Investigating Temporal Effects of Value and Risk Perceptions, and Product Satisfaction on Behavioral Intentions - Longitudinal Study

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Abstract

This study investigates changes in the relationship between product satisfaction and behavioral intention based on perceived value and risk over time in the context of smartphones, which is a typical product in the issue of smart devices these days.

As the smartphone market is a typical product market that changes rapidly, changes in user needs appear largely over time, according to improving product performance and the turning of competitive environments. Therefore, a study of the contemporary time as a parameter in the smartphone market is assessed as offering very important implications.

A study of Ha & Son [7] has confirmed change over time in the relationship between product usage satisfaction and loyalty intentions based on performance and financial risk. However, it has used a portion of risk factors and provider's overall satisfaction, switching cost and stipulated time to moderate variables, so it is necessary to extend the study on relationships between generally perceived risk and value. Thus, this study focuses change overtime in the relationship, perceived value, perceived risk and time for satisfaction and behavioral intention, based on a traditional consumption-system approach by Mittal, Kumar and Tsiros [27].

The purpose of this study is to research changes of value and risk overtime that are inherent in the psychology of customers in mobile service, product and related industries as well as the smartphone market. Findings show that perceived value and risk have an influence on product satisfaction positively and negatively at time points T and T+1, and that product satisfaction has an effect on behavioral intention [10]. However, while perceived value affects behavioral intention directly, perceived risk does not. Carryover effects appear significantly for all variables, perceived value, perceived risk, product satisfaction and behavioral intention.

In this study, through finding the changes in customer's satisfaction and intention and the effect between earlier time and continuous time, it provides theoretical implications through the extending of previous research and managerial implications to change the perception of customers due to the time variable.

Keywords: Smartphone, Longitudinal study, Perceived value, Perceived risk, Product satisfaction, Behavioral intention

1. Introduction

One of the most quickly developing smart devices is the smartphone amid recent rapid development of information and communications technology [17]. While,

most studies are related to applications, user interface and mobile shopping in regards with smartphones, more studies have been carried out recently in the education and medicine fields such as addiction due to excessive use of smartphones. Those studies are concerned with the characteristics of consumers at a specific point in time, and it is difficult to identify consumers' characteristics' change over time in the smart devices market, where changes occur rapidly as shown in the smartphone market. Therefore, research through termination study is essential to understand consumer's behavioral mechanism over time [10].

Product performance improvement is carried out fast, due to fierce competition among smartphone manufacturers in the smartphone market. More importantly, high performance and high- priced products constitute mainstream in the Korean market, and the value and risk perceived by consumers rapidly increase [10]. The changes in a consumer's perceived value and risk appear over time, which means changes in product satisfaction and future intention can occur. Also, there is a possibility that carryover effects, in which past time point affects future time point, may appear in the perceived value, perceived risk, product satisfaction and behavioral intention over time.

This study empirically examines how the relationship between product satisfaction and behavioral intention over time changes, based on perceived value and risk using the consumption-system approach [10, 27]. Because the consumption-system of satisfaction-behavioral intention changes according to properties assessment of a specific product and service over time, there can be a difference in the relationship between product satisfaction and behavioral intention according to customer-perceived value and risk in using a smartphone. Consumer perception has difficulty directly affecting behavioral intention [9], and thus, this study pays attention to checking all these, and examining smartphone users' change by consumption-system approach. This study takes notice of how perceived value and risk assessment on smartphone use changes over time, whether differences occur according to time point, and if so, what countermeasures can be against such differences. From the position of smartphone manufacturers or marketing managers, what strategy needs to be established concerning user value assessment can be an important matter to consider preventing existing customer secession, and appealing to new customers.

This study checks the role of product satisfaction and behavioral intention of perceived value and perceived risk, and investigates changes overtime. This study presents theoretically and managerially important implications by verifying differences in each relationship over time, as well as differences according to time points regarding perceived value and risk, product satisfaction and behavioral intention.

2. Theoretical Background

2.1. Relationship between Perceived Value/Perceived Risk Assessment and Product Satisfaction

According to a study by Bagozzi [24], the general self-regulatory mechanism contains such framework as process assessment → emotional response → coping response. This actually means value and risk on a product or service is assessed, emotional responses like satisfaction/dissatisfaction with the product or service is revealed, and a decision is made on how to cope with the response [10]. Likewise, the perceived value and risk may work as preceding requisites suitable for product satisfaction in the assessment of a product or service [21, 22].

The relationship between value and satisfaction has been studied by many researchers [3, 14, 20, 23], and a result that value significantly affects satisfaction

has been presented [14]. Although studies on the relationship between perceived risk and satisfaction have been quite limited, studies on the relationship between risk and satisfaction or between risk and intention have been actively performed recently [6, 9, 18]. The reason is that benefits and losses occur in purchasing and using a specific product, which works for subjective assessment on product use, and the assessment is revealed in the form of satisfaction and dissatisfaction [4].

