경영학박사 학위논문

Two Essays on Mobile App Success

:Empirical Analyses of Retention and Monetization in Mobile Games

모바일 앱의 성공 요인에 대한 실증 연구
: 모바일 게임의 사용자 유지와 유료화를 중심으로

2018 년 2 월

서울대학교 대학원
경영학과 경영정보 전공

장문경

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이 논문을 경영학박사 학위논문으로 제출함

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Abstract

Two Essays on Mobile App Success: Empirical Analyses of Retention and Monetization in Mobile Games

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The market growth of mobile applications (app) is remarkable, as they are becoming more important to the global economy. Among the various categories of mobile apps, mobile gaming apps have an enormous number of users and earn high revenue. Many new games are released and then disappear quickly, and mobile game users do not stick with particular games for long. Thus, business practitioners mainly focus on user acquisition, retention, and monetization, because those factors are essential for long-term profitability. Mobile gaming also gains plenty of attention for academic researchers, but there is still limited understanding of the drivers of retention and monetization, and the business implications. Regarding this lack of knowledge, this research aims to make a contribution for academic researchers, as well as

business practitioners, to capture the motivators on user retention and purchasing behaviors in mobile gaming apps by analyzing a large-scale game log dataset. The research is organized into two related and distinct studies.

The first essay empirically investigates key factors influencing user retention in mobile gaming apps based on the uses and gratifications theory. This theory explains why people decide to continuously use a certain app among many alternative apps to satisfy their different needs. This essay focuses on three categorizes of gratifications – (1) hedonic gratification; (2) utilitarian gratification; and (3) social gratification – based on the key tenets of the uses and gratifications theory. The empirical results of duration analysis show that hedonic gratification and social gratification have significant positive impacts on user retention, but the effect of utilitarian gratification is significantly negative on user retention in the mobile gaming app.

The second essay empirically investigates key factors of in-app-purchase (IAP) consumption, one monetization method, using the key tenets of flow theory. The key tenets are: (1) skill; (2) challenge; and (3) the balance of skill and challenge. The essay also investigates the impact of competition as an important source of challenge. The empirical result shows that challenge and the balance have significantly positive impacts on IAP consumption. Skill does not show a significant effect on IAP

consumption. Competition also has noticeable positive impact on IAP consumption.

The dissertation research makes key contributions to the IS literature by highlighting two key managerially and theoretically important findings related to mobile gaming apps: (1) hedonic gratification and social gratification are key drivers of high retention probability and (2) the levels of challenge, the balance of skill and challenge, and competition are substantial factors to increasing IAP consumption. It is also expected that the finding will contribute for business practitioners to provide effective ways for extending user retention and effective monetization in mobile gaming apps.

Keyword: Mobile Gaming Apps, In-App-Purchase, Retention, Monetization, Flow Theory, Uses and Gratifications Theory

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Chapter 1. Introduction

1.1. Research Background and Motivation

Along with the widespread use of smartphones, the growth of mobile application (app) markets has been enormous over the past decade. Noticeably, among over 20 app categories, the growth of the mobile gaming apps has been remarkable. Mobile gaming is one of prominent options for spending leisure time based on advance in computing performance and network speed. Mobile game rapidly evolved, and users of mobile games do not stick with particular games long. Therefore, many game companies present their new games and disappear quickly. Mobile games increasingly have the shortest lifecycle of any app category (Flurry report 2014). Thus, business practitioners are trying to capture users' attention in this highly competitive marketplace, to retain them as long as possible once they start to use, and, at the same time, to monetize within short time of their play. Therefore, business practitioners mainly focus on user retention and monetization because those are essential for the long-term profitability of IT systems. As a result, mobile game gets a lot of attention not only business practitioners but also academic researchers. However, there is still limited understanding users' behavior in mobile gaming apps. Especially, the drivers of user retention and

monetization on mobile gaming apps and their business implication has been an under-researched area.

Among various monetizing methods, mobile game providers frequently use Freemium (Free-to-Play) strategy as their business model (Hanner et al. 2015; Kimppa et al. 2016). Freemium (Free-premium) means that users play a game for free but they can obtain additional functionality or benefits by paying money. The game providers can vastly exquisite users since this strategy offers free entry into a game. User retention can be seen unrelated regarding In-App Purchase (IAP) because they can continuously play the mobile game without additional paying (Anderson and Sullivan, 1993). Casual games particularly have adopted this model successfully (Zarnekow, 2015). Unlike hardcore or core games, casual games can be easily learned and played occasionally, and includes arcade games, puzzles, hidden objects, and brain teasers (Wohn, 2011). However, it is not guaranteed to gain profit because only a few users spend money on IAP, normally far below 5.0 percent of users, in most social casual games. Despite of this low portion of users, the revenue amount of mobile casual game is enormous. For example, Supercell, one of successful mobile game company using freemium strategy, generates revenue of $1.7 billion in 2014 due to hits of mobile casual games like Clash of Clans, Hay Day, and Boom Beach. Moreover, compared to other gaming genre, casual games have

relatively very low retention rate (Runge et al. 2014). Thus, it is important to figure out the factors to affect users' continuous use and purchasing behavior for game developers.

Despite the importance and prevalence of playing behavior and item-purchasing behavior in mobile casual games, there is little academic study which has investigated actual playing and purchasing behavior in mobile games due to difficulty to obtain micro-behavior data from game companies. Furthermore, regarding these topics, most of previous studies have examined users' intention to use or purchase rather than actual playing or purchasing behavior.

1.2. Research Goals and Research Questions

To investigate the gap of current studies and enhance understanding users' playing and purchasing behavior in mobile gaming apps, this dissertation research attempts to find answer the following salient research questions:

- *What are the key motivators of user retention and how do the motivators differently affect user retention in mobile gaming apps over time?*
- *What are the key motivators stimulating IAP consumption in mobile gaming apps and how do the motivators differently*

affect users' IAP consumption over time?

1.3. Overview of Essays

1.3.1. Essay #1: Key Factors Influencing User Retention in Mobile Applications

The goal of the first essay is to investigate the factors related to retention in mobile gaming apps. For this, this essay considers that mobile gaming is one type of hedonic IT systems and assumes that users continuously use the apps for their gratification based on the uses and gratifications theory. The essay categorizes the users' gratifications into three gratifications – (1) hedonic gratification; (2) utilitarian gratification; and (3) social gratification – based on the key tenets of the uses and gratifications theory. This essay analyzes the effect of three gratifications on user retention of a mobile gaming app. An extensive dataset of 223,555 individual players recorded over 8 weeks in 2015 from a leading mobile game developer is used for empirical analyses. The empirical results show that the effects of hedonic and social gratifications are significantly positive, but the effect of utilitarian gratification is significantly negative on user retention on the mobile gaming app. To extend user retention, this result implies that the game developers need to make various

ways into their game design for encouraging users' habitual and social playing behavior, constantly providing new contents, and satisfying users' expectation about IAP. It is also expected that the finding will contribute not only to understand the key factors in user retention of hedonic IT system, but also to provide effective ways to make players continuously use hedonic IT system.

1.3.2. Essay #2: Key Motivators of In-App-Purchase Consumption in Mobile Applications

The objective of the second essay is to explain users' motivations for consuming IAP options during their gameplays, This essay utilizes the key tenets of flow theory: (1) skill; (2) challenge; and (3) the balance of skill and challenge. The effect of competition with other players is also considered as one of important source of challenge. To evaluate the impacts of these factors on users' dynamic IAP consumption over time, this essay has considered continuous use(how often purchased) of IAP. An extensive dataset of 18,143 individual players (including 525 paying users) recorded over 66 days in 2016 from a leading mobile game developer is used for empirical analyses. The results show that the suggested factors have different effects on players' consumption. Challenge and the balance are positively related to

continuous use of IAP, whereas the effect of skill is not significantly related to continuous use of IAP. In addition, the effect of challenge with competition has similar to that of challenge without competition. Based on this result, game developers try to set the balance of skill and challenge, and encourage players to join competition instead of playing alone. The findings of this research will contribute to the prior literature on studying the key factors in IAP, and to mobile-application developers by suggesting how to make users consume mobile contents including IAP for a long-term success.

Chapter 2. Key Factors Influencing User Retention in Mobile Applications

2.1. Introduction

The electronic entertainment system is becoming important to the global economy as its market growth has been remarkable (Hechler et al. 2016). However, Information system researchers have traditionally focused on utilitarian perspective about IT system and overlooked research on these services (Lowry et al. 2013). The electronic entertainment system is hedonic IT system, which is used primarily for pleasure rather than for productivity. The characteristics of hedonic IT system are fundamentally different from utilitarian IT system. In contrast to utilitarian IT system, which is normally used for productivity, certain tasks or goals in a professional context, the hedonic usage of IT systems is a goal in itself (Van der Heijden 2004).

Among various types of the hedonic IT system, mobile gaming app is one of prominent options for spending leisure time based on advance in computing performance and network speed. Many mobile game companies are fiercely competing to survive in the competitive market. Mobile gaming can be normally categorized into hardcore, core, and casual games depending on game features. Unlike hardcore or core games, casual games are characterized by

uncomplicated rules and short-term user commitment. Therefore, most people can easily learn casual games and play occasionally and easily when they have short-rest time. Casual games include arcade games, puzzles, hidden objects, and brain teasers (Hou, 2011; Wohn, 2011). Since people can easily learn how to play this type of games and there are many alternative games with similar functionalities or characteristics, mobile casual games have relatively very low retention rate than other gaming genre (Runge et al. 2014). Thus, it is essential to understand the factors to affect users' continuous use for game developers. Therefore, this essay specifically investigates the following research question.

- *What are the key motivators of user retention user retention in mobile gaming apps?*
- *How do the motivators differently affect user retention in mobile gaming apps over time?*

To answer these questions, this essay assumes that users continuously use the apps for their gratification based on the uses and gratifications theory. This essay categorizes users' gratification into three: (1) hedonic gratification; (2) utilitarian gratification, and (3) social gratification. This essay looks into the effect of these gratifications on user retention of mobile gaming

apps. For the empirical analyses, an extensive dataset of 223,555 individual players recorded over two months in 2015 from a leading mobile game developer is used.

The remainder of this essay is organized as follows. In Section 2.2, previous theoretical studies are reviewed. In Section 2.3, a research model and relevant hypotheses to verify the model are suggested. Section 2.4 explains the research dataset from one of Korea mobile game companies and research methodology considered the data feature. Section 2.5 shows the empirical results and discusses the results. Finally, Section 2.6 presents the conclusion and limitation of this research.

2.2. Literature Review

The ultimate viability of IT systems is dependent on individuals' continuous use of the IT systems (Karahanna et al. 1999; Bhattacherjee 2001). The continuous use decision or user retention is important for the long-term profitability of IT systems (Parthasarathy and Bhattacherjee 1998; Reichheld and Schefter 2000; Bhattacherjee 2001). The potential benefits from increasing user retention rate can include a substantial reduction in operating costs and possibly a dramatic increase in profits (Reichheld and Sasser 1990; Crego and Schiffrin 1995). Owing to the significant influence of continuous use on the long-term

viability of IT systems, it is important to research the factors that influence individuals' post-adoption behavior. As with IS research, research on consumer behavior suggests that post-adoption behaviors are the keys to a firm's survival in the highly competitive marketplace (Reichheld et al. 2000). Following the tradition of adoption research, post-adoption research often emphasized individuals' cognitions as the determinants of post-adoption behaviors (Jasperson et al. 2005). Furthermore, during the last decade, gaming becomes a big part of entertainment, consumer culture, and people's daily lives. Therefore, IS researchers are fascinated to study user behavior in a game which is a type of hedonic information systems. Previous research about hedonic IT system finds that perceived enjoyment is an important factor to intention to use hedonic IT system (Van der Heijden 2004; Hsu and Lu 2004). Table 1 shows previous research about hedonic IT system. Most of previous studies have examined users' intention to use or purchase rather than actual playing or purchasing behavior by conducting survey.

Table 1. Prior Research on Hedonic IT System

Author	Theory	Antecedents	Dependent var.	Methodology	Domain
Heijden, H. Van Der. (2004)	TAM	Perceived usefulness, Perceived enjoyment, Perceived ease of use	Intention to use	Survey , Structural equation model	Dutch movie website
Lin and Bhattacherjee (2010)	TAM	Attitude perceived Enjoyment, Social image, Technical quality, Interaction quality	Intention to use	Survey	Online video games
Turel et al. (2010)	Theory of consumption values	Overall value of hedonic digital artifact – Visual/Musical appeal value, Social value, Playfulness value(Escapism, Enjoyment), Value for money	Intention to use Intention to positive word-of-mouth	Survey, PLS	Ringtones

Park and Chang (2011)	Theory of consumption values (TCV)	Character identification , Integrated value of purchasing game item (Enjoyment value, Character competency value, Visual authority value, Monetary value), Satisfaction about game	Game item purchase intention	Survey, PLS	Online game
Kim et al. (2011)	Customer value theory	Functional value (Price utility, Functional quality), Emotional value (Aesthetics, Playfulness), and Social value (Social self-image expression, Social relationship support)	Intention to purchase digital items	Survey, Structural model	Social networking community
Zhou et al. (2012)	Dedication-constraint framework of commitment	Dedication-based commitment/ affective commitment, Constraint-based commitment / calculative commitment	Intention to continuous use	Survey, Structural model	Second Life

Wu and Lu (2013)	TAM, Motivation Theory, Self-determination theory (SDT)	Extrinsic motivator (Perceived usefulness, Job relevance, Image, Affiliation motivation, Reward, Punishment), Intrinsic motivator (Enjoyment, Flow, Playfulness, Pleasure, Arousal)	Intention to use	Meta-analysis	-
Goel et al. (2013)	Awareness-attention Theory, Process theory	Social perception, Social awareness, Flow experience (Focused immersion, Temporal dissociation)	Intention to return	Laboratory experiment and survey, PLS	Second Life
Kim et al. (2012)	Self-presentation theory	Personal control (Online presentation self-efficacy), Social influence (Virtual community involvement, Online self-presentation norms), Online self-presentation (Desire for online self-presentation)	Intention to purchase digital Items	Survey, PLS	Cyworld and Habbo

Li et al. (2015)	Uses and gratifications theory	Hedonic gratification (Enjoyment, Fantasy, Escapism), Social gratification (Social interaction, Social presence), Utilitarian gratification (Achievement, Self-presentation)	Intention to use	Survey	Online game
Turel (2015)	Social Cognitive Theory	Self-efficacy to discontinue, Guilt feelings, Habit of using the site, Satisfaction with the site, Addiction to using the site	Discontinuance Intentions	Survey, Structural model	Facebook

While mobile game is one type of hedonic IT systems, but mobile game has own characteristic. User retention of mobile games quite short compared to other hedonic IT systems. Besides, casual mobile game has relatively shorter user retention than other types of games do because of its characteristics. Casual game is typically distinguished by its simple rules comparing to complex hardcore game. Consequently, casual game requires no long-term time commitment or special skills to play. In addition, producers need comparatively low production and distribution costs. Due to these distinctive characteristics, casual games are especially suitable for the mobile environment. In this regard, numerous mobile casual games are released with similar design and function, and users easily switch to other mobile casual games whenever they want (Runge et al. 2014).

