The Motivation of Gaming Behaviors

The Implicit Measurement in the PlayerUnknown's Battleground Study

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Abstract

This study examined player's motivation of playing the PlayerUnknown's Battleground. Based on previous motivation studies, we expected player's motives toward this game should show competitive and affiliative tendencies, rather than achievement and immersion. The research used self-report measurement and Stroop priming test to testify hypotheses. Although the self-report results supported our hypothesis, the Stroop priming test failed to detect the motivation's differences. According to the experimental outcomes, the reliability and validity of Stroop priming paradigm were discussed.

Keywords: computer game, motivation, Stroop priming test

Content

Introduction

Ever since the first computer game invented, *Spacewar!* (1962), the computer and mobile games already became an essential part of modern life. In 2010, the first-person shooting game, *Call of Duty: Black Ops*, reached the $650 million in worldwide sales in five days after it was released. This record was much higher than the box office of the most top-grossing movie *Star Wars: The Force Awakens* in the first five days ($325 million) (Bilton, 2010). In general, games already reached an irreplaceable level in the modern entertainment. Statistics indicated that the sales amount of computer games in the USA achieved $22.41 billion in 2015, and more than 150 million Americans reported the gaming as a habit (Seo, Buchanan-Oliver, & Fam, 2015).

With the development of the gaming industry, game studies and player analysis become essential for every designer and producer. In order to the increase sales and expand market, the publishers shall assess the player demands. Our research took a hot-sale product as an example to analyze player intrinsic motives toward games, which can discover the reason of playing behaviors and provide empirical research data for the player analysis field. There was one game brought our attention, the PlayerUnknown's battleground (PUBG), which created incredible and enviable sales record in 2017. Statistics showed that the number of worldwide players of PUBG already crossed ten million from May to October 2017. And the peak concurrent players reached 1.52 million on September 23, 2017 (The Statistics Portal, 2017). This brilliant achievement attracts numbers of companies that want to reproduce this great success. Hence, developers are eager to find out the underlying mechanism: What brings about the user's desire, purchase and repeated playing behaviors for the PUBG. However, the analysis on game techniques, styles and contents are far from enough for the researchers and producers to understand players' behavior. Additionally, the unique motivation and in-game experience of players in the PUBG need to be considered.

1.1 User Experience in the Game

Video games, as a type of interactive system, are designed for providing entertainment to the players. In gaming field, a good user experience means the game meets players' leisure purpose (González Sánchez, Padilla Zea, & Gutiérrez, 2009). Compared to traditional devices or programs, video games' specific usability requires distinct user experience: e.g., *players feel good when they play*, which is subjective feeling and differ from individuals. According to González's model, the player experience, especially the satisfaction category strongly depends on the player's motivation and instant feeling. The satisfaction raises when the in-game content meets user's motivation and demands. While these subjective thoughts like motivation or feeling could vary from person to person depending on personal experience, or personality, which increases the measurement's difficulties and complexity.

A number of previous studies applied the self-report measurement in the analysis on gamers, for example, using a questionnaire to get information on how player feel when they play one game. Due to the fundamental limitation of self-report methods, the outcome could not completely reveal the actual phenomenon. Thus, this paper introduces a new paradigm in the experiment — the Stroop priming test, to support self-report measurement, explain subjects' subconscious thoughts and get a better understanding of players' motivation(Schmettow, Noordzij, & Mundt, 2013; Sparrow, Liu, & Wegner, 2011).

1.2 Player's motivation and game genres

1.2.1 Motivation

There were a number of researchers tried to discover the diverse motivation of individuals to support various gaming behavior. A couple of studies started with the fundamental desire of playing behavior (not limited in computer games). The labor/leisure tradeoffs theory suggested after a complex have-to task, i.e., the work, individuals' motivation will shift to a want-to task (Kool & Botvinick, 2014). Meanwhile, the difficulty of prior task increases motivation-related brain responses in a risk game, which means individuals prefer a game with more challenge,

provoked and delightful feedback. The want-to task can recover the balance between labor reward and leisure reward (Schmidt et al., 2017).

Gaming behaviors do not fulfill only the leisure demand, but also other implicit needs. Ferguson (2010) found when the participants felt depressed, they sought the media including violent contents, for example, shooting game, which can reduce the stress and depresses level (Ferguson & Rueda, 2010; Reinecke, 2009).

More research focused on the internal motivation of the video game playing behaviors. For example, the fictional games can meet some children's demands which are hard to be achieved in the daily life, like the competence, social relatedness and conflicts requirements (Ferguson & Olson, 2013). Similarly, Sherry (2003) surveys confirmed that video games have some rare content and factors can attract players to play games. These factors usually are missing in the real world. These factors and contents include: 1. Social interaction, consider computer games as a social platform; 2. competition, compare own ability to others'; 3. challenge, pass levels in games; 4. fantasy, gain incredible power or skills, e.g., flying; 5. diversion, escape from real life; 6. arouse. Therefore, players play the computer games to satisfy some psychological needs which are missed or hard to meet in daily life.

Apart from satisfying daily demands, there are other power drives people to seek for fun. Merrick (2016) believed all gamers have their purposes and styles when they play a game. The goals are not only limit in the relaxation, entertainment, and socialization, but also to enjoy the story, master the game, accomplish achievement, and explore the virtual worlds. In Merrick (2016) book, he first cited Bartle (1996) players' interest model. According to Bartle model, the types of players located in four quadrants: achievers, killers, socializers, and explores. Four types of players all have different interests and demands for games. There are two dimensions in this model (shown on the horizontal and vertical axis in figure 1). The horizontal dimension describes the player's interest in the game or the other players. Achievers and explorers prefer

to enjoy the game (the tasks, the environment, or interact with the no-player-characters). On the contrary, killers and socializers more like to play with other players. The second dimension varies from the acting to the interacting. The acting behavior aims to achieve specific goals or win the combats. Whereas, the explorers and socializers focus on the interaction with the world or other gamers (the model sees the picture below).

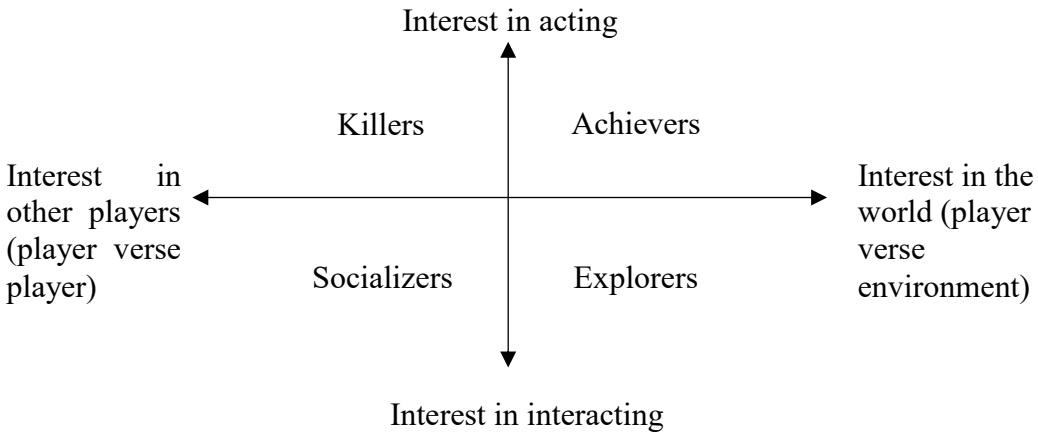

Figure 1 the motivation models in Bartle (1996) theory.

