Variety in the video game industry: An empirical study of the Wundt curve

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Abstract

This study analyzes the effect of variety on consumer utility using historical behavioral information for 1,397 consumers participating in 729,049 unique rounds of play. We show that consumers generally exhibit a preference for variety as part of their gameplay utility. The relationship between variety and utility is non-linear and follows, at least for some types of variety, an inverted u-shape as predicted by the Wundt curve. Our results represent the first such evidence on the importance of variety in video gaming, which has significant implications for consumption through optimization of gameplay utility to satisfy the demand for variety.

Keywords: Preferences; Video game industry; Fixed effects regression; Wundt curve; Variety

JEL Classification: C33; C55; D12; L82; M21

Introduction

The market for video games has evolved significantly since its origins in the amusement arcades of the late 1970s and early 1980s, particularly thanks to the pervasiveness of Internet connectivity, multiplayer online experiences, and mobile and social gaming. The supply of new and innovative ways in which video games can be played has led to adoption by a wide variety of consumers and recent evidence has shown that around half of American adults play video games of some form (Pew Research Center 2015). Indeed, far from being the exclusive preserve of adolescent boys, the average video gamer in the US is now suggested to be 35 years of age and has been playing for 13 years, with a gender split of around 59/41% between male/female gamers, respectively (Entertainment Software Association 2016). The commercial performance of the video gaming sector continues to grow substantially around the world. For example, the US market is expected to grow at a rate of 3.6% annually from 2015 to reach a total of $20.3 billion by 2020, outperforming anticipated growth in other entertainment products such as TV, cinema and music (PwC 2016). The global market is predicted to expand even more rapidly, increasing in size from $91.8 billion in 2015 to $118.6 billion by 2019 (NewZoo 2016). A succession of individual video game software titles have also achieved noteworthy sales performances in recent years. The game Minecraft has now sold more than 100 million copies (Mojang 2016) and Grand Theft Auto V generated sales of 11.21 million units and revenues of more than $815 million during the first 24 hours of release, setting a world record for the launch of an entertainment product (Guinness World Records 2013).

As a consequence of such significant revenue potential, the relatively concentrated market for video gaming hardware is categorized by fierce competition between rival firms to establish a dominant technical standard (Shapiro and Varian 1999). Given that individual video game titles have a limited lifespan due to their tendency to become 'played out' (Hagiu 2009), competition between hardware platforms has tended to be driven by the degree of variety offered in the number of compatible software products (Clements and Ohashi 2005). Additionally, video game publishers are increasingly adopting a range of new approaches to monetization, including 'in-app' purchases, micro-transactions and subscription-based services (Davidovici-Nora 2014), leading to the evolution of individual software titles into viable content delivery platforms in their own right. Video game publishers make use of these platforms to sell complementary add-on and subscription services and must therefore consider how to best incentivize repeat consumption to sustain these new business models (Cheung et al. 2015). Practitioners as well as academics face challenges in identifying the specific, observable factors that affect the consumers' utility in multiplatform and multiplayer video games. If successful in doing so, video game publishers will be able to maximize the benefits associated with the offering of new expansion packs, premium accounts including access to additional content, and the release of new game titles. As expansion packs and additional content increase the level of variety within the gameplay experience, establishing an optimal level of variety within the gameplay has become an important managerial issue.

Our study develops and extends these arguments through investigating the extent to which variety affects consumer utility in the context of multiplayer online video gaming. Ours is the first study to our knowledge that provides empirical evidence on the importance of variety of gameplay using real, in-game data reflecting actual consumer behavior. As a consequence, our research outlines the extent to which video game publishers might be able to improve consumer utility through the design of games to meet consumer preferences for variety. The remainder of this paper is organized as follows. The following two sections outline the key theory and literature that lead to the development of our research hypothesis. This is followed by a section where we provide a more detailed description of our data and modeling approach. Finally, we present a section containing an analysis of our empirical findings, followed by a discussion of the results, which includes a number of important managerial implications.

The Wundt curve

Scitovsky (1976) was the first one to use insights from the psychology literature to highlight the associations between consumer utility and variety, pleasure and change. He showed that the relation between variety and utility follows an inverted u-shape. This function is known as the *Wundt curve* in honor of Wilhelm Wundt (1874), an experimental psychologist who used it to demonstrate the relationship between stimuli and the resulting pleasantness (Berlyne 1971).

Scitovsky (1976) informally introduced the *Wundt curve* in an economic context by applying psychological principles to economic problems. According to Scitovsky and the behavioral "law" of psychology, change is an important aspect of utility derivation, which in turn calls into question the very notions of fixed consumption patterns and static equilibria implied by the notion of stable preferences. Utility might be gained by a stimulus depending on the novelty of the consumer's experience. This subjective novelty represents variety in the consumption of a good. Additionally, the relationship between subjective novelty/variety and consumer utility is characterized by an inverted u-shape, essentially highlighting how increases in variety can be utility enhancing up to a point, while additional variation or variety becomes welfare reducing.

