Factors Affecting Smartphone Dependency and Digital Dementia

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Abstract

Smartphone is affecting not only our everyday life but also our business, directly causing diverse side-effects. But up until now, many researches that have been conducted on smartphone were focused on continuance intention for smartphone use and user satisfaction. Thus, the objective of this research is to investigate the effects that smartphone dependency has on digital dementia which is one of negative effects of smartphone. For the purpose, we have reviewed studies that are related to perceived characteristics of existing smartphones. As perceived characteristics variables, we have adopted perceived ease of use and perceived usefulness. And to present our research model, we have adopted smartphone dependency as psychological attitude variable and digital dementia as consequence variable. To implement an empirical analysis of our research model, we have conducted a survey with college student groups as research target who use smartphone most.

Keywords : Smartphone Dependency, Digital Dementia, Perceived Ease of Use, Perceived Usefulness, Smart PLS 2.0.

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1. Introduction

Dissemination of smartphone in South Korea, which began in November 2009 with the introduction of iPhone, proceeded very rapidly. As of the end of November 2014, the number of smartphone subscribers in Korea exceeded 40 million, which includes almost everyone in Korea [Ministry of Science, ICT and Future Planning, 2015]. The smartphone, a mobile phone that is capable of carrying out many of the basic functions of a computer, is a kind of integrated platform. It enables smartphone subscribers to use it with ease, and allows them to select and install any application he or she desires [Kwon et al., 2010]. Characteristically, this special feature of smartphone has changed our life by making it more convenient and rewarding. At the same time, however, it is also true that there is increasing concern as to over-use of smartphone and smartphone dependence.

Actually, according to the result of a Trend Monitor survey conducted in August 2014 by Macromill Embrain, an expert market survey company with 1,000 adults of 19 years of age or older including both male and female, 6 out of 10 smartphone users (59.9%) as target showed a high degree of smartphone dependency by responding that they feel uneasy when a smartphone is not readily available. This phenomenon was more pronounced among female users (64.2%) than male users (55.6%), and among users in their 20's (62.4%) and 30's (62%) than those in their 40's (58%) and 50's (57.2%) [Trend Monitor, 2014].

Also, according to '2013 Survey of Internet Addiction' that has been carried out by National Information Society Agency [NIA, 2014], smartphone use time per person in Korea is 4.1 hours a day on the average. Those users who are at the risk of smartphone addiction are spending 5.4 hours and using their phone 23 times a day, each one lasting for about 14 minutes. In terms of age distribution, the group that is most vulnerable to smartphone addiction risk turned out to be users in their 10's (25.5%), to be followed by those in their 20's (15.0%).

Kim and Kang [2013] explained that the emergence of smartphone is leading the smart society that provides the convenience and enjoyment of life. But, the side effects including smartphone syndrome have come in many different forms compared to the electronic devices in the past. In one example, Kim and Kang [2013] explained that smartphone dependency can cause digital dementia or digital addiction, which can lead to a mental health problem related to memory disorder or over indulgence. Especially, digital dementia is one of the most representative side-effects that are caused by smartphone dependency in recent years. In 2004, this word was already registered at the National Institute of Korean Language as a newly created word.

Under this circumstance, many researches that have been conducted on smartphone were focused on continuance intention for smartphone use and user satisfaction. Most of the researches that have been carried out on negative effects of smartphone were only interested in analyzing types of negative effects [Kim, 2010; Kim and Kang, 2013; Sohn et al., 2011; Lee and Chung, 2011; Jeong and Jang, 2010; Cho, 2012; Chen et al., 2009; Park et al., 2013]. Against this

background, an attempt was made in this research to conduct an empirical analysis of the effects that smartphone dependency has on digital dementia. In order to accomplish this purpose, we have first analyzed existing smartphone related researches and adopted perceived ease of use and perceived usefulness of smartphone as core variables of the research model. Also, in order to constitute the research model, we have adopted smartphone dependency as psychological attitude variable and digital dementia as consequence variable. The remainder of this paper is organized as follows: In section 2, we have examined preceding researches that have been conducted on perceived characteristics of smartphone and psychological attitude. In section 3, we have set up a research model and hypothesis to analyze the inter-relationship among major concepts. In section 4, we have examined the validity on verification of the hypothesis and the analysis result. Lastly, in section 5, we have presented results of the research and its implications.

We expect that the result of this research will contribute to diversity of smartphone related researches and will provide a theoretical foundation for discussion of proper responses to digital dementia.

