

The Mediating Role of Technology Self-efficacy in Understanding User Attitude Toward NFC-based Payment Service

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Thanks to the spread of smartphones and the rapid technological advances of IoT (internet of things), devices capable of NFC payment services are rapidly increasing. However, the majority of users still prefer traditional credit cards and debit cards rather than contactless NFC payment services. This is a major crisis for service providers. However, academic research on NFC payment service has not been sufficiently conducted yet. In this study, an empirical test was conducted to understand consumer attitude and influencing factors of NFC payment service. The framework of this study was partially borrowed from the SCT (social cognitive theory) model. Particularly, technology self-efficacy of consumers who come into contact with new technology was used as a mediating variable of intention to use and perceived ease of use, transaction security, and service smartness as antecedents affecting self-efficacy. According to the implications of the study, NFC payment service providers should strive to provide more customer-oriented services. In other words, companies should provide smart and convenient services rather than emphasizing the technical merits of NFC payments.

JEL Codes: M30, M11 and M15

1. Introduction

Smartphone and related services have become an integral part of everyday life in Korea. This phenomenon cannot be explained simply by the penetration rate of more than 100% of mobile communication service, but rather by the fact that the smartphone has taken various functions through digital convergence. In addition to using the smartphone for a call, it is used for versatile purposes such as listening to music, watching movies, reading newspapers, and navigating.

A recent smartphone feature is a mobile payment. Thanks to Wi-Fi and new 5G communication services, many users are doing financial transactions on mobile devices rather than personal computers. Mobile payment is illustrated as a transfer of funds in which a mobile device is functionally involved in executing and confirming payment (Shin & Lee 2014).

Mobile payment is an emerging market and there are many related studies. One of the important features of mobile payments is the active use of new technologies. In particular, NFC (near field communication) technology is attracting attention as a key enabler for future mobile payment services.

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NFC is a kind of an m2m (machine to machine) communication protocol that makes contactless payments possible by establishing wireless communication between different devices (Chae & Hedman 2015).

The market potential for NFC applications is huge and optimistic in the market. This prospect is getting stronger, especially as the spread of new smartphones with NFC functions reaches market saturation. For example, to promote NFC payment service in Korea, the GNAK (Grand NFC Alliance Korea) was formed in 2011 and Korean mobile service providers have been introducing up-to-date NFC-based payment services to attract more prospects. However, despite this positive market outlook and continuous efforts of service providers, the technology is still not widely adopted in real life. Currently, only a handful of people are using NFC payments, and most people prefer traditional credit cards and debit card. Thus, the purpose of this study is to promote understanding of NFC-based mobile payments and related consumer attitude.

The rest of this paper is constructed as follows. This paper introduces prior researches about user adoption of new technology and NFC technology. Then, the author presents the research hypotheses and suggests the empirical methodology, followed by analysis results. The paper concludes with managerial implications of the research findings.

2. Literature Review

NFC technology, which is a standard radio transmission protocol, regulates the way to individual devices communicate through an RF (radio frequency) interface. This technology is contactless and can be used as a peer to peer communication method mainly in short range (Gronil et al. 2015).

Over the last few years, NFC technology has grown tremendously, and the number of pilots seeking to incorporate this technology into a variety of futuristic financial services has increased. These attempts are expanding to a global phenomenon. For instance, Apple added NFC capability to its smartphones to support 'Apple Pay' service, which is an NFC-based mobile payment service. ICICI bank in India introduced a mobile payment solution to enable its credit card customers to make payment by just swiping their smartphones. In Korea, one of the most successful examples is the "High Pass" highway toll collection service.

However, despite the proven convenience of NFC-based mobile devices, the technology is not yet being used on a large scale. Nordlund et al. (2012) insisted that the lack of proper handsets in the marketplace is the biggest barrier to spreading usage of contactless payment service. However, almost everyone has a smartphone with NFC capabilities now, and the barrier disappeared. But NFC payment is still not widespread. As a result, it is necessary to study the user's acceptance behavior to explain why NFC payment functions are not easily spread to majority user group in the market.

A number of key frameworks have been proposed in relation to explaining technology acceptance behavior. The most pioneering work is very well known Technology Acceptance Model (TAM) proposed by Davis (1989) and other researchers. Davis (1988) argues that perceived ease of use and perceived usefulness affect intention to use, and many studies have been repeatedly performed in various areas to demonstrate the

usefulness and flexibility of the TAM model.