Middleton (1986; 1987) was the first one to actually model this particular relationship formally. He shows that the relationship between subjective novelty and consumer utility is characterized by an inverted u-shape and thus gives theoretical evidence for the existence of the Wundt curve. In Middleton's framework, variety is considered to be utility enhancing for a consumer due to its potential to offer subjective novelty; in other words, consumers value new and unexpected experiences. Utility is derived through a combination of both "physical" characteristics and "informational" utility. Whereas physical characteristics are defined by intrinsic tastes, i.e. individual preferences for first-person shooters over adventure games, informational utility is enhanced as a result of exposure to new information or characteristics. In the context of video gaming, this might be the introduction of different player roles which alter the gameplay when changing between them. As a consequence, consumer preferences will be fluid due to both informational context and the pursuit of subjective novelty from product characteristics.

More specifically, Middleton (1986) models informational utility, which reflects a consumer's preferences for subjective novelty, using the framework of information theory. Assume a series of n mutually exclusive, independent events $E_1, \ldots, E_n$. As a consequence of exposure to "messages" containing information $s_1, \ldots, s_n$, the probabilities of each event occurring $p_1, \ldots, p_n$ is publicly known. The surprise occurrence $h(p_i)$ of an event E_i is therefore defined as

$$h(p_i) = \log \frac{1}{p_i} \qquad \text{for all } i = 1, \ldots, n. \tag{1}$$

Newly available information contained in message s_i' updates the probability of event E_i occurring to q_i for all $i = 1, \ldots, n$. The probability of a surprise event now changes from $h(p_i)$ to $h(q_i)$ with the marginal information offered by the message given by

$$h(p_i) - h(q_i) = \log \frac{q_i}{p_i} \qquad \text{for all } i = 1, \ldots, n. \tag{2}$$

This measure is equal to zero if the two probabilities are equal, $p_i = q_i$, which would be the case should the message not reveal any new information. If the probability of a surprise outcome diminishes, i.e. $q_i < p_i$, the measure becomes negative. If the event E_i subsequently occurs, the message s_i' would have offered a negative information value. The *expected information* $I(p : q)$ by message s_i' changing p_i to q_i over n events is

$$I(q : p) = \sum_{i=1}^{n} q_i \log \frac{q_i}{p_i}. \tag{3}$$

Middleton (1987) argues that a consumption decision involves N non-mutually-exclusive characteristics. *Subjective novelty* Φ may then approximated by summing all the expected information across the distributions of different characteristics n_j ($j = 1, \ldots, N$):

$$\Phi = \sum_{j=1}^{N} I(q : p) = \sum_{j=1}^{N} \sum_{i=1}^{n} q_i \log \frac{q_i}{p_i}. \tag{4}$$

Thus, subjective novelty occurs by the revelation of new information. Subjective novelty might also be called variety. More clearly, in our game context, a consumer experiences variety by using different opportunities the game offers, such as playing different roles. With the use of each new role, new information is handed over to the consumer.

After modeling the subjective novelty Φ, Middleton (1986) now formulates its relationship with (informational) utility W. The introduction of subjective novelty or variety is beneficial for consumers at first. But if the amount of subjective novelty becomes larger, the increase in utility gets smaller first before it is reversed and utility is actually decreased. The consumer faces too much new information or too much variety. This relationship is demonstrated by the *Wundt curve* (see Figure 1) as follows

$$W = -\Phi^2 + b\Phi \qquad\qquad (b > 0) \tag{5}$$

which is maximized at $\Phi = \frac{b}{2}$. Up to this point, subjective novelty is utility enhancing; afterwards, the relationship is reversed and the utility is decreased by more variety. Thus, there exists an optimal amount of subjective novelty where utility is maximized.