2. Literature Review

2.1 Perceived Characteristics of Smartphone

A review of researches on perceived characteristics of smartphone makes it clear that most of them have been carried out from the perspective of Technology Acceptance Model (TAM). Davis [1989] has defined the perceived usefulness of information technology that was introduced from a technology acceptance model on an organizational dimension as the "degree to which one believes his or her business performance will be improved through the use of an information technology," and defined the perceived ease of use as the "degree to which one believes that using an information technology does not require much effort." This kind of technology acceptance model is grounded on a theoretical foundation called Theory of Reasoned Action (TRA). What informs this kind of theory is a cause-and - effect structure in which a belief affects one's attitude, an attitude affects one's intention, and an intention affects one's action.

〈Table 1〉 Perceived Characteristics of the Smartphone Presented in Preceding Research

Researcher	Perceived characteristics	Inter-relationship variable
Chen et al. [2009]	Usefulness Ease of use	Attitude Behavioral intention Behavior
Verkasalo et al. [2010]	Usefulness Ease of use	Use intention
Jeong and Jang [2010]	Usefulness Ease of use	Use intention Use behavior
Kim et al. [2010]	Usefulness Ease of use Playfulness	Adoption intension
Lee and Chung [2011]	Usefulness Ease of use Convenience	Reliability Continuous usage intention
Sohn et al. [2011]	Usefulness Ease of use	Adoption timing
Cho [2012]	Usefulness Ease of use	Sense of security Sense of dependence
Park et al. [2013]	Usefulness Ease of use	Continual usage intention Dependency

As can be seen in <Table 1>, most of the smartphone related researches have adopted ease

of use and usefulness as perceived characteristics of smartphone. Besides, in many of the smartphone related researches, perceived ease of use and perceived usefulness are defined as core variables that affect use behavior and use intention of smartphone.

2.2 Dependency as Psychological Attitude to Smartphone

Ball-Rokeach et al. [1985] explained that theoretical foundation of the concept of smartphone dependency is the media system dependency theory. Grant et al. [1991] measured the importance of mass media in an individual's life through the concept of media dependency that comes from the media system dependency theory.

Kim [2004] defined 'smartphone dependency' as a concept that denotes the importance of a smartphone in everyday life of an individual. He distinguished smartphone dependency from smartphone addiction, and used the latter as a concept that denotes an individual's inability to control the amount and frequency of use of a certain media.

Cho [2012] defined 'dependence on smartphone' as a state in which smartphone use is more deeply involved in one's everyday life and the user is more reliant on it in public situation. And as it performs diverse functions and roles unlike a common mobile-phone, the smartphone generates certain psychological attitude. He also set up dependency as psychological attitude to smartphone, and confirmed that there is a positive relationship in-between the two. According to Cho [2012], this kind of relationship represents a reflection of the current phenomenon in which more information related to everyday life is provided by smartphone and this has a direct effect on user behavior. Cho [2012] went on to emphasize that, in the future, dependence of users on smartphone will be increased further.

Kim and Shin [2013] defined smartphone dependency as a concept that indicates the structural position (i.e., whether it is positioned centrally or peripherally in terms of importance) that a smartphone occupies in an individual's life. The authors explained that if a smartphone is considered as an essential instrument in many areas of one's life (personal relationship, decision making, acquisition of information, etc.) even if one does not spend much time in smartphone use, this also indicates high degree of dependency.

Park et al. [2013] stated that perceived usefulness and perceived ease of use, two core variables of the Technology Acceptance Model (TAM), affect not only one's attitude toward a certain technology or use intention but can also affect other psychological results. The authors also stated that, as the smartphone is a personal communication platform, is much more useful than a traditional mobile-phone, and is the most advanced platform, there is a good possibility that smartphone users will become more dependent on it.

2.3 Smartphone Characteristics Model

Cho [2012] presented a smartphone characteristics model in order to investigate the effects that core characteristics perceived in a

smartphone have on psychological attitude and the effects that the psychological attitude has on consequence variables, and found a theoretical foundation for smartphone characteristics model from the job characteristics model of Richard Hackman and Greg Oldham. In the job characteristics model, Hackman and Oldham [1976] explained that there are sequential effect relations among job characteristics, major psychological state, and consequence factors. Cho [2012] applied this kind of logic to smartphone, and as psychological attitude variables for perceived ease of use and usefulness set up sense of relief and dependence in an effort to confirm that there exist effect relations among these factors.

2.4 Digital Dementia

Kim [2007] defined digital dementia as a state in which memory and calculation ability of the person who uses digital devices declined as he or she was too reliant on them. In other words, while brain functions that are necessary for search are developed, essential brain functions decline gradually.

Kim and Kang [2013] explained digital dementia as a state in which memory and ability to calculate decline as a result of unconscious reliance on digital devices to the extent that symptoms of forgetfulness are manifested. The authors also explained that digital dementia is a phenomenon in which the brain pushes out peripheral information due to excessive information to the extent that symptoms of forgetfulness and panic disorder are manifested rather than a brain disease. As dementia is a serious disease that erases memory completely from the brain, Kim and Kang [2014] called digital dementia as digital forgetfulness.

