Correlation Between Personality and Social Interactions in Online Strategy Games

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***Abstract*—Personality inference could create useful information, especially for the game industry. In this paper, we investigate whether and how the player personality is revealed in the player social interactions in a massively multiplayer online strategy game. We conduct an online survey with $50,319$ participants to collect the player personality traits. We then develop proper features to capture the player in-game social interactions, and analyze correlations between personality and social interactions using these features. Our results show that the in-game social interactions are correlated with personality, and reveal how personality can affect social interactions in massively multiplayer online strategy games. Then we further discuss the implication of our results.**

***Index Terms*—personality, social interaction, game analytics**

I. Introduction

With the game industry blooming in recent years, playing games has became an important part of many people's daily life and the in-game activity becomes a significant part of their behaviors. As personality is believed to correlate with human behavior and given the significant engagement of the game players in video games, researchers are looking to find out whether and how the personality and in-game behavior are correlated. Existing research has shown that video games, which record the digital footprints of the players, can reveal personality traits in cognitive science and social science areas; see, e.g., [1]–[11].

While the majority of previous work [1]–[11] focuses on the role-playing games (including MMORPGs and multiplayer online battle arenas (MOBAs)) and first-person shooter (FPS) games, in this paper we study a popular massively multiplayer online strategy game (MMOSG). Unlike those in the role-playing games and FPS games, the players in the strategy games do not play as a specific character or champion. Instead, they are usually the managers or commanders to manage their bases/cities, bloom their economy, build armies and plan military actions. The strategy game is one of the most popular genres of games. According to [12], among the top 41 highest-grossing mobile games, six games are strategy games and one is a real-time strategy game. However, despite their popularity, there is however a lack of research on the strategy games. As [7] points out, since the strategy games are fundamentally different from the role-playing games and FPS games, it would be interesting to investigate the relation between personality and the in-game behavior in the strategy games.

In order to gather the information on player personality, we conduct an online survey with $50,319$ participants to collect their personality traits (measured by the Five-Factor Model [13]) using personality questionnaires. To characterize the player behavior, previous work mainly uses the in-game actions[1], key performance indicators (KPIs)[2], and demographic information as features. Many of these features are game-dependent. In this paper, we focus on the in-game social interactions[3] (i.e., the in-game actions that occur among different players) as the features and study how these features are revealing in the player personality. We group these gameplay-related social interactions into certain game-independent categories. While almost all of the previous work uses accumulate records, we also consider the records of in-game social interactions over time, which may be more revealing.

To the best of our knowledge, this paper is the first to analyze the relation between the player social interaction and personality. It is also the first paper that focuses on analyzing the player behavior in a MMOSG. The main contributions of our work are as follows:

- We conduct a survey consisting of a large number of participants.
- We develop features that characterize and capture the player social interactions and the preference for the social interactions to understand the big picture.
- We characterize and analyze the correlation between the player preference for social interactions and personality. Then we discuss about the implication of our results.

The rest of the paper is organized as follows. Section II explains how we collect the personality data from survey and the in-game social interaction data. Section III describes the social interaction features we develop and how to characterize them. Section IV presents and analyzes the relation between personality and social interactions. Section V discusses the implication of our results. Section VI concludes the paper.

II. Data Gathering

In this section, we give a brief introduction to the massively multiplayer online strategy game (MMOSG), describe how the player personality data is collected, and explain the player social interaction data.

A. Massively Multiplayer Online Strategy Game

In this paper, we focus on a popular MMOSG released by Yoozoo Games[4], in which the players are acting as lords in a medieval world. This game offers a large sandbox map where each player owns a city. A player can develop his/her land,

[1]In this paper, the in-game actions refer to the actions that the players take, such as walking, sitting, and moving.

[2]KPIs refers to those variables that measure the player performance in a game, such as kill death ratio and score per minute.

[3]According to [14], the in-game social interactions that we consider in this paper are contributed to *implicit* social relationships. *Implicit* social relationships are formed passively by players through interactions.