[Figure 1 about here]

According to Middleton (1986), the consumption of books, music and similar goods yields mostly informational utility. Based on this model, we aim to establish whether there is informational utility gained from video games or, more precisely, whether the utility derived from exposure to variety in video games follows the inverted u-shape. Following the model of Middleton (1986; 1987), a consumer derives informational utility from subjective novelty or variety offered by a good, although this utility function follows an inverted u-shape as per the Wundt curve. Greater variety therefore initially results in an increase in utility that diminishes at the margin up until the relationship is reversed and further increases in variety resulting in a decrease in utility. Thus, there is an optimal amount of variety in the gameplay that yields the maximum level of utility. Summarizing the discussion above, the following competing and testable hypothesis can be derived:

H_1*: The relationship between utility and variety is characterized by an inverted u-shape.*

Previous studies on variety

Video games represent classical examples of experience goods, as consumers are not able to assess their product quality before consumption (Cox and Kaimann 2015). Thus, video games are characterized by information asymmetry between consumers and producers and a lack of ex ante knowledge of product quality. Other examples of experience goods are wine, movies or music. However, relatively little empirical evidence on the relationship between the Wundt curve and experience goods has appeared in the economics literature to date, meaning that consumer behavior in the context of information asymmetry remains a vivid research area. Simonton (1980) represents one of the few studies that have empirically tested the u-shape relationship predicted by the Wundt curve for the music industry. Simonton has investigated the melodies of musical themes and has stated that the aesthetic value of melodies first increases up to a peak arousal level and thereafter declines. The result is the curvilinear inverted u-shape relationship, also described as the Wundt curve (Berlyne 1971).

Bils and Klenow (2001) have examined how a new variety of products or product innovations have changed consumers' spending patterns. Using data of 106 product categories such as television and cable television or computers (hardware and software), audio and video equipment, they have found that consumers' spending has shifted from goods with little variety to goods with greater variety. This study gives first evidence that variety is commercially important for consumption in general and for software in particular. Nevertheless, we do not find detailed information on the relation between variety and video games.

The majority of studies into variety of consumption opportunities adopt theories and methodologies from the consumer psychology literature. Weibull (1985) has found in his structural model of media use that consumption of particular media is highly correlated with the available number of media use options. Additionally, more dynamic approaches to modeling preference and utility such as random utility models have argued that consumers attach a given positive probability to each outcome when faced with the choice between multiple consumption possibilities. More specifically, Caminal (2016) has shown that repeat consumption in markets for leisure goods, including video games, is influenced by the variety of consumption opportunities available, while also being subject to satiation given that consumption reduces subsequent demand for that same variety.

Sherry et al. (2006) have empirically investigated the effect of variety on video game consumption and model the behavior of entertainment software consumers using a combination of focus group interview sessions with 96 participants alongside a larger survey with 1,265 respondents. The authors have found that variation in consumption impacts the total number of hours spent playing video games. The survey data have been collected from two universities, three high schools, two middle schools, and two elementary schools in the Midwestern region of the United States. This population is particularly appropriate because it is the first generational cohort to grow up exposed to the consumption of video games both at home and in arcades. Specifically, the study has identified six unique features of consumption variety (i.e. arousal, competition, challenge, diversion, fantasy, social interaction) that are correlated with higher levels of consumption. Among these six features, challenge, competition and social interactions are found to be the strongest predictors on the number of hours played per week. Thus, consumers enjoy playing video games to push themselves to a higher level of skill or personal accomplishment (the challenge feature), prove to others who has the best skills and can react or think the fastest (the competition feature), and interact with friends or learn about the personalities of others (the social interaction feature).

Jansz and Tanis (2007) have presented one of the first studies analyzing the consumer behavior in the context of first-person shooter games. The authors have conducted an Internet survey involving 5,751 participants to gather information about the characteristics of consumers of online first-person shooters and the reasons why they spend time playing this particular kind of video game. The study has found that members of professional gaming groups known as 'clans' scored highest on motives with respect to competition and challenge compared to members of amateur clans and non-members. This study clearly demonstrates that online video games are not played in isolation and that the motive of social interaction is the strongest predictor of the time spent on gaming.

Myślak and Deja (2015) have investigated the matchmaking system of *League of Legends*, a famous Multiplayer Online Battle Arena (MOBA) game. MOBAs belong to the game genre eSports where two teams engage in combat with the help of a chosen avatar, often called a 'champion'. They have used data gathered from over 200,000 games between July and August 2014 to predict a team's chances of winning. They have found evidence that the consideration of consumers' preferences over roles or champions, as these roles are called in the game, improve the chances of winning by 65% in this game. Whereas they have found a first justification for the importance of the consumers' preferences, chances of winning are not necessarily correlated to consumers' utility. Losing a challenging game might be more appealing than winning an undemanding game.

Clements and Ohashi (2005) have analyzed the effects of software variety and hardware price throughout the evolution of the industry with a particular focus on network externalities. Using monthly data between January 1994 and March 2002, the study has found that introductory pricing is an effective practice at the beginning of the product cycle, while the expansion of software variety becomes more important at later stages. Indeed, the hardware console itself has not shown to have any value apart from facilitating the use of software. Holding factors including console price and quality equal, the authors have concluded that consumers prefer to buy the console that offers a wider variety in software titles.