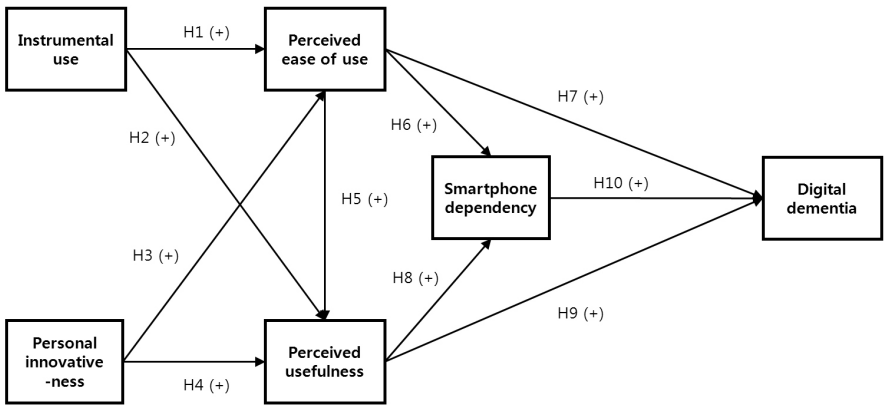
3. Research Design

3.1 Research Model

Based on preceding researches described above, we have formulated a research model. As verified in preceding researches, perceived characteristics of smartphone have employed in many researches perceived ease of use and usefulness. Accordingly, we have basically adopted ease of use and usefulness as perceived characteristic variables in this research.

Also, unlike existing information technology, present smartphone is a personal communication platform, and users are considering very personalized platforms. Furthermore, the smartphone is much more useful than a traditional handphone, and is the most advanced platform, Therefore, we have thought that smartphone users are very likely to rely on smartphone more, and in this research chosen smartphone dependency as a dependent variable of perceived usefulness and ease of use. And in order to complement simpleness and limitations of “universality” of the model, we have chosen instrumental use and personal innovativeness as external variables that can have certain effect on the perceived ease of use and perceived usefulness.

As we have discovered in preceding researches, digital dementia is different from medical definition of dementia. Whereas dementia is ba-



〈Figure 1〉 Research Model

sically an illness that loses intelligence or memory due to a disease of cerebral neuron, digital dementia denotes a phenomenon in which those affected by it lose memory and calculation ability as they habitually relied on digital devices instead of memorizing what they had to memorize. Accordingly, we have set up digital dementia as a dependable variable of smartphone dependency. In order to grasp the direct effects that perceived usefulness and perceived ease of use have on digital dementia, we have set up a research model as shown in <Figure 1>.

3.2 Setting Research Hypothesis

3.2.1 Instrumental Use

Ling and Yttri [1999] defined instrumental use as a case when a mobile-phone is used as a security device in an emergency or is used to coordinate diverse activities in our everyday life. Leung and Wei [2000] have derived motivations for seven kinds of cellular phone use while explaining that, in cellular phone use, instrumental use is the most pronounced. Park et al. [2013] have explained that instrumental use of a smartphone is associated with perceived usefulness and perceived ease of use.

As it is an evolved form of traditional mobile phone, a smartphone can be explained in the same context as the behavior of mobile-phone use. Those who carry out diverse activities in everyday life (i.e., making appointments or Internet-shopping with smartphone) feel that the smartphone provides diverse and useful information anytime, anywhere, cheaply and conveniently.

Utilizing existing research results and logic, this research has established following hypotheses:

H1: Instrumental use will have a positive effect on perceived ease of use.
H2: Instrumental use will have a positive effect on perceived usefulness.

3.2.2 Personal Innovativeness

Many researches allege that personality traits that individuals already possess have great effects on accepting new media. Rogers [1995] explained that such personality traits as individual's preference for a new product, intellectual

preference for something new, and confidence have great effects on adoption of new technologies. Rogers [2003] has defined personal innovativeness as a personal trait that will have a favorable and positive effect overall on adoption of new technologies.

In a study conducted with a smartphone as target, Park et al. [2013] have confirmed that personal innovativeness has certain effects on perceived usefulness and ease of use. At present, smartphone is the most advanced communication technology in the world, and new applications are being developed and introduced continuously. Therefore, personal innovativeness should be considered as a major variable in adopting smartphone. And those who have favorable and positive effects overall on adoption of new technologies can use newly developed technologies with ease and diverse functions more effectively through smartphone applications. In other words, those who think they will have favorable and positive effects on adoption of technologies may think that smartphone is easy to use and very useful in everyday life.