Based on Bartle's model, Yee (2006) developed a more complete model to complement motivation theory by empirical analysis. Yee summarized three components in the motives forming. The first element of motivation is the achievement, which consists of three subcomponents: the desire for advancement (to gain progress or power), the interest in analyzing the virtual world and the willingness to compete. The second component Yee defined is the socializing motivation, which includes the desire to casual interaction and build a stable relationship and teamwork. The third element is described as the immersion. The immersion component has four subcomponents which are: discovering the world, role-playing (e.g., prefer tasks or story), customization (focus on the character's appearance) and escaping from real life.

The playing willingness can originate from a variety of factors. This work makes a comparatively comprehensive understanding of motivation theories. The summarized multiple motivation theories from the former studies are listed in the table below (Table 1).

Table 1 The integrated motivation theory

	Interest in world	Interest in other players
Achieve goal	● Achievement Master of game Fantasy: gain power and skills	● Competition win
interacting	● Immersion Discover the world Role-playing Diversion: escape from real life	● Affiliation Socializing Relationship teamwork

1.2.2 Game genres

In the real world, no game can satisfy all players' needs. Indeed, every commercial game has specific user types. Themes and play styles are designed for particular interests and motivation. There are several fundamental genres and play-styles: action, role-playing, simulation and strategy (Apperley, 2006; Fencott, Lockyer, Clay, & Massey, 2012). There are precise definitions for each game types. The action games specifically refer to the games which need players to control in-game characters' movement to meet the situation. The role-playing game (RPG) is a type of games in which players can experience a fictional character in a virtual game world. Simulation games simulate the real-world situation in general (e.g., football games, racing games, or simulated life). Strategy games require management abilities and a global perspective. Nowadays, video games are already evolved into a pluralistic stage—combining couples play-styles in one game to catering wider user groups, for example, the massively multiple online role-playing games (MMORPG). In fact, this type of games was popular in motivation studies. Because researchers believed the games which have multiple ways of playing could reflect gamers' different interests and characteristics based on the styles they preferred (Dickey, 2007; Graham & Gosling, 2013; Worth & Book, 2014).

As the 2017 best-seller PUBG belongs to the type of the last man standing (LMS) game. The LMS game refers to multiplayer deathmatch playing style. Players aim to defeat other players or teams to remain alive. LMS incorporates many basic game genres. Normally, LMS is developed based on the action game (e.g., shooting game) (Carter, 2017). In the PUBG, the player allows to team-up with another gamer to form a team (2 to 4 people). In the beginning, one hundred players land in an island without any weapon. Everyone needs to search weapons, vehicles and other equipment in buildings, which can help them defeat enemies. Based on the game-style of the PUBG, we assume the game should meet the target groups which interest in other players (competition and socialization). However, the actual motivation, desire, and preferred in-game experience could differ from person to person. To test player motivation in the real world, researchers should conduct some user analysis, especially their motivation and experience.

1.2.3 The motivation measurement

In this paper, the primary research goal is to get knowledge about the motivation of playing PUBG to explain a player's in-game behaviors and the popularity of PUBG. It's clear that the motives origin from individual differences: the personal experience, life state, the psychological condition, and even the personality. But how to reveal individual differences and the underlying motivation becomes an issue for researchers. Based on the theories mentioned early, Yee (2006) generated a motivation questionnaire: *Motivations for Play in Online Game (MPOG)*. This mature questionnaire was used in many multiplayer online role-playing game (MMORPG) studies (Graham & Gosling, 2013). The original survey was designed for the MMORPG which shares many common factors with the PUBG (multiplayer, online game, full of competition and cooperation, etc.). The MPOG can clearly capture the player's preference. Therefore, this paper introduces this scale to measure participants' subjective motivation. The MPOG has four sub-components: achievement, competition, socialization, and immersion. Meanwhile, MPOG

is a five-point fully labeled construct-specific scale. During the measurement, the participants need to answer the question, such as “How much do you enjoy competing with other players?”, and the answers include five options: “Not At All, A Little, Some, A Lot, and A Great Deal.” These five-point scales could help us calculate the sub-components scores, which could be the convincingly demonstrate the player’s motivation direction. For instance, a high score in socialization shows player’s strong social requirement. These four subcomponents are the main factors to measure in this motivation study. Besides, apart from MPOG scale, we introduce an implicit method to support self-report results in our study: the Stroop priming task.

1.3 Stroop priming test and motivation study

Almost every previous study applied self-report methods in the gamers analysis. Researchers usually utilize questionnaires to test motivation, personality, demographics, gaming behaviors, or other subjective thoughts. Table 2 summarizes the recent studies which used self-report measurement in the player behaviors studies:

Table 2 Recent relevant studies with self-report measurement

Abstract	Authors
Flow and enjoyment analysis, supported by personality testing.	(Baumann, Lürig, & Engeser, 2016)
Gender different in gaming behavior, questionnaire.	(Bonanno * & Kommers, 2005)
Personality and video game behavior (Big Five).	(Braun, Stopfer, Müller, Beutel, & Egloff, 2016)
Personality and violent video game.	(Chory & Goodboy, 2011)
Gender difference in high school student gaming behavior, questionnaire.	(Chou & Tsai, 2007)
An online survey on computer game enjoyment and personality	(Fang, Chan, & Nair, 2009)

Extraversion personality and computer gameplay	(Fang, Zhu, & Chan, 2014)
Child motivation for gameplay	(Ferguson & Olson, 2013)
Violent video game effect on aggressive behavior, hostile feelings, and depression	(Ferguson & Rueda, 2010)
The personality associated with different motivation for game playing	(Graham & Gosling, 2013)
Gaming addiction, online-based questionnaire	(Lehenbauer-Baum et al., 2015)
Big five personality and game difficulty adaptation	(Nagle, Wolf, & Riener, 2016)
Discovered the links between personality and motivation of playing	(Park, Song, & Teng, 2011)
Personality and video genre preferences	(Peever, Johnson, & Gardner, 2012)
Gender differences in genre preferences	(Rehbein, Staudt, Hanslmaier, & Kliem, 2016)
The relationship between gamer personality and game use	(Teng, Jeng, Ker-Chang Chang, & Wu, 2012)
Personality and behavior in MMORPG	(Worth & Book, 2014)
Game addiction among adolescents	(Xu, Turel, & Yuan, 2012)

As table 2 displays, the self-reports have already become widespread in the gamer study, user engagement evaluation, and even in human computer interaction (HCI) field (Mounia, Heather, & Elad, 2014). Self-report measurement has several advantages include flexibility, easy-to-use, anonymity, and large sample amount. However, some scale did not go through rigid reliability and validity test. Even when the mature questionnaires are applied, self-report methods still have many inherent limitations. The self-report measurement often involves the response bias or the motivational distortion problems (either intentional or unintentional)

(Helmes, Holden, & Ziegler, 2015). The outcomes could be different from the actual phenomenon. To compensate the limitation of self-report measurement, we introduce the advanced Stroop priming task which focuses explicitly on testing player's implicit motivation, demands and the predisposition toward technologies.