Summarizing the available evidence, it appears that on the one hand existing studies have tried to isolate the impact of variety characteristics on perceived utility (e.g. Jansz and Tanis 2007; Sherry et al. 2006) and on the other hand studies have concentrated on the identification of individual consumer types and their preferences for product variety and taste (e.g. Clements and Ohashi 2005; Myślak and Deja 2015). To operationalize perceived utility, studies commonly use product time spent as a proxy (e.g. Sherry et al. 2006). Nevertheless, more work needs to be done to quantify the actual impact of different features of the game that enhance variety. Additionally, the studies have missed the non-linear relationship of variety and utility.

In addition, a limitation of most of the previous studies in this area is a reliance on data reflecting stated preferences and behaviors typically generated through surveys with voluntary participation. Unfortunately, the information gathered by a survey is useless unless it covers a representative and accurate population percentage (Fricker and Schonlau 2002). Thus, the self-selective nature of respondents may lead to samples that are not entirely representative of the population being studied. Accordingly, shortcomings of surveys are represented by their coverage, sampling, non-response, and measurement errors (Groves 2004). In addition to coverage, the honesty of responses, particularly for questions of a sensitive nature, may lead to significant biases given that its self-reported nature may not accurately reflect reality (Fricker and Schonlau 2002). Jansz and Tanis (2007) have pointed out these problems in the presented study as the data is correlational and cross-sectional and the sample is self-selected.

Our study is unique due to our identification of variety and its impact on utility through the use of a dataset consisting of direct observations covering 1,397 consumers participating in 729,049 unique game rounds, making it especially well-suited for use in an econometric analysis. Our large-scale panel dataset covers a representative sample of gamers as the consumers are chosen randomly while capturing all rounds these consumers participated in. We account for the non-linear relationship between variety and utility and are thus the first to test the Wundt curve in a video game setting. In contrast to the existing studies which rely on survey data (e.g. Jansz and Tanis 2007; Sherry et al. 2006), we are able to observe actual consumer behavior and quantify consumer preferences and characteristics.

Data description and model

To test our research hypothesis, we use a unique dataset provided by the Wharton Customer Analytics Initiative and a major international video gaming company, which offers an unprecedented insight into patterns of consumption for online video games. The data allow a detailed analysis of revealed preferences for variety in the consumption of digital entertainment goods, which primary or survey data could not offer. The dataset relates to a multiplayer first-person shooter game available for two home consoles (Sony Playstation 3 and Microsoft Xbox360) and PC and consists of historic behavioral data for 1,397 consumers participating in 729,049 unique game rounds. Complete longitudinal tracking is undertaken for two cohorts of consumers, covering every round played by each cohort member, as well as all the consumers they ever played alongside, from product launch in October 2011 over a period of 28 months.

We study the relationship between variety and the consumer's perceived utility. As utility is not directly measurable, we use the amount of seconds an individual consumer spends in the round as a proxy for perceived utility. A similar approach was already used in previous studies (e.g. Jansz and Tanis 2007; Sherry et al. 2006). As consumers may leave a gameplay round at any point in time, we assume that they continue to participate only as long as they derive utility; in other words, it seems rather unlikely that consumers leave a round if they are enjoying participating in it. According to the data in Table 1, consumers in our dataset spend an average of around 13 minutes participating in each round, with a standard deviation of 11 minutes. A full summary of key descriptive statistics for variables used in the empirical analysis, along with their definitions, can be found in Table 1. In particular, we observe that consumers tend to adopt a wide variety of gameplay options during their participation in gameplay rounds. On average, each consumer adopts about 1.5 roles and 0.6 vehicles in each round they play (cf. Table 1).

[Table 1 about here]

The regression model explaining the number of seconds the consumer has spent in the round is therefore

$$
\begin{aligned}
TimeSpent_{ir} = \alpha + \beta_1\, Variety_{ir} + \beta_2\, Variety_{ir}^2 \\
+ \mu\, ConsumerControls_{ir} + \nu\, RoundControls_{ir} + \varepsilon_i \qquad (6)
\end{aligned}
$$