Applying existing research results and logic, this research has established following hypotheses:

H3: Personal innovativeness will have a positive effect on perceived ease of use.
H4: Personal innovativeness will have a positive effect on perceived usefulness.

3.2.3 Perceived Ease of Use

Davis [1989] has defined perceived ease of use for information technology in technology acceptance model(TAM) as the “degree to which one believes using information technology does not require much effort,” and explained that perceived ease of use has indirect effect on technology use through perceived usefulness.

If smartphone use does not require much investment in time and there is no difficulty in using it, people will use it willingly to enhance his or her job performance. Nowadays, many people can find desired information anytime anywhere using smartphone and can handle diverse application functions with ease. This kind of ease of use can transform these people to a habitual user of smartphone, rendering them smartphone dependent without realizing it. And as smartphone is available easily anytime anywhere, basic thinking itself can be assumed by smartphone to such an extent that people become vulnerable to digital dementia.

Applying existing research results and logic, this research has established following hypotheses:

H5: Perceived ease of use will have a positive effect on perceived usefulness.
H6: Perceived ease of use will have a positive effect on smartphone dependency.
H7: Perceived ease of use will have a positive effect on digital dementia.

3.2.4 Perceived Usefulness

Davis [1989] has defined perceived usefulness of information technology as the “degree to which one believes the use of information technology will improve his or her job performance.”

Smartphone provides diverse information immediately through a multitude of functions. For this reason, many people can finish his or her job fast or can improve the results of job performance in their everyday life. This may transform many people more reliant on smartphone, reducing the amount of time to think on their own, which in turn can result in the failure of their memory.

Applying existing research results and logic, this research has established following hypotheses:

H8: Perceived usefulness will have a positive effect on smartphone dependency.

H9: Perceived usefulness will have a positive effect on digital dementia.

3.2.5 Smartphone Dependency and Digital Dementa

Kim and Kang [2013] have regarded digital dementia as a type of smartphone syndrome. According to their explanation, smartphone dependency causes digital dementia which contributes to the failure of one's memory or cause a mental health problem due to over-indulgence.

In a situation where smartphone plays such an important role in our daily life, relying too much of work on it may result in reduction of time to think causing memory loss or a decline in calculation ability.

Applying existing research results and logic, this research has established following hypotheses:

H10: Smartphone dependency will have a positive effect on digital dementia.

3.3 Operational Definition of Research Variables and Measurement Items

Based on preceding researches, this research drew operational definitions and measurement items on constructs. The items have been measured using a 5-point Likert Scale (Refer to <Tables 2> and <Tables 3>).

〈Table 2〉 Operational Definitions

Construct	Operational definition
Digital dementia	Degree to which calculation ability declined temporarily or memory was lost due to too much dependence on smartphone
Smartphone dependency	Degree of importance that smartphone use occupies in an individual's everyday life
Perceived ease of use	Degree to which an individual believes that using a smartphone does not take too much effort
Perceived usefulness	Degree to which an individual believes that smartphone use will improve his or her job performance
Personal innovativeness	Degree to which it is believed that individuals will have a favorable and positive effect on adoption of new technologies
Instrumental use	Degree to which a smartphone is used in everyday life to carry out diverse activities

〈Table 3〉 Measurement Item

Construct	Measurement Item		Source
Digital dementia	DD1	(After I began using a smartphone) I forget other person's telephone number immediately after hearing it.	Kim [2007], Kim and Kang [2013]
	DD2	(After I began using a smartphone) I cannot calculate changes after buying an object.	
	DD3	(After I began using a smartphone) I cannot remember a website ID or password well.	
	DD4	(After I began using a smartphone) I easily forget the name of the person who was introduced a few minutes ago.	
Smartphone dependency	DE1	Smartphone is quite important for maintaining a good interpersonal relationship with others.	Kim [2004], Kim and Shin [2013], Park et al. [2013]
	DE2	I usually use smartphones to obtain information.	
	DE3	The smartphone is very important in my life.	
	DE4	I make decisions on diverse activities through smartphone.	
Perceived ease of use	PE1	I can handle smartphone easily.	Davis [1989], Davis et al. [1989]
	PE2	I can find information easily using a smartphone.	
	PE3	I can handle diverse functions of application for smartphone.	
	PE4	Anyone can use smartphone functions easily.	
	PE5	I can easily access the internet using a smartphone.	
Perceived usefulness	PI1	Internet browsing capabilities of the smartphone is helpful for me.	Davis [1989], Davis et al. [1989]
	PI2	I can finish my job faster when using a smartphone.	
	PI3	Smartphone is very useful in my life	
	PI4	My job performance was enhanced through smartphone use.	
	PI5	Smartphone changed my life for the better.	
Personal innovativeness	IN1	I am interested in new ideas and information.	Rogers [1995, 2003], Park et al. [2003]
	IN2	I am interested in newly developed technologies.	
	IN3	When it comes to accepting new things, I stand second to none.	
Instrumental use	IU1	I find information necessary for everyday life using my smartphone.	Ling and Yttri [1999], Park et al. [2013]
	IU2	I make appointments with others using my smartphone.	
	IU3	I do internet shopping with smartphone.	
	IU4	I manage my schedule through smartphone.	