The traditional Stroop test discovered that the internal process would interfere with the reaction time. When the participant named a color word which is printed in an incongruent color, the reaction time became longer (Stroop, 1935) (e.g., the word "green" is print in red, which is incongruent.). This phenomenon is known as *Stroop effect.* The extensive explanation of Stroop effect is that the reaction delay comes from the conflict between color and the target words. However, scientists hold different opinions about the cognitive mechanisms hidden behind. The major theories have two tendencies: the automaticity level and the attention priority/strategy. The automaticity level suggests that the RT latency comes from different automatic process levels. The higher word reading process inhibits the lower level color naming task (MacLeod and Dunbar, 1988). While in the attention priority/strategy theory, the strategy of attention selection and executive system causes the Stroop effect. In fact, the strategy prefers to pay attention to the word reading (Wang, Tang, & Deng, 2016), which is probably due to the fact that individual treats the word dimension as a shortcut (Phaf, Van der Heijden, & Hudson, 1990).

Apart from classic Stroop test, there are plenty variants to the standard setting. For instance, the picture-word paradigm, the spatial version Stroop task (present the word "below" on the top of the screen) (Palef & Olson, 1975) and even the musical Stroop task (naming musical notes instead of word's color) (Grégoire, Perruchet, & Poulin-Charronnat, 2013). The variants have similar procedures: presenting the distractor ahead of colored symbols. In this paper, the Stroop priming task is used.

The priming effect origins from the semantical priming effect, which refers to the words are reacted faster when the participant first saw the semantically related word: *Priming word "bank" present first, the time of categorizing for the target word "money" will be faster than the word "flower" (usually participants need to categorize the target word or recognize the pronunciation).* Dozens of studies manifested the effect which the semantical association between words will accelerate the reaction time (de Wit & Kinoshita, 2014; Hutchison et al., 2013). Almost every account applied activation spreading theory to explain semantical priming effect. Activation spreading theory suggests when the nodes (semantic memory) activates, the activation would spread through links (relations between nodes) (Posner & Snyder, 1975). For example, the word "money" receives greater activation from the "bank" which share several semantic features. Then, the spreading activation increases the availability of relevant semantic memory, which upgrades the further process speed. In the Stroop priming task, the priority task evolves from word categorization into the color-naming task. The participants see the priming targets before the colored words. Although the spreading activation raises the target word process speed, the color naming task would delay when they encounter related word (color naming the word "money" is slower than the "flower"). The color naming task should be interfered by the spreading activation. Both automaticity level and attention strategy theories can apply to the phenomenon. Either the automaticity level or the attention priority/strategy could explain this phenomenon: The automatic spreading and semantics process level are higher than the color naming process, or people prefer to read the meaning of words first.

Sparrow et al. (2011) first applied the Stroop priming effect in HCI field to test an interesting theory: Whether internet changed the way humans think. They believed when people intent to access sophisticated knowledge, they are priming to recall the online searching technique. The Stroop priming task supported the theory, after hard questions (knowledge domain), participants' color naming task in computer-related words turned slower compared to

general target words. The similar outcome also appeared in the brand words: The reaction time in searching engines brand words (Google) was slower than traditional brand words (Nike) after they encountered hard questions. The evidence manifested the hard questions active the internet-relevant concepts.

Similarly, Schmettow et al. (2013) applied Stroop priming method in the user analysis. They switched priming targets to the pictures of computers, smartphones or other digital devices. The participant linked the images to three categories words: hedonic, utilitarian, and geekism (enthusiasm about technologies). The response time indicated that participants' different attitudes or demand toward the digital devices. The longer reaction time meant the pictures of the digital device activated the concepts. Indirectly reflects the implicit thoughts about the priming objects.

Therefore, there are couples of reasons for taking Stroop priming task as the measurement in motivation study: 1. Implicitly test can compensate the root drawbacks from self-report measurement; 2. offer quantitative outcomes (the reaction time); 3. Stroop priming test can reveal which concept is activated and which one has the strong association with the game; 4. manifest whether the spreading activation can affect the color naming process. Besides, these results will offer a new method in the player's motivation study field. In our experience, we converted the priming target to the in-game pictures, which can invoke participant's related memory. Then the target words followed, which had four categories, competition, affiliation, achievement and immersion. Participants' time of color naming task was recorded.

1.4 Research question

The purpose of this research is to understand and verify the reasons why players want to play the PUBG (the motivation) by using traditional questionnaire and Stroop priming task. The main playing-style of PUBG is to defeat other players or teams to remain alive. These game styles involve many competitive and affiliative contents (like defeat other players or cooperate

with teammates). Therefore, if the motivation theories stand, we assume players have high competition and affiliation motivation and the questionnaire score in the competition and affiliation should be higher than the other two. Besides, according to Stroop effect and spreading activation theories, the reaction time in Stroop priming test assumes to differ in various experimental setting. After seeing gaming priming- picture, the participant supposes to have longer reaction time in the color-naming task, especially the word related to the competition or affiliation concepts (the hypothetical results can be found in Table 3).

Table 3 The hypothetical results in Stroop priming task

Color naming time	competition	affiliation	immersion	achievement
PUBG screenshot	slow	slow	faster	faster
Neutral photo (control group)	fastest	fastest	fastest	fastest

In addition, we hope to get similar outcomes from both research methods (i.e., the motivation results from two testing methods are the same), which could bring high credibility to our motivation studies' results. Besides, we consider the questionnaire as the predictor for the reaction patterns in Stroop priming test. If someone has high competitive or affiliative preference, after game pictures presented, the longer reaction time in competition or affiliation word should be observed. Hence, there should be some degrees of correlation between tradition self-report scores and two experimental variables. This part is essential for testing the Stroop priming task's reliability and availability in the motivation study and user analysis fields. In conclusion, our hypotheses are as follows:

1. In the MPOG questionnaire, the participant supposes to have a higher score in competition and socialization subcomponents, rather than achievement and immersion.
2. The reaction time of color naming task should be longer when participants see the priming-gaming pictures, compared to the control group (neutral pictures).

