Spending Real Money: Purchasing Patterns of Virtual Goods in an Online Social Game

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ABSTRACT
Researchers have found that "social" factors contribute to purchasing intentions of virtual goods in an online social game, but little is known about *actual* purchasing behavior. Study 1 examined the relationship between social factors and virtual goods purchasing patterns using large scale data obtained by server logs of an online social game. Exchange of virtual goods and number of friends increased the likelihood of spending real money compared to no spending. Among those who did spend real money, giving virtual goods to others was the strongest factor associated with the amount of spending. Study 2 examined purchasing patterns of players who spent real money: high real-money spenders were buying items for visual customization while low spenders were buying consumable items necessary to sustain playing the game.

Author Keywords
social game; virtual goods; big data; consumer behavior; social exchange; customization; e-commerce

ACM Classification Keywords
K.4.4. Electronic Commerce

General Terms
Human Factors; Design; Measurement.

INTRODUCTION
Purchasing virtual goods is increasingly becoming a common feature of virtual worlds and online games [3,9,16,24]. The global virtual goods market has been rapidly growing: one market report estimated that the global market value of virtual goods was $14.8 billion in 2012 and would increase at an annual growth rate of 12.5% to 2016 [6]. Moreover, sales of virtual goods—once seen only in massively multiplayer online games (MMOs) and social network sites based in Eastern Asia—are now becoming a common feature of social network sites in the United States

and Europe, especially in social network game (SNG) applications [9,24].

Despite the prevalence of virtual good purchasing behavior in online games, there is little academic research that has examined *actual* virtual good purchasing behavior. Part of this is due to the fact that game companies do not share such information. Thus much of the research on virtual goods has been conducted from the player's (consumer's) perspective, and examining intention to purchase rather than actual behavior. Study 1 examines the relationship between behaviors captured by log data and players' actual spending behavior. This data-driven approach takes observable variables that are informed, but not exact proxies of psychological variables studied in prior research, providing a model that can be easily replicated in other game contexts. Study 2 examines spending patterns based on different types of virtual goods. By differentiating the spending behaviors of low and high real-money spenders, the results inform targeted design of virtual goods.

Understanding the factors that are associated with purchasing patterns of virtual goods is important to the HCI community because game companies are increasingly relying on sales of these goods as their main source of revenue. Traditionally, online games were subscription-based, requiring the player to pay a fixed amount every month or year to play the game. Now, newer games employ a free-to-play model, in which the game is free, but players can purchase virtual goods with real money to enhance their playing experience, whether that is to make their virtual character or space more visually pleasing, or to accelerate their progress.

Since most people play without purchasing anything, game designers must appeal to the pocket of the paying player without turning away the non-paying player in order to retain a large number of players. This poses a design challenge because the system must attract and retain two different types of players. This distinction is important because, as mentioned above, traditional online games with a single business model (subscription-based) were designed under the assumption of a uniform user.

Virtual Goods in Online Games
Most early online games—especially those popular in the Western hemisphere—did not require players to use real

money to buy virtual goods. For example, World of Warcraft had an internal economic system that required players to buy virtual goods with currency that could only be earned within the game. However, more game companies are now changing their revenue models to incorporate sales of virtual goods. In the context of online multiplayer games, which include MMOs and SNGs, one popular genre of virtual goods is that related to visual customization. These goods include clothing, hairstyles, and accessories for virtual characters (avatars), as well as furniture and home décor for virtual space. Another genre of virtual goods is related to game mechanisms, such as experience points. In many cases, these two genres are not mutually exclusive. For example, a piece of clothing may be aesthetically pleasing and be related to a game mechanism, such as enhancing certain skills.

Most often these virtual goods can be purchased from an in-game "store" that is run by the game company. Maple Story is a game that is a successful example of using virtual goods sales as a source of revenue: players can buy clothing for their avatars, digital pets, and items that are required to take care of the pet.

Not all virtual goods are purely eye candy. Farmville, for example, a SNG that lets players build a virtual farm, enables players to purchase virtual goods that will expedite their progress in the game. Kart Rider, an online social racing game, allows players to purchase virtual goods that will help themselves (such as a speed booster) or hinder others (such as a bomb).

Study Context: Puppy Red
This paper presents two studies that examine virtual goods purchasing behavior in the context of Puppy Red, a 3D social game service based in South Korea. Puppy Red is similar to social media services such as Webkins or Club Penguin and targets female players. Each player is provided with an empty island, which they can decorate with virtual goods.