A smartphone is a representative product wherein consumers buy services simultaneously with the product when consumers buy the product in the Korean market [10]. Most products released in the market are high priced products, and maintenance cost occurs. Therefore, consumers should use them for a certain period of time, due to a certain rate system and agreed use period with a mobile carrier. Because of this, replacement with another product is not easy until the agreed use period expires. When a user wants to replace the product, penalty on the agreed use period needs to be paid, or the user has to wait until the agreed use period ends. This means not only perceived value, but also many risks affecting consumer's smartphone purchase.

This study measures an assessment on smartphones, assesses emotional response as product satisfaction/dissatisfaction using the perceived value and risk of smartphones as leading variables, and identifies the relationship between perceived value/risk and product satisfaction [10].

2.2. Relationship between Product Satisfaction and Behavioral Intention

Emotional response like satisfaction and dissatisfaction with products is revealed by using products, and such a response forms future behavioral intention [24]. Behavioral intention means a consumer has an intention to repurchase products continuously from a company's standpoint. If a consumer is satisfied with a specific product, there is a possibility to indicate an intention to repurchase the specific product continuously [8]. Although this is a different concept from satisfaction considering the cognitive aspect, the relationship has various dynamics. For this reason, behavioral intention is studied as an important part from a long-term perspective [1, 25], and satisfaction is indicated as having a positive influence on future behavioral intention in many studies [10-12, 14, 15].

In a study by Mittal, Kumar and Tsiros [27], significant influences were revealed at time points T1 and T2 in the relationship between product and service satisfaction and behavioral intention, respectively, in the case of full model and dual-mediation model. However, a significant influence was revealed only at T1 in the direct model. This implies that a significant relationship in the smartphone product, the subject in this study, can occur at both T and T+1. The study result of Ha & Son [7] backs this up.

2.3. Relationship Change between Product Satisfaction and Behavioral Intention

The smartphone market has been a rapidly changing representative product market from its inception up until now. A study using time as medium offers very important implications, because product performance improvement, competition environment change and user needs change all hugely occur together.

The consumption-system [27] divided main properties considered upon purchase of a car into the car's own product and service properties revealed in the car purchasing process targeting car buyers. Through properties' level assessment, their study confirmed satisfaction at T significantly affects behavioral intention at T+1 through the dual-mediation model, using termination study on the relationship between product and service satisfaction and future behavioral intention of manufacturers and service providers. The consumption system of smartphones forms future behavioral intention in the consuming and assessing process of products

(smartphone and manufacturer) and additional service (mobile communications service) in a complex manner over time as shown in the study of Mittal, Kumar and Tsiros [27].

Ha & Son [7] studied use satisfaction with smartphone products and loyalty intentions over time using external factors like switching costs, overall satisfaction of providers, and remaining contract time, based on performance risk and monetary risk. As a result, their study confirmed that there was change in the relationship between the two types of risks and use satisfaction over time, and that carryover effects were revealed in use satisfaction and loyalty intentions. Such a result demonstrates that remarkable changes occur in the user's assessment on product properties, perceived risk, satisfaction and future intention over time in view of rapidly changing smartphone products and market. As for a product having a continuous use pattern like smartphone, assessment on the product is continuously accumulated, and the possibility of long-term consumption change is continuously revealed [8]. This means that termination study was emphasized in a study on satisfaction-loyalty intensions by Keiningham, Cooil, Aksoy, Andreassen and Weiner [26]. This study researches user's cognitive status, satisfaction and behavioral intention through termination study on smartphones. Very significant implications are expected from the confirming aspect of carryover effect's dynamics over time in many existing termination studies.

This study extends the study by Son, Kang & Ha [9], which extended consumer system approach through perceived assessment → emotional response → coping framework to a termination study type. Thus, this study examines changes of perceived value and risk, product satisfaction and behavioral intention over time.

2.4. Carryover Effects

As presented above, this study mainly verifies how the perceived value and perceived risk, product satisfaction and behavioral intention at T change at T+1, and whether carryover effects are revealed over time in each variable.

The study by Ha & Son [7] focused on risk change over time, and tested carryover effects using performance risk and financial risk, which are perceived risk factors. As a result of the test, the carryover effects of performance risk and financial risk were confirmed at significance levels of 0.01 and 0.05, respectively. The performance risk showed a higher carryover effect than the financial risk. The study used two sub-factors among the sub-factors of perceived risk used in this study. The perceived risk, which is an upper level concept, is judged to appear as well. From the context like perceived risk, the degree of perception on perceived value is conjectured to change over time. According to Oliver [22] and Johnson, Herrmann and Huber [19], attitude and satisfaction affect repurchasing intention, and both satisfaction and repurchasing intention show carryover effects [8]. This supports study results of the termination study of Ha [5] asserting that positive behavioral attitude appears according to satisfaction assessment, and the degree of change occurs strongly over time.