Since then, additional research models have been developed and used to improve the constraints of TAM. For instance, Innovation Diffusion Theory (IDT), which has core constructs such as relative advantage, ease of use, image, visibility, compatibility, demonstrability, was used to study innovations for various products and services (Moore & Banbasat 1996). Unified Theory of Acceptance and Use of Technology (UTAUT) and the extended UTAUT-2 model were formulated recently to integrate existing frameworks (Venkatesh et al. 2003, Venkatesh et al. 2012).

Among these powerful frameworks, Social Cognitive Theory (SCT) is useful to explain technology utilization. In the SCT, user behavior is motivated and controlled by the on-going exercise of self-influence (Bandura 1991), and self-efficacy is a key construct to explain human behavior. People form beliefs and attitudes about what they are able to do and guide their behavior in a proactive way. Self-efficacy is one's belief in his ability to execute a particular job and task (Bandura 1986). Recently, this concept has been extended to understand the ability to use technologies such as computers. For instance, Compeau and Higgings (1995) developed CSE (computer self-efficacy) concept and proved the relationships between CSE and one's behavioral intention.

Technology self-efficacy relating to the internet, mobile service, and e-learning, focuses on how one believes he can maintain and use the technology now or in the future. It is not only a judgment of one's capability but also a measure of the specific skills of the individual in using the technology. For instance, Holden and Rada (2011) discovered a significant relationship between teachers' proficiency with using technology and the degree to which they use it in their classrooms. Technology self-efficacy can influence one's attitude and behavior toward a product. Our study tries to apply and to modify SCT in the context of NFC payment utilization.

3. Research Framework and Model

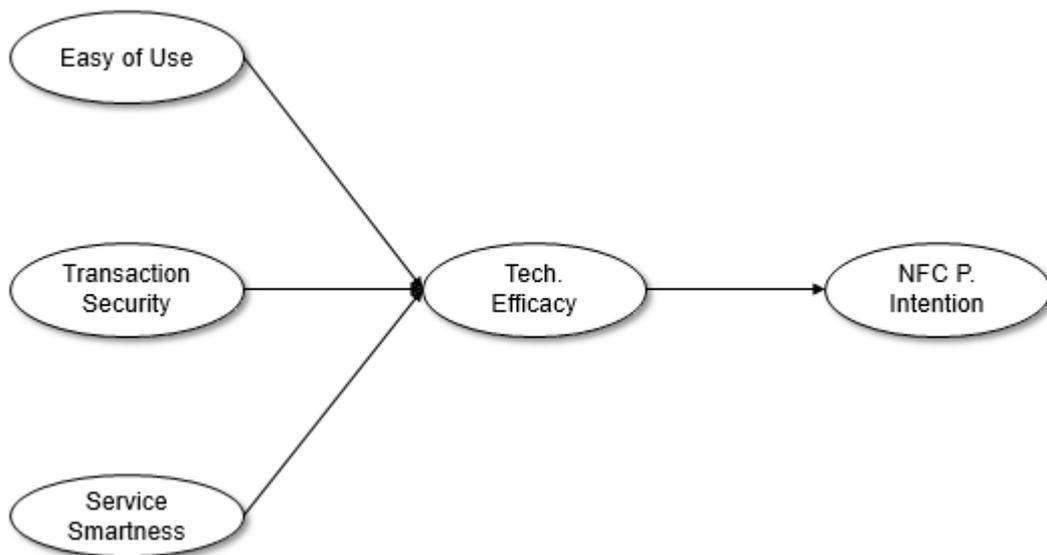
3.1 Research Framework

Previous studies such as TAM and UTAUT model have provided a useful framework for explaining user attitude and acceptance of the technology. However, these studies have mainly focused on general technology, such as the Internet, and did not target specific fields such as financial service. Also, the psychological variables perceived by the users during the technology acceptance process were insufficiently studied.

Therefore, research on technology acceptance in the financial sector has the effect of broadening the horizons of existing research. In addition, understanding psychological variables such as self-efficacy as important parameters are meaningful to evaluate the psychological characteristics of technology acceptance.

The purpose of this study is to examine the effects of major technical and psychological characteristics of NFC-based payment service on user intention mediated by technology self-efficacy. The research framework is shown in Figure 1.