2.3. Hypotheses Development

According to the uses and gratifications theory, individuals' gratifications have effects on continuous use of hedonic IT system. The uses and gratifications theory explains why people decide to use one system among many systems to satisfy their different needs (Katz et al. 1974; Weibull 1985). This theory is widely used for voluntary use of IT systems in various context such as email, social network sites, virtual communities, etc. (Cheung and Lee 2009; Dimmick et al. 2000; Xu et al. 2012). According to this

theory, people act to satisfy their needs and gain satisfaction in their hedonic IT usage. Based on the uses and gratification theory, this essay categorizes users' gratifications into three gratifications: (1) hedonic gratification; (2) utilitarian gratification; and (3) social gratification.

Unlike utilitarian IT systems, people use hedonic IT system mainly for their hedonic gratifications (i.e. enjoyment). Enjoyment is identified as a dominant intrinsic motivation driving continuous use of hedonic IT system (Ryan and Deci 2000; Van der Heijden 2004; Hsu and Lu 2007; Xu et al. 2012; Xu et al. 2012). Similarly, in games, enjoyment has positive effects on continuous playing (Wu et al. 2010; Boyle et al. 2012). Game players can gain hedonic gratification from the fun when they play an online game. Therefore, this research considers that enjoyment is one main factor to motivate continuous use of mobile game. As such, the first hypothesis is:

Hypothesis 1: Enjoyment is positively associated with continuous use in mobile gaming apps.

In addition, according to motivation theory, motivation is usually divided into two types: intrinsic and extrinsic motivation. Intrinsic motivation means that people act because fun of the activity itself. People satisfy of enjoy which comes from doing the activity. On the other hands, extrinsic motivation is outside of

oneself. It generally indicates rewards such as praise or punishment for studying, salary for job or the in-game achievement (Murphy et al. 2014). Hedonic needs can be satisfied by both motivations. Enjoyment can be refereed to intrinsic motivation, and achievement can be referred to extrinsic motivation. Hedonic needs related to extrinsic motivation can be fulfilled by goal-directed activities (Hoffman and Novak 1996; Novak et al. 2003). People tend to be highly motivated by elaborated goals that are specific, difficult but achievable. They can enjoy and be satisfied when they achieve a certain goal (Fishbein and Ajzen 1977; Khansa et al. 2015). In the game context, multi-tiered goal structures attract players to keep achieving their goals by effectively reducing boredom of game players (Fields and Cotton 2011; Zarnekow 2015). Thus, utilitarian gratification in hedonic IT system can be captured by achievement (Wan and Chiou 2006; Yee 2006). Game players can feel a sense of achievement by gaining more power and performance points/score, gathering more virtual items, and competing other players (Yee 2006; Wu et al. 2010; Lee et al. 2012). Previous studies shows that achievement has positively effects on continuous intention to play an online game (Suznjevic and Matijasevic 2010; Wu et al. 2010). Thus, this leads to formulate the following hypothesis:

Hypothesis 2: *Achievement is positively associated with continuous use in mobile gaming apps.*

In addition to hedonic and utilitarian gratification, people can also satisfy their gratifications when they socialize and build relationships with others in mobile games. Previous research finds that social interaction is an important feature of games as players often compete or collaborate with other players in games (Wang and Wang 2008; Thurau and Bauckhage 2010). Various entertainment elements come from the multiplayer experience although users could play the game on their own. For example, users can play mobile games by themselves, but in the same time they can get gratifications by sending message or presenting virtual-item gifts to their friends for showing friendliness. Thus, the needs of social gratification can be satisfied by social interaction. Lin and Lu (2011) find that the number of friends who are using is a significant factor affecting intention to use hedonic IT system. In this research, the number of friends can be estimated based on the number of users in social interaction of game playing. Accordingly, the hypothesis is formulated as follows:

Hypothesis 3: *Social interaction positively associated with continuous use in mobile gaming apps.*

Based on these research hypotheses, the research framework is presented in Figure 1.

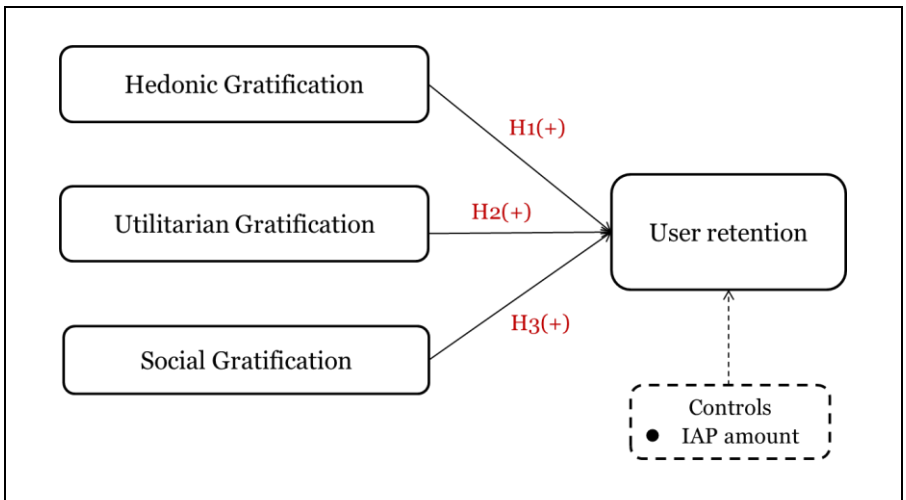


Figure 1. Research Framework

2.4. Research Methodology

2.4.1. Data

The dataset used for this paper is an extensive dataset of user-level gameplay log collected from one Korean mobile game company. The chosen game is one of the famous mobile casual games in Korea released in 2013. Figure 2 presents screenshots of the chosen mobile casual game. In this game, players control a continuously running and bouncing their avatar ("Cookie") that they need to guide through a series of generated maps for collecting as many coins and free items as possible. The players

can control their avatar by touching the left or right side of the device (which make their avatar jump or slide). The players can also get coins to avoid obstacles in an attempt to get a new high score. If the avatar collides with obstacles several times or if it falls off a cliff, the game session ends (i.e. the avatar "dies"). The play frequency in this essay is defined as the number of rounds of play from the beginning of the game until the avatar "died".

Figure 2. Snapshots of the Mobile Casual Game

This essay analyzes an extensive dataset of 223,555 individual players recorded over 8 weeks in 2015 for empirical analyses. The strength of analyzing the user-level log data is providing behavior information more objectively and accurately than self-reported behavior data from surveys. The data contains the information about gameplay and virtual-item purchasing of each user. Positioning user identifier variable as a panel variable,

this study reformulates the dataset into a weekly panel dataset to avoid day of week effect. Summary of key variables and correlation matrix of those variables are presented in Table 2 and Table 3.

According to previous research, the portion of paying users is normally far below 3.0 percent of users in most social casual games. Despite of this low portion of users, the revenue amount of mobile casual game is enormous (Swrve 2016). The dataset of this research shows the portion of paying users is only 3.05 percent of all users.

In addition, the company provides the join date of all users, but does not the exact leaving date of all users because most of the players just stop playing the game without declaring withdrawal. Therefore, this research assumes that the user already left when the user did not play within one week, based on opinions of game developers and field experts. Therefore, the user is considered as a past player if the user did not play within a week. Based this, the dataset shows the proportion of leaving users is about 54.4 percent of total users.

Table 2. Summary of Key Variables					
Variables	Definition	Mean	S.D.	Min	Max
$HazRatio_{it}$	***Hazard ratio,*** Player i"s the probability to leave the game at t	–	–	–	–
$PlayFreq_{it}$	***Enjoyment,*** Player i"s play frequency at t	29.33	54.2	1	4,725
$MaxScore_{it}$	***Achievement,*** Player i"s the highest score at t	1.21e+07	2.68e+07	0	4.43e+08
$Gift_{it}$	***Social interaction,*** Player i"s the number of gifting item at t	6.76	119.7	0	20,460
$IAPamount_{it}$	The amount of IAP by i at t	335.19	7,208.72	0	891,000
(Users: 223,555; Observation: 393,393)					

Table 3. Correlation Matrix of Key Variables				
	$PlayFreq_{it}$	$MaxScore_{it}$	$Gift_{it}$	$IAPamount_{it}$
$PlayFreq_{it}$	1			
$MaxScore_{it}$	0.450	1		
$Gift_{it}$	0.344	0.188	1	
$IAPamount_{it}$	0.163	0.166	0.051	1

Furthermore, it is necessary to consider how the data is treated when it is right or left censored since the main focus of this research is retention duration. First, retention status of all users is hard to get after the end of the observation period, October 31 in 2015 whether they will keep or stop playing the mobile gaming app. It would be misleading if the researchers assume that all users will stop playing the mobile game at the end of the observation period and arbitrarily calculate retention duration. To solve this issue, this research uses the right censoring sample (Tunali and Pritchett 1997). Second, the users who start playing the mobile game before beginning of the observation period, September 1 in 2015, could have different probability distribution from that of the users who join the mobile game during the observation period. For example, at the time *t*, the probability of churn would be different among users who has been playing the game over two years and who just joined the mobile game. Therefore, it is reasonable to consider the

probability distributions of churn vary among users.

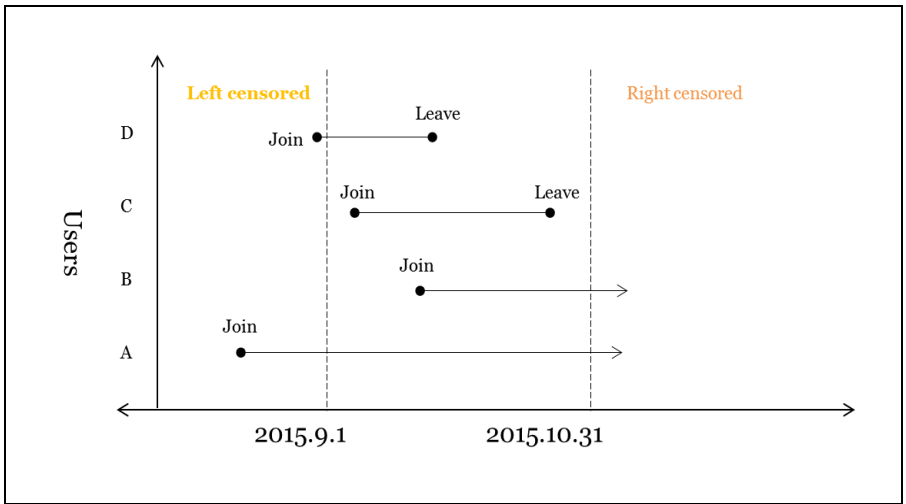
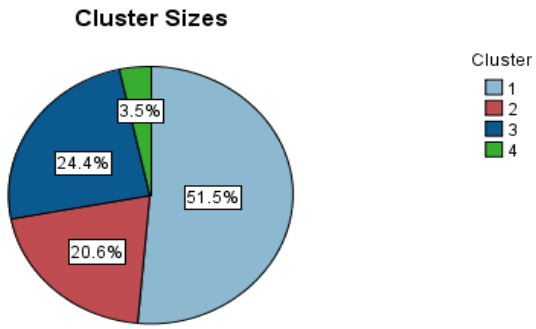


Figure 3. Data Censoring

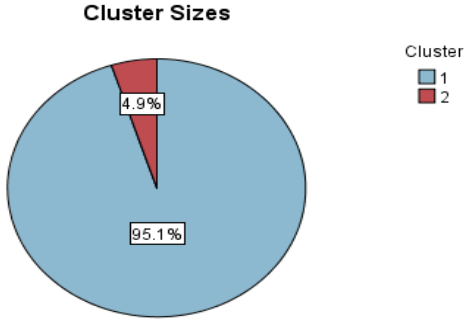
This essay takes the flow sampling method, which only considers the users who joined the mobile game during the observation period. By doing this, the left censoring issue and selection bias can be reduced (Lancaster and Chesher, 1981). Thus, this essay only considers the flow sampling to deal with the selection bias. For example, Samples who start to play the mobile game during the observation period are considered (User B and C in Figure 3).