The study of Ha & Son [7] showed the carryover effects of satisfaction and loyalty intentions over time, and the two variables were confirmed to have positive and significant influences. Meanwhile, in the study by Mittal, Kumar and Tsiros [27] using the study's key theory, consumption system approach, the relationship between satisfaction and intention weakened over time, which is conflicting with the preceding studies' result asserting dynamics over time. Such a result clearly shows a certain change is revealed at a continuous time in point, although the direction of the relationship between satisfaction and intention may not be clearly defined due to dynamics, according to the time variable [8].

Having said that, this study judges that the perceived value and risk, and product satisfaction and behavioral intention at T will have significant effects on the perceived value and risk, and product satisfaction and behavioral intention at T+1. In consideration of rapidly evolving smartphone product characteristics, the effects of the value and risk felt by smartphone users on behavioral intention through satisfaction are conjectured to be stronger over time.

This study sets hypotheses on what effects of the relationship of perceived value and risk, and product satisfaction and behavioral intention are demonstrated at two points in time, and tests the hypotheses. This study also sets hypotheses on the carryover effects of perceived value, risk and product satisfaction and behavioral intention at T on those at T+1 with a medium of time, and tests the hypotheses.
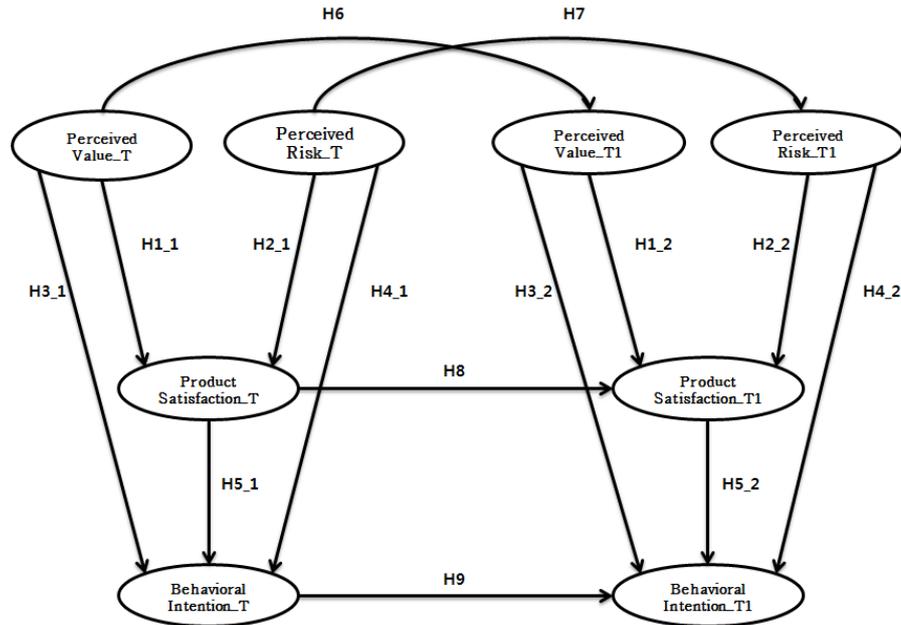

Figure 1. Research Model

3. Methodology and Empirical Analysis

3.1. Data Collection and Methodology

The Korean smartphone market was at its early development stage with 14.2% of market share in 2010. However, the market grew fast to 79% in the total Korean mobile market at the end of 2012 [25]. This study carried out questionnaire surveys two times, targeting adults aged 20 or older in order to verify the research model. The questionnaire survey was conducted targeting 529 adults in March 2010. Ultimately, 428 people's responses data was collected at T excluding 47 insincere responses. In April 2012, 22 months later, the second questionnaire survey was conducted targeting the respondents who responded at T. As time went on, the respondents at T+1 decreased quite a lot due to change of contact point and no-reply, therefore, only 288 people responded to the questionnaire survey. Among the 288 respondents who responded at T and T+1, ultimately 243 people's responses were used for this study by excluding 35 people who gave insincere responses, and ten people's responses having abnormal responses through an analysis [10].

The same questions were used at different time points to check the change of respondents, and a re-sampling technique composing samples at the next point in time from the first sample (n=529) was used. In this manner, the ratio of final

respondents was 45.9% (n=243) at T+1, after conducting the questionnaire survey at T (n=529)[10].

As for demographic characteristics of the sample, people in their 20s were the most with 152 people (62.6%), followed by 65 (26.7%) in their 30s, 23 (9.5%) in their 40s and 3 (1.2%) in their 50s. Because people in their 20s-30s approach high tech electronic equipment easier and use the equipment most, they took up 89.3%. Therefore, such composition is judged to be proper distribution to us as sample.