3. When participant sees the priming-gaming pictures, the color naming reaction time would be slower in the competition or affiliation target words, compared to achievement and immersion word groups
4. If the participant has a high interest on the competition or affiliation domain, when they see the priming-gaming pictures, the color naming reaction time should be slower to the competition and socialization target words, compared to achievement and immersion groups.

Method

2.1 Experiment design

Based on the research questions and goals, the experiment chose the 2×4 (the type of priming picture × the target words groups) factors within-subject design. Every subject encountered the same experience design (two types of priming pictures and four groups of target words). There were two category valuables which were the priming picture (game picture or neutral picture), and the target words categories (achievement, immersion, competition, and affiliation). The dependent values were the color naming time.

2.2 Participants

All participants recruited by voluntary or recommended by acquaintances. Thirty participants, with four female subjects, attended the experiment. The participants are all Chinese (the age varies from 20-29) and most of them are still students (college or master students). The mother language is Chinese. Besides, they have various degrees of experience in the PUBG and other types of computer games. Participants' total gaming time in PUBG were above 50 hours and all participants played PUBG at least three times a week.

Before the research started, the experimenter asked whether participants have normal or corrected-to-normal vision. Meanwhile, at the end of experiment, everyone who attended the

experiment received a small gift (e.g., a piece of chocolate) and three Euro as experimental rewards.

2.3 Materials & Apparatus

To provoke Stroop effect, ten distracting pictures were picked from the PUBG screenshots. These screenshots can represent the theme or the main gameplay of PUBG (Figure2). In the meantime, ten neutral priming images were exploited as the control group (Figure 3). The neutral pictures were photos of modern architectures (nothing related to the PUBG or any other computer games). All priming pictures are converted into black-and-white version beforehand to prevent the distraction from the color naming task.

Figure 2 Priming picture: The screenshot from PUBG.

Figure 3 Priming picture: Neutral modern architecture photo.

According to the motivation theories, the first author compiled four types of target words and 25 target words for each category (the complete target word table are reported the appendix 2, and the example can see the Table 4). These words were mostly collected from everyday

gamers' phase and terms (Wikipedia, bulletin board system, the official websites), and either demonstrated the core play-style or the in-game condition. Also, the experiment avoided the professional game jargon and complicated terminology to ensure that all target words were easy to understand and recognize for every participant. The second author checked the target word and the Cohen's Kappa was 0.787. Besides, the target word was presented in Chinese. The translation was checked by Chinese co-workers (with relevant gaming history).

Table 4 A few examples of target words.

Competition	Affiliation	Immersion	Achievement
Defeat	*helping*	*searching*	*finishing*
Match	*teammate*	*farming*	*prize*

The questionnaire was modified version of Yee's scale *Motivations for Play in Online Game* (MPOG). Some questions were adapted to relate the PUBG (exchanged some in-game jargon) and translated into Chinese.

2.4 Procedure

The experiment started with a brief instruction about the test. This guidance explained the general process about the Stroop priming task. The response keys were ← , ↓ , and → , which represented the color red, green and blue. Participants complied the instruction to watch a black-and-white pictures (priming target) first, then recognized and selected the following word's color by pressing the key as fast as possible. The priming pictures appeared 1 second which provided subjects enough time to recall relevant in-game experiences. The fixation cross (one second) came subsequently. Then the target words presented. The participants responded to the word's color with direction key and the program recorded the response time.

After the instruction, participants experienced the training part. The training section was designed for allowing subject familiar with the procedure and the response keys. The priming pictures in the training session selected neural photos (the monochrome fruits, sees the Figure

4) and the target words switched into the meaningless Chinese string “可天”. After that, the main experiment followed. The priming pictures in the main experiment were either game pictures or the neutral photos. And the target words randomly showed out.

Figure 4 Priming picture: a monochrome apple in training section

The training stage consisted of ten trails. The priming picture first shown, then the fixation cross, followed by the target word in the end (the experiment flow displays in figure 5). The main experiment was composed of five blocks with twenty trails each. Moreover, there was a break of 10 seconds between blocks. 20 priming pictures were randomly shown in each block without repetition and the frequency of occurrence of the three colors was set to be identical. After the Stroop priming experiment finished, the participant filled the MPOG scale and some questions about their demographics, the frequency of playing game, and total playtime (all in simplified Chinese).

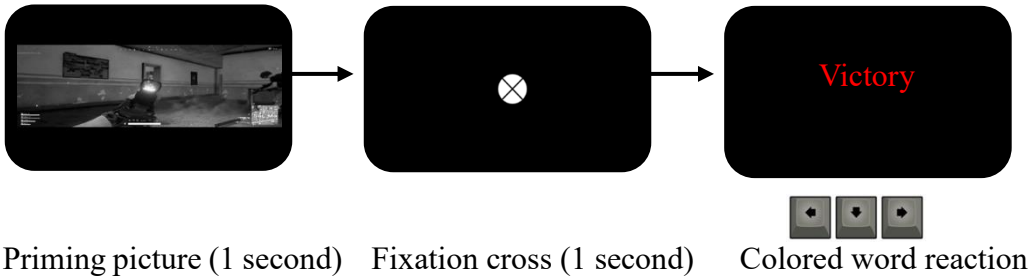

Figure 5 The experiment flow in the Stroop priming tasks.

2.5 Data analysis

The primary research purpose is to identify player's motivation about PUBG. Based on the motivation theories and measurement, four hypotheses came out. The first hypothesis speculated the tendency of self-report results. According to Yee's (2006) questionnaire factor weights, four subcomponents score (achievement, immersion, competition and affiliation) were counted. For testifying the first hypothesis, the R-studio function ggpairs() were applied to detect scale scores' distribution and the correlation coefficient in each component. Meanwhile, grand mean model (the stan_glm() function) was used to test the average differences between sub-components. These results could describe the relationship between subcomponents and answer the first research question whether the players have stronger motives in competition and affiliation than achievement and immersion.

The second hypothesis described the possible trends of response time under the different priming picture conditions (neutral pictures and the gaming pictures). Multi-level generalized linear models (GLM) and modified Gaussian (ex-Gaussian) regression were used to test the main effect of priming pictures. Furthermore, apart from the priming picture sets, there was another group-level categorical variable: the target word categories (achievement, immersion, competition, and affiliation). The third hypothesis concerns about the interaction effect between two variables. We assumed the presented of gaming pictures could affect the reaction time in the word group competition and affiliation. This part could verify by the interaction effect between priming picture categories and target word categories. GLM calculated the effect between two variables. If the interaction effect exists, the hypothesis three is tenable.

Except for analysis how independent variables (priming picture sets and word categories) affect reaction time, the crucial part is to investigate whether the questionnaire results have power to predict the reaction time differences under various experimental conditions, which could be tested by the interaction effect between the questionnaire's scores and independent variables. The GLM computed how reaction time different under three parameters -- target

words categories × priming-pictures sets × questionnaire scores. According to hypothesis four, the GLM checked when the competition or affiliation sub-scores is high, how the reaction time change under the game pictures and competition or affiliation words settings. In this way, the GLM model could help us identify the relationship between the predictor and the experimental variables and verify the predictive power.