After data preprocessing, two-step clustering analysis is conducted to figure out overall data features. Based on suggested variables (i.e. play frequency, the highest score, the frequency of item gifting, the amount of IAP), all users are divided into four clusters as Figure 4.



Size of Smallest Cluster	424 (3.5%)
Size of Largest Cluster	6179 (51.5%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	14.57

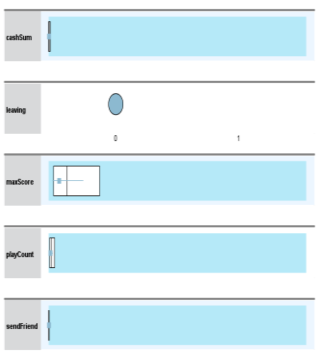
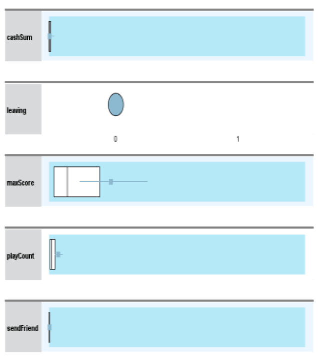
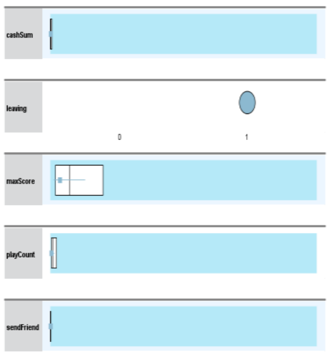
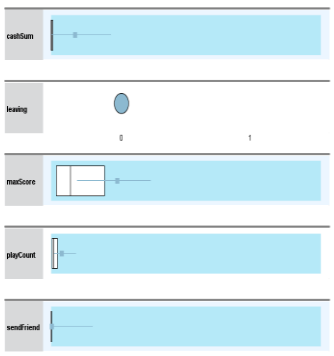
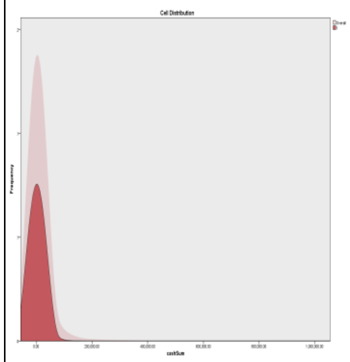
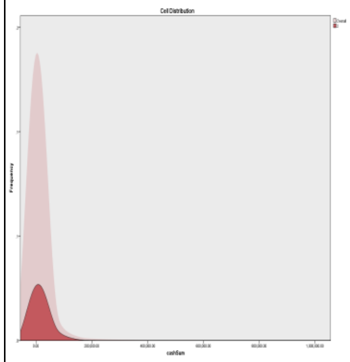
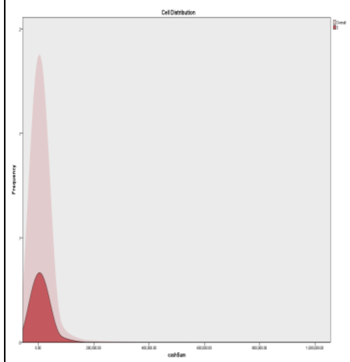
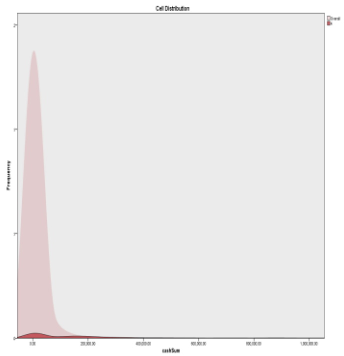
Figure 4. Clusters of All Users

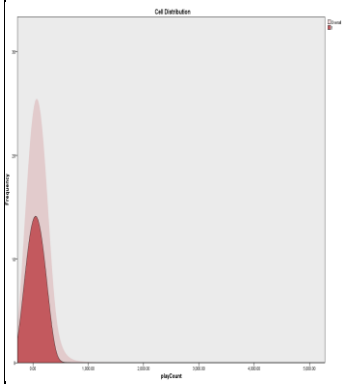
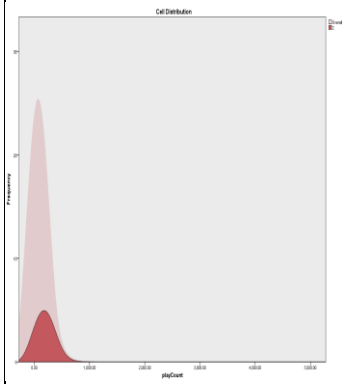
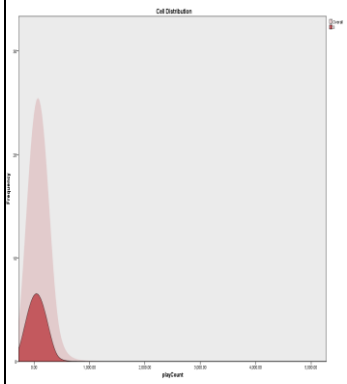
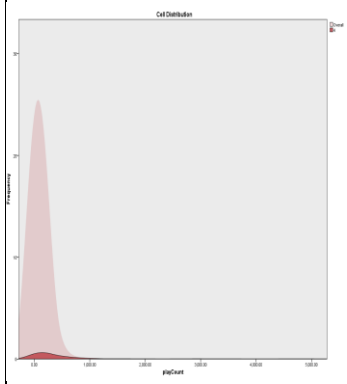
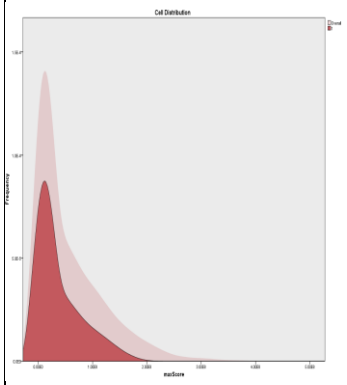
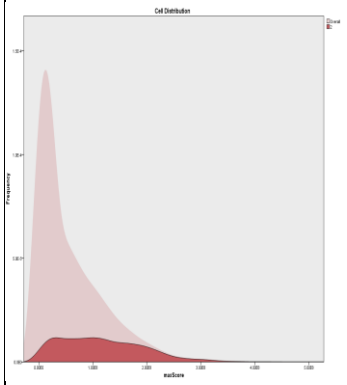
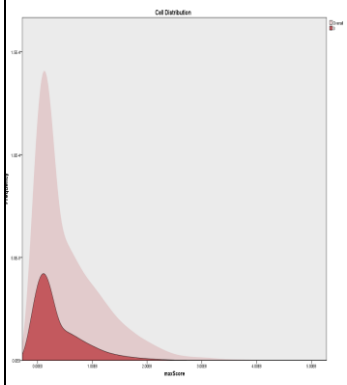
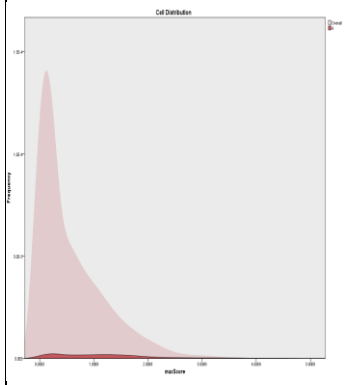


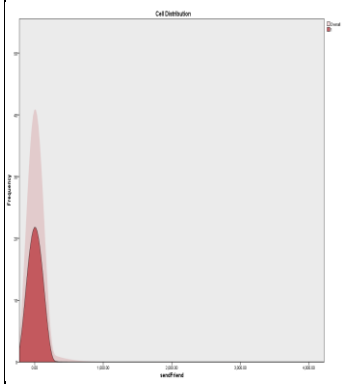
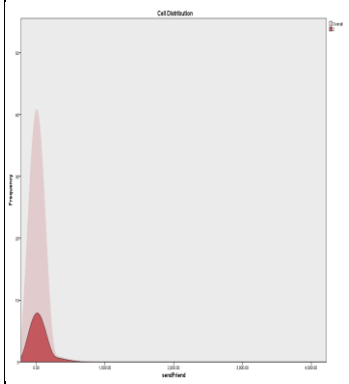
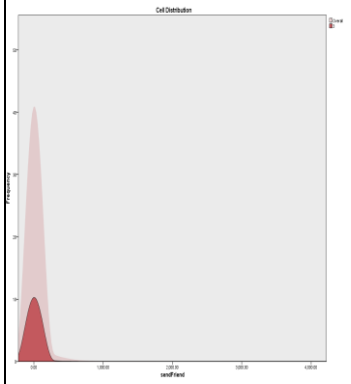
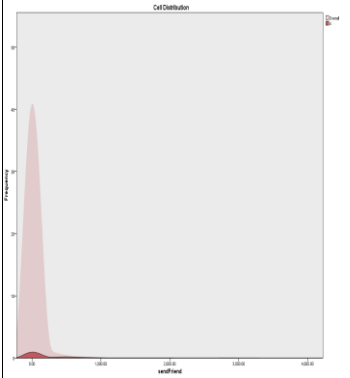
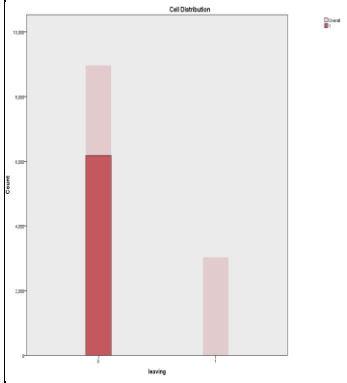
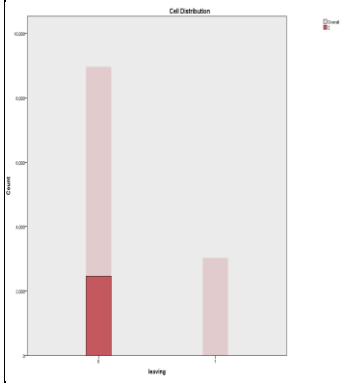
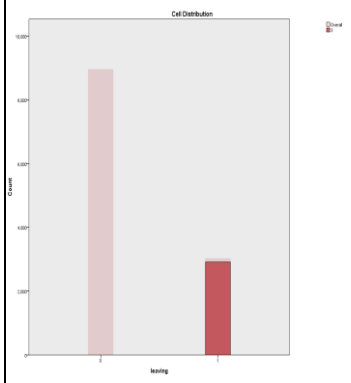
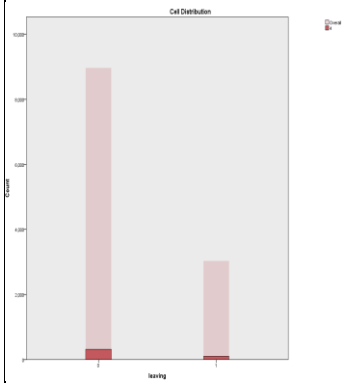
Size of Smallest Cluster	593 (4.9%)
Size of Largest Cluster	11403 (95.1%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	19.23

Figure 5. Clusters of Paying Users

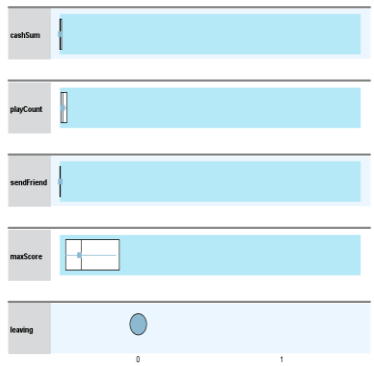
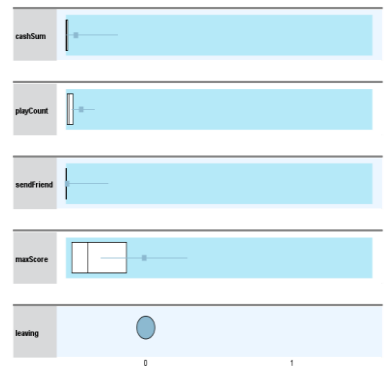
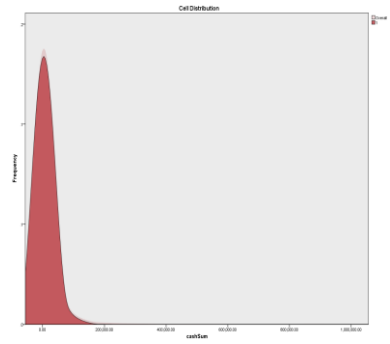
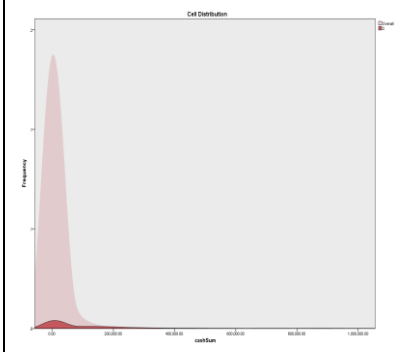
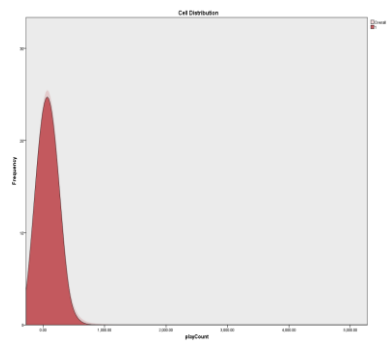
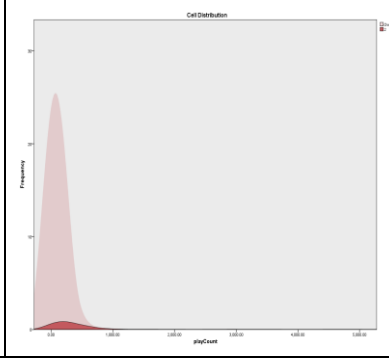
Table 4. Cluster Comparison

