TAM factors' robustness in understanding user acceptance behavior in the setting of digital pills. Moreover, the study shows that there is a strong connection between TAM to user adoption and intention of continuous use of digital pills, suggesting an enlarged TAM with the addition of technology readiness index (TRI) characteristics as antecedents of TAM.

Digital pills are largely regarded as a critical piece of medical technology. This research made a substantial contribution by observing a significant effect on the TRI variables: optimism, inventiveness, discomfort, and insecurity. According to the findings of the study, the constructs of optimism, inventiveness, and discomfort are critical for the widespread adoption of digital pills. The findings show that the optimism and innovativeness variables are important for users' impressions of perceived usefulness and ease of use, which leads to adoption and the desire to use digital pills indefinitely.

This research establishes a favorable correlation between the relative benefits of digital pills and patterns of the technology readiness index (TRI) to determine the type of actor interested in adopting digital pills. Digital pills should be intended to encourage people to employ technology to its full health potential on a regular basis, with the goal of inspiring a healthy lifestyle through use. As a result, digital pill marketers need to focus on the user's competence in order to increase their reliance and satisfaction. Because of the study's limitation of being a cross-sectional study, it is felt that the findings should be carefully evaluated. A qualitative study could reveal more unique aspects and details regarding digital pills in the future.

Further research in other countries is required to provide a more accurate and generalizable perception of digital pills. Before digital pills can fulfill their promise of revolutionizing the lives of end-users, particularly those with physical or mental limitations, several difficulties must be overcome. Despite these obstacles, it is critical not to overlook the enormous advantages that digital pills can provide. SEM analyses support the hypotheses and reveal numerous essential findings.

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