Launched in 2003, the game has 5 million registered players and provides more than 15,000 different virtual items that range from avatar clothing and home decorations to pet accessories. Players create and dress up their own avatar and decorate their house. They can visit other players' houses, congregate in a public space, and engage in mini games or tasks within the game—such as picking apples—which will give them virtual currency in the form of beans.

Players can then use these beans to purchase clothes and animations for their avatar, furniture and decorations for their house, and food and accessories for their pets among others. The game operates on a free-to-play business model. There is no membership fee, but players have the option to purchase coins with real money. Coins are not necessary to play the game, but can be used to purchase special items.

Some items can only be purchased with coins, while others can be purchased with both beans and coins.

ECONOMIC BEHAVIOR IN ONLINE GAMES
Much of the research on economic behavior in online games has been conducted in the context of MMOs such as World of Warcraft and Everquest. Players of MMOs can visually represent themselves through a virtual character, or avatar, and traverse in an immersive environment that resembles a physical space. The economy within the game emerges out of the activities of the aggregate behavior of individuals through complex mechanisms of individual and interactive behavior. Scholars found that activities that the behaviors players engage in within the game draw parallels to "real world" activities that economists call production, trade, consumption, and labor [17].

Although there have been studies on macro-economic trends in online games [3,4], there has been relatively little literature on micro-economic behavior, such as consumer behavior, that incorporates behavioral data. Studies on micro-economic behavior—in particular, purchasing behavior of players—have been limited by the difficulty in acquiring large enough samples. Only a small proportion of players actually spend real money to buy virtual goods in online games, which makes it extremely difficult for academics to identify the players who spend real money, even if there are tens of thousands of people who fall into this category. Industry statistics have shown that about 34 percent of people who played MMOs bought virtual goods and 23 percent bought goods in a social network game [23]. Even for Nexon, a company that is considered a successful case in terms of profiting from virtual goods sales—it operates at a 35 percent margin—only 90 percent of the people who play its games actually pay actual money [2].

The literature on virtual goods purchases mainly comes from two perspectives. The first is a player perspective, examining psychological motivations and decision processes that are involved in the purchase of virtual goods. In the context of MMOs, Nojima [20] looked at the relationship between players' motivations and revenue models, finding that certain motivations—such as immersion—are correlated with higher levels of spending. Lehdonvirta [17] identified several different motivations unique for explaining virtual goods purchases: advancement in status, competitive advantage, keeping up with other players, experiencing new content, customization, and self-expression. He found that players' attitudes towards virtual good purchases are correlated with their motivations. Researchers have also tested the technology acceptance model of how perceived usefulness and attitude leads to purchase intention of virtual goods through player surveys [5,18].

The second perspective taken by scholars studying virtual good purchases is a pragmatic one that focuses more on technical affordances or design factors that affect purchasing. For example, Oh and Ryu [21] looked at how

game mechanics can be used to create and sustain demand for virtual goods. Hamari and Lehdonvirta [12] identified several mechanics that drive the desirability of virtual goods and then looked at how different types of game mechanics based on segmentation of players can generate repeated purchases or create settings for additional virtual goods.

These two perspectives are useful in understanding general purchasing behavior in an online environment, but this study will focus on the player perspective. In an online game that is inherently social in nature, interpersonal and group dynamics could strongly influence people's behaviors. The following section thus examines the social factors involved in purchasing behavior.

STUDY 1: SOCIAL FACTORS ASSOCIATED WITH SPENDING

Literature points to three social factors that have been empirically examined in the context of virtual goods purchases: social motivations, social presence, and social influence,

Social motivations have been found to be associated with spending. In the context of SNGs, researchers [24] found asked adult Facebook game players about whether or not they spent real money to buy virtual cash in the games. They found a significant positive correlation between social motivations (e.g., I play games on Facebook to… "find people like me," "to feel like I belong to a group") and spending. Motivation, however, is something that is difficult to examine with behavioral data, so we were unable to derive any testable hypotheses.

Social presence in a virtual environment has also been found to be positively correlated with purchasing intention [14]. Social presence is the feeling that an individual has that they are with other people in the virtual world [13], or the degree of salience of other people in an interaction [22]. In an experimental study, social presence and social interaction in Second Life were found to be positively related to purchase intention [14]. Social presence was also found to be positively correlated with purchasing intention of virtual goods in studies of Second Life [1] and Habbo Hotel [19].

The relationship between social influence and spending is mixed. Kim et al. [15] surveyed players of Cyworld and Habbo Hotel and, and found that players who had higher desire for online self-presentation were more likely to motivate their purchasing behavior. They explained that this self-presentation desire was driven by social norms [15]. However, although social influence has been hypothesized to predict spending in virtual worlds [10], empirical evidence has not been able to find a direct correlation between social influence and spending behavior in the context of Second life [11].