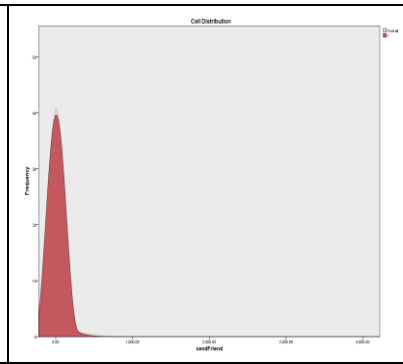
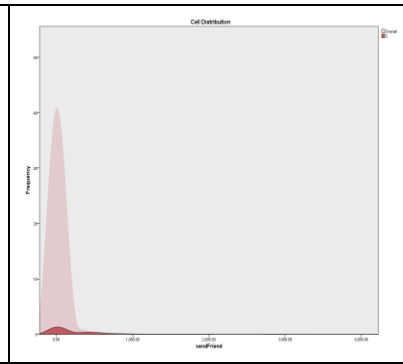
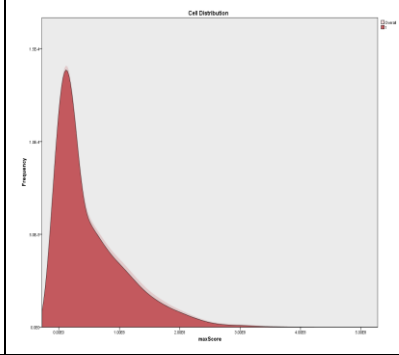
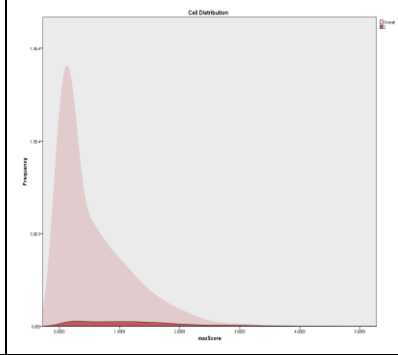
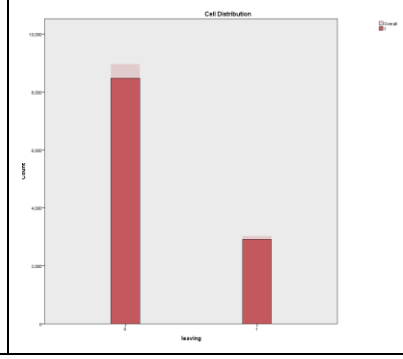
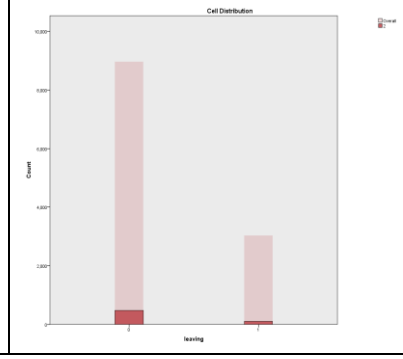
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Overall				
IAP Amount				

Play Frequency				
Max Score				

Item-gifting Frequency				
Churn				

As presented in Table 4, Cluster 1 and Cluster 3 have similar values of play frequency and item-gifting frequency. However, although the most members of Cluster 1 keep playing the mobile game, the most members of Cluster 3 leave the mobile game. The differences between two clusters are the amount of IAP and max score. The members of those two clusters spend similar amount of IAP, but the members of Cluster 1 gain higher scores than those in Cluster 3. It can be explained by users' expectation about IAP. Many functions of virtual items in the mobile casual game are giving additional features or reducing barrier to achieve higher score such as enhancing avatar's ability or extending limited time to play. Therefore, users normally expect higher score or performance when they purchase and use virtual items because they spend their real money into the mobile game. It seems usual that when they cannot gain enough performance after purchasing, the users are disappointed and tend to leave. To see more detail information about paying users, cluster analysis of paying users is also conducted. Cluster information of paying users is presented in Figure 5 and Table 5. This result also shows paying users with high performance tend to stay longer than paying users with low performance.

Table 5. Cluster Comparison of Paying Users		
	Cluster 1	Cluster 2
Overall		
IAP Amount		
Play Frequency		

Item-gifting Frequency		
Max Score		
Churn		

2.4.2. Analysis Model

The goal of this research is to investigate the factors related to user retention in mobile gaming apps. Therefore, survival analysis is conducted. Survival analysis, or duration analysis, is a type of regression model which captures the changes of a probability of survival over time. In this context, the event is defined as churn. The hazard ratio of predictor indicates how the relative likelihood of the event increases or decreases with an increase or decrease in the predictor. In this sense, this essay uses Kaplan–Meier estimator (Kaplan and Meier 1958) and Proportional hazard model (Cox 1972). The bottom line of survival analysis is the distribution during the duration time T. Let T be the random variable representing the retention duration between joining and leaving the mobile gaming app. The survival function $S(t)$ then will be the unconditional probability of an employee still active in a company at time t. Therefore, the relation between the survival function $S(t)$ and the distribution of duration(T) can be expressed as the equation (1):

$$S(t) = Pr(T > t) = 1 - Pr(T \leq t) = 1 - F(t) \qquad (1)$$

Kaplan–Meier (K–M) estimator is one of the nonparametric statistics that is used to estimate the survival function. It doesn't

need to consider other independent variables but only considers the observed duration information. Therefore, it is frequently used for the simple summary statistics in survival analysis since it enables us to estimate the distribution of dependent variable (retention duration) without any particular assumption. On the other hand, for the proportional hazard model (PHM), a semi-parametric statistics, this essay can derive a maximum likelihood estimator without considering a baseline hazard rate by using partial likelihood method. This essay defines the hazard ratio function, $h(t)$ at the time t as the probability to leave the company during $(t+\Delta t)$ if an user is in the mobile gaming app at the time t:

$$h(t) = \lim_{\Delta t \to 0} \frac{Pr[t+\Delta t > T > t | T \geq t]}{\Delta t} = \frac{f(t)}{S(t)} = -\frac{d \log S(t)}{dt} \qquad (2)$$

Again, by using PHM, this essay sets every individual unit implies the same baseline hazard ratio function $h_0(t)$ and estimate the proportion of each user's hazard rate, which is different from each other according to their individual characteristics. The hazard ratio function of PHM is equal to product of the baseline hazard ratio and the exponential of explanatory variables. The relationship between explanatory and dependent variables can be expressed as follows:

$$h(t|x) = h_0(t) exp(x'\beta) \qquad (3)$$

$h_0(t)$ is a baseline hazard function which equally applies to every user in terms of its value from the equation (3). x represents explanatory variables which affect user' leave. β is a coefficient of x, representing magnitude of the effect of each explanatory variable on the event, churn.

2.5. Analysis Results and Discussion

From the K-M survival function, this research finds that the probability of staying in the mobile game (survival rate) at the time t continuously decreases and the graphical result is illustrated as Figure 6. The result of K-M survival function shows that about ten percent of users remain after two months. This implies that user retention of mobile game relatively short than other hedonic IT system.

Furthermore, previous research finds that the characteristics of paying users and free users are definitely different (Shi et al. 2015). Despite of the small portion of paying users, they generate huge profit of mobile game companies. Therefore, it is important to figure out the difference between free users and paying users. Normally, players can exchange real-world money with virtual hard currency (i.e. "Crystal" in the research dataset) at and then exchange the hard currency with in-game currency (i.e. "Coin" in

the research dataset) or items (“Pet”, “Cookie”, “Heart”, etc. in the research dataset) inside the game world. Among these several situations about item transaction cases, this essay defines paying users as users who purchase virtual items by spending real money during the observation period.

K-M survival estimates between free users and paying users is carried out for figuring out the difference of them. The result shows that the survival rate of paying users(‘payinguser = 1’) is higher than that of free users(‘payinguser = 0’) until 40 days, but the survival rates of paying users and free users become similar after 40 days as Figure 7.

Through the K-M survival estimates, survival rate at the time t can be intuitionally figured out. However, it is hard to analyze specific effects of individual characteristics or the suggested gratification (i.e. hedonic gratification, utilitarian gratification, and social gratification) on retention. Therefore, PHM is carried out for evaluating the effects of hedonic gratification, utilitarian gratification, and social gratification on user retention in the mobile gaming app.

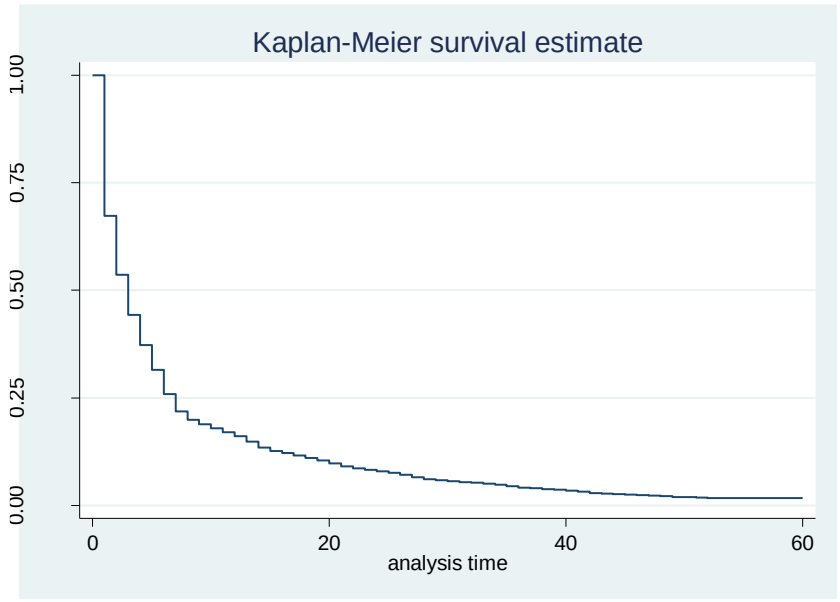


Figure 6. Kaplan−Meier Survival Estimates

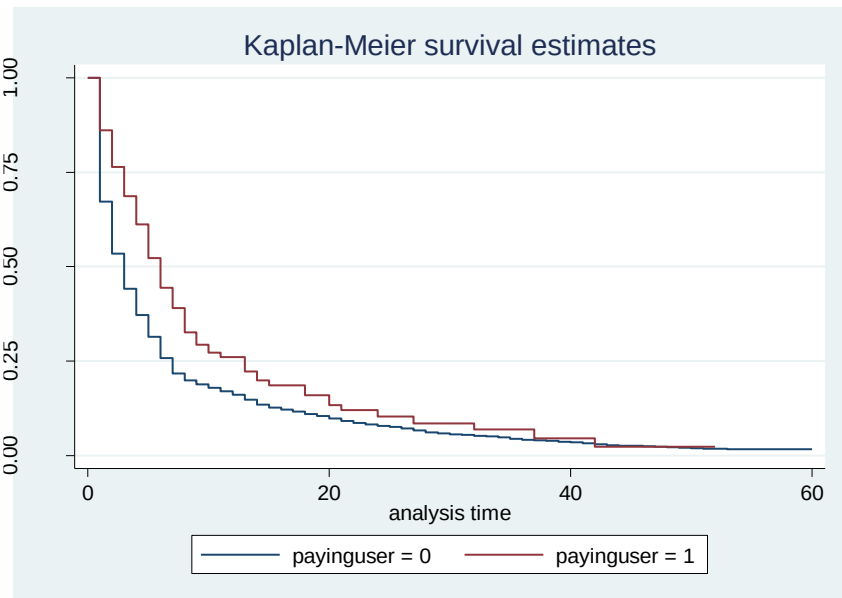


Figure 7. Kaplan−Meier Survival Estimates for Free and Paying Users

First, PHM with all users (i.e. free and paying users) is conducted. The detailed results of PHM are summarized in Model Ⅰ of Table 6. The results show: (1) the users who play the mobile game more have about 15 percent lower hazard rate (i.e. probability to leave the game) than those who do not; (2) the users who gain higher score have about 8 percent higher hazard rate than those who do not in the mobile game; (3) the users who give item gift to their friends more have about 5 percent lower hazard rate than those who do not in the mobile game. In addition, the users who are spending more money have about 4 percent lower hazard rate than those who are not in the mobile game. To sum up, the empirical result presents that the user who plays the game and sends item gifts more frequently tends to stay longer than the user who does not. In addition, the user who gains the higher score in the game tends to leave sooner than the user who does not.

Table 6. Estimation Outcomes

	Model Ⅰ (Free & Paying users)	Model Ⅱ (Paying users only)
$PlayFreq_{it}$	0.848^{***} (0.004)	0.725^{***} (0.045)
$MaxScore_{it}$	1.079^{***} (0.005)	1.048^{***} (0.061)
$Gift_{it}$	0.948^{***} (0.007)	0.958^{***} (0.068)
$IAPamount_{it}$	0.969^{***} (0.007)	1.054^{***} (0.019)

$* p<0.05$, $** p<0.01$, $*** p<0.001$

People play the mobile game in their free time and they have various motivations. If they casually play the mobile game with no definite idea during their free time such as waiting the bus or short breaking time. In this case, people are likely to play the mobile game just for spending their short time and focus on enjoyment or fun, not their performance in the mobile game. This type of users login and play the game frequently and they can be also described as habitual users. This type of users keeps playing the game because of their habitual playing behavior and satisfying hedonic gratification. In addition, some people play the mobile game for keeping or expending their friendship. They are likely to play the mobile game because their friends play the game and they want to spend their time with their friends in the game. This type of users can be described as social users. Social users are likely to play the game for interact with their friends and satisfying social gratification. This type of users is likely to stay longer because their relationship with friends already is made up in the game. On the contrary, some people play the game for achieving higher score every time they play. This type of users can be described as goal-oriented users. They tend to play intensively in relatively short time to gain higher score, i.e. to satisfying utilitarian gratification. This type of users simply leaves the game once they gained the score which they want. They are also likely to leave easily once they could not gain the score which they want after

they played intensively in short time. Both cases present this type of users have shorter retention duration than other types of users.