4. Empirical Analysis

4.1 Collection of Data

This survey was conducted for 2 weeks from May 1 to May 15, 2014 with students who are attending 4-year colleges that are located in Chungbuk province as target. The questionnaires were distributed through 'Google Drive'. 152 copies were recovered and a total of 133 copies were used for final analysis excluding those that contained insincere responses. The reason the survey target was limited to college students is that, when the survey is carried out

〈Table 4〉 Demographic Characteristics

Variables	Levels	Frequency	Percentage (%)
Gender	Male	67	50.3
	Female	66	49.7
Age	15~19	2	1.5
	20~24	86	65
	24~29	41	31
	30~34	4	3
Usage time of Smartphone	Less than 30 minutes,	-	-
	More than 30 minutes Less than 1 hour 30 minutes	16	12
	More than 1 hour 30 minutes Less than 3 hour	35	26.3
	More than 3 hour Less than 5 hour	48	36.1
	More than 5 hour	34	25.6
Sum		133	100%

with older people, it is difficult to distinguish actual dementia and digital dementia, and most of the college students are in their 20's who are familiar with digital device use and are actually using it actively. The fact that digital dementia is most pronounced among youth who use computers often was also taken into consideration [Glossary of Economy Terms, 2015]. Demographic characteristics of the questionnaire that was used for final analysis were as shown in <Table 4>.

4.2 Method of Analysis

For analysis of questionnaire results, Smart PLS 2.0 was used. Bagozzi and Fornell [1982] explained that structural equation modeling techniques such as LISREL and PLS are second generation statistical tools for high quality statistical analysis of multivariate research model. Chin [1998] explained that PLS has a number of other features in comparison to LISREL in the sense that an analysis is possible even with small number of samples and that there is no restriction for regular distributions. Wold [1982] explained that with PLS, a simultaneous evaluation can be carried out for a measurement model and a theoretical structural model. Fornell and Bookstein [1982] stated that PLS has adopted a scheme that can minimize errors of an endogenous variable and model construction is possible for formative indicators. Teo et al. [2003] explained that PLS can analyze a formative indicator model by grasping the relationship between measurement items and constructs. The authors added that this is an appropriate method which is suitable for development of a theory that is not fully validated at its initial stage.

In view of the character of this research which is exploratory research rather than vali-

dation of a theory, PLS is deemed adequate for an analysis of research.

4.3 Reliability and Validity Analysis

For PLS analysis, convergent validity, internal consistency, and discriminant validity should be carried out for constructs and measurement items used [Kwon and Yoon, 2010]. In this research, to determine convergent validity first, factor loading of the measurement item that is loaded on a construct and its t-value were used through Bootstrap method. For factor loading of a measurement item, 0.7 or above that was proposed by Fornell and Lacker [1981] was used as criterion. Excluding 6 items the factor loading of which is below 0.7, a total of 19 measurement items were analyzed. The result turned out to be significant as t-value of each factor loading turned out to be 2.576 or above within 1% of significance level. As for internal consistency of a measurement item, it was validated by composite reliability, AVE(average variance extracted), and Cronbach's α coefficient. Composite reliability turned out to be above 0.7 as demanded by Nunnally et al. [1975] and Straub et al. [2004]. AVE turned out to be above 0.5 as demanded by Fornell and Larcker [1981] and by Chin [1998]. As for Cronbach's α coefficient, it turned out to be somewhat lower as smartphone dependency was 0.690, but overall figure turned out to be above 0.7 proposed by Gefen et al. [2000], confirming the inner consistency requirement (Refer to <Table 5>).