The above literature suggests that various social factors are correlated with spending. These constructs, however, are primarily psychological, requiring a self-report from the player. What has not been explored, however, is how social behaviors—such as exchange of virtual goods—and network factors—such as number of in-game friends—are associated with real-money spending. These factors do not require administration of a survey, and can be easily examined through log data by the designer. While not exact representations of the psychological constructs discussed above, these elements were selected with theories of social behavior in mind:

RQ1: *Are social factors (number of friends, giving and receiving virtual goods) associated with the likelihood of spending money in the game?*

The above research question examines how much social factors contribute to a player's *likelihood* to spend money in a game. However, do they explain the degree of spending? To our knowledge, consumer behavior literature has not examined this question, as studies have mainly looked at purchasing behavior as a dichotomous variable. If one were to look at spending as a continuous variable (i.e., how much money a player spends), would social factors still account for who spends more? We thus have an open research question that examines the relationship between social factors and the amount of real money spent by the player.

RQ2: *Are social factors (number of friends, giving and receiving virtual goods) associated with how much money a player spends in the game?*

One demographic factor to consider, especially in the context of this particular game, is age. Because the game caters to both under-age players and adults—and adults have more money to spend—these demographic groups should be examined separately.

RQ3: *Are there different spending patterns between adults and minors?*

Study 1 Methods

Tri-D provided access to three months of log data from Puppy Red. The company had been keeping track of all players' actions within the game for the entire seven years it had been in service, but did not provide all the data due to proprietary reasons. The log data comprised of demographic, behavioral and network variables that were recorded by the game server. Demographic data was based on the player's national ID information in their game account, which indicates birth date and gender. Behavioral data was captured when the individual performed a visible activity (i.e., clicking) that required a response from the main computer. This included the aggregate number of virtual items that were sent to other people by the player, aggregate number of virtual items received by the player, aggregate number of beans (virtual currency) collected by the player, and amount of real money (coins) spent in the

game. The server also recorded when the player logged in and out, thus enabling us to calculate how frequently a player visits and how much time they spend on the site. The data also showed how many in-game connections, or "friends" the player has. Much like the concept of Facebook Friends, this was not an indicator of true friendship, but a signal that two players mutually agreed to officially connect with each other within the game.

Puppy Red players were mostly female (76.4%), aged nine to 85 (*M*=20.91, *SD*=14.927). However, age information was based on the account information, which may not reflect their actual age. The game required players to enter their government-issued ID number, which confirms their date of birth—this is a common form of authorization used in South Korea. Players who are 18 years old or younger must receive authorization from their parents through a mobile age-authentication system, a system commonly used in South Korea. Underage players who went through this authentication process would have their actual age reflected in their game profile. However, it is very probable that parents create the account and have their children use it.

Due to the nature of how age data was collected, it could be that some children used their parent's or grandparent's ID, but it would be unlikely for an adult to use a child's ID. Thus any effects of age seen in adult data should be interpreted with caution, but age in the data for children's behavior may be a more valid measure.

Membership length ranged from less than one year up to seven years. The lower quartile of players had been on the site for less than a year while the upper quartile consisted of players who had been on the site for four or more years.

Analysis was confined to players who accessed the site at least once during the past three months, as there were many who had been inactive during that timeframe. We defined these players as "active players" (*N*=264,934). Among this population, 69,269 players (26.1% of total active players) had spent real money at least once during the three-month period. We defined this sub-sample (*N*=69,269) of active players who had spent real money as "active spenders." Active spenders were mostly female (79.7%), aged nine to 53 (*M*=22.75, *SD*=14.77).

Study 1 Results

Modeling likelihood of spending real money
To identify the factors that contribute to spending, a Binominal Logistic Regression was conducted on the data of all active players. The dependent variable measured spending of real money, with "not spending any money" coded as 0 and "spending money" coded as 1. Independent variables included the two social interaction factors (giving and receiving virtual goods), and number of friends. Game-related variables included membership length, frequency of visits, time spent on the site, and number of harvested beans, as someone who is more invested in the game may be more inclined to spend more real money. Lastly, individual factors such as gender and age were included into the model.