Next, PHM is conducted for paying users only. The portion of paying users is only about three percent so it is hard to figure out the effect of IAP even though the characteristics of free users and paying users are difference (Shi et al. 2015). In addition, regarding profit of mobile gaming apps, it is important to understand the characteristic of paying users. The detailed results of PHM are summarized in Model Ⅱ of Table 6. The results show: (1) The users who play the mobile game more have about 27 percent lower hazard rate than those who do not; (2) The users who gain higher score have about 5 percent higher hazard rate than those who do not in the mobile game; (3) The users who give item gift to their friends more have about 4 percent lower hazard rate than those who do not in the mobile game. In addition, the users who are spending more money have about 5 percent higher hazard rate than those who are not in the mobile game. To sum up, the empirical result presents that the user who plays the game and sends item gifts more frequently tends to stay longer than the user who does not. In addition, the user who gains the higher score in the game tends to leave sooner than the user who does not.

Comparing with the result of Model Ⅰ, the result of Model Ⅱ presents that the hazard rate of paying users is much lower than that of all users who play the game more frequently. This result

implies that the mobile game company needs to manage carefully the users who purchase items and play the game frequently.

In addition, the result of Model Ⅱ illustrates that the users with larger IAP amount have higher hazard rate than the users with smaller IAP amount among paying users. The reason of this result can be explained by Cluster analysis in Section 2.4.1. Play frequency and item-gifting frequency of Cluster 1 and Cluster 3 are similar, but max score and retention status are different between two clusters. Cluster 1, the users with higher score and similar amount of IAP, does not leave the game, whereas Cluster 3, the users with lower score and similar amount of IAP, leaves the game. This result shows that people who spend real money in the mobile game expect higher performance or score in the game because many functions of virtual items are relaxing the rules of the mobile game such as extending limited time or strengthen avatar's ability. Therefore, the users expect much higher score when they spend more money. Once the users cannot gain acceptable high score after purchasing, they are likely to leave the game.

Based on the empirical results, for extending users' retention in the mobile game, the game developers need to apply the ways into their game design for encouraging users' habitual and social playing behavior, constantly updating new contents, and satisfying users' expectation about IAP.

2.6. Conclusion

This research investigates the key factors influencing continuous use of mobile game based on the uses and gratifications theory. This research offers one of the first empirical evidence that examines the factors on user retention in mobile gaming apps based on large-scale user log data. The empirical results of survival analysis show hedonic gratification and social gratification have positive effect, and utilitarian gratification has negative effect on user retention. It is also expected that this research can give significant implications to game developers who try to lengthen players' retention. The findings will contribute not only to the prior literature on studying the key factors in retention of hedonic IT system, but also to mobile-application developers by suggesting how to make users continuously use hedonic IT system.

However, this study is not without limitation. First, this research analyzes the effect of suggested factors in one mobile casual game only, so this research cannot figure out the differences among other games because the effects could be different depending on game genre. Therefore, additional research is planned to obtain data of other multiple mobile games. The future research will consider game characteristics to strengthen the current results. In addition, the effects of additional salient

factors can be considered. For example, the effect of promotional events in mobile games (e.g. offering free items) on user retention could be applied in the future study. Therefore, this research will be strengthen and elaborated after considering the above-mentioned limitations.

Chapter 3. Key Motivators of In-App-Purchase Consumption in Mobile Applications

3.1. Introduction

Along with the widespread use of smartphones, the growth of mobile application (app) markets has been enormous over the past decade. Peculiarly, gaming apps solely (among over 20 app categories) generated over three-quarters of total mobile apps revenue in 2015 (Venturebeat 2016). In a short history of mobile app markets, gaming app developers have experimented various monetization methods like subscription fees, in-app-purchase options, in-app advertising, etc. Especially, in-app-purchase (IAP) is the most common and well-accepted monetization method by app developers, which attracts players to play for free at first and charges a fee later for additional features and virtual items. However, this method does not always guarantee for all games to gain a profit since the portion of paying users is relatively low, normally far below 3.0 percent (Swrve 2016). As such, it is required for game developers to understand what motivate app users to take advantage of IAP options during their gameplays and to evaluate how the motivators affect users' IAP consumption over time. Although a few researchers have started investigating this important issue (Hamari 2015; Lehdonvirta

2009), there are still lack of academic research works on app users' IAP consumption. Therefore, the main purpose of this study is to examine the key drivers/motivators influencing app users' IAP consumption over time and to answer the following salient research questions:

- *What are the key motivators stimulating IAP consumption in mobile apps?*
- *How do the motivators differently affect users' IAP consumption over time?*

The key tenets of flow theory are utilized to make theoretical grounds in explaining users' motivations for consuming IAP options during their gameplays. The flow theory has been widely adopted for understanding "the state of concentration and engagement that can be achieved when completing a task that challenges one's skills" (Nakamura and Csikszentmihalyi 2002). Based on this theory, the study proposes the three key motivators stimulating IAP consumption to achieve a set of goals in mobile games: (1) skill; (2) challenge; and (3) the balance of skill and challenge. In addition, this research also considers the effect of competition with other players. To evaluate the impacts of these factors on users' dynamic IAP consumption over time, this research has considered continuous use of IAP (how often

purchased) of IAP. An extensive dataset of 18,143 individual players (including 525 paying users) recorded over 66 days in 2016 from a leading mobile game developer is used for the empirical analyses in this research.

It is expected that the findings of the study will bear significant research insights for the prior literature on mobile apps and platforms and will provide actionable and managerial implications for game developers and platform providers who are keen to introduce the best monetization mechanism in the mobile app platforms.

The remainder of this essay is organized as follows. In Section 3.2, previous theoretical studies are reviewed, and a research model and relevant hypotheses to verify the model are suggested. Section 3.3 explains a dataset from one of Korea mobile game companies and analyzing method considered the research data feature. Section 3.4 shows the empirical results and discusses the results. Section 3.5 shows the empirical results of robustness check. Finally, Section 3.6 presents the conclusion of this research and a future research plan.

3.2. Hypotheses Development

Based on the flow theory, people feel fun in a certain activity from flow experience. Flow experience is explained as “states

of intense concentration or absolute absorption in an activity" (Csikszentmihalyi 1975). Many IS researchers have borrowed this concept from psychological studies to explain user experience (e.g., online consumer behavior and user acceptance of IT system) in the context of information systems (Xu et al. 2012; Shin and Kim 2008). Table 7 shows selected research about the flow theory in IS field.

Furthermore, the past literature has revealed that the flow experience significantly influences users' willingness to pay in an online environment (Korzaan 2003; Liu and Shiue 2014; Siekpe 2005).

This research argues that users can be in flow status from (1) skill, (2) challenge, and (3) the balance of skill and challenge in the mobile app context. In addition, it also considers the effect of competition with other players. Then, the different roles of these elements in affecting users' IAP consumption (i.e., the continuous consumption of IAP) are expected.

Many researchers studied why people voluntarily and continuously spend their resources (i.e effort, time and money) without any economic benefits in hedonic experience. Flow status is one of pertinent concepts to explain this. According to the flow theory, when people experience flow status, people can feel total involvement and easily spend their resources without consciousness (Csikszentmihalyi 1975). People can more easily

get into flow status when they are experienced and good at certain activities. For example, game beginners need to learn how to play the game with their time and effort. Once they become proficient to play the game, they can effortlessly know right actions to do and not to do.

Therefore, users who are more proficient can more easily experience the flow status. In addition, people tend to be highly motivated by elaborated goals that are specific, difficult but achievable (Fishbein and Ajzen 1977; Khansa et al. 2015). When the game is too easy for players, they easily get bored with the game. On the contrary to this, when the game demands abilities beyond the capability, “anxiety” or “worry”, negative feeling to the game, are created (Csikszentmihalyi 1975). Therefore, games normally make explicit and attractive multi-tiered goal structures that promote players effectively to induce their involvement according to their skill level (Fields and Cotton 2011; Zarnekow 2015). Thus, Flow status can be anticipated by skill and challenge independently in addition to their relative balance (Hoffman and Novak 1996; Guo and Poole 2009).

Table 7. Flow Theory in IS field

Author	Antecedents of Flow	Dimensions of Flow	Definition of Flow	Consequences of Flow	Methodology	Domain
Jiang and Benbasat (2004)	Visual control; Functional control	Control; attention focus; Cognitive enjoyment	An affective state when individuals are involved in certain activities.	–	Experiment; Survey	e-commerce
Webster et al. (1993)	Perceived characteristics of the software (flexibility & modifiability); Experimentation; Expected voluntary use	Control; Attention focus; Curiosity; Intrinsic interest	"in control of our actions, masters of our own fate… we feel a sense of exhilaration, a deep sense of enjoyment" (Csikszentmihalyi, 1990, p. 3).	Actual technology use; perceived communication quantity and effectiveness	Survey; Confirmatory factor analysis (CFA)	lotus software; e-mail

Hoffman and Novak (1996)	Perceived congruence of skills and challenges ; focused attention; interactivity; telepresence	Control; Attention focus; Cognitively enjoying	"the process of optimal experience" achieved when a sufficiently motivated user perceives a balance between his or her skills and the challenges of the interaction, together with focused attention.	Increased learning; Perceived behavioral control; Exploratory mindset; Positive subjective experience	–	e-commerce
Guo and Poole (2009)	Clear goal; Fast and unambiguous feedback mechanism; perceived balance of challenge & skil	Concentration; Merging of activity and awareness; Perceived control; transformation of time; Transcendence of self; Autotelic experience	Flow represents a 'peculiar dynamic state – the holistic sensation that people feel when they act with total involvement' and an 'ordered, negentropic state of consciousness	–	Survey, SEM	e-commerce

For considering these factors, Moneta and Csikszentmihalyi (1996) develop the regression model to estimate the status of flow experience. They find that both skill and challenge has positive effect on flow experience and the imbalance of skill and challenge (i.e. the absolute difference of skill and challenge) has negative effect on flow experience. Furthermore, game players who get into the flow status have more willingness to pay for game contents (Chen 2007; Kim et al. 2013). Thus, in this essay, IAP consumption represents one's flow status. As such, the hypotheses are formulated as follows:

Hypothesis 1: *The effect of skill will be positively related to IAP consumption in a mobile game.*

Hypothesis 2: *The effect of challenge will be positively related to IAP consumption in a mobile game.*

Hypothesis 3: *The effect of the balance of challenge and skill will be positively related to IAP consumption in a mobile game.*

Game design can be considered as IT-mediated competition among players. Competition is one of important source of challenge in game (Liu et al. 2013; Vorderer et al. 2003). Previous research shows that competition has positive impacts on flow

(Tauer and Harackiewicz 1999; Song et al. 2013; Liu et al. 2013; Santhanam et al. 2017). Therefore, this research considers challenge within two categories: (1) challenge with no competition (i.e. when people play a game alone in a single-player mode); and (2) challenge with competition (i.e. when people play a game with other people in player-and-player mode). Players will be willing to pay more in people-and-people interaction than the other (Baek et al. 2004). Then, this essay analyzes the effect of these two types of challenges on flow status. Thus, this leads to formulate the following hypothesis:

Hypothesis 4: *The effect of challenge without competition will be positively related to IAP consumption in a mobile game.*

Hypothesis 5: *The effect of challenge with competition will be positively related to IAP consumption in a mobile game.*

Hypothesis 6: *The effect size of challenge with competition will be bigger than the effect of challenge without competition on IAP consumption in a mobile game.*

Based on the research hypotheses, the conceptual model is presented in Figure 8.

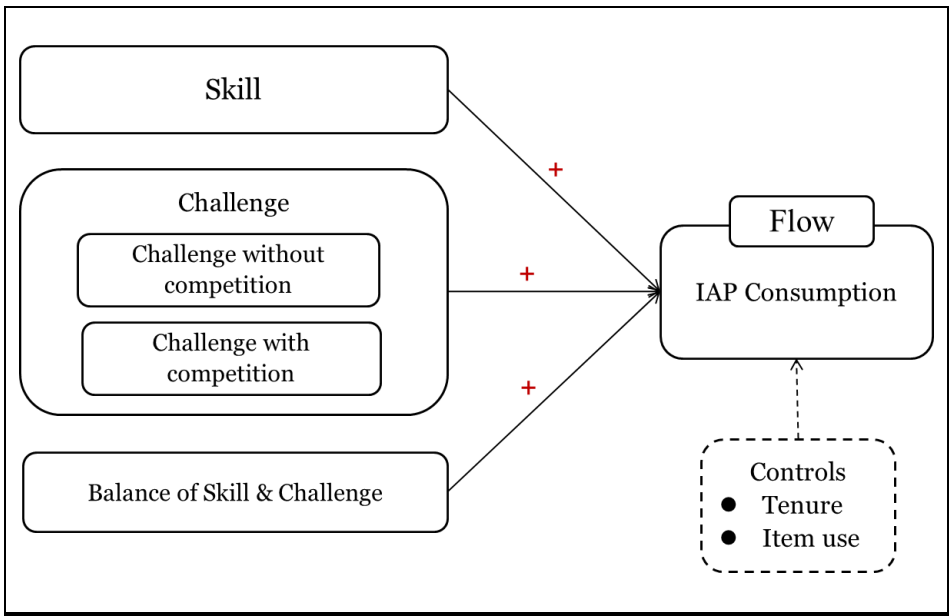


Figure 8. Research Framework

3.3. Research Methodology

3.3.1. Data

The research dataset for empirical analyses includes user-level gameplay log records gathered from a leading mobile game company in Korea. The chosen game is one of the most popular mobile puzzle games in the app store markets. Figure 9 presents screenshots of the mobile casual game. The basic mechanism of this game is similar to Candy Crush.