The reason why the multi-level GLM was applied in the data analysis part was the consideration of nested experimental designs. Specifically, the between-subject factors and within-subject factors coexisted in the experiment, the former refers to the individual's motivational differences and later refers to the participant received different experimental setting (the target words categories and priming pictures sets). Therefore, the experimental designs fit the multi-level GLM. On the other hand, the ex-Gaussian distribution was applied to analyze the continuous temporal variables in GLM. Ex-Gaussian distribution, which has typical characteristics and advantages, is proposed in modeling response time in the psychological experiment. Firstly, this model usually fit the data set whose the randomness boundaries are bonce within the maximum and minimum value, and the minimum value is never close to zero. Secondly, the ex-Gaussian regression plotting generally presents a steep normal distribution curve with a long right tail and short left tail. The preliminary analysis showed the Stroop priming test RT dataset mainly meet the ex-Gaussian distribution (as can be seen in Figure 6). In R, we used version 2.2 package brm() function to call the ex-Gaussian distribution.

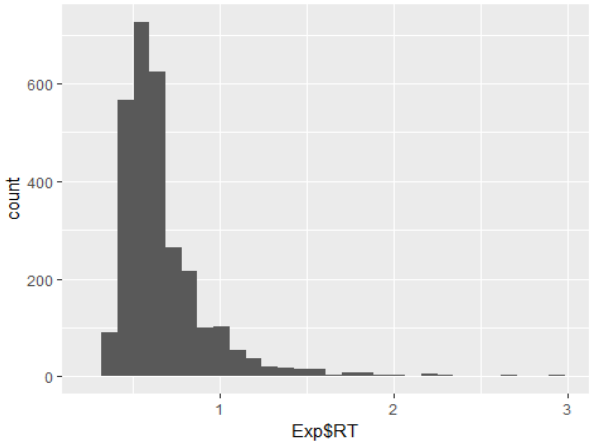

Figure 6 The total Stroop reaction time plotting. RT stands for the reaction time

Result

During the experiment, 30 *Motivations for Play in Online Game* (MPOG) questionnaire results were collected. The summary of MPOG scale result listed in Table 5. Firstly, initial descriptive analysis reflected that the competition factor has the highest score with large standard deviation. Figure 7 shows the distribution situation and correlation between each section. The curves and spots indicated the distribution of each component. The figure suggests the competition and immersion scores had the highest correlation coefficient (0.443) which was a moderate correlation. Secondly, to attest whether the participants have strong motives tendency on the competition or affiliation compared to achievement and immersion, we applied the grand mean models to detect the differences between each sub-component. The grand mean model's results indicated the score in subcomponent achievement and immersion were almost equal. Whereas, the coefficient of affiliation and competition were positive, and the 95% confidence interval excluded the zero. Hence, compared to the achievement and immersion, player scores in affiliation and competition subcomponent were approximately 5 to 6 points high (specific numbers see Table 6). Thus, players have a propensity to seek more competition and affiliation from gaming behaviors, which confirms the hypothesis 1.

Table 5 The descriptive result of MPOG questionnaire score

	achievement	immersion	competition	affiliation
Mean score	39.74	36.19	46.42	45.41
Standard deviation	6.36	6.02	6.80	6.74

Table 6 Grand mean model results of questionnaire score.

Fixed-effect	Coefficient	Lower 95% CI	Upper 95% CI
Intercept	39.834811	36.854613	42.7245285
affiliation	5.556749	1.442851	9.7983950
competition	6.387777	2.274668	10.5567031
immersion	-3.646987	-7.920246	0.5318346

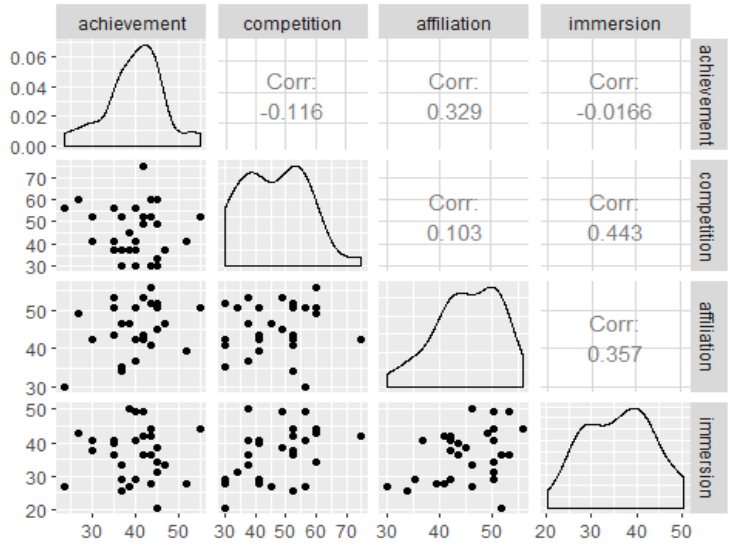

Figure 7 The matrix of plots with MPOG questionnaire results. "Corr" stand for the Pearson correlation coefficient

Then, 30 participants' 3000 response time for 100 target words were collected. The wrong responses and outliers (> 3 seconds) were excluded. The descriptive statistics toward reaction time (RT) showed the mean of RT was 0.69s with 0.64s standard deviation. Based on the

research questions, the main effect of priming-picture categories needed to be first checked. First of all, the hypothesis 2 assumed the priming gaming pictures presented would delay the RT. As table 7 shows, the reference group was the word category achievement × neutral priming picture. Under the priming-category parameter, fix-effects coefficients showed a negative figure (-0.02s), which means the effect of gaming pictures on RT decreases by 0.02s. The credibility limits in priming-pictures categories included zero. Thus, we cannot conclude with 95% certainty that there is an effect. This evidence showed the player's RT after exposed the game pictures and control sets were almost identical. The results disagreed with the hypothesis 2. The main effects of priming-picture categories were quite low.

Secondly, the research concerned about the interaction effects between the priming-picture and target words categories. According to motivation theories and Stroop priming effects, the in-game pictures should evoke the competition or affiliation concept, which will lead to a longer RT in the competition or affiliation words. As table 7 shows, under the category PA × Prime-cat P and PI × P conditions (stand for the word-category-competition × gaming-picture, and word-category-affiliation × gaming-picture), the participants seemed to have different reaction time tendencies. After the gaming pictures showed, the competition words triggered negative RT change (-0.15), which means the participants have shorter RT under word-category competition. On the other hand, the RT in the affiliation word-category was longer (0.09s) compared to the reference group. However, the credibility limits under condition word-category × priming-category all include zero, which suggests no significant evident could reject that the RT gaps between reference group and conditional groups were zero. The distance between lower and upper intercept varied from 0.42 to 0.43s. Compared to geekism experiment results, a broader interval appeared (Schmettow et al., 2013). Therefore, based on the regression outcomes, we concluded that the interaction effect between the target-word groups and priming-

picture sets were weak. The gaming pictures did not strike the RT delay in the competition and affiliation words.