Two models were created to see the added effect of social factors. The first model contained demographic and game-play variables (time spent, number of visits), while the second model added social variables (number of friends, virtual goods given and received). Both models were significant with a Hosmer & Lemeshow Goodness-of-Fit Test of the models' chi-square statistic (*p*<.001). Model 1 explained 78.5% of spending correctly (Nagelkerke R^2=.24) while Model 2 explained 83.7% of spending correctly (Nagelkerke R^2=.41). Adding the social variables made a significant change (*p*<.001) in the R^2. Variance Inflation factors (< 2.8) indicated that colinearity was not an issue.

As can be seen in Table 1, all coefficients are statistically significant, which is expected with such a large sample size,

Variables	Model 1			Model 2		
	Beta	Wald	Exp	Beta	Wald	Exp
Constant	-1.45**	16929.37	.23	-1.94**	16736.40	.14
Age	-.01**	2196.56	.99	-.01**	1660.26	1.10
Gender (Male)	-.04**	13.36	.96	-.09**	43.95	.55
No. of visits	.03**	2630.40	1.03	.02**	1066.02	1.02
Time spent in game	.00**	854.55	1.00	.00**	266.11	1.00
No. of beans	.00**	3004.64	1.00	.00**	655.93	1.00
Virtual goods given				.62**	7507.63	1.86
Virtual goods received				.04**	320.36	1.04
No. of friends				.02**	14137.55	1.02
Model Chi-square [df]	45,402.98 [5] (*p*<.001)			87,931.68[8] (*p*<.001)		
Block Chi-square [df]				40,869.38[3] (*p*<.001)		
% Correct Predictions	78.5			83.7		
Nagelkerke R square	.24			.41		

Dependent variable: spending/not spending, ****p*<.001

Table 1: Modeling likelihood of spending money among active players (*N*=264,934)

	Model 1			Model 2		
Variables	Beta	Wald	Exp	Beta	Wald	Exp
Constant	-1.45**	16929.37	.23	-2.56**	3480.44	.08
Age	.05**	287.37	1.01	.05**	272.81	1.05
Gender (Male)	-.08**	16.68	.92	.04*	4.35	1.02
No. of visits	.03**	1100.15	1.03	.02**	503.88	1.02
Time spent in game	.00**	537.62	1.00	.00**	186.53	1.00
No. of beans	.00**	1846.84	1.00	.00**	427.03	1.00
Virtual goods given				.57**	3493.38	1.76
Virtual goods received				.03**	102.12	1.03
No. of friends				.02**	8164.58	1.02
Model Chi-square [df]	22541.29 [5] (p<.001)			43501.05[8] (p<.001)		
Block Chi-square [df]				20959.75[3] (p<.001)		
% Correct Predictions	75.6			80.1		
Nagelkerke R square	.22			.39		

Dependent variable: spending/not spending, *p<.05, **p<.001

Table 2: Modeling likelihood of spending money among active players under age 19 (N=138,166)

thus interpretation of the coefficients should be focused more on the effect size, which can be seen through the odds ratio. Giving virtual goods (β=.62, odds ratio=1.86) to other players and receiving virtual goods (β=.04, odds ratio=1.04) from other players were positively related with likelihood to spend real money. Each additional friend increased the likelihood of spending real money by 1.02 (β=.02, odds ratio=1.02). Comparing spenders with non-spenders, a post-hoc T-test comparison of means indicated that spenders (M=46.09, SD=55.71) had more friends than non-spenders (M=7.34, SD=22.76), t(264,932)=253.656, p<.001.

In terms of demographic variables, younger players were more likely to spend real money and females were more likely to spend real money than males. However, variables related to game play had a minimum impact on the likelihood to spend. In particular, time spent playing the game and virtual currency earned within the game almost had no effect at all on the likelihood to spend.

As it could be that adults simply have more money to spend that children and teens, the same analysis was conducted only looking at the subset of the sample that was under the age of 19, which is the legal age in South Korea. The results in regards to the effect of social interaction variables were very similar (Table 2), showing a very strong positive relationship between giving virtual goods to others and the likelihood of spending real money. Age, however, had the opposite effect; among players who were under 19, older players were more likely to spend real money.

Explaining amount of money spent
As noted above, only 26% of the population had spent real money in the game. The range of money spent during the three-month period was 455 won (about $.40) to 662,500 won ($587.15) with the mean at 3,160 won ($2.80). To

identify the factors that contribute to how much more money is spent among those who spend money, a negative binomial regression was executed on just the population of active spenders, looking at the amount of real money spent as a dependent variable. Somewhat similar to an OLS regression, a negative binomial allows a continuous count variable to be the dependent variable, but is used when the dependent variable is over-dispersed (standard deviation is higher than the mean) and the distribution is skewed. In the case of this data, the skewness was 11; skewness under 2 is considered to be a normal distribution.