For an empirical analysis in this study, the reliability of measured variables was verified using Cronbach's coefficient α prior to the hypotheses verification of the measurement model. This study extracted primary components through a factor analysis for the dimension reduction of measured variables, and verified the model's validity by performing a confirmatory factor analysis and an exploratory factor analysis. Also, the difference at T and T+1 was verified through mean comparison, and hypotheses test was carried out through structural equation model's path coefficients using AMOS 21. In addition, this study verified the differences between each path through comparison of each coefficient between the model's paths.

3.2. Reliability Analysis

To check the reliability of the variables used in this study, this study verified the reliability of measuring tools using Cronbach's coefficient. Cronbach's coefficient is a method to assess internal consistency of items by excluding the items disturbing reliability from measuring tools, in the case of using several items to measure the same concept. The standard presented by Hair, Black, Babin, Anderson and Tatham [13] regards as reliability existing, if Cronbach's coefficient is higher than 0.6. As shown in Table 1 in this study, reliability was confirmed, since the Cronbach's coefficient of all measuring items was higher than 0.6 at T and T+1.

Table 1. Reliability Analysis

Variables		T		T+1	
		N	Cronbach's α	N	Cronbach's α
Perceived Value	Emotional Value	3	0.895	3	0.914
	Functional Value	2	0.703	2	0.726
	Monetary Value	3	0.732	3	0.790
Perceived Risk	Performance Risk	3	0.734	3	0.742
	Psychological Risk	2	0.630	2	0.711
	Financial Risk	3	0.726	3	0.736
Product Satisfaction		3	0.904	3	0.911
Behavioral Intention		2	0.873	2	0.936

3.3. Principal Component Analysis

This study carried out questionnaire surveys using many questions in order to check the relationship of perceived value and risk, product satisfaction and behavioral intention. More importantly, various sub-items were measured to measure sub-factors of emotional value, functional value, monetary value and performance risk, psychological risk and financial risk concerning perceived value and perceived risk. To use the sub-factors of perceived value and risk as one observed variable, respectively, the principal components of each factor were

extracted through the factor analysis. The principal component analysis method is to extract factors based on total variation, and it uses the total variance. Therefore, the principal component analysis is an effective extraction method, because it can reduce the loss of information, and total variance of variables can be explained as much as possible [2].

As a result of the analysis, factor loading was more than 0.5, and there was validity through which a measuring tool can precisely reflect each factor's properties [13]. The extracted primary principal component explained 73.830% at T and 76.298% at T+1.

3.4. Validity Analysis

As a result of the exploratory factor analysis in the principal component analysis, this study confirmed validity at both T and T+1. For measurement model's validity verification using the primary principal components additionally, this study reviewed concept reliability by calculating average variance extracted (AVE). If concept reliability is over 0.7, it is regarded as there is convergent validity in general [16]. As shown in Table 2, as a result of AVE, the concept reliability of perceived risk at T was 0.514, and all other variables except it showed more than 0.7. Therefore, convergent validity was confirmed.

Concerning perceived risk, concept reliability was slightly low, but the meaning of structural concept can be altered if variables are removed unconditionally. There were factor loading values less than 0.5, given that factor loading was 0.434, 0.650 and 0.419, respectively. However, the values were not too low, and the concept reliability values revealing the significance of factor loading were 3.708 and 3.615, which were more than 1.965 [16]. Therefore, validity was verified in the exploratory factor analysis, which was revealed in the main component analysis. In this regard, it is judged to have no difficulties in using without removal.

Looking at fit index of the measurement model of confirmatory factor analysis, the statistical value of χ^2 (=355.251, df =181) showed significance at P<0.01 level. As shown in Table 2, CFI (Comparative Fit Index) = 0.942, TLI (Turker-Lewis Index) = 0.927, IFI (Incremental Fit Index) = 0.943 and RMSEA (Root Mean Square Error of Approximation) = 0.063, and thus, the measurement model in this study was interpreted to fit general assessment index.