〈Table 5〉 Analysis Results of Convergent Validity and Reliability

Construct	The number of removed item	Measurement Item	Factor loading	t-value	Composite reliability	AVE	Cronbach's α
Digital dementia	1	DD1	0.805	20.496	0.859	0.671	0.767
		DD2	0.773	16.755			
		DD3	0.875	36.158			
Smartphone dependency	2	DE3	0.918	62.370	0.862	0.758	0.690
		DE4	0.821	20.982			
Perceived ease of use	1	PE1	0.715	8.969	0.851	0.589	0.765
		PE2	0.777	20.258			
		PE3	0.856	29.808			
		PE4	0.713	13.742			
Perceived usefulness	1	PI2	0.762	18.377	0.852	0.590	0.771
		PI3	0.791	31.376			
		PI4	0.755	17.623			
		PI5	0.764	16.976			
Personal innovativeness	-	IN1	0.730	8.753	0.840	0.636	0.729
		IN2	0.840	23.360			
		IN3	0.819	20.400			
Instrumental use	1	IU1	0.777	15.308	0.864	0.679	0.763
		IU2	0.875	30.620			
		IU4	0.818	16.751			

PLS analysis also requires a confirmatory factor analysis [Gefen and Straub, 2005]. Accordingly, in this research a confirmatory factor analysis was also carried out. And the result showed that the factors were appropriately loaded as factor loading for each of the constructs turned out to be bigger than that of the other constructs (Refer to <Table 6>).

Discriminant validity is confirmed if the smallest square root value of AVE turned out to be bigger than the highest correlation value among constructs [Astin, 1993]. In this case, the discriminant validity was confirmed as the smallest square root value of AVE was 0.767 which is bigger than 0.521, the highest correlation value (Refer to <Table 7>).

〈Table 6〉 Results of Confirmatory Factor Analysis

Construct	Measurment Item	Factor loading					
		Digital dementia	Smartphone dependency	Perceived ease of use	Perceived usefulness	Personal innovativeness	Instrumental use
Digital dementia	DD1	**0.805**	0.084	-0.207	0.058	-0.179	-0.146
	DD2	**0.773**	0.170	-0.164	0.056	-0.216	-0.168
	DD3	**0.875**	0.189	-0.333	0.101	-0.048	-0.028
Smartphone dependency	DE3	0.159	**0.918**	0.358	0.530	0.196	0.341
	DE4	0.175	**0.821**	0.220	0.352	0.054	0.385
Ease of use	PE1	-0.288	0.188	**0.715**	0.219	0.256	0.391
	PE2	-0.209	0.165	**0.777**	0.378	0.223	0.380
	PE3	-0.256	0.331	**0.856**	0.297	0.329	0.370
	PE4	-0.185	0.361	**0.713**	0.319	0.345	0.171
Usefulness	PI2	0.064	0.294	0.350	**0.762**	0.327	0.363
	PI3	0.097	0.502	0.365	**0.791**	0.261	0.446
	PI4	0.132	0.339	0.218	**0.755**	0.282	0.212
	PI5	-0.001	0.429	0.258	**0.764**	0.383	0.248
Personal innovativeness	IN1	-0.012	0.014	0.230	0.182	**0.730**	0.128
	IN2	-0.128	0.155	0.317	0.273	**0.840**	0.193
	IN3	-0.183	0.164	0.333	0.442	**0.819**	0.263
Instrumental use	IU1	-0.019	0.243	0.341	0.406	0.309	**0.777**
	IU2	-0.100	0.401	0.364	0.369	0.161	**0.875**
	IU4	-0.189	0.373	0.352	0.260	0.159	**0.818**

〈Table 7〉 Analysis Results of Discriminant Validity

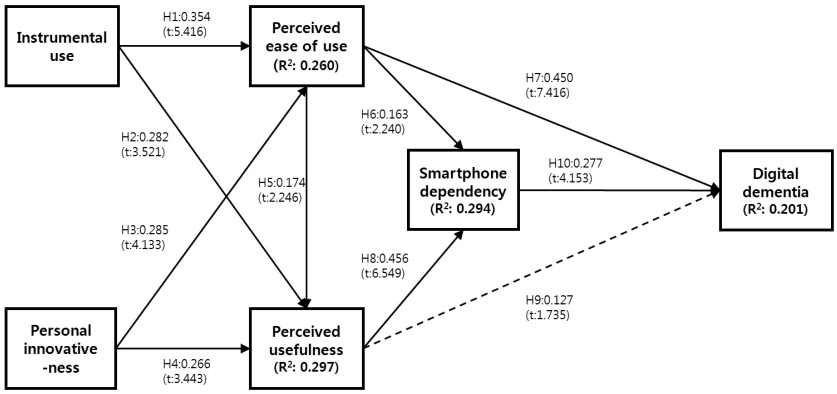
Construct	Personal innovativeness	Instrumental use	Digital dementia	Perceived ease of use	Smartphone dependency	Perceived usefulness
Personal innovativeness	**0.798**					
Instrumental use	0.259	**0.824**				
Digital dementia	-0.155	-0.118	**0.819**			
Perceived ease of use	0.377	0.428	-0.305	**0.767**		
Smartphone dependency	0.157	0.409	0.188	0.344	**0.871**	
Perceived usefulness	0.405	0.426	0.093	0.395	0.521	**0.768**
AVE	0.636	0.679	0.671	0.589	0.758	0.509