Independent variables were the same as the ones used for the first three hypotheses; these included social factors such as number of friends, giving and receiving virtual goods; as well as time spent on the site, number of visits, number of harvested beans, gender, and age.

The first model was for active spenders who were 19 years old and older (Table 3). The mean age for players in this group was 51 years. The regression model was significant (Likelihood ratio Chi-square= 2,620.77, df= 8, p<.001). Again, due to the large sample, results should be interpreted by looking at the effect size in addition to statistical significance. Social interaction factors were a positive indicator of spending, although they were extremely weak. Giving virtual goods to other players was positively associated with the amount of real money spent. Receiving virtual goods from other players and the number of friends had a very small effect close to zero.

Game variables had a weaker effect in explaining how much real money a player spends in the game. Spending more time in the game or playing more frequently had next to no relationship to amount spent. Also, having a large amount of virtual currency was not statistically related to

spending more real money. Gender was insignificant and there was almost no effect of age.

	Beta	SE	Sig.
(Intercept)	9.38	.02	.000
Age	-.004	.00	.000
Gender (male)	.008	.00	.580
Time spent in game	1.99E-9	2.35E-10	.000
No. of visits	-.001	.00	.020
No. of beans	-1.77E-8	2.99E-8	.554
No. of Friends	.001	.00	.000
Virtual goods given	.056	.00	.000
Virtual goods received	.003	.00	.000

Table 3: Factors explaining amount of spending among active spenders 19 and older (*N*= 28,608)

The second model (Table 4) examined active spenders under 19 years of age, Likelihood ratio Chi-square= 2,015.45, df= 8, *p*<.001. Older players and females were more likely to spend more real money. Similar to the adult data, the amount of time spent in the game was weakly linked with using real money to buy virtual goods. Different from the adult data was a significant effect of gender: males were more likely to spend real money. Giving virtual goods was positively associated with amount of spending; receiving virtual goods was very weakly associated with amount of spending.

	Beta	SE	Sig.
(Intercept)	8.72	.03	.000
Age	.025	.00	.000
Gender (male)	.131	.02	.000
Time spent in game	1.18E-9	2.05E-10	.000
No. of visits	.001	.00	.036
No. of beans	9.60E-8	2.99E-8	.001
No. of Friends	.001	.00	.000
Virtual goods given	.053	.00	.000
Virtual goods received	.002	.00	.000

Table 4: Factors explaining amount of spending among active spenders under 19 (*N*= 40,661)

STUDY 2: PURCHASING PATTERNS: HIGH SPENDERS VS LOW SPENDERS

Study 1 looked at factors that contribute to likelihood of spending real money and factors that contribute to more spending of real money. However, the data did not provide any insights into what types of virtual goods were being purchased. The purpose of Study 2 was therefore to examine what kind of items players are purchasing and what currencies (real or virtual?) they are using to purchase those items because game had dual currencies: one that can be earned through play (beans), and another that can be purchased with real money (coins).

In the context of Puppy Red, it was difficult to compare the value of these two currencies because virtual currency requires time and effort inside of the game, while real money requires time and effort outside of the game. For certain currencies—such as gold in World of Warcraft or Linden dollars in Second Life—there are exchange systems where people can exchange real money for virtual currency. The famous "gold-farms" of China are a wonderful example of how people who want to save time purchase virtual currency from others [7]. However, not all items in the game can be bought with real money; in World of Warcraft, certain items can only be obtained by fulfilling a quest, and these items are not transferrable to other players. Similarly, in simulation games such as Farmville, there are items that can only be bought with real money, regardless of how much time one spends on the game. This raised additional questions about the relationship between players' behaviors in regards to the two different types of currency in an environment where the two currencies are not exchangeable:

RQ4: *What is the relationship between currency purchased with real money and currency earned through play?*

RQ5: *What are sales patterns of items by type of virtual good?*

RQ6: *What are the purchase patterns of high spenders vs. low spenders?*

Study 2 Method
Two separate data sets were obtained from Puppy Red: an item sales log and transactional data of players. The item sales log was an inventory list of all items and their sales during a one-month period, which included how many items were sold, what currency was used to purchase the item, and the price of the item. It did not contain any information on who the buyers were. The player transaction data was based on a random sample of 1,295 players who spent real money during the past three months as of the time of data collection. The game operator provided a log showing what items they bought and what type of currency (real or virtual) they used to purchase items.