where $TimeSpent$ captures the number of seconds consumer i spends in the round r. As the distribution of the variable $TimeSpent$ is skewed and does not follow a normal distribution, we use the natural logarithm of the variable $TimeSpent$ in our regression analysis. $Variety$ is a vector consisting of $roles$ and $vehicles$. $Roles$ is a variable measuring the number of different roles adopted by consumer i during round r (i.e. assault, recon, engineer, support) and $vehicles$ is the number of vehicles (i.e. armored and unarmored land vehicles, jet, boat, helicopter) used by consumer i during the round r. $ConsumerControls$ represents a vector of variables reflecting the difference between kills and deaths (i.e. the number of kills made by consumer i minus the number of times consumer i died during the round r) averaged over the number of seconds in which they participated in the round r, as well as a measure of the non-combat score earned by consumer i averaged over the number of seconds in which they participated in the round r. The vector also includes a lagged variable capturing the number of seconds spent participating in the previous round and a rookie variable measuring a consumer's lack of experience by counting the difference between the number of days since the launch date of the game and the number of days a consumer has played the game. Additionally, the vector includes the consumers' age, gender and home country, the signup date and the cohort. $RoundControls$ represents a vector of control variables that might also have affected the length of time that consumer i spends participating in a round r, such as the game mode (e.g. Conquest, Rush or Team Death Match); the number of other consumers both allowed and engaged in the same round r; as well as the total (absolute) number of seconds the round lasted and the hardware platform. Additionally, we introduce lag terms for all variables that can vary between rounds to account for the dynamic structure of these variables and to incorporate their feedback over time. Specifically, the values of the β coefficients allow us to test our hypothesis H_1. Thus, variety has an increasing effect on the consumer's utility first before the relationship is reversed and variety has a decreasing effect on the consumer's utility.

Results

In this section of the paper, we model variations in the length of time spent engaged in a given game round at the level of the individual consumer. In Table 2, we present output of the panel regression where the dependent variable is the length of time (in seconds) that consumer i chooses to spend participating in each round r. Although we produced an initial set of results using both fixed and random effects, results from a Hausman test suggest that fixed effects estimations are preferred. This, combined with the observation that coefficient estimates appeared to be relatively similar, means that we simply present the results from fixed effects for individual consumers.

[Table 2 about here]

The results presented in Table 2 allow us to test Hypothesis H_1 and assess the extent to which the predictions of the Wundt curve hold in the context of video game consumption. Through the inclusion of squared terms in addition to the linear parameters, we show that consumer preference for variety does appear to be non-linear. In the case of role adoption, the negative coefficient estimate for the squared term combined with a positive coefficient estimate for the linear term implies that an inverted u-shaped relationship exists between role adoption and play time. Thus, the relationship between the subjective novelty in terms of $roles$ and the utility W_r is characterized as a Wundt curve:

$$W_r = -0.057 \cdot roles^2 + 0.572 \cdot roles.$$

The maximum of this function is reached at approximately 5.018 roles. We represent the estimated relationship graphically in Figure 2 using the coefficient estimates to visualize the maximum point where utility increases up to the use of around 5 different roles within a particular game round and decreases thereafter. It should be noted that the maximum number of different roles that can be adopted in a given round in this particular video game is 4. However, based on our estimation results we are able to calculate a hypothetical maximum point at the usage of 5 roles. The implied shape of the curve does demonstrate diminishing utility of variety in the use of player roles.

[Figure 2 about here]

Table 2 also includes a squared term to capture non-linearity in the relationship between time spent participating in a game round and the use of vehicles. Here, the positive coefficient for both the linear and squared terms implies an increasing level of utility derived from increased variety in the consumer's use of vehicles within a given gameplay round. We also graphically represent this relationship in Figure 3, which shows increasing marginal utility in the case of vehicle use and not the inverted u-shape relationship predicted by the Wundt curve. Thus, the relationship between the subjective novelty in terms of $vehicles$ and the utility W_v is characterized by a non-linear relationship; specifically, it can be described by a quadratic function but not a Wundt curve:

$$W_v = 0.02 \cdot vehicles^2 + 0.174 \cdot vehicles.$$

When taken together, the output from these fixed effects estimations offer only partial support for hypothesis H_1. Although we technically show that both variables of interest demonstrate a non-linear relationship with the duration of round participation, only the use of player roles follows an inverted u-shaped relationship consistent with the Wundt curve. We nonetheless conclude that the consumer's appetite for variety appears to be non-constant at the margin.

[Figure 3 about here]

We have also included lagged versions of key variables to incorporate the dynamics of exposure to variety over time. However, somewhat contrary to expectations, the lagged terms for these variables indicate that increased use of roles and vehicles in the previous game round is associated with a shorter gameplay duration in the current game round. This may be indicative of a higher expectation formation on the part of the consumer, indicating that greater variety in the previous game round raises expectations for future game rounds, which reduces the utility and duration of participation in the current round ceteris paribus. The same finding might equally indicate that consumers prefer to alternate between using a variety of roles and vehicles and subsequently limiting themselves to a smaller range. In itself, this might further support the hypothesis that consumers exhibit a preference for variety in the consumer's desire to vary the extent to which they adopt multiple roles and vehicles used between rounds.