Thirdly, the primary question in this study is whether the RT would different under diverse conditions depends on questionnaire scores. Specifically speaking, we assumed gamer's RT will slow down when the game pictures were presented and followed by relevant game jargons (competition or affiliation words). Meanwhile, if questionnaire has enough predictive power, the high score in competition or affiliation sub-component could predict this RT delay. This part was expressed as three ways interaction effect: priming-picture × word-category × scores. However, under the word-category-competition × priming-gaming-picture × competition-score condition, the RT only increased 0.06ms compared to reference group. Similarly, RT under the condition word-category-affiliation × priming-gaming-picture × affiliation-score was 4ms delay. In the meantime, the 95% confidence interval included zero and was quite narrow. So, the results suggested the interaction effect was very weak, which differ from our hypothesis. In other words, even participants have strong subjective preference toward the game, questionnaire result fail to predict the reaction patterns in the Stroop priming test.

Table 7 The regression outcome of Stroop priming test

Fixed-effect	coefficient	Lower 95% CI	Upper 95% CI
Intercept	0.6626872	0.3251745	0.9839498
WordcatGI	0.0333644	-0.1366127	0.2091831
WordcatPA	0.1203496	-0.0333019	0.2814762
WordcatPI	-0.0770560	-0.2156489	0.0599378
PrimecatP	-0.0248217	-0.1787145	0.1289858
Achievement score	-0.0004907	-0.0061399	0.0051725
Competition score	-0.0011911	-0.0047646	0.0025741
Affiliation score	0.0027934	-0.0038659	0.0094237
Immersion score	-0.0014107	-0.0070240	0.0041551
WordcatGI:PrimecatP	0.0630819	-0.1524249	0.2835145
WordcatPA:PrimecatP	-0.1522364	-0.3672500	0.0634574
WordcatPI:PrimecatP	0.0954848	-0.1269303	0.3142216
WordcatGI:achievement	0.0012040	-0.0018198	0.0043110
WordcatPA:achievement	-0.0024339	-0.0052959	0.0002159

WordcatPI:achievement	0.0016531	-0.0008335	0.0039627
WordcatGI:competition	-0.0008490	-0.0028696	0.0010932
WordcatPA:competition	-0.0001171	-0.0018658	0.0016593
WordcatPI:competition	0.0009623	-0.0006939	0.0025572
WordcatGI:affiliation	-0.0020604	-0.0055830	0.0012615
WordcatPA:affiliation	-0.0002914	-0.0035363	0.0030407
WordcatPI:affiliation	-0.0012294	-0.0039726	0.0015417
WordcatGI:immersion	0.0016913	-0.0010972	0.0046670
WordcatPA:immersion	0.0003797	-0.0025012	0.0030547
WordcatPI:immersion	0.0008381	-0.0016437	0.0032244
PrimecatP:achievement	0.0023682	-0.0004664	0.0051615
PrimecatP:competition	0.0013407	-0.0004865	0.0030735
PrimecatP:affiliation	-0.0027561	-0.0058241	0.0003720
PrimecatP:immersion	0.0004011	-0.0023276	0.0030798
WordcatGI:PrimecatP:achievement score	-0.0027436	-0.0066712	0.0011680
WordcatPA:PrimecatP:achievement score	-0.0004292	-0.0043146	0.0035183
WordcatPI:PrimecatP:achievement score	-0.0031358	-0.0072621	0.0011160
WordcatGI:PrimecatP:competition score	-0.0001504	-0.0025299	0.0023756
WordcatPA:PrimecatP:competition score	0.0000645	-0.0023867	0.0024775
WordcatPI:PrimecatP:competition score	-0.0012738	-0.0035564	0.0011584
WordcatGI:PrimecatP:affiliation score	0.0026366	-0.0015643	0.0070387
WordcatPA:PrimecatP:affiliation score	0.0043393	-0.0000194	0.0088084
WordcatPI:PrimecatP:affiliation score	0.0022139	-0.0022331	0.0065239
WordcatGI:PrimecatP:immersion score	-0.0018917	-0.0056249	0.0017193
WordcatPA:PrimecatP:immersion score	-0.0016457	-0.0053689	0.0021914
WordcatPI:PrimecatP:immersion score	-0.0008687	-0.0045069	0.0029492

Note: Estimates with 95% credibility limits. Reference groups for the treatment contrasts are word category=achievement, priming picture= neutral, GI stands for immersion, PA stands for competition, PI stands for affiliation

Discussion and conclusion

In this research, player's motivation about the PlayerUnknown's battleground (PUBG) was tested. According to the previous game motivation theories, researchers suspected gamers would show more competitive or sociable willingness than the in-game achievement and immersion when they play PUBG. To test the assumption, the Stroop priming test and the self-report measurement were applied to capture the intrinsic motives of playing behaviors. The

questionnaire results confirmed the hypothesis, while the Stroop priming results did not support our hypothesis.

Specifically, researchers and game designers expect participants seek competitive or affiliative experiences in the PUBG. The subjective self-report results supported this expectation. Participants' sub-component score in competition and affiliation were higher than the immersion and achievement dimension. The experimental results suggested people's motivation of playing PUBG fits the game designs. These findings add more empirical proofs in the gaming motivation theories and PUBG studies.

More importantly, we hoped the Stroop priming test may detect participants' motivation. The experiment applied two types of pictures as priming object presented first: the gaming and neutral picture. Then the gaming-related words showed out, the participants need to react the color of the word immediately. According to Stroop priming effects and spreading activation theory, the gaming priming-picture supposed to active some relevant concepts which can interfere the color-naming process, postpone the response time accordingly. However, the data suggested the reaction time in two priming-picture types were almost equal. Secondly, the in-game priming pictures presume to active competition and affiliation concept and delay the response time of color-naming task. The regression analysis may not support the expectation. There was no interaction effect between the priming-pictures and target word categories.

Furthermore, the primary research question is whether the MPOG questionnaire results can predict participants' reaction time tendency. When the participant shows high score in competitive or affiliative factor, the reaction time would be longer under the condition priming-gaming-picture × competition or affiliation words. However, as data analysis showed, the interaction effect between the predictor and variables was weak, which means the self-report results failed to forecast the reaction tendency. Generally, the Stroop priming test's outcomes did not satisfy our hypotheses. These Stroop priming results suggested participants had similar

interests toward the game world and other players, which were contradictory with the questionnaire results. Therefore, immediately concluding that players have no preferences toward the game through the experiment results is illogical. The reliability and validity of this experiment and the experimental paradigm need to be reconsidered.