First, categories of items were identified taking into consideration the existing taxonomy of items in the game's virtual shops and Lehdonvirta's [17] categorization of virtual goods. There were three main categories: avatar-oriented items, space-oriented items, and play-oriented items. Avatar-oriented items served the purpose of decorating or customizing the look of the avatar. An avatar is a virtual character that often represents the player and is created according to the player's preferences [8]. Items in this category included clothing items, beauty items—which can give variations on the avatar's hair and facial features—and accessories such as bags, jewelry, and gloves.

Space-oriented items were those that could be used for household decoration or landscaping. In the game, a humble house with bare furnishings and an empty island are provided to each player by default. Players can expand or renovate their space by purchasing items. Like avatar-

oriented items, space-oriented items were all about visual customization. They include home décor such as wallpaper and furniture, and landscaping items such as ponds and bridges. Although some expensive items served utilitarian functions—for example, a ferris wheel could provide avatars a ride—but most items were merely decorative. Play-oriented items were perishable items that would assist raising pets or caring for crops. The consumable aspect made play-oriented items different from avatar or space-oriented items, because they diminish with use.

Study 2 Results
RQ4 inquired into the relationship between spending and the two types of virtual currencies. Results indicated that increased membership length generally increased the average amount of virtual currency that was being spent, suggesting that players become more efficacious in how to earn virtual currency. For real money, spending increased for players up to four years, then declined. This may be reflecting an exit pattern, or lack of new items that can be purchased with real money. However, given that the system generates new items every week, it is more likely to be the former explanation than the latter.
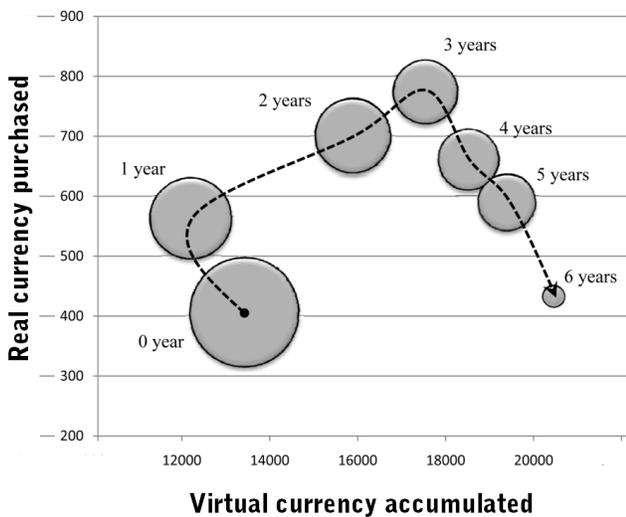

Figure 1: Relationship between amount of virtual currency accumulated (X-axis) and real currency purchased (Y-axis) based on membership duration

To see the relationship between the two different types of virtual currency, players were divided into seven groups in one-year intervals depending on how long they had been a member. As indicated in Figure 1, "0 year" indicates the player group whose membership period is less than 1 year and "6 years" are players who were on the site for more than six years but under seven years .The bubble size represents the number of players belonging to each group and the values of X- and Y-axis respectively indicate the groups' average amount of collected beans and coins bought with real money per month.

The "0 year" group has the largest player pool, but has the least amount of coins, indicating that newest players spend the least real money. The number of coins increases and peaks for players who were on the site for three or more years but less than four years, but subsequently declines.

To explore RQ4, item sales were aggregated within each category and the frequencies were converted to percentages (see Table 5). A price index for each category was calculated by dividing the average price of items affiliated to each category by the average price of total items. The price index for avatar items was 1.20, indicating that the price of avatar items are 1.20 times the average price of all items.

As mentioned above, Puppy Red uses two kinds of currency in parallel: coins (real money) and beans (virtual currency). There were noticeable differences regarding how people spent these different currencies. In terms of the quantity of items bought with real money, players spent most real money on avatar-oriented items (60.6%), followed by space-oriented items (26.8%) and play-oriented items (12.6%). However, the order was reverse with items bought using virtual currency (beans): players spent most beans on play-oriented (45.8%) items, followed by space-oriented (41.7%) and avatar-oriented (12.5%) items. This suggested that players are spending real money on items that enable visual customization, while items used for game mechanics were purchased with beans, which can be obtained through play. Play-oriented items required continuous replenishment, which may be why players were more inclined to purchase those items with beans.