Figure 1: Research Model



3.2 Hypothesis and Model

Davis (1989) argued that ease of use is the degree to which people believe that effort is not required to use a particular technology. There is a consensus among researchers that ease of use is an important part of mobile payment services. Many studies have shown that ease of use is an important factor in determining whether to use mobile payment services (Venkatesh 2000). Thus, if the perceived ease of use of the NFC payment service increases, it can be inferred that the individual will be more confident about his or her abilities to use the technical service.

H1. Perceived ease of use will positively influence technology self-efficacy of NFC payment service.

Because NFC payment services involve banking service and monetary transactions, users are more sensitive to security and privacy. It is difficult for the user to directly identify the transaction process in an online payment system, which gives the user greater uncertainty while causing distrust (Dastan & Gurler 2016). Therefore, if users believe that the NFC payment process is secure, they will have greater confidence in the transaction process.

H2. Perceived transaction security will positively influence technology self-efficacy of NFC payment service.

Rijsdijk and Hultink (2007) expected that smart products that are able to learn will be perceived as more advantageous. For instance, a smart device such as T, V can gain a relative advantage of being capable of giving a viewer with more information after it analyzes a viewer's channel selection behavior. Shin and Lee (2014) also noted the positive impact of intelligent services on the diffusion of technology innovation. According to their empirical studies, service smartness is related to user's positive attitude formation.

H3. Perceived service smartness will positively influence technology self-efficacy of NFC payment service.

The relations between self-efficacy and consumer intention has been proved in many previous researches (Holden & Rada 2011). Especially, self-efficacy is known to have a positive effect on user acceptance of new internet technology or e-learning technology (Lai 2008, Park 2009). According to the previous results, if a user has a high self-efficacy, then he believes he will be successful in using the technology. Especially in e-learning research, the direct relation between self-efficacy and intention has been found empirically (Park 2009).

H4. Technology self-efficacy of NFC payment service will positively influence intention to use NFC payment service.

4. Results

4.1 Measurement

Measurement items were developed in several stages. In the initial stage, all items were borrowed from the previous researches and modified for the research purpose. In the next stage, a list of all items was submitted to a group of marketing academicians to establish initial content validity.

Table 1: Measurement Items

Construct	Items	Source
Ease of Use	<ol style="list-style-type: none"> 1. Learning how to use NFC payment is easy for me 2. My interaction with NFC payment is clear and understandable. 3. I find NFC payment easy to use 4. It is easy for me to become skillful at using NFC payment 	Venkatesh et al. (2012)
Transaction Security	<ol style="list-style-type: none"> 1. NFC payment is only available to authorized users 2. User information during the NFC payment process is kept confidential 3. NFC payment forbids large transfers for security 4. NFC payment is doing its best to enhance security 	Han (2001),
Service Smartness	<ol style="list-style-type: none"> 1. NFC payment is intelligent 2. Using NFC payment services make me look smart 	Pechmann & Ratneshwar (1994) Shin & Lee (2014)
Technology Self-efficacy	<ol style="list-style-type: none"> 1. I am good at using NFC payments 2. It is not difficult for me to use NFC payments 3. I know the right thing to do in using NFC payments 	Sujan et al. (1994)
NFC Payment Intention	<ol style="list-style-type: none"> 1. I intend to continue using MPS in the future 2. I will always try to use MPS in my daily life. 3. I plan to continue to use MPS frequently 	Venkatesh et al. (2012)

4.2 Sample and Data Collection

The target population for this research consisted of the students from metropolitan areas in Korea. The areas are selected as a matter of accessibility to NFC service users. Within this metropolitan area, including Seoul, people have easier access to new technologies compare to their counterparts in rural areas.

The data used in the research were collected through online surveys. The online questionnaire form was available on the relevant web page for about a month and our research team evaluated all completed questionnaires. A total of 75 questionnaires was collected, except for those questionnaires that were incomplete. It was difficult to collect a large sample because the NFC payment service had not yet spread to the market. Although most smartphones already have NFC functionality built in, users who use these features in real life are still very rare.

The demographic characteristics of respondents are briefly summarized as follows. Of all respondents, 60.0% were male and 40.0% were female. Their average age is 22.4 years old. One important characteristic of a sample is that all of the respondents' jobs are college students. In Korea, college students are the most favored groups of technology services and the most powerful group of W.O.M activities at the same time.