[4]https://www.yoozoo.com/

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collect resources, research technologies and train troops. All the players in a server are located on the same map, and are allowed to interact with each other with large degrees of freedom. For instance, they can solely or jointly attack others' cities to loot resources and gain prestige. They can also reinforce others when they get attacked, and help others by sending them resources or gifts.

B. Survey Description

A survey was designed to collect player personality traits, demographic information (age and gender), and response times. The survey was conducted in game, and each participant was offered an in-game currency reward worth about 4 US dollars. The average time for filling the survey questionnaire was 288 seconds. In the survey, we used the Big-5 model that measures five traits: Extraversion (E), Agreeableness (A), Conscientiousness (C), Emotional Stability (ES) and Openness (O)[5]. We drew Big-5 Ten Item Personality Inventory (TITP) from [15] as our questionnaire, which has been proven to be reliable. For each personality trait, two corresponding items in the questionnaire were used to measure the trait. Participants were asked to rate themselves on each item using a seven-point scale ranging from 1 (strongly agree) to 7 (strongly disagree).

C. Survey Data Filtering

The survey had $50,319$ participants, with $35,134$ having complete in-game records. Motivated by [7] and to maximize data integrity, we excluded those participants who gave a biased answer (i.e., overused one response on TITP). Motivated by [6] and [5], we also excluded those who spent little time on the questionnaire. We only considered those participants who spent no less than 3 minutes on the questionnaire following the criteria in [5].

Among these $35,134$ participants, $6,395$ were giving a biased answer and thus excluded. Out of the remaining $28,739$ participants, $7,182$ spent no less than 3 minutes on the questionnaire and were therefore treated as valid participants. These valid participants ($5,757$ are male, $1,425$ are female) came from 149 different countries and regions across 6 different continents. Among these valid participants, the means of the personality scores are: E: 3.69; A: 4.68; C: 5.21; ES: 4.95; O: 4.55. The standard deviations of personality scores are: E: 1.13; A: 0.99; C: 1.27; ES: 1.31; O: 1.04.

D. In-game Behavior Data

This MMOSG allows different social interactions between the players. The types of interactions include:

- Scouting, Solely or jointly attacking other players' cities.
- Solely or jointly defending others from attacks.
- Executing other players' lord (after capturing the lord).
- Reinforcing other players when they get attacked.
- Helping other players by sending them resources or gifts.

The above interactions are common in most MMOSGs. Since our specific interest in the player behavior is on how the players interact with each other, we collected the data of the above types of interactions as the data of gameplay interactions between the players from the database of the game server. And we tracked the gameplay interactions for each player for 60 days.

[5]Throughout this paper, we use E to represent Extraversion, A to represent Agreeableness, C to represent Conscientiousness, ES to represent Emotional Stability, and O to represent Openness in tables.

III. Characterizing Player Social Interactions

In this section, we develop proper social interaction features from the player behavior data.

A. Gameplay Interaction Related Features

We first group the interactions into game-independent categories to understand the big picture, specifically along the following 3 dimensions:

- Friendly versus unfriendly interactions. Friendly interactions include those interactions that show support between the players, such as sending reinforcements, resources, or gifts. Unfriendly interactions include those that show hostility, such as attacking or executing lords. We use the ratio between the numbers of friendly and unfriendly interactions as a feature to show the preference of friendly interactions to unfriendly interactions (f_{friendly}):

$$f_{\text{friendly}} = \frac{\#\text{friendly interactions}}{\#\text{unfriendly interactions}}.$$

- Group versus individual interactions. Group interactions involve more than two event initiators, such as group attacking or defending. Individual interactions involve only one event initiator, such as sole attacking or defending. We use the ratio between the numbers of group and individual interactions as a feature to show the preference of group interactions to individual interactions (f_{group}):

$$f_{\text{group}} = \frac{\#\text{group interactions}}{\#\text{individual interactions}}.$$