Table 2. Validity of Variables at T and T+1

Latent Var.	Obs. Var.	Est.	Var. S.E.	AVE	CR
Perceived Value_T	FAC1_1	0.917	0.145	0.560	0.768
	FAC1_2	0.846	0.267		
	FAC1_3	0.309	0.881		
Perceived Risk_T	FAC1_5	0.434	0.769	0.269	0.514
	FAC1_6	0.65	0.542		
	FAC1_7	0.419	0.822		
Product Satisfaction_T	satis_13_1	0.872	0.126	0.845	0.942
	satis_12_1	0.87	0.141		
	satis_11_1	0.863	0.147		
Behavioral Intention_T	purch_12_1	0.88	0.201	0.792	0.884
	purch_11_1	0.878	0.203		
Perceived Value_T1	FAC1_9	0.875	0.223	0.570	0.787
	FAC1_10	0.849	0.264		
	FAC1_11	0.44	0.777		
Perceived Risk_T1	FAC1_13	0.563	0.661	0.448	0.701

	FAC1_14	0.824	0.321		
	FAC1_15	0.572	0.648		
Product Satisfaction_T1	satis_21_1	0.846	0.198	0.836	0.938
	satis_22_1	0.895	0.113		
	satis_23_1	0.887	0.14		
Behavioral Intention_T1	purch_21_1	0.918	0.153	0.880	0.936
	purch_22_1	0.953	0.085		

χ^2 =3355.251, df =181, P=0.000, CFI=0.942, TLI=0.927, IFI=0.943, RMSEA=0.063

3.5. Difference Verification

Before hypotheses test was carried out to check the differences among perceived value, perceived risk, product satisfaction and behavioral intention at T and T+1, respectively, this study conducted a t-test. This study was to analyze differences by time difference targeting the same subjects. Using response sample t-test that tests differences targeting the same group, differences on each factor acquired through the principal component analysis were verified.

As a result of t-test on response sample at T and T+1, it was confirmed that no statistically significant differences were found at significance level of 0.05 for all factors. Namely, although average differences of each factor according to time difference were -0.02~0.079, they were not statistically significant levels. Therefore, it was confirmed that time difference did not affect each factor's average change.

Table 3. Differences between T and T+1: Paired t-test

paired T -- T+1	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. error means	95% Confidence Interval of the Difference				
				Lower	Upper			
Emotional Value	0.014	1.147	0.074	-0.131	0.159	0.187	242	0.852
Functional Value	0.002	1.141	0.073	-0.142	0.147	0.031	242	0.975
Monetary Value	0.010	1.218	0.078	-0.144	0.164	0.128	242	0.898
Performance Risk	0.017	1.127	0.072	-0.126	0.159	0.230	242	0.819
Psychological Risk	-0.023	1.233	0.079	-0.179	0.133	-0.294	242	0.769
Financial Risk	-0.020	1.237	0.079	-0.176	0.136	-0.252	242	0.801
Product Satisfaction	0.079	0.799	0.051	-0.022	0.180	1.539	242	0.125
Behavioral Intention	0.034	1.029	0.066	-0.096	0.164	0.508	242	0.612

3.6. Hypothesis Verification

As a result of analyzing the research model's fit index, χ^2 =386.962, df =195, P=0.000, CFI=0.937, TLI=0.925, IFI=0.937 and RMSEA=0.064. Therefore, the model showed overall satisfaction. As a result of hypothesis verification, the hypotheses 4_1 and 4_2 on the relationship between perceived risk and behavioral intention were rejected. Therefore, it was confirmed that perceived risk at T and T+1 did not have a significant influence on behavioral intention, respectively. However, all hypotheses except for hypotheses 4_1 and 4_2 had

significant influences at significance level of 0.05, and they were confirmed to be adopted. As a result of hypotheses 1_1 and 1_2 verification, perceived value positively affected product satisfaction, and they had significant effects at significance level of 0.01 at T and T+1, irrelevant of time difference. As a result of hypotheses 2_1 and hypotheses 2_2 verification, perceived risk negatively affected product satisfaction: negatively affected at T at significance level of 0.05, and negatively affected at T+1 at significance level of 0.01. The results mentioned above are the same as the results of the study targeting smartphone user groups by Son, Kang & Ha [9]. Therefore, it was confirmed that perceived value and risk had statistically significant influences on product satisfaction, irrelevant of time change. As a result of hypotheses 3_1 and 3_2 verification, perceived value positively affected behavioral intention, and had a significant influence at both T and T+1 at significance level of 0.01. However, in the verification results of hypotheses 4_1 and 4_2, they were not statistically significant at both T and T+1, and the hypotheses were rejected. Such a result is slightly conflicting with the study result of Son, Kang & Ha [9] asserting that the perceived value of smartphone user groups did not have an influence on behavioral intention, while the perceived risk affected behavioral intention. However, various study results existed concerning the relationship between perceived value/risk and behavioral intention in the preceding studies mentioned above. Also, the number of sample used for analysis diminished, because the number of sample used at T+1 was reduced. It is judged that different results from existing studies were demonstrated, because there was information loss, while the dimensions were reduced with primary principal components through the principal component analysis. As a result of hypotheses 5_1 and 5_2 verification, product satisfaction positively affected behavioral intention at T and T+1 as shown in many previous studies.