4.3 Data Analysis

Prior to testing hypotheses, the measurement models were tested through reliability analysis and factor analysis. Internal consistency of dependent variables was measured by calculating Cronbach's alpha score. The alpha scores were between .085 and .916 and found to be higher than the required standard (Nunnally 1967). In addition, to test the validity of dependent variables, factor analysis was performed using VARIMAX rotation option. As a result, three factors were extracted as expected.

Table 2: Reliability Test and Factor Analysis Result

Items	1	2	3	eigen	Variance %	Mean	alpha
E.O.U2	0.904	0.091	0.096	4.327	43.27%	3.59	.895
E.O.U1	0.894	0.068	0.089	4.327	43.27%	3.59	.895
E.O.U4	0.825	0.144	0.133	4.327	43.27%	3.59	.895
E.O.U3	0.778	0.091	0.322	4.327	43.27%	3.59	.895
Security2	-0.017	0.877	0.010	2.069	20.69%	3.08	.805
Security3	-0.019	0.796	0.172	2.069	20.69%	3.08	.805
Security1	0.248	0.747	0.251	2.069	20.69%	3.08	.805
Security4	0.223	0.686	0.131	2.069	20.69%	3.08	.805
Smartness2	0.161	0.180	0.918	1.177	11.77%	3.49	.916
Smartness1	0.261	0.233	0.902	1.177	11.77%	3.49	.916

4.4 Hypothesis Test

A path model to check the hypotheses of the research was tested by utilizing the maximum likelihood technique. Major fit indices except chi-square were satisfactory in general. The chi-square value is 93.475(d.f=3, p=.000), however, other fit statistics such as GFI(.924), CFI(.829), and RMR(.071) could be more proper than a chi-square statistics especially in a small size of the sample (Bagozzi & Yi 1988).

According to the empirical test results, every hypothesis is accepted. Ease of use, transaction security, and service smartness affects the technology self-efficacy directly. Technology self-efficacy also affects intention to use NFC payments significantly.

Table 3: Hypothesis Testing

	Hypothesis	Estimates (Std.)	S.E	CR	P (*<.05)
H 1	E.O.U → Tech, Efficacy	.426(.433)	.044	9.774	.000*
H 2	Security → Tech, Efficacy	.117(.096)	.052	2.234	.025*
H 3	Smartness → Tech, Efficacy	.212(.208)	.047	4.510	.000*
H 4	Tech. Self-efficacy → NFC P. Intention	.552(.531)	.044	12.645	.000*

5. Summary and Conclusions

In this study, all of the hypotheses were proved to be significant, providing various managerial implications. First, the effect of perceived ease of use on technology self-efficacy was confirmed. Considering that the age group of smartphone users varies from teenagers to older people, service providers need to increase their confidence by ensuring ease of use. Basically, NFC devices work through m2m (machine to machine) communication, which does not require frequent human intervention. Therefore, the problem of perceived ease of use is related to the preparation before use rather than experience in use. As a result, it is necessary to make the installation and authentication processes of the NFC payment application easier to spread the service.

Second, the effect of transaction security on technology self-efficacy was proved. This is due to the nature of the payment service. In other words, a payment service that is vulnerable to security is highly likely to cause personal loss. Thus, an individual user will be more sensitive to the security of the service. Service providers must prepare provisions for vaccine installation, standardized communication protocols, and compensation policy for personal security.

Third, smartness is a representative attribute of services related to smartphone, and it has a significant effect on technical self-efficacy. Intelligent services reduce needs for learning or reading manuals and strengthen confidence in service use. Therefore, service providers should continuously develop better and easier payment methods that minimize human interference or personal information. For example, they need to consider how to enter fingerprints instead of typing SSN or password each time their customers pay.

Fourth, technology self-efficacy has proven to be a predictor of intention to use NFC payment service. This means that it is necessary to switch from a company-oriented approach to a customer-oriented approach. While companies are shipping the latest technology quickly, more and more customers are struggling to keep up with these technological changes. Technological innovation is important, but NFC payment's diffusion is possible only if the user's psychological confidence is acquired. Companies should make efforts to ensure compatibility of technology and to enhance continuity of user experience.

However, this study also has limitations that may introduce further studies. The possibility of generalization of the study results should be increased by enlarging the sample size. At present, it is difficult to increase the sample size because the number of NFC payment service users is small, but future sample enlargement will be necessary. It is also necessary to consider more variables to explain the characteristics of NFC payment service. NFC services are still under development and are in the early stages of the market. As a result, the services will continue to evolve with more features in the future. In line with this, the expansion of the research model will also be inevitable.

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