4.1 The uncertainty about the Stroop priming paradigm

So far, the Stroop priming paradigm has only been applied a few times, leaving us doubting the theories and whether the paradigm works. The Stroop priming paradigm developed from the semantic priming experiment and classic Stroop tasks. Compared to the classic Stroop task which usually uses incongruent colored words as the distractor, the Stroop priming paradigm present distractors first before the colored words. These distractors usually use more general simulation to reach the conflict, like pictures. According to the spreading activation, automatic spreading and semantics process level theories, the strong association between the priming simulation and words is supposed to trigger the delay of the color-naming task. For example, the distractor is a photo of the *Little Red Riding Hood*, which should successfully trigger the concept of *Wolf* or *Grandmother* in your mind. When the target word is something like the *Wolf*, the response time assumes to be longer. This paradigm was first used in "Google" studies and later the "geekism" study (Schmettow et al., 2013; Sparrow et al., 2011). In the "Google" study, researchers chose a series of questions as priming target. They believed the hard question can active the concept of online search engine. The experimental results confirmed this theory. To get similar results in motivation study, we imitated and improved partly experimental design of "Google" study. In motivation experiment, the priming pictures were used as priming target, and gaming-related words were the target word. Unlike "Google" study, the priming-picture have little effect on the reaction time. Therefore, the experiment outcomes gave us several reasons to doubt the reliability and validity of the Stroop priming paradigm.

In the consideration of getting higher precise and rigorous results, the more intense stimulates were used as priming target in the game study. Based on the semantic Stroop task study from De Marchis, Rivero Expósito, and Reales Avilés (2013), the response time increased when the semantic distance between priming words and color words reduced. Thus, the degree of interference depends on the mental distant between priming target and target word, i.e., the shorter mental distant, the longer reaction time. Hence, for getting positive results in the motivation experiment, we selected the priming target and target word with a short mental distance. There are several reasons can prove the mental distant between priming pictures we selected and words. First of all, in motivation study, the experiment went through rigorous participant selection: only gamer who had rich PUBG experience attended the test. Since for every PUBG player, these classic in-game screenshots can fast and accurately rouse relevant gaming experiences and the recognition will distract the color-naming tasks. Many recognition studies supported these arouse mental processes. For example, the unified visual attention model suggested that the fast and robust visual recognition relies on the top-down familiarity (Lee, Kim, Kim, Kim, & Yoo, 2010). If the subjects are acquainted with the images, they can fast recall relevant memory. Respectively, a study from the University of California purposed that the preexisting familiarity to the picture could accelerate the coding speed into the visual short-term memory, which enhances the further information processing in short-term memory and recognition in long-term memory(Xie & Zhang, 2017). Obviously, participants have higher familiarity toward the priming-gaming-picture rather than the questions. Therefore, the mental distance between gaming pictures and gaming words is shorter than the questions and “Google”. In other words, the player is more likely to recall the concepts like “killing” or “teamwork” when the screenshot emerged and trigger longer reaction time in color-naming. However, these theories cannot be authenticated by our experiment results. The stronger triggers get poorer results, that is the reason we doubt the paradigm.

Moreover, although the “Google” study achieved gratifying results, the experimental designs still lacked rigorousness. To get strict results, the motivation study modified and improved some experimental procedures and materials. Firstly, the “google” experiment only applied two blocks times ten trails Stroop naming tasks which were far lower than the repetition times of other studies. For the classic Stroop tasks, the participant would usually take experimental items around a hundred times (MacLeod, 1991). And another Stroop priming test, the “geekism” designed ninety times repetition (Schmettow et al., 2013). The large repeated measurement in within-subjects designs can reduce intra-participant variability and make data less “noisy” to increase statistical power (Vickers, 2003). For these reasons, the motivation research employed five blocks × twenty trails with twenty-five target words for each category, which makes sure that every participant received a hundred times color-naming task. Secondly, the “google” test only used eight computer-related words and sixteen unrelated words as color words. The experimental procedures did not mention the peers review of the words, and the words numbers did not reach the same level. To avoid these problems, the gaming target words went through elaborate design and peers review. However, these improvements seem to bring undesired outcomes, which were another reason to doubt the validity of Stroop priming paradigm based on our repetitive measure results.

Furthermore, in 2013, Martin Schmettow et al. (2013) applied Stroop priming test in user experience testing to testify people implicitly associates with technologies. The team used digital devices pictures as the priming target and followed by three types of words: the geekism, hedonism, and usability. Meanwhile, there was a scale The Need for Cognition Scale (NCS) for assessing the geek predisposition. And the experiment selected computer science students as participants who have strong predisposition for geekism compared to the psychology students (the control group). The experiment considered the NCS and participants’ subjects as two predictors which can predict reaction time tendency. Like motivation study, the results of

"geekism" study found the main effect of word categories was low. Whereas, the interaction effects between predictors and target word categories were significant, which means the NCS and participants' subjects successful predicted participants' reaction. On the other hand, the MPOG questionnaire, also treated as predictor in the motivation study, failed to detect the response time patterns. The reason could be the reliability and validity of the predictor MPOG scale did not be verified. The prediction is short of preciseness and rigorousness compared to the need-for-cognition scale. In the geekism experiment, the predictor need-for-cognition scale which experienced plenty assessment (Cacioppo, Petty, & Chuan Feng, 1984), was used for the geekism detection. The result found the interaction effects between the geekism predictors and target word categories successfully. In this research, the criteria were the MPOG, which is the modified version of the Yee (2006) questionnaire. Yee collected 3000 online massive multiplayer online role-playing game (MMORPG) players data, and the components analysis found ten convinced subcomponents. However, the game type we tested only share some factors with MMORPG styles, and the MPOG did not go through the rigid and large-scale of validity test. In another word, the MPOG could suffer the problem of low prediction power.

In the comparison between motivation study and previous researches, this paper questions the validity of Stroop priming paradigm. From two strict experiment designs, (the "geekism" and this motivation studies) the main effect of neither priming pictures or target words are significant. Besides, the inherent problems of predictor also exist in this study. From our perspective, the uncertainty about the paradigm needs to be checked. The reliability and validity of the Stroop priming test require more empirical studies to test. Unlike traditional Stroop tasks or semantic Stroop task, Stroop priming tasks are more complicated. This means these paradigms will involve more complex mental processes than single color words printed in incongruent colors, or the semantic activation spread. Besides, the previous semantic Stroop task applied word as priming target, rather than pictures (De Marchis et al., 2013). Thus, the

theory – whether the picture can elicit spreading activation of concept, and whether the color naming task will be disturbed by these spreading activations, should have more empirical experiments to testify, improve and perfect. For the further research, scientists should take more priming task. For instants, take the picture of *Little Red Riding Hood* as priming target, or other concepts people familiar with, followed by relevant and irrelevant words, to test whether the stronger association between priming targets and words can trigger longer reaction time. In other words, these general-concept priming targets shall explain the feasibility of theories and the paradigm, before applying these methods in the user analysis fields.