Unlike the hypotheses mentioned above, hypotheses 6~9 are those to check the carryover effects of variables at T on the variables at T+1. As a result of hypothesis 6, the perceived value at T positively affected the perceived value at T+1. Namely, it was confirmed that as recognition on value was higher, while using smartphones, the value recognized after time went on was formed higher. As the verification result of hypothesis 7 was adopted, the perceived risk at T positively affected the perceived risk at T+1. This is the result of confirmed carryover effects of perceived value and risk, according to time, beyond the study of Ha & Son [7] that analyzed carryover effects using only performance risk and financial risk. As a result of hypotheses 8 and 9 verification, product satisfaction and behavioral intention at T significantly affected the product satisfaction and behavioral intention at T+1 at significance levels of 0.01 and 0.05, respectively. This is the result that confirmed carryover effects according to time as shown in the study result through dual-mediation model of Mittal, Kumar and Tsiros [27], and the study result of Ha & Son [7], which are the core theories in this study. Table 4 shows the verification results of the hypotheses in this study through path analysis using the structural equation model, and Figure 2 reveals the path coefficient analysis results of the research model through hypotheses verification mentioned above.

Table 4. Hypothesis Testing in the Path Model

Hypothesis	Relationship			Non-standardized Estimation Value	Standardized estimation value	S.E.	C.R.	P	Results
H1_1	PV_T	→	PS_T	0.449	0.621	0.048	9.300	0.000	Supported
H1_2	PV_T1	→	PS_T1	0.616	0.731	0.052	11.812	0.000	Supported
H2_1	PR_T	→	PS_T	-0.312	-0.208	0.126	-2.483	0.013	Supported
H2_2	PR_T1	→	PS_T1	-0.232	-0.179	0.073	-3.186	0.001	Supported
H3_1	PV_T	→	BI_T	0.329	0.349	0.075	4.413	0.000	Supported
H3_2	PV_T1	→	BI_T1	0.438	0.412	0.108	4.055	0.000	Supported
H4_1	PR_T	→	BI_T	-0.216	-0.11	0.148	-1.466	0.143	Rejected
H4_2	PR_T1	→	BI_T1	-0.098	-0.06	0.096	-1.026	0.305	Rejected
H5_1	PS_T	→	BI_T	0.583	0.447	0.107	5.449	0.000	Supported
H5_2	PS_T1	→	BI_T1	0.431	0.341	0.131	3.296	0.000	Supported
H6	PV_T	→	PV_T1	0.354	0.364	0.069	5.119	0.000	Supported
H7	PR_T	→	PR_T1	0.522	0.398	0.173	3.016	0.003	Supported
H8	PS_T	→	PS_T1	0.237	0.209	0.057	4.122	0.000	Supported
H9	BI_T	→	BI_T1	0.127	0.116	0.059	2.158	0.031	Supported

Note. PV: Perceived Value, PR: Perceived Risk, PS: Product Satisfaction, BI: Behavioral Intention
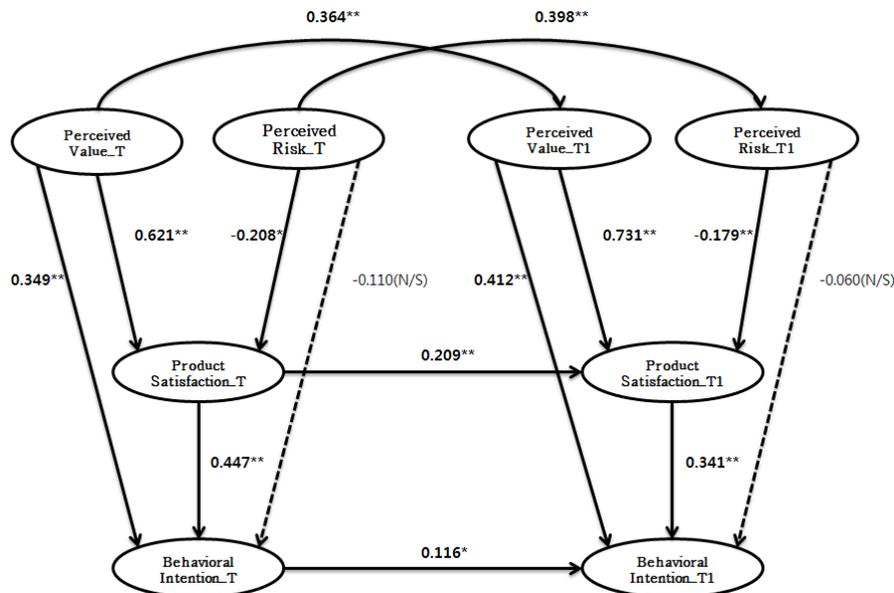
Note: *, p < .05; **, p < .01

Figure 2. SEM Path Coefficients

3.7. Comparison of Coefficients between Paths

This study carried out difference verification through means comparison at T and T+1 prior to hypothesis verification, and it was confirmed that there was no significant difference between the two time points. Now, this study checks whether a significant difference exists between paths through coefficient comparison between hypothesis paths set in this research model.