4.4 Validation of Structural Model

Goodness-of-fit(GoF) analysis for structural model is assessed by R^2, redundancy, and overall GoF. According to Gefen [2000], GoF is confirmed when redundancy value, which is an indicator that represents the statistical estimate of the structural model, is a positive number. As a result of analysis, redundancy values of digital dementia, ease of use, usefulness, and dependency turned out to be 0.023, 0.173, 0.168, and 0.057 respectively, positive numbers that confirms the required GoF. According to Cohen [1988], GoF can be assessed by R^2 value of the endogenous variable. GoF is classified as 'good' when R^2 value is 0.26 or above, 'fair' when R^2 value is 0.13 or above, and 'poor' when R^2 value is between 0.02 and 0.13. As a result of analysis, R^2 values of smartphone dependency, ease of use, and usefulness turned out to be 0.294, 0.260, and 0.297 respectively, confirming the 'good' GoF, whereas R^2 value of digital dementia turned out to be 0.201, confirming its 'fair' GoF. According to Tenenhaus et al. [2005], overall GoF is assessed by square root of the product of average value of R^2 and average value of communality. GoF is classified as 'good' if the resulting value is 0.36 or above, as 'fair' if the resulting value is between 0.25 and 0.36, and as 'poor' if the resulting value is between 0.1 and 0.25. As a result of analysis, R^2 value of the endogenous variable was 0.263, AVE average value was 0.654, the product of the above two values was 0.172, and square root was 0.415,

〈Table 8〉 Analysis Results of Goodness-of-Fit

Construct	R-Square	AVE	Redundancy	GoF
Digital dementia	0.201	0.671	0.039	0.415
Smartphone dependency	0.294	0.758	0.063	
Perceived ease of use	0.260	0.589	0.078	
Perceived usefulness	0.297	0.590	0.086	
Personal innovativeness	0	0.636	0	
Instrumental use	0	0.679	0	



〈Figure 2〉 Result of Hypothesis Testing on the Full Sample

〈Table 9〉 Result of Hypothesis Testing on the Full Sample

Hypothesis	Path	Path coefficients	t-value	Results
H1	Instrumental use → Perceived ease of use	0.354	5.416*	Supported
H2	Instrumental use → Perceived usefulness	0.282	3.521***	Supported
H3	Personal innovativeness → Perceived ease of use	0.285	4.133***	Supported
H4	Personal innovativeness → Perceived usefulness	0.266	3.443***	Supported
H5	Perceived ease of use → Perceived usefulness	0.174	2.246*	Supported
H6	Perceived ease of use → Smartphone dependency	0.163	2.240*	Supported
H7	Perceived ease of use → Digital dementia	0.450	7.416***	Supported
H8	Perceived usefulness → Smartphone dependency	0.456	6.549***	Supported
H9	Perceived usefulness → Digital dementia	0.127	1.735	Not supported
H10	Smartphone dependency → Digital dementia	0.277	4.153***	Supported

Note: ***p < 0.001, **p < 0.01, *p < 0.05.

which exceeded standard value 0.36 for 'fair'. In short, the overall GoF turned out to be high (Refer to <Table 8>).

4.5 Verification of Hypothesis

Path analysis of a structural model can verify statistical significance through t-value that is provided by the Bootstrapping method of Smart PLS. As can be seen in <Figure 2> and <Table 9>, t-value of 9 hypotheses excluding Hypothesis 9 turned out to be bigger than 1.96, which is sufficient for adoption within 5% of significance level.

5. Conclusion and Implications

5.1 Significance of Analysis Result

In this research, smartphone dependency was chosen as a variable for psychological attitude on perceived characteristics of smartphone, and the effect that smartphone dependency has on digital dementia was examined. As a result of analysis, both instrumental use ($\beta = 0.354$, $p < 0.001$) and personal innovativeness ($\beta = 0.285$, $p < 0.001$), two external variables that affect perceived ease of use, turned out to be significant. With regard to perceived usefulness as well, instrumental use ($\beta = 0.282$, $p < 0.001$) and personal innovativeness ($\beta = 0.266$, $p < 0.01$) turned out to have significant effect. Especially, instrumental use turned out to have more effect on perceived characteristics of smartphone than personal innovativeness. The more smartphone is used in everyday life such as making appointments or Internet shopping, and the bigger is the degree to which users feel favorable to innovative technologies such as smartphone, smartphone was accepted and interpreted as useful and easy to use that much. Also, although the smartphone is at present the most advanced and integrated technology platform, users no longer feel innovative about smartphone as when they were exposed to it first as it is already several years since the smartphone first appeared, or so it seems. For this kind of reason also, it is possible to know personal in-

novativeness has less effect than instrumental use on perceived characteristics.