Figure 9. Snapshots of the Mobile Casual Game

This game has two types of play mode. Figure 10 presents these two types of play mode. One is a single player mode, “Stage mode”. In this mode, players can proceed the next stage after finding all card pairs with the same patterns in a limited period (e.g. 30 seconds or one minute). If players cannot match all card pairs in the limited time, they cannot move to the next stage and they can play again the same stage until they find and match all card pairs. Figure 11 presents the distribution of users by stage. X-axis presents the stage number, and y-axis presents the number of users.

Figure 10. Snapshots of Single and Multiplayer Modes

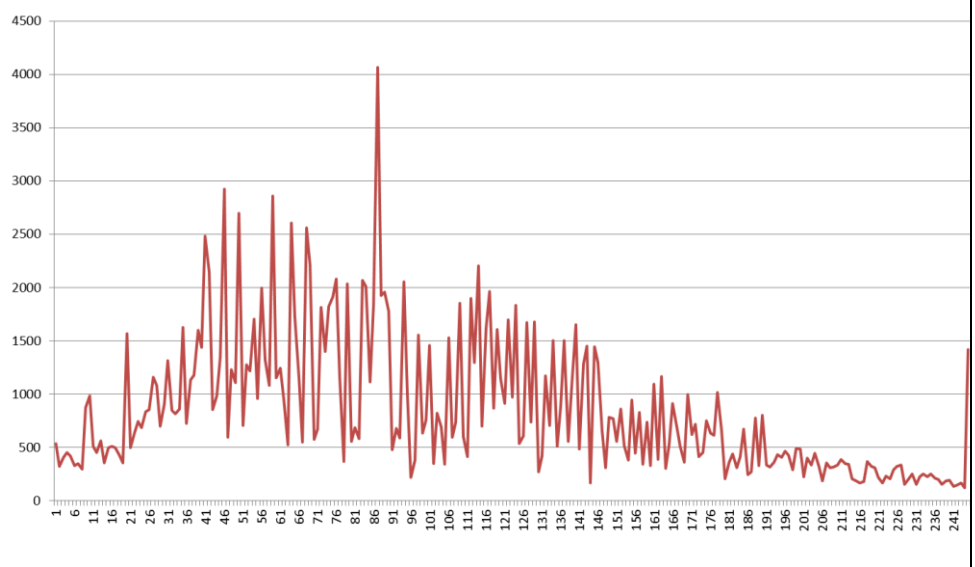


Figure 11. Number of Users by Stage

The other one is a multiplayer mode, “War mode”. In this mode, the game rule is game but players can compete with other player. The first one can be referred as “Challenge without competition”, and the second one can be referred as “Challenge with competition”.

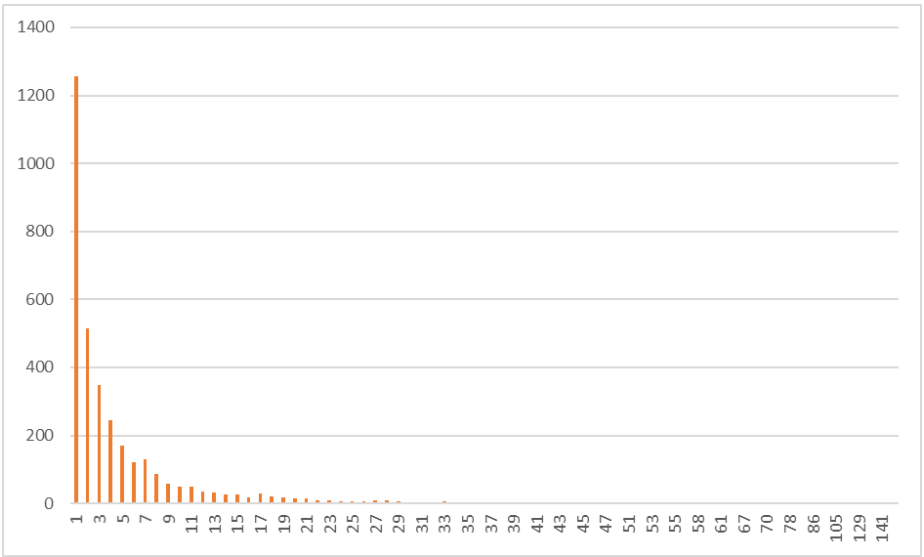


Figure 12. Number of Users by Purchase Frequency

Moreover, players can purchase virtual item with real-world money. In this research dataset, they can exchange money with “Diamond”. The price of ten “Diamonds” is 1.09 US dollars. Players can exchange Diamond with other virtual items, such as “Coin”, “Heart”, “Costume”, “Pet”, etc. Player can earn all items in the game, but in most cases “Diamond” can be purchased with real-world money. In this essay, paying users are defined as players who purchase virtual items (i.e. Diamond) by spending

real-world money during the observation period.

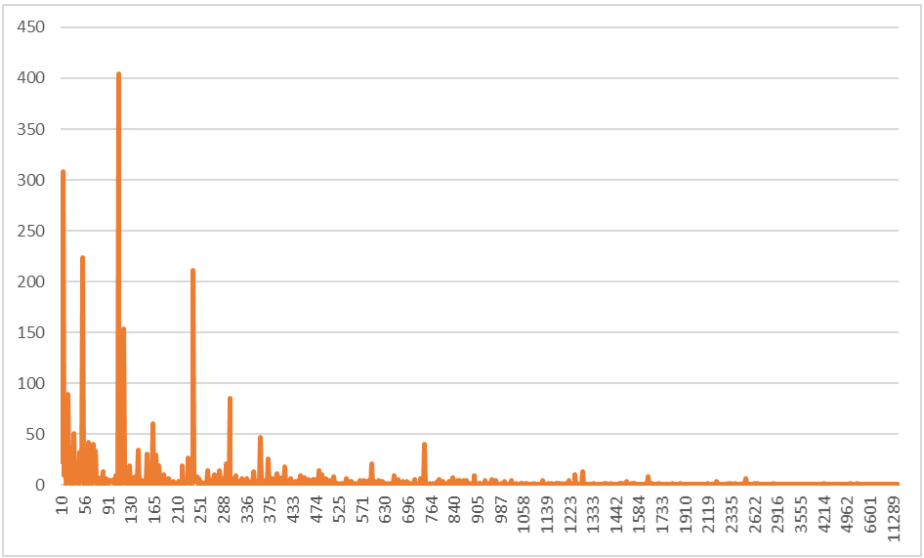


Figure 13. Number of Users by Purchase Amount

The detailed game playing information for 18,143 individual players (including 525 paying users) were recorded for 66 days from April 9 to June 13 in 2016. Specifically, the data contains the gameplays (e.g., play frequencies) and IAP consumption (i.e., purchase frequency and amount of IAP over the study period) of each player. Figure 12 and Figure 13 show the distributions of purchase frequency and purchase amount. X-axis presents the purchase frequency, and y-axis presents the number of users in Figure 12. X-axis presents the purchase amount, and y-axis presents the number of users in Figure 13. Two graphs shows power curve, and most of paying users purchase less than five

times or less than 100 items. In addition, most of paying users start to buy virtual items within a week as Figure 14. The details of key research variables and descriptive statistics are summarized in Table 8.

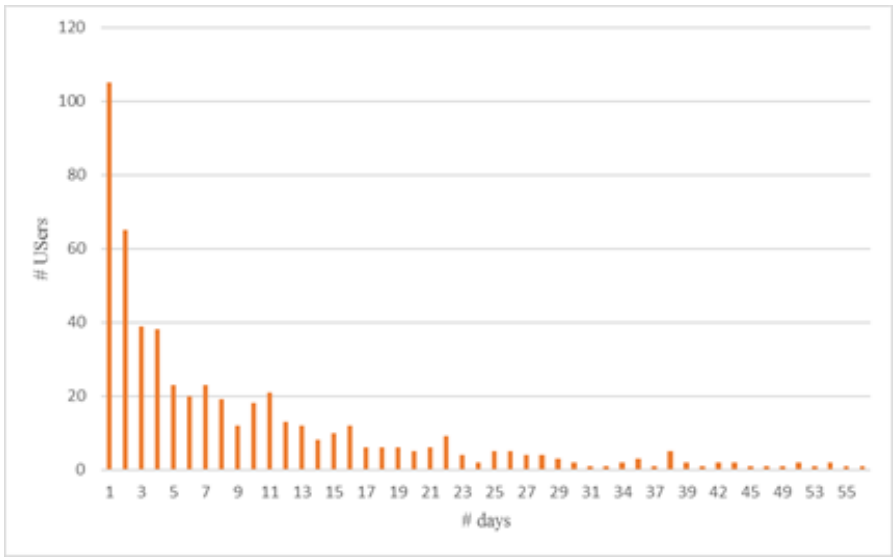


Figure 14. Number of Days until First Purchase

Table 8. Summary of Key Variables						
	Variables	Definition	Mean	S.D.	Min	Max
Dependent Variable	IAP_Freq_{it}	Player i's IAP frequency at t	0.218	0.895	0	31
Explanatory Variables	$Skill_{it}$	**Skill**, Player i's the ratio of latest stage to the last stage of game at t	0.201	0.109	0.002	0.931
	$Challenge_{it}$	**Challenge**, Player i's the ratio of losing frequency to total play frequency at t	0.617	0.243	0	1
	$Imbal\_Sk\_Ch_{it}$	**Imbalance between Skill and Challenge** Player i's imbalance at t, $\lvert Challenge_{it} - Skill_{it} \rvert$	0.433	0.219	0	0.973
	Ch_NoComp_{it} $_t$	**Challenge without competition** Player i's the ratio of losing frequency to total play frequency when i plays a game alone in player-and-machine mode at t	0.642	0.283	0	1

	Ch_Comp_{it}	**Challenge with competition** Player i's the ratio of losing frequency to total play frequency when i plays a game with other people in player-and-player mode at t	0.233	0.279	0	1
Controls	$NumDays_{it}$	Number of days by i at t after starting the game	21.602	15.301	1	190
	$ItemUseFreq_{it}$	Number of items used by i at t	2.929	8.918	0	65
(Paid Players: 525; Observation: 12,587)						

3.3.2. Analysis Model

The research dataset presents a large number of free players who never consumed IAP options during the study period (about 98% of all players) and a remarkably small number of paying users who consumed IAP at least once as Figure 15.

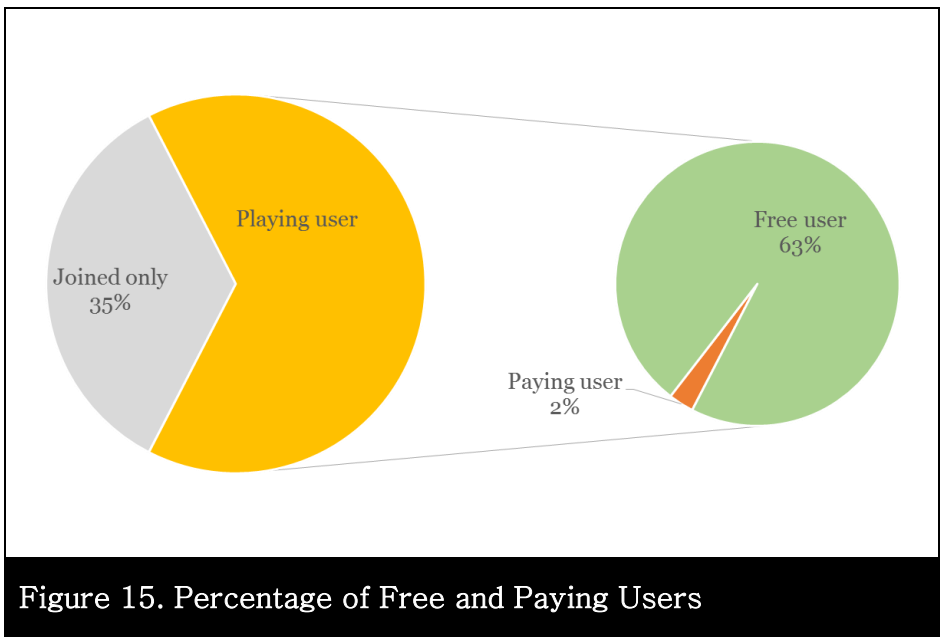


Figure 15. Percentage of Free and Paying Users

This reflects the fact that mobile app users are hardly paying for additional features or virtual items available from IAP options. A negative binomial regression for panel data over 66 days is utilized to examine the sampled players' IAP consumption over time (i.e., accumulated purchase frequency until a given time, t).