The analysis method is the same as mulitiple group analysis method, namely, this study verifies by comparing the non-contrainted model without contraints with the

equal constrained model with a constraint saying two paths are equal (Yu, J.P., 2012).

Significant differences can be revealed in the coefficient comparison between paths, when the value of $\Delta\chi^2$ is more than 3 [16]. As a result of coefficient comparison as shown in Table 5, the value was 5.24 only in the relationship between perceived value and product satisfaction, bigger than 3.84. Therefore, there was a difference in coefficients at T and T+1. In this regard, this study confirmed the perceived value at T (0.621) had a bigger positive influence on product satisfaction than at T+1 (0.731). In the coefficient comparison of the relationship paths, where perceived value and perceived risk from T to T+1 had an influence, respectively, the value was 1.003.

Therefore, there was no coefficient difference. This study confirmed that there was no difference in the influence of the perceived value and perceived risk at T on the perceived value and perceived risk at T+1, because the perception of value and risk increases similarly, although users perceive more on value and risk on the smartphones in general, while they use the smartphones, as time goes on.

Table 5. Comparison of Path Coefficients between T and T+1

T	--	T+1	Unconstrained model $\Delta\chi^2$	Constrained model $\Delta\chi^2$	Constrained model-unconstrained model $\Delta\chi^2$
Perceived Value	→	Product Satisfaction	386.962	392.205	5.243
Perceived Risk	→	Product Satisfaction	386.962	387.277	0.315
Perceived Value	→	Behavioral Intention	386.962	387.615	0.653
Perceived Risk	→	Behavioral Intention	386.962	387.374	0.412
Product Satisfaction	→	Behavioral Intention	386.962	387.731	0.769
	df		195	196	$\Delta df = 1$

Table 6. Comparison of Path Coefficients between Perceived Value and Risk

Perceived Value	--	Perceived Risk	Unconstrained model $\Delta\chi^2$	Constrained model $\Delta\chi^2$	Constrained model - unconstrained model $\Delta\chi^2$
T	→	T+1	386.962	387.965	1.003
	df		195	196	$\Delta df = 1$

4. Conclusion

4.1. Summary and Implications

This study empirically verified what influence the value and risk of a smartphone perceived by smartphone users have on product use satisfaction and future behavioral intention, and how they change over time targeting the rapidly changing smartphone product market, based on information technology's fast development from its inception period until now. This study confirmed the carryover effects, which can be the change of perceived value, perceived risk, product satisfaction and behavioral intention over time, based on the consumption-system approach [27].

This study also verified not only differences between points in time using a t-test, but also the difference of path coefficients. The summary of the findings in this study are as follows:

First, perceived value and risk had a significant influence on product satisfaction at both T and T+1, and there was no difference at the two time points. Meanwhile, perceived value at T+1 had more influence on product satisfaction than the perceived value at T+1. This means that perceived value and risk positively and negatively affected production satisfaction respectively, irrelevant of time change. Although there was increase/decrease of mean between time points, there was no statistically significant difference. However, perceived value is judged to have increased its influence on product satisfaction, because perception of value increases as the use period of a smartphone increases.

Second, while perceived value positively affected behavioral intention at both T and T+1, perceived risk did not affect at both T and T+1. Also, there was no difference between path coefficients, as well as means at both points in time. This finding is conflicting with the study result of Son, Kang & Ha [9] targeting smartphone users asserting that perceived value did not have a significant influence, but perceived risk had a negative influence. The reason is conjectured that product specifications or user interface was not established in the early smartphone market, and therefore, perceived risk on inconvenience was higher than perceived value that a smartphone user perceives. However, as smartphone convenience has improved and utilization has increased recently, the perceived value has gone up, and the perceived risk on the feasibleness of use has relatively decreased.

Third, product satisfaction at T and T+1 had a positive influence on behavioral intention, and there was no difference between the two time points. This has actually reconfirmed the significant relationship between satisfaction and intention asserted by Bagozzi [24] through presenting the same study result as that of the full model and dual-mediation model in a study of Mittal, Kumar and Tsiros [27]. This study has confirmed that future behavioral intention is positively affected over time, as product satisfaction felt by smartphone users is bigger, while they use smartphones due to developing technology.

Fourth, as a result of carryover effect verification according to time change, the perceived value and risk, product satisfaction and behavioral intention at T affected all of them at T+1, and therefore, it was confirmed that there was a carryover effect. There was no difference in the degree of influence at T and T+1 with regard to perceived value and perceived risk. This has actually extended the study of Ha & Son [7], and carryover effects exist, according to perceived value and time, as well as a specific risk. With this, this study also has empirically verified that the present point in time affects future point in time. In the relationship between product satisfaction and behavioral intention over time, this study has confirmed the same results as in the previous studies.