Item category	Sales (Units)		Sales (Price)		Price index
	Beans	Coins	Beans	Coins	
Avatar	12.5	60.6	36.5	65.1	1.20
Space	41.7	26.8	41.3	28.0	0.78
Play	45.8	12.6	22.1	6.8	1.08
Total	100.0	100.0	100.0	100.0	

Table 5: Percentage of virtual goods spending patterns by category

This item-buying pattern is similar to that of the real world in the sense that people first satisfy basic needs to sustain living with hard-earned money and then allocate their extra resource into luxuries later. Players spent their beans to buy the play-oriented items in terms of necessities for sustaining services (such as feeding their pet), and then used real money to pursue the higher hierarchy of needs such as cosmetic products or cars.

Once virtual items are designed and released, the marginal cost for reproducing these items is close to zero for the characteristics of distribution of digital contents, therefore selling expensive items means higher profit to the service operator. The price index is a relative measure of how expensive the item is in comparison to other items. The price index of each item category in Table 5 shows that the

price of play-oriented items (consumable items used to take care of pets or plants) is cheaper than avatar-related items. This indicated that despite the fact that "rearing" items were relatively less expensive to buy with coins compared to other items, players still chose to buy those items with beans.

To examine RQ5, players were divided into three groups based on their level of spending real money. These three groups were labeled "high spenders," "low spenders," and "non-spenders." Players who never spent real money were defined as non-spenders. Non-spenders did not spend real money to buy virtual items; they only used beans.

Spenders were players who had logged into the game at least once in the past three months and had spent real money at least once during that time. In this population, players had spent real money on virtual items ranging from $.05 to $210, with the mean amount at $9. High and low spenders in this player sample were defined by sorting the players by the amount they spent during the sampled period and then drawing a boundary that equates the aggregate sum of money spent between the high and low spenders; in other words, 89.7% (low spenders) cumulatively spent as much as the other 10.3% (high spenders).

Item-buying patterns between these two groups were examined by calculating the percentage of real money spent on each category of items then testing the significance of the difference between the two groups through means comparison T-tests. Low spenders spent 48.6% of their real money on play-oriented items mainly for taking care of their pets, followed by avatar (28.6%) and space (22.8%) items. In contrast, high spenders preferred to spend their money on items to customize their avatar (48.4%) and space (44.8%) rather than consumable play-oriented items (6.8%). The differences between these two groups were significant at the $p<.001$ level for all three item categories.

DESIGN IMPLICATIONS

In Study 1, log data of a 3D social game was used to examine factors that contribute to spending of real money. Using two regression models, results indicated that engaging in more social interaction, such as giving virtual goods, and having more in-game friends increased the likelihood of spending. However, social factors played a weaker role in terms of how much money players were spending.

Study 2 investigated what types of virtual items are sold and how the item-purchase patterns differ according to the extent of spending. High spenders mostly buy decorative avatar-oriented and space-oriented items using real money, while low spenders mostly buy consumable play-oriented items with hard-earned virtual currency.

The Effect of Social Factors

Time spent on site and earning virtual currency on the site had no effect on the likelihood to spend real money. This suggests that merely playing a lot on these sites doesn't encourage spending, but social playing does. In particular, giving virtual goods to other players was the strongest factor of all independent variables that contributed to whether or not the player spent real money. This suggests that game operators, when marketing their virtual goods to players, should focus on creating advertisements, promotional campaigns, or in-game quests that appeal to "gifting" behavior.

For example, Puppy Red sends out a weekly newsletter via email to its players informing them of the new items added to the virtual shop. Instead of presenting a static list of items, adding a persuasive message, such as "your friend may appreciate this new item" or framing certain items as a "perfect housewarming gift" may be a way to encourage players to purchase the item to give to their friend. Since giving virtual goods to others increases the likelihood that someone will spend real money, game designers may also want to provide reminders to players about their friends or even suggest reciprocity when the player receives a virtual item from another player.

Having more friends in the game also increased the likelihood of spending real money; this implies that game designers can devise in-game quests that encourage connecting with other people, or build more communication channels within the game to facilitate social interaction.

Social factors were strongly associated with whether or not an individual spent real money. However, they were not very strong in explaining *how much* money people spent. This suggests that different design strategies are required when trying to get people to spend more. Even with the weak associative value, social interaction factors can still contribute to significant increase in revenue when looking at large-scale populations. Of note, game-related factors, such as time spent and frequency of play, were not salient at all in explaining the extent of spending real money.

For both adults and minors, giving virtual goods to others in the game was the strongest positive factor associated with how much the player spends in the game. Time was a very weak factor. Time, which is often seen as a proxy of engagement, is strongly correlated to habit strength [25], so for game designers, efforts that are aimed at keeping players engaged in the game may not directly relate to their revenue. This may be particularly important for free-to-play games, because this indicates that players do not have to spend more time in the game to be spending money. Thus keeping the players engaged in the site in a short timeframe becomes just as important, if not more, than attracting players into the game. Constantly introducing new virtual goods that are related to aesthetics may be a way to retain high spenders.