1.2 Other experimental level limitations

Expect the inherent problems of the Stroop priming paradigm, there was another limitation in our own experiment design: the exposure time of screenshots can be longer. In the experiment, participants need to finish a hundred color-naming tasks in total. To avoid subjects lose their patience, we cut down the screenshots presented time (one second). One second is enough for the picture recognition. The ERPs measurement proved the objects recognition happened around 200ms. Still, for future studies, the researcher could prolong the exposure time to ensure subjects can associate more relevant memory.

4.3 Conclusion

This paper aimed to discover the motivation of playing the PUBG. Through literature review, we suspected players should have higher competition and affiliation motivation, rather than achievement and immersion. The traditional self-report measurement and Stroop priming test were used in the experiment to identify participants' motive tendencies. Although the questionnaire's result confirmed our hypothesis, the Stroop priming test failed to detect the motivation differences. This research gave us a living sample on player and user experience study. We encourage the further researches to focus on the Stroop priming paradigm to get an in-depth understanding of this implicit measurement. Once the validity analysis shows

reliability, these methods are no longer restricted to the motivation and requirement measurement, but also can be applied for analyzing the attitudes, preference, behavior pattern and other subjective concepts of users. Quantitative data from the reaction time could be the supplement to other investigate methods and provide more direct and unconscious responses than the self-report.

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Appendix 1

The Motivation for Play in Online Game

Subcomponent	Inventory Item	Factor Loading
Advancement (a = .79)	How important is it for you to level up your character as fast as possible?	.68
	How important is it for you to acquire rare items that most players will never have?	.77
	How important is it for you to become powerful?	.81
	How important is it for you to accumulate resources, items or money?	.69
	How important is it to you to be well-known in the game?	.53
	How much do you enjoy being part of a serious, raid/loot-oriented guild?	.60
Mechanics (a = .68)	How interested are you in the precise numbers and percentages underlying the game mechanics?	.78
	How important is it to you that your character is as optimized as possible for their profession / role?	.65
	How often do you use a character builder or a template to plan out your character's advancement at an early level?	.67
	How important is it for you to know as much about the game mechanics and rules as possible.	.69
Competition	How much do you enjoy competing with other players?	.64
(a = .75)	How often do you purposefully try to provoke or irritate other players?	.81
	How much do you enjoy dominating/killing other players?	.72
	How much do you enjoy doing things that annoy other players?	.82
Socializing	How much do you enjoy getting to know other players?	.82
(a = .74)	How much do you enjoy helping other players?	.65
	How much do you enjoy chatting with other players?	.77
	How much do you enjoy being part of a friendly, casual guild?	.63
Relationship (a = .80)	How often do you find yourself having meaningful conversations with other players?	.71
	How often do you talk to your online friends about your personal issues?	.88
	How often have your online friends offered you support when you had a real life problem?	.86
Teamwork	Would you rather be grouped or soloing?	.79

(a = .71)	How important is it to you that your character can solo well?	.77
	How much do you enjoy working with others in a group?	.60
	How important is it for you to have a self-sufficient character?	.63
Discovery (a = .73)	How much do you enjoy exploring the world just for the sake of exploring it?	.82
	How much do you enjoy finding quests, NPCs or locations that most people do not know about?	.77
	How much do you enjoy collecting distinctive objects or clothing that have no functional value in the game?	.55
	Exploring every map or zone in the world.	.80
Role-Playing (a = .87)	How much do you enjoy trying out new roles and personalities with your characters.	.66
	How much do you enjoy being immersed in a fantasy world.	.62
	How often do you make up stories and histories for your characters?	.83
	How often do you role-play your character?	.85
Customization (a = .74)	How much time do you spend customizing your character during character creation?	.73
	How important is it to you that your character's armor / outfit matches in color and style?	.81
	How important is it to you that your character looks different from other characters?	.80
Escapism (a = .65)	How often do you play so you can avoid thinking about some of your real-life problems or worries?	.81
	How often do you play to relax from the day's work?	.62
	How important is it to you that the game allows you to escape from the real world?	

Appendix 2

The table of target words			
Interest in other players		**Interest in the game world**	
Competition	**Affiliation**	**Immersion**	**Achievement**
Against	*Aid*	*appearance*	*Ability*
aggressive	*Assisting*	*Climbing*	*Accomplishing*
Ambush	*Back-up*	*Collecting*	*Achieving*
Assaulting	*Buddy*	*constructing*	*Completing*
Attacking	*Chatting*	*Cooking*	*Earning*
Competition	*Collaborating*	*Crafting*	*Enhancing*
Conflict	*Cooperating*	*Creating*	*Finishing*
Defeat	*Following*	*Discovering*	*Gaining*
Defense	*Friend*	*Driving*	*Grade*
dominating	*Group-up*	*Explore*	*Improving*
Enemy	*Healing*	*Farming*	*Increasing*
K.O.	*Helping*	*Finding*	*Level-up*
Lose	*Joining*	*Fishing*	*Obtaining*
Match	*Leading*	*Hunting*	*Powerful*
Murder	*Offering*	*Jumping*	*Prize*
Offense	*Partner*	*Mining*	*Record*
offensive	*Protecting*	*Monster*	*Reward*
Open-fire	*Providing*	*Picking-up*	*Score*
Opponent	*Sharing*	*Planting*	*Skillful*
PK	*Socializing*	*Running*	*Solving*
Race	*Supporting*	*Searching*	*Strength*
Rival	*Teaching*	*Swimming*	*Superpower*
Slaughter	*Teammate*	*Time-killer*	*Trophy*
Victory	*Teamwork*	*Using*	*Unlocking*
Win	*Together*	*Weather*	*Upgrading*

Appendix 3

The original statement of data analysis in R studio

```
devtools::install_github("paul-buerkner/brms")
devtools::install_github("schmettow/mascutils")
devtools::install_github("schmettow/bayr")

library(knitr)
library(tidyverse)
library(readxl)
library(brms) ## developer version from github with changed parametrizatio
n of exgaussian regression
library(mascutils) ## github
library(bayr)
library(GGally)

options(mc.cores = 4)
MCMC = F

opts_chunk$set(results = "asis")

load("CL18.Rda")
```

Data preparation

Data exploration

```
Part %>%
  select(achievement:immersion) %>%
  ggpairs()


qplot(Exp$RT)

## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.


Exp %>%
  ggplot(aes(x = Wordcat, col = Primecat, y = RT)) +
  geom_boxplot()
```

Regression

```
M_1 <- CL18 %>%
  brm(RT ~ Wordcat * Primecat  + (Wordcat * Primecat|Part) + (1|Word) + (1
|Prime),
      family = exgaussian(),
      data = .)
```

```r
save(M_1, file = "M_1.Rda")

M_1

load("M_1.Rda")
fixef(M_1)




M_2 <- CL18 %>%
  brm(RT ~ Wordcat * Primecat * (achievement + competition + affiliation +
 immersion) +
        (Wordcat * Primecat|Part) + (1|Word) + (1|Prime),
      family = exgaussian(),
      data = .)

save(M_2, file = "M_2.Rda")

load("M_2.Rda")
fixef(M_2)
```