The findings as above mean that this study has meticulously analyzed the differences over time, as well as presented a comprehensive model through the extension of previous studies based on the smartphone product market, which is a representative product of the smart devices market that has recently become the hottest issue.

The findings of this study present the following implications from the theoretical and practical aspects:

First, smartphone manufacturers should pay attention to the fact that currently perceived value affects future perceived value, and that influence on satisfaction goes higher over time. A smartphone is a representative product wherein consumers buy services simultaneously with, and it is a product wherein consumer's intervention is high. Consumers research a lot of product information before buying a product, and then choose a product through lots of comparison with the currently

used smartphones. This actually is comparison between the value perceived as a consumer uses existing smartphones, and the value perceived on the smartphone to buy in the future. Namely, the current value on a smartphone positively affects the future value on a smartphone. Consequently, smartphone manufacturers need to examine the functions with which consumers are satisfied and develop such functions in developing a new product, and they should increase functional values of performance and quality among the values of smartphones presented in this study. To this end, it is important to identify the functional values that consumers value through manufacturers' marketing managers' actively investigating consumers. Checking the functional values cherished by consumers, and reflecting them to product production may positively affect product satisfaction, and such an activity can be perceived as another marketing activity to consumers, which will positively affect the manufacturer's image. Manufacturers need to actively publicize that perceived risk including psychological, performance and financial risks can be offset by providing more excellent value than competitors' products to consumers. This can be done through various methods via expanding marketing communication with consumers so that consumers can perceive core values including a product's emotional and monetary value, in addition to functional value. This will positively affect the value and satisfaction perceived by consumers in the future, and will play an important part for forming future purchase intention. All these were empirically verified, and important implications were offered in this study.

Second, marketing managers need to perceive that carryover effects over time, such as the perceived value and risk of smartphones, product satisfaction and behavioral intention, are revealed. Time is an important variable explaining the change of social phenomena. That currently perceived value and risk on smartphones have an influence on the future value and risk, and that current satisfaction and behavioral intention affect future satisfaction and behavioral intention are very important at the current point in time. In the mobile telecommunications market up until now, one-off marketing activities like price discounts to increase the current sales volume have been focused on in conducting various marketing activities. However, as regulations on subsidy support have been consolidated, since the enforcement of the Handset Distribution Structure Improvement Act, such marketing activities were fully suspended. In this regard, this study considers the consolidation of image marketing activities to instill positive perception of their own products into consumer's minds can positively influence a consumer's behavioral intention. Korean mobile communications carriers put ads using such image marketing, since the execution of the Handset Distribution Improvement Act. They actually continue marketing activities to increase psychological value, rather than product value. Likewise, smartphone manufacturers need to expand image marketing emphasizing psychological value and satisfaction gained by using their products beyond general marketing activities like product's performance-focused advertising. This can be an important method to prevent shift into competitors' products through brand competitiveness enhancement at present, when product performance is upward levelling. The emphasis of carryover effects in the findings of this study can work as an important factor to positively bolster future brand competitiveness, and to reduce brand shift.

Third, this study has expanded the theory through consumer system approach on perceived value and risk, based on time flow, and has made a model of consumption system for smartphone market. This has extended the study of Ha & Son [7], and has offered an implication in that this study completed a comprehensive model by combing the consumption-system approach with the smartphone market. This study also has analyzed differences between two time points through verification at T and T+1, and analyzed differences between the relationships between paths at the two

time points. This study has contributed to the consumption system's theoretical development in that deeper research on carryover effects over time was conducted.

4.2. Limitation and Future Direction

The findings in this study offer meaningful implications theoretically and practically, however, the following limitations also exist:

First, the consumption-system approach researched automobile market by dividing it into product and service. In the case of this study's subject, smartphones, it is a representative market wherein product and service are both bought simultaneously. However, a consumption system was applied by limiting it to just products. In further studies, there is a need to expand the smartphone market's consumption system in consideration of service together.

Second, this study has approached the consumption system on the basis of the perceived value and risk of smartphones. This has actually replaced the assessment of properties used in consumption system. Therefore, the modeling of consumption system that is made by each property on the basis of various properties of smartphones is necessary.

Third, the smartphone market is rapidly expanding globally. However, since this study focused on the domestic market only, it is a little difficult to generalize the global smartphone market, although the Korean smartphone market has advanced a lot. It is necessary to propose a generalized consumption system through studies on their own countries' markets by many countries' researchers in the future.

Fourth, the smartphone market is a representative market that is rapidly changing on the basis of global competition, and consumption pattern over time is also rapidly changing. This means that studies according to time change is very important, and it is needed to measure consumption pattern change of smartphone users from many time points rather than just two time points, through continuous measurements in the future.

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