People who had more friends were more likely to spend money than people who had less friends, but the added number of friends did not explain increased spending

among spenders. These results suggest that the quality, not quantity, of social relationships within the site could affect why players spend more. Creating more features in the game that allow players to strengthen those strong ties could lead to more spending, while features in the game that allow players to build weak ties could encourage players who do not spend anything to spend at least something.

Age Differences in Spending

Among younger players, more virtual currency earned in the game was weakly but positively associated with real money spent in the game. This may seem counter intuitive, because if you had a lot of virtual currency, why would you want to use real money? However, the dual currency system of Puppy Red may work in their favor—as mentioned earlier, some virtual goods in Puppy Red can only be bought with real money. Thus one currency does not necessarily decimate the value of the other, and people who are more likely to purchase virtual items show the same pattern using both virtual and real currency. This suggests that having a dual currency system where the two currencies are not interchangeable can be advantageous to the game designer because it encourages the player to spend both time in the game and real money. However, this pattern was not present among older players. For players who were 19 years old or older, the amount of virtual currency they had in the game did not have any relation with the amount of real money they spent. This may be because the value of the time required to acquire virtual currency is greater for adults. Further exploration is needed to see why there are differences between adults and children, and if there are differences between adults who are playing for their own pleasure and adults who are playing because of a child.

High spenders vs. Low Spenders

The results of study 2 showed that players who spend a lot of real money purchase items that have decorative but no functional value, while players who spend a little money purchase items that are more consumable. This mirrors purchasing behavior of luxury items in the physical world and supports research on MMOs [3] that have found parallels between in-game economy and real-world economies.

From a marketing perspective, these results provide insights about how different marketing strategies should be used for these different sub groups. Currently, most gaming companies send out bulk newsletters, or have the same introductory screen when players log into the game. If the companies are able to identify what type of spender the player is, they will be able to deliver a more effective marketing strategy.

From a design perspective, it may be advantageous to keep the price range for consumable items narrow, since low spenders are the ones who are purchasing those items, and increase the price range for avatar and space-related items. Creating visually unique items, or limited-edition items may increase the appeal for high spenders.

Limitations

This study is based on log data of a social game service, which makes behavioral data more accurate than self-reported behaviors via surveys. However, this methodology has limitations in that it does not explain why the players are engaging in such behavior. Future studies should try to merge both player perception through surveys and pair it with behavioral data, which would provide more insight into why players engage in certain spending patterns or what elements of social interaction influence different types of spending.

The game service is based in South Korea where broadband penetration rate is high, youth have high Internet usage, and micro-payment services are widespread [21]. This may make our results difficult to generalize to all countries or cultures, especially as some studies have found that cultural differences in game play are associated with virtual goods spending [16]. However, these purchasing patterns at the very least may generalize to other collectivist cultures, and could be valuable to countries that are beginning to see rapid developments in micro-transaction revenue models involving virtual goods. These results may not generalize to all games, especially those games that are action-oriented or have more linear narrative-driven game play. However, findings may apply to the understanding behavior of players in games that have strong mechanisms for visual customization (e.g., avatar decoration, virtual space decoration) and caretaking (e.g., raising a pet, growing crops).

CONCLUSION

As selling virtual items become a major revenue source for social network and social game service operators, this study takes a big data analysis approach to factors that are associated with virtual goods purchasing patterns. This study tested variables that were informed by theory-based empirical studies, and while prior studies mainly examined behavioral intention, this study was able to examine actual behavior.

By examining actual behavior, this study found that social factors play different roles in terms of explaining an individual's likelihood of spending and the extent of their spending. Most consumer theories of purchasing do not make the distinction between these two concepts. This behavioral data suggests that the socio-psychological mechanisms involved in purchasing intention are different from those that are involved in how much money an individual spends, and informs development of future theories.

The results of this study also inform game design by identifying how different types of players based on their

spending patterns. Study 1 suggests that game elements that enhance social presence, such as virtual goods exchange and having more in-game friends, are important in distinguishing real money spenders vs. non-spenders. When it comes to looking within spenders, however, Study 2 shows that there are major differences in purchasing patterns between high spenders and low spenders. Understanding player types from the perspective of how much they spend will allow for different strategies, especially in the design of different types of virtual goods and different types of marketing strategies of those goods.

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