- Gameplay versus communication interactions. Gameplay interactions depend on the gameplay design and are more related to playing the game, such as attacking, executing lords, and defending. Communication interactions do not depend on the design of the gameplay, and are more related to communications such as sending messages. We use the ratio between the numbers of gameplay and communication interactions as a feature to show the preference of gameplay interactions interactions to communication interactions (f_{gameplay}):

$$f_{\text{gameplay}} = \frac{\#\text{gameplay interactions}}{\#\text{communication interactions}}.$$

Notice that we use the ratios instead of the actual numbers of interactions as features, since the actual frequencies of interactions may be related more to the player activeness than their preference. Ratios capture better the player preferences, which are more revealing in the player personalities.

B. Evolution of Features Over Time

We also consider the evolution of features over time as features to understand the relation between personality and the evolution of player in-game social interaction. We divide the lifetime of first 60 days for each player evenly into 3 periods (i.e., 1st day to 20th day, 21st day to 40th day, and 41st day to 60th day) and calculate the corresponding features mentioned in Section III-A for each period. We then calculate of the changing rate of features over periods as features. For the feature f_x where $x \in \{\text{friendly}, \text{group}, \text{gameplay}\}$, we set the rate of change from period i to $i+1$ ($i \in \{1, 2\}$) as:

$$g_x^i = (f_x^i - f_x^{i+1})/f_x^i.$$

TABLE I
PEARSON CORRELATION COEFFICIENTS BETWEEN PERSONALITY AND PLAYER SOCIAL INTERACTION PREFERENCE FOR VALID PARTICIPANTS

	Feature	E	A	C	ES	O
Static Feature	f_{friendly}	-0.07***	0.05*	-	-	-
	f_{group}	-0.08***	-	-	-	-
	f_{gameplay}	-0.06**	-	-0.07**	-	-0.06***
Rate Feature	g^1_{friendly}	-	-	-	0.05*	-
	g^2_{friendly}	-	-	-	0.06**	-
	g^1_{group}	-0.05*	-	-	-	-
	g^2_{group}	-	-	-	-	-
	g^1_{gameplay}	0.05**	-	-	-	-
	g^2_{gameplay}	-	-	-	-	-

Throughout this paper, the number of stars indicates p-values, *** : $p < 0.001$, ** : $p < 0.01$, *and* * : $p < 0.05$. *Only significant correlations coefficients* ($p < 0.05$) *are shown. Min-max normalization is applied to each feature before calculating the correlation coefficients.*

IV. RELATIONSHIP BETWEEN PERSONALITY TRAITS AND SOCIAL INTERACTIONS

A. Relationship Between Personality Traits and Social Interactions

In order to avoid confusion introduced by the players with neutral personality traits in the data, we adopt the method in [6] to consider only those whose personality score is less than first quantiles and greater than 3rd quantiles for each personality trait. To analyze how personality is expressed in the social interaction in MMOSGs, we examine the Pearson correlation coefficients between the features we develop in Section III and the personality scores, see Table I. The Pearson correlation coefficient is widely used to examine the relation between personality and player behaviors [1], [3], [4], [7].

In addition, in previous work [6] and [7], the player activity level is a filter to decide the valid players. Here, we use the player activity level of social interaction as a metric to divide the participants into 4 quartiles, resulting in 4 subsamples. We rank the participants between 1 and 4 according to the activity level of their social interactions and which quartile they are in. Table II shows the Pearson correlation coefficients between the features we develop in Section III and personality scores for the group of rank i players ($i = 1, 2, 3, 4$).

The relationship between social interactions and each personality trait will be explained next.