Our regression results also include a number of control variables, the coefficient estimates which offer considerable insight into consumer preferences for video game consumption. Across all specifications, we show strong evidence that a consumer's skill level, measured in terms of the difference between deaths and kills averaged over the duration of play, is associated positively with the length of time that they spend playing in a given round. However, the lagged effect for this variable is not statistically significant, indicating that a better performance in combat actions in previous rounds is not associated with variations in the length of time spent participating in subsequent rounds. Broadly speaking, consumers are more likely to continue playing in game rounds when they kill others with greater frequency than they are killed themselves. This finding also indicates that consumers who are killed with higher frequency tend to drop out of rounds after shorter periods, which seems reasonable given the likely disincentivizing effect of 'losing' in player-versus-player combat situations on a repeated basis. Conversely we show that, while statistically significant, non-combat actions (which we proxy through measuring the score earned from such activities in each round) appear to demonstrate a relatively weak relationship with the length of time spent participating in the round. The relevant lagged effect is statistically and economically insignificant.

In our estimation, we also measure the effect of consumer experience on the length of time spent participating a round through the inclusion of a variable capturing what we refer to as a 'rookie effect'. The negative coefficient estimated for this variable implies that more experienced consumers spend slightly more time participating in a given gameplay round in comparison with less experienced consumers. However, although the estimates are statistically significant in each case, the coefficients themselves are relatively small, indicating a comparatively weak relationship with the amount of time spent participating in each game round.

Our model also includes controls reflecting the characteristics of the round in which the consumer participates. Our coefficient estimates for these variables show that both a longer absolute round duration and the official 'completion' of a round are associated with greater amounts of time spent by an individual consumer in a given gameplay round. With regard to our measure of the number of additional consumers participating in each round, the amount of time played by any individual consumer increases by around 0.6% per additional consumer. This suggests that consumers typically choose to play for longer in larger rounds where greater numbers of individuals are active at any one time. Conversely, an increase in the maximum number of consumers permitted to participate in a round leads to a reduction in the amount of time spent in a round of about 0.1% per additional permitted consumer. Although this may appear contradictory given the finding relating to the number of actual participating consumers, this is likely to be indicative of a preference for larger numbers of players engaging in smaller-scale gameplay environments, thus maximizing the opportunities for in-game action, variety and combat. Controls for variation in the type of round played (Death Match, Capture the Flag, etc.) also show significant heterogeneity in the length of time spent between different gameplay modes.

Overall, these results help shed considerable light on the relationship of variety and perceived utility by individual video game consumers. In the broadest sense, we find that consumers demonstrate a preference for variety in terms of their use of different roles and vehicles. We also show that the relationship between consumer utility/time spent participating in each round is significantly non-linear, although only following the pattern predicted by the Wundt curve in the case of player roles. Moreover, we show that combat-related action and consumer skills, measured in terms of kills and deaths, is associated strongly and positively with the amount of time spent participating in a gameplay round. We therefore conclude some support for our hypothesis H_1.

Managerial implications

In terms of managerial implications, our findings suggest a number of important insights into consumer behavior in the context of video game consumption. We demonstrate that consumers not only prefer video game hardware that offers a wider variety of software titles (Clements and Ohashi 2005), but also prefer software titles that offer a wider variety in terms of gameplay. Thus, we find evidence to support that consumers value variety not only in the set of available products but also within the product itself. This is likely to have significant implications in terms of understanding video game consumption, as video game publishers are adopting new approaches to generate profits specifically through the introduction of 'in-app' purchases and the offering of additional content and expansion packs (Davidovici-Nora 2014). Thus, additional content increases the level of subjective novelty or variety within the product without the need for having high costs of new product development.

Our empirical analysis demonstrates a strong, positive association between gameplay duration and the use of different roles and vehicles. This result indicates that game designers should prioritize the availability of a wide variety of gameplay options that require consumers to approach software titles in different ways. At the same time, developers also need to ensure that the available options are sufficiently well balanced and interdependent so as to encourage variation in their adoption. This relationship has already been shown in Multiplayer Online Battle Arena (MOBA) games (Myślak and Deja 2015). Nevertheless, publishers have to assure to find the right level of variety and subjective novelty as consumers' utility might decrease otherwise. This implies that video game developers have to understand consumer needs to maximize consumer utility.

Conclusion

In this article, we use real-world data to investigate variety in the video game industry. A key contribution of this research is the use of a large-scale dataset to offer new insights into the drivers of behaviors among video game consumers. Specifically, in contrast to prior research, our study significantly extends and develops the literature on variety and consumer utility, which have up to now only been partially examined in the context of video gaming (Bils and Klenow 2001). Variety is found to be a strong predictor of variations in the amount of time consumers choose to spend participating in a given game round, which serves as a proxy for the consumer utility. Specifically, the use of player roles and vehicles is associated positively and significantly with greater levels of utility.