First, this research analyzes the effects of skill, challenge and the balance of skill and challenge as the first model, equation (1). Users are indexed by i and time is indexed by t. β_i is coefficients'

estimates for the frequency of item purchases this week. μ_i accounts for the individual cross-sectional effect, which is user characteristic. τ_t accounts for the time dummy. The error term $\varepsilon_{i,t}$ control for the idiosyncratic effects. Furthermore, to see the effect of competition, this research analyzes the effects of skill, challenge without competition, challenge with competition and the balance of skill and challenge as the second model, equation (2).

$$IAP\_Freq_{i,t} = \beta_1 Skill_{i,t} + \beta_2 Challenge_{i,t} + \beta_3 Balance_{i,t} + \beta_4 ItemUsedFreq_{i,t} + \beta_5 NumDays_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (1)$$

$$IAP\_Freq_{i,t} = \beta_1 Skill_{i,t} + \beta_2 Ch\_NoComp_{i,t} + \beta_3 Ch\_Comp_{i,t} + \beta_4 Balance_{i,t} + \beta_5 ItemUsedFreq_{i,t} + \beta_6 NumDays_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (2)$$

3.4. Analysis Results

3.4.1. Model-Free Evidence of Effect by Challenge with Competition

Before the results of main models, this essay seeks from the data suggestive evidence that could motivate the assumption of challenge with competition.

The distributions of paying users are difference depending on competition. The results can be explained by how people act to

challenge with competition or without competition. Challenge without competition can be in a single-player mode, and challenge with competition can be in a multiplayer mode in the context of this essay. Figure 16 presents the distribution of paying users based on skill and challenge without competition. Figure 17 presents the distribution of paying users based on skill and challenge with competition. As Figure 16, the values of challenge without competition are close to one for most users. This means that most users purchase items when they fail to win. As Figure 17, the values of challenge with competition are close to 0.5 for most of users. This means that most users purchase item when they have a closely matched battle. Most users are likely to buy when they want to win the game, but the values of challenge are different regarding the existence of competition feature. Most users purchase items when they reach their limit of their ability to win the game in the single-player mode. However, at the multiplayer mode, they purchase item when they think they still have a chance to win with a little assistance such as virtual items. For detail information, Table A1 presents the distribution of users by skill, challenge, challenge without competition, and challenge with competition in Appendix.

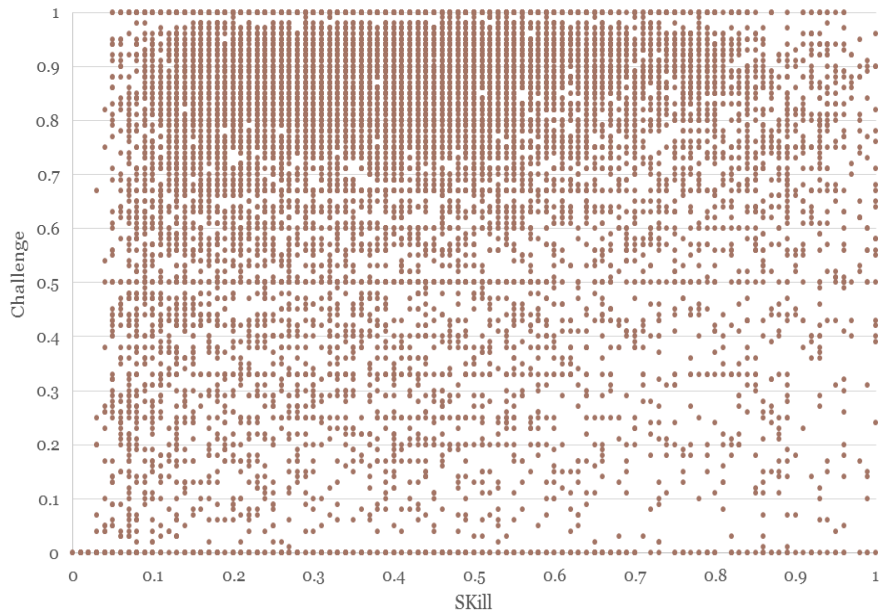


Figure 16. Distribution of Paying Users (without Competition)

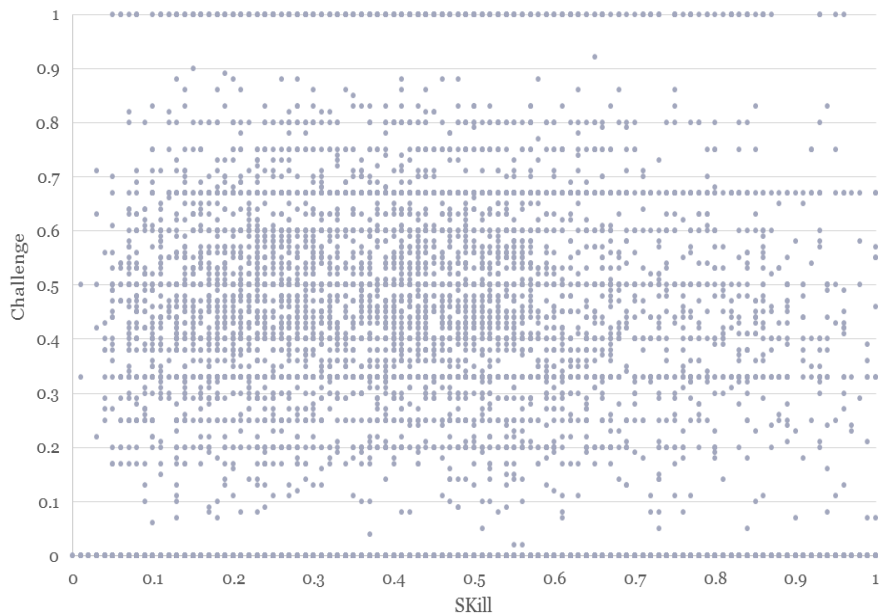


Figure 17. Distribution of Paying Users (with Competition)

3.4.2. Empirical Results of Model Ⅰ

The main results of this research are shown in Table 9. A negative binomial regression for panel data is carried out by considering these three factors (i.e. the effects of skill, challenge, and the balance of them) on players' IAP consumption. The results show that the effect of skill is positive but insignificant to the IAP consumption. Meanwhile, this essay finds the positive impact of challenge and negative impact of imbalance of skill and challenge on paying players' IAP consumption.

Table 9. Analysis Results From Model Ⅰ	
	IAP_Freq_{it}
$Skill_{it}$	0.737 (0.517)
$Challenge_{it}$	2.158^{***}(0.371)
$Imbal\_SK\_Ch_{it}$	-2.738^{***}(0.393)
$ItemUseFreq_{it}$	0.027^{***}(0.002)
$NumDays_{it}$	-0.044^{***}(0.008)
$NumDays_{it}^2$	0.000^{**}(0.000)
Constant	-1.398^{***} (0.120)
AIC(BIC)	9104.781 (9633.011)
Player Fixed Effects	Yes
Time(Day) Fixed Effects	Yes
# Observations	12,580
# Paying Players	525

** p<0.05, ** p<0.01, *** p<0.001*

3.4.3. Empirical Results of Model Ⅱ

Furthermore, to evaluate the effect of competition on continuous IAP consumption, a negative binomial regression for panel data is carried out by considering additionally challenge with no competition and challenge with competition. Table 10 presents the estimation results of model Ⅱ. Both challenge with no competition and challenge with competition show positive impacts on continuous use of IAP.

Table 10. Analysis Results From Model Ⅱ

	IAP_Freq_{it}
$Skill_{it}$	1.073^{*}(0.509)
$Imbal\_SK\_Ch_{it}$	-1.293^{***}(0.267)
Ch_NoComp_{it}	0.687^{**}(0.229)
Ch_Comp_{it}	0.538^{***}(0.112)
$ItemUseFreq_{it}$	0.025^{***}(0.002)
$NumDays_{it}$	-0.040^{***}(0.008)
$NumDays_{it}^{2}$	0.000^{**}(0.000)
Constant	-1.387^{***} (0.121)
AIC(BIC)	9094.3 (9161.259)
Player Fixed Effects	Yes
Time(Day) Fixed Effects	Yes
# Observations	12,580
# Paying Players	525

** p<0.05, ** p<0.01, *** p<0.001*

In sum, the findings of this essay suggest that skill, challenge and imbalance of them have different effects on players' consumption. Challenge is positively related to continuous use of IAP and imbalance of skill and challenge is negatively related to continuous use of IAP. Interestingly, this essay finds that the effect of skill is not significantly related to continuous use of IAP. In addition, the effect of challenge with competition has similar to that of challenge with no competition.

Table 11. Robustness Test From Model I	
	$log(IAP\_Amt_{it})$
$Skill_{it}$	0.124(0.414)
$Challenge_{it}$	0.254(0.144)
$Imbal\_SK\_Ch_{it}$	-0.655^{***}(0.159)
$ItemUseFreq_{it}$	0.041^{***}(0.006)
$NumDays_{it}$	-0.015^{***}(0.005)
$NumDays_{it}^2$	0.000^{**}(0.000)
Constant	-1.398^{***} (0.120)
AIC(BIC)	43123.37 (43175.46)
Robust Standard Errors	Yes
Player Fixed Effects	Yes
Time(Day) Fixed Effects	Yes
# Observations	12,580
# Paying Players	525

* p<0.05, ** p<0.01, *** p<0.001

3.5. Robustness Check

For robustness check, this research also conducts a fixed effects panel regression to examine the impacts of suggested factors on paying players' continuous usage of IAP (i.e., accumulated purchase amount until a given time, *t*). Table 11 presents the estimation results of robustness test from model Ⅰ. Among the effects of skill, challenge and imbalance of skill and challenge, only the effect of the imbalance is significant on the amount of IAP.

Table 12. Robustness Tests From Model Ⅱ

	$log(IAP\_Amt_{it})$
$Skill_{it}$	0.313(0.419)
$Imbal\_SK\_Ch_{it}$	-0.374^{**}(0.121)
Ch_NoComp_{it}	−0.043(0.102)
Ch_Comp_{it}	0.265^{***}(0.056)
$ItemUseFreq_{it}$	0.041^{***}(0.005)
$NumDays_{it}$	-0.015^{***}(0.005)
$NumDays_{it}^2$	0.000^{**}(0.000)
Constant	-1.387^{***} (0.121)
AIC(BIC)	43103.87 (43163.4)
Robust Standard Errors	Yes
Player Fixed Effects	Yes
Time(Day) Fixed Effects	Yes
# Observations	12,580
# Paying Players	525

** p<0.05, ** p<0.01, *** p<0.001*

Furthermore, in the respect of competition, challenge with competition shows significantly positive impact, but challenge with no competition shows insignificant on the amount of IAP as shown as Table 12. This implies that game developers need to more focus on generating the balance of skill and challenge, and encourage players to join competition instead of playing alone.

3.6. Discussion and Conclusion

This study investigates the key drivers influencing continuous use of IAP. The findings of this research suggest effective ways to motive continuous use of IAP with lens of flow theory. The findings of this research will contribute not only to the prior literature on studying the key factors in IAP, but also to mobile-application developers by suggesting how to make users continuous use of content consumption including IAP for a long-term success.

This research requires further improvements. First, there might be a causal relationship between IAP and playing frequency correlated. Players may play more and be more skilled after purchasing items, or vice versa. In the later version of this essay will control for this issue. In addition, the effects of promotional events in mobile games (e.g. offering free items) on IAP consumption could be considered in the future study. Therefore,

this research will be strengthen and elaborated after considering the above-mentioned limitations.