At the same time, as factors that affect smartphone dependency, both perceived ease of use ($\beta = 0.163$, $p < 0.05$) and perceived usefulness ($\beta = 0.456$, $p < 0.001$) turned out to be significant. Especially, perceived usefulness was confirmed to have more effect than perceived ease of use in comparison. This kind of effects can be regarded as a recognition that diverse and useful information can be obtained and utilized easily anytime and anywhere through smartphone and also as a result that this fact was reflected on the behavior of smartphone users. From this, it is also clear that smartphone dependency is caused not so much by ease of smartphone use as by the diverse information provided by the smartphone on our everyday life in general.

And perceived ease of use turned out to have direct effect on digital dementia. In contrast, perceived usefulness turned out to have indirect effect on digital dementia using smartphone dependency as a parameter. This means that, obtaining useful information through smartphone does not bring about loss of memory in itself but ready availability of smartphone that provides such diverse information regardless of time and place reduces time to memorize or calculate to such an extent that it affects digital dementia cumulatively.

Like many preceding researches, perceived ease of use also turned out to affect perceived usefulness. And lastly, it was confirmed that smartphone dependency itself affects digital dementia directly.

5.2 Implications of the Research

This research is an empirical research on digital dementia, which is one of the negative effects of smartphone that attract popular attention recently, that has been carried out based on perceived characteristics of smartphone and smartphone dependency which represents psychological attitude of smartphone. As a result, smartphone dependency was confirmed to have certain effects on digital dementia. This means that, as things to memorize increases along with development of society, what cannot be stored in our brain tends to be stored through digital devices, which increases our dependence on search rather than memory to such an extent that this practice becomes customary, an adverse effect that nobody has anticipated. According to '2014 Consciousness Survey of the Nation's College Students', which has been conducted by the Planning and Evaluation Team of Korea's Campus Newspapers in October 2014, smartphone dependency of Korean students turned out to be quite high as the students' smartphone use time turned out to be 3~4 hours per day on the average, In the survey, those who answered that they use their smartphone 7 hours a day or longer constituted a 7.1% of the total respondents [Korea's Campus Newspapers, 2014].

As described above, quite a few Korea's college students are depending on smartphone in their everyday life. And this suggests that avoiding negative effects of smartphone such as digital dementia is no longer possible. On the contrary, this realization should serve us as a re-

minder that we no longer can indulge in convenience of smartphone and overlook its negative effects. Already in the world, there is a growing concern on digital addiction and dependence as evidenced by European Digital Detox movement. Digital Detox denotes a movement that urges modern men to stop using electronic devices and recover their original state both in body and mind through meditation and reading [Naver Knowledge Encyclopedia, 2015]. However, not using digital devices altogether cannot be an effective alternative since we will find ourselves in the danger of falling behind. At the same time, we should be careful not to follow the example of Shut Down policy which is the restriction about providing game services for adolescent under age 16 at midnight and is activated law in South Korea. Because Shut Down policy is a belated attempt of the game industry to resolve the problem of game addiction. Therefore we should come up with a more effective solution through discussion. And the discussion should be focused on diverse side-effects of smartphone dependency, not just on the problem of digital dementia.

Academic implications of this research can be summarized as follows. First, whereas existing researches have been primarily concerned on perceived characteristic factors and use intention based on the technology acceptance model, this research has introduced psychological attitude variable as other consequence variable for the perceived characteristics in an attempt to analyze an in-depth analysis of user behavior. Second, we have set digital dementia as a dependent variable for negative effects of smartphone, overcoming the limitation of existing researches that were focused mostly on user satisfaction and continuance intention for smartphone use. Our effort, we believe, has contributed to the diversity of on-gong researches as well.

5.3 Future Research Directions

In what follows, we would like to present our ideas on the direction of future research based on the findings of this research. First, there is a need to expand survey target and the number of samples taking spatial and age characteristics into consideration. These days, people use smartphone anytime and anywhere regardless of their sex or age. By taking these characteristics into consideration, we expect more meaningful research results will be derived. Second, research models that take characteristics of smartphone sufficiently should be developed. Like other smartphone related researches, perceived characteristics of the technology acceptance model was applied to the research model in this study. However, as it is very much a personalized technology platform unlike ordinary mobile-phone or other information technology, a smartphone can present quite distinct psychological attitude to the users. Hence, a research model that fully reflects distinct characteristics of smartphone needs to be developed. Third, a more broad literature review is needed in selecting external variables for perceived characteristics of smartphone.

If these points can be complemented, we can expect more significance in the results of future research.

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