Nevertheless, we also find evidence to partially support the concerns expressed by Scitovsky (1976) and Middleton (1986; 1987), that it might be possible to introduce too much variety into the video gaming consumption. While the usage of some roles yields an increase in utility, this relationship becomes inverted when too many roles are adopted within a single gameplay round. The relationship therefore follows the inverted u-shape presented in the Wundt curve and resultantly demonstrates supporting evidence for Middleton's model (Middleton 1986). However, we do not find that the same relationship holds in the case of vehicle use. In summary, our results therefore partially support the findings of Jansz and Tanis (2007) and Sherry et al. (2006), who argue that various possibilities in a video game enhance the time spent on gaming.

In terms of limitations, we are unable to directly test the effect of consumer exposure to underlying information and other extrinsic cues and we cannot unambiguously rule out direct causality explanations. Despite this uncertainty, as noted previously, our study is still able to make an important and unique contribution to the existing empirical literature on variety and its effect on consumer behavior in the video game market. An interesting direction for further research would be to undertake an empirical investigation into the effect of inter- and intra-round variety on video game consumption patterns. Whereas our study directly addresses intra-round variety, i.e. factors that influence consumption during a round, inter-round variety could focus upon factors that differ between rounds but are predetermined before consumption.

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A Appendix: Tables

Table 1 Key descriptive statistics for variables used in the empirical analyses

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
Dependent Variables						
Time Spent in Round in Seconds	Number of seconds the consumer spent in the round.	729049	796.029	671.789	1	5953.2
Variety						
Number of Roles Played	Number of different roles a consumer played in the round.	729049	1.455	0.694	1	4
Number of Different Vehicles	Number of different vehicles a consumer made use of in the round.	729049	0.625	0.865	0	5
Consumer Controls						
Age	The consumer's age.	729049	30.432	9.441	15	80
Gender (Female Consumers)	The consumer's gender with 1="female".	729049	0.004	0.06	0	1
Home Country U.S.	Consumers living in the U.S. with 1="U.S.".	729049	0.323	0.468	0	1
Difference (Kills-Deaths) per Second	The difference between the number of kills and deaths made by the consumer per second in the round.	729049	0	0.065	-10.001	4.425
Non Combat Score per Second	Score earned by a consumer per second in a given round derived from non-combat.	729049	4.186	99.91	0	50726.47
Rookie Effect	Difference between the number of days a consumer has played the game and the launch date.	729049	181.571	157.248	2	843
Lifetime Purchase Amount	How much, in USD, the consumer has spent with the company as of the time the data was pulled (March 4, 2014).	729049	42.062	178.374	0	3289.028
Consumer's Signup Date	Date on which the consumer opened account with company.	729049	18475.22	510.217	15612	19023
Cohort 1	Designates whether a consumer belongs to cohort 1 (consumers started playing the game in the first month after the launch) or cohort 2 (consumers started playing afterwards) with 1="cohort 1".	729049	0.568	0.495	0	1
Round Controls						
Hardware Platform (PC)	Consumers using a PC as the gaming platform with 1="PC usage".	729049	0.241	0.428	0	1
Hardware Platform (PS3)	Consumers using the Sony PS3 as the gaming platform with 1="PS3 usage".	729049	0.379	0.485	0	1
Hardware Platform (XBOX)	Consumers using the Microsoft XBOX 360 as the gaming platform with 1="XBOX usage".	729049	0.38	0.485	0	1
Game Mode (Conquest)	Round is played using a Conquest game mode with 1="Conquest".	729049	0.486	0.5	0	1
Game Mode (Rush)	Round is played using a Rush game mode with 1="Rush".	729049	0.22	0.414	0	1
Game Mode (Team Death Match)	Round is played using a Team Death Match game mode with 1="Team Death Match".	729049	0.153	0.36	0	1
Round Duration in Seconds	The number of seconds the round lasted.	729049	1394.809	1028.158	27.66	5953.2
Round Completed?	Designates whether or not a round was completed with 1="completed".	729049	0.999	0.036	0	1
Max Simultaneous Consumers	Maximum number of consumers active in the game round at any single point in time.	729049	20.723	9.873	0	64
Max Simultaneous Consumers Allowed	The maximum amount of consumers allowed in the round at any given time.	729049	44.193	19.448	2	100

Table 2 Panel model specifications estimating consumer utility in a given game round