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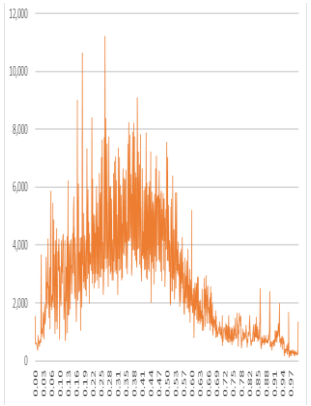
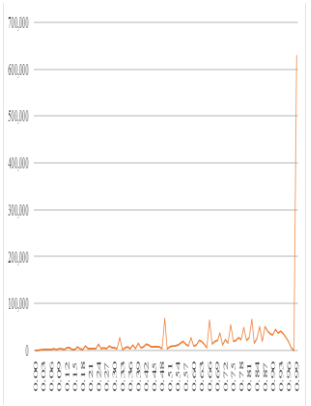
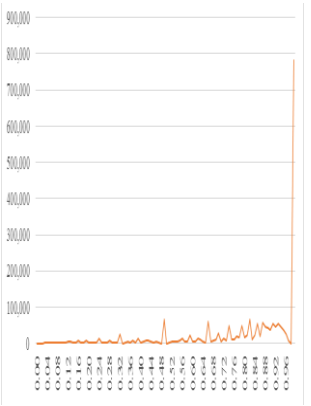
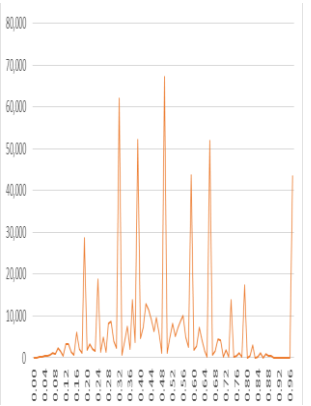
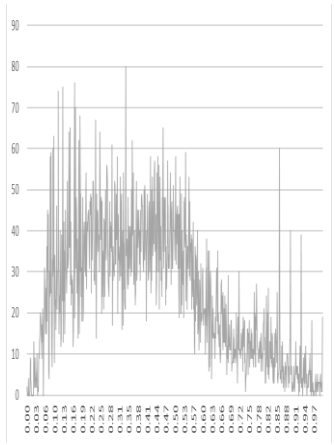
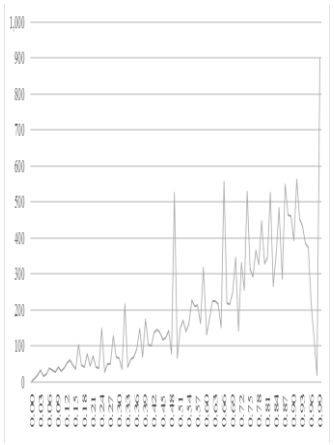
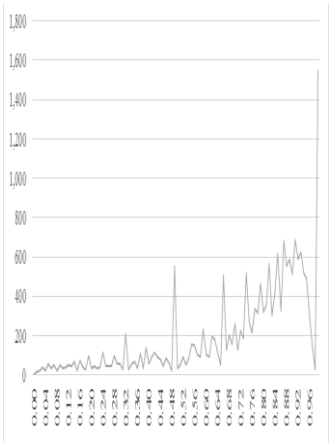
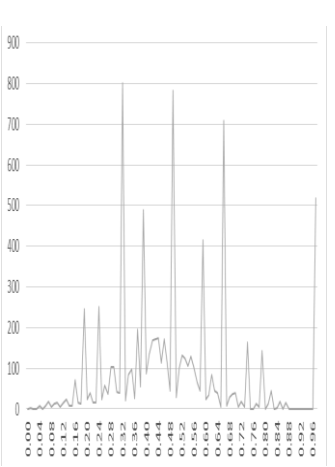
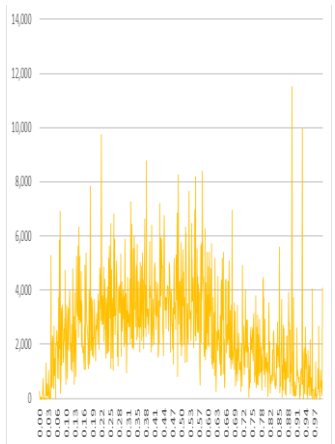
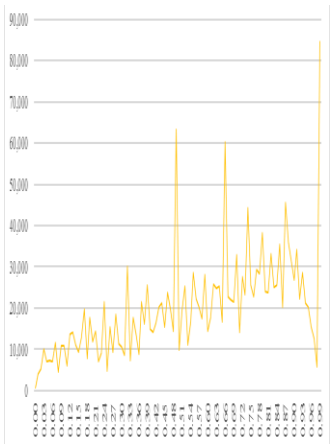
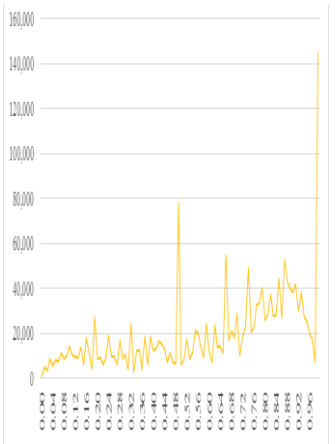
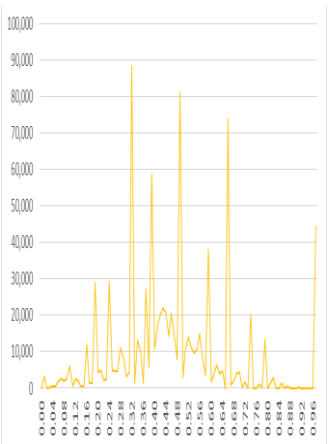
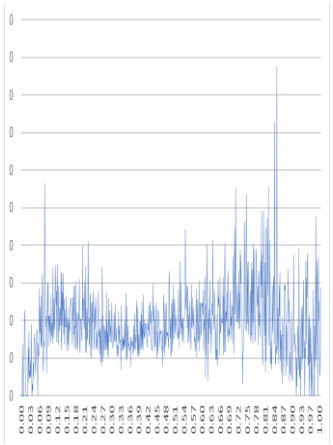
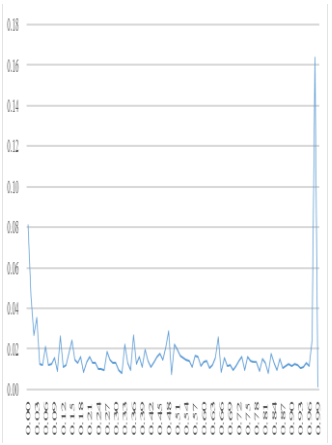
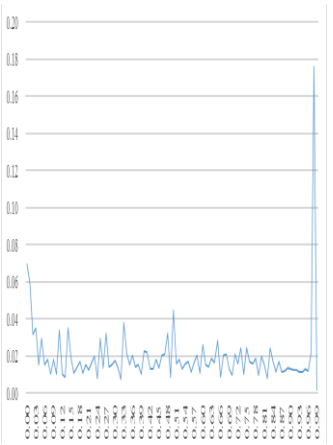
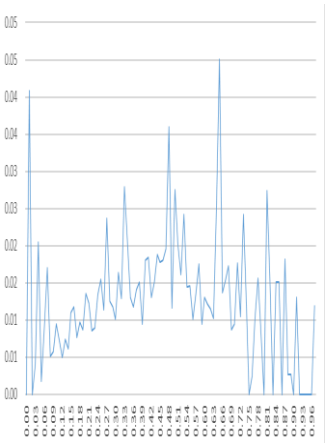
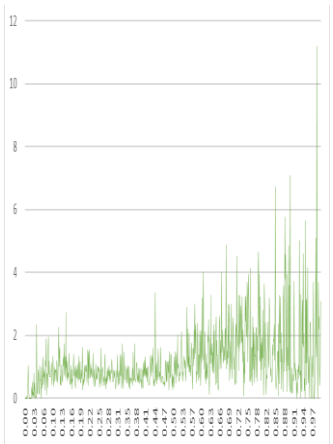
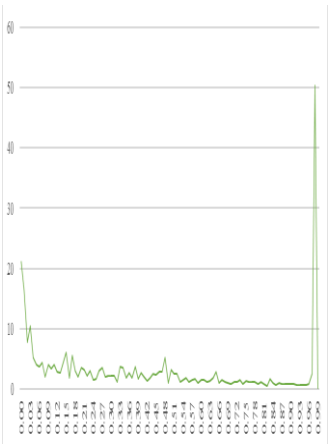
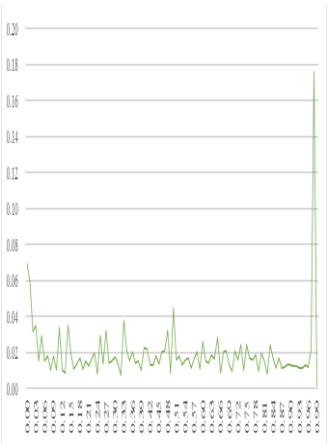
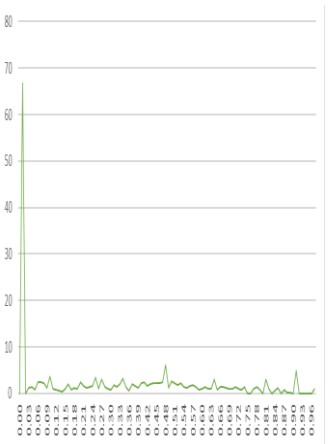
Table A1. Distribution of Users by Key Variables				
	Skill	Challenge	Challenge without competition	Challenge with competition
Number of Users				

Number of Item Purchase				
Amount of Item Purchase				

Average Number of Item Purchase				
Average Amount of Item Purchase				

초 록

모바일 앱의 성공 요인에 대한 실증 연구

: 모바일 게임의 사용자 유지와 유료화를 중심으로

장문경

서울대학교 대학원

경영학과 경영학 전공

고성능 스마트폰의 보급과 빠른 네트워크 환경으로 모바일 어플리케이션 (앱) 시장은 급속도로 성장하고 있다. 이렇듯 빠르게 성장 중인 모바일 앱 시장의 다양한 카테고리 중에서 단연 두드러지는 분야는 바로 게임 카테고리이다. 모바일 게임 앱은 많은 수의 유저를 보유하고 어느 카테고리의 앱보다 높은 수익을 달성하고 있지만, 동시에 경쟁이 가장 치열한 분야이기도 하다. 또한, 다른 카테고리에 비해 앱의 라이프 사이클이 비교적 짧기 때문에, 회사의 장기적인 성공을 위해 사용자의 앱 사용 기간과 인앱 구매에 영향을 주는 원인을 분석하는 것이 앱 개발자나 마케터들에게 중요한 이슈로 대두되고 있다. 더불어 모바일 게임 앱은 헤도닉 IT 시스템의 한 종류로 연구자들에게도 많은 관심 받고 있다. 하지만 모바일 게임 앱의 산업적 중요성과 향후 발전성에 비해 이에 대한 실증적 연구는 아직 미미한 실정이다. 이러한 기존 연구의 한계점을 극복하기 위해 본 연구에서는 사용자가 모바일 개임 앱을 사용하기 시작한 후

행동의 두가지 측면 – 모바일 게임 앱의 지속적인 사용과 인앱 구매 – 에 영향을 미치는 요인을 실증 분석하고자 한다.

먼저, 첫 번째 논문에서 모바일 게임 앱의 지속적인 사용에 영향을 미치는 요인들을 파악하고, 각 요인들의 영향력에 대해 고찰해보고자 한다. 주로 사용자들의 주관적인 느낌이나 생각에 따라 앱의 지속적인 사용이 어떻게 이루어지는가에 대한 기존 연구는 많이 시도되었으나, 실제 사용자의 앱 사용 이력 데이터를 바탕으로 실증 분석한 연구는 아직까지 미진한 실정이다. 이에 따라, 본 논문에서는 이용과 충족 이론(Uses and gratifications theory)을 바탕으로 앱 사용자의 니즈(Needs)와 그에 대응하는 충족(Gratification)이 앱의 지속적인 사용에 미치는 영향력에 대해 약 22만명의 8주 동안의 게임 로그를 생존분석으로 분석하여 고찰하였다. 먼저, 이용과 충족 이론을 바탕으로 사용자가 앱을 사용하여 얻을 수 있는 충족은 헤도닉 충족(Hedonic gratification), 실리적 충족(Utilitarian gratification), 사회적 충족(Social gratification)으로 나눌 수 있다. 각 요인들이 앱의 지속적인 사용에 미치는 영향을 분석한 결과, 헤도닉 충족과 사회적 충족은 앱의 지속적 사용기간에 양의 관계를 가지는 것으로 나타났으나, 실용적 충족은 앱의 지속적인 사용기간에 음의 관계를 가지는 것으로 나타났다. 이 결과는 앱의 사용기간을 늘리기 위해서 게임 개발자는 헤도닉 충족과 사회적 충족을 효과적으로 만족시킬 수 있는 요소를 게임 디자인에 반영해야 한다는 것을 의미한다. 그리고 사용자의 실리적 충족이 지속적으로 계속 만족되지 않을 때 이탈하기 때문에 끊임없는 콘텐츠 업데이트가 이루어져야 한다는 것을 뜻한다. 본 논문은 사용과 충족 이론을

바탕으로 모바일 게임 앱의 지속적인 사용에 미치는 요인을 도출하고, 앱 사용자의 실제 사용 로그를 분석하여 각 요인들이 앱의 지속적인 사용에 미치는 영향을 실증 분석하였다는 점에서 연구의 의의를 찾을 수 있다.

두 번째 논문에서는 모바일 앱의 유료화 방법 중의 하나인 인앱 구매에 영향을 미치는 요인들을 파악하고, 각 요인들의 영향력에 대해 고찰하고자 한다. 기존 연구들이 주로 사용자들의 주관적인 느낌이나 생각을 설문으로 파악하여 그에 따라 인앱 구매에 미치는 영향이 어떻게 다른지에 대한 연구를 시도하였으나, 실제 사용자의 앱 사용 이력 데이터를 바탕으로 실증 분석한 연구는 미흡한 상황이다. 이에 따라, 두 번째 논문에서는 플로우 이론(몰입 이론; Flow theory)을 바탕으로 사용자의 능력(Skill), 도전(Challenge), 그리고 이 둘의 균형(Balance)이 인앱 구매에 미치는 영향력에 대해 고찰하였다. 또한, 도전에 중요한 요인 중의 하나인 경쟁(Competition)이 인앱 구매에 미치는 영향력에 대해서도 연구하였다. 먼저, 제안한 세 가지 요인 – 능력, 도전 그리고 이 둘의 균형 – 이 인앱 구매에 미치는 영향을 분석한 결과, 도전과 균형은 인앱 구매에 양의 관계를 가지는 것으로 나타났으나, 능력은 인앱 구매에 유의미한 영향을 가지지 않는 것으로 확인하였다. 다음으로, 제안한 네 가지 요인 모두 – 능력, 경쟁 요소가 없는 도전, 경쟁 요소가 있는 도전, 그리고 능력과 도전의 균형 – 를 고려한 결과, 네 가지 요소 모두 인앱 구매와 양의 관계를 가지는 것으로 나타났다. 이 결과는 게임 개발자가 사용자의 능력에 맞는 도전 정도를 효과적으로 맞춰주고, 혼자 게임을 하는 것보다 경쟁

모드에서 게임 하는 것을 유도하는 것이 인앱 구매에 긍정적인 영향을 미친다는 것을 의미한다. 본 논문은 플로우 이론을 바탕으로 인앱 구매에 미치는 요인을 도출하고, 이를 앱 사용자의 실제 사용 로그를 분석하여 각 요인들이 인앱 구매에 미치는 영향을 실증 분석하였다는 점에서 연구의 의의를 찾을 수 있다.

주요어 : 모바일 게임, 인앱 구매, 플로우 이론, 이용과 충족 이론, 리텐션, 유료화

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