	DEPENDENT VARIABLE: LOG TIME SPENT IN ROUND (in Seconds)
INDEPENDENT VARIABLES	CONSUMER FIXED EFFECTS
Variety: Roles	
Number of Roles Played (t-1)	-0.042***
	(0.002)
Number of Roles Played	0.572***
	(0.007)
Number of Roles Played^2	-0.057***
	(0.002)
Variety: Vehicles	
Number of Different Vehicles (t-1)	-0.017***
	(0.001)
Number of Different Vehicles	0.174***
	(0.003)
Number of Different Vehicles^2	0.020***
	(0.001)
Consumer Controls	
log Time Spent in Round in Seconds (t-1)	0.036***
	(0.001)
Difference (Kills-Deaths) per Second (t-1)	0.001
	(0.016)
Difference (Kills-Deaths) per Second	2.519***
	(0.016)
Non-Combat Score per Second (t-1)	0.000
	(0.000)
Non-Combat Score per Second	-0.000***
	(0.000)
Rookie Effect	-0.000***
	(0.000)
Round Controls	
Game Mode (Conquest)	-0.194***
	(0.004)
Game Mode (Rush)	-0.102***
	(0.004)
Game Mode (Team Death Match)	0.026***
	(0.004)
log Seconds Round Lasted	0.595***
	(0.002)
Round Completed? (Yes=1)	0.427***
	(0.028)
Max Simultaneous Consumers	0.006***
	(0.000)
Max Simultaneous Consumers Allowed	-0.001***
	(0.000)
Constant	0.789***
	(0.032)
Observations	729,049
R^2	0.271
Number of Consumers (Number of Groups)	1,397

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
All standard errors are clustered in 1,397 groups using individual consumers.
We winsorized the distribution of gameplay round durations, i.e. the absolute period of time from its beginning until its conclusion by setting values above the 99th percentile at the 99th percentile. This variable remains relatively long-tailed, even after the data have been winsorized.

B Appendix: Figures

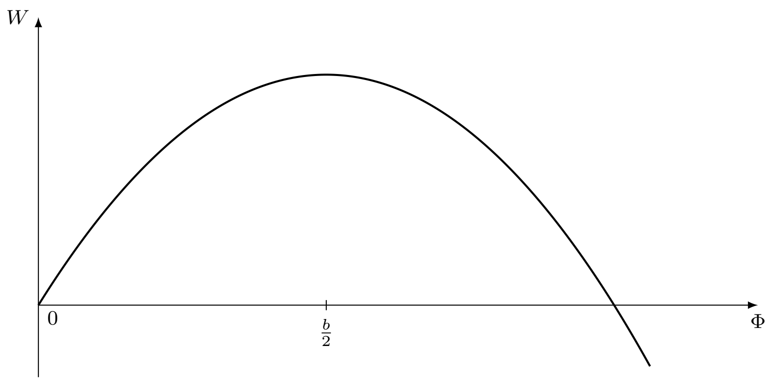

Figure 1 The Wundt curve represents the relation between subjective novelty (Φ) and informational utility (W)

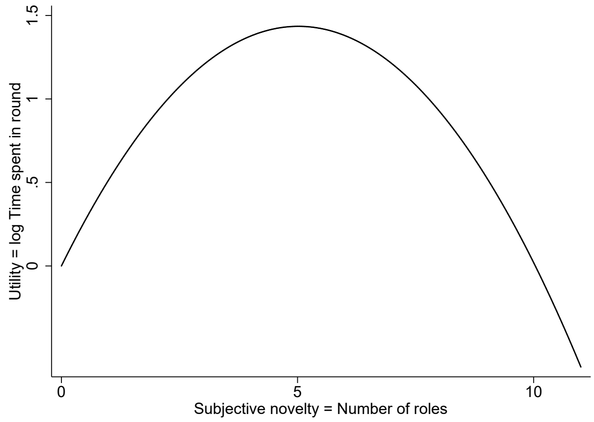

Figure 2 Relation between gameplay duration and the number of roles played in a round by a consumer

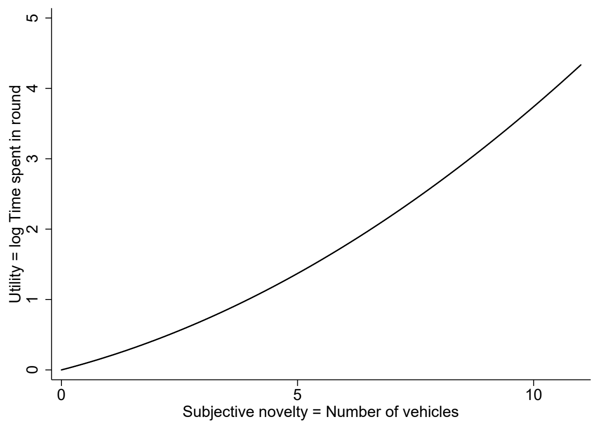

Figure 3 Relation between gameplay duration and the number of vehicles played in a round by a consumer