1) Extraversion: Extraversion represents how outgoing and social a person is [6]. In the total sample that includes all the valid survey participants, Table I shows that extraversion is negatively correlated with the preference of friendly and group events. This implies that the players with high extraversion tend to start interaction with other players directly instead of following others as a group. In addition, extraversion is negatively correlated with the preference of gameplay, i.e., positively correlated with the preference of communication. This shows that the players with higher extraversion have higher preference of communication as expected. Seen for the correlation coefficient results in subsamples in Table II, extraversion of the group of rank 4 participants is negatively correlated with the preference of friendly and group events, which is similar to the result for the total sample but with higher effect size. Moreover, the negative correlation coefficient between extraversion and the preference of friendly and group events becomes stronger over time as the corresponding rate features are negative. Extraversion of the group of rank 4 participants is positively correlated with the discussion on alliance events, which shows that the active players are more engaging with the alliance events discussion with higher extraversion score.

2) Agreeableness: Agreeableness represents how caring and friendly a person is [1]. Table I shows that agreeableness is positively correlated with the preference of friendly interaction as expected.

3) Conscientiousness: Conscientiousness represents how organized, self-disciplined, and dutiful a person is [1]. Table I shows that conscientiousness is negatively correlated with the preference of gameplay for the total sample, which shows that the players with high extraversion tend to communicate besides playing the game. Moreover, the group of higher rank of activity level shows higher value of correlation coefficient.

4) Emotional Stability: Emotional stability represents how clam, secure, and confident a person is [1]. Table I shows that emotional stability is positively correlated with the increasing trend of the preference of friendly interactions over time.

5) Openness: Openness represents how imaginative, curious, and creative a person is [1], [6]. Table I shows that openness is negatively correlated with the preference of gameplay, which shows that the players with high openness tend to communicate besides playing the game.

As in [1] and [7], the absolute values of correlation coefficients appear to be low, ranging from 0.04-0.19 in Tables I and II. As mentioned in [1], since there is a large variance in demographics, the small effect size is probably not surprising. As in [7], our results show equal or larger effect size than that found in medical field and for other personality assessment method. We can conclude that our results in general have effective size of proper magnitudes. While experiments conducted with small sample size have higher effect size with lower statistics power, our results are valid as we have a large sample size (though with lower effect size) [7], [16].

V. DISCUSSION

In this section, we discuss the implication of our results.

Overall, the above result implies that extraversion shows significant correlations with all three types of in-game social interactions, while the rest four personalities show less number of significant correlations with in-game social interactions. This is because of the nature of online strategy games. On the one hand, online strategy games provide a platform for players to possibly interact with each other while the interaction types are limited by game design. So we can see that players with higher extraversion scores have the opportunity and take the opportunity to interact with other players, communicate with other players, and lead other players for group events. On the other hand, for the other four personalities, players have a pretty limited chance to reflect them via in-game social interactions. For instance, players are able to reflect agreeableness by more friendly interactions. But it's unlikely to reflect agreeableness via group events or gameplay events. This gives a hint to game companies, players with higher extraversion scores are easier to identify via their in-game social-interaction records. These players with higher extraversion scores help make other players engaged in the game, and make other players feel they are not alone. Hence these players are actually important for a good gaming environment. Game companies could take advantage of our findings in this paper to identify players with higher extraversion scores and keep them playing in the game to help improve the gaming environment.

We can also see that some correlations between in-game social interactions and extraversion becomes stronger over

TABLE II
PEARSON CORRELATION COEFFICIENTS BETWEEN PERSONALITY AND PLAYER SOCIAL INTERACTION PREFERENCE FOR GROUP OF RANK i PARTICIPANTS ($i = 1, 2, 3, 4$)

	Rank 1 Players					Rank 2 Players					Rank 3 Players					Rank 4 Players				
Feature	E	A	C	ES	O	E	A	C	ES	O	E	A	C	ES	O	E	A	C	ES	O
f_{friendly}	-0.09*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.19**	-	-	-	-
f_{group}	-	-	-	-	-	-	-	-	-	-	-0.1*	-	-	-	-	-0.19**	-	-	-	-
f_{gameplay}	-	-	-0.16***	-0.08*	-	-	-	-	-	-	-	-	-0.11*	-	-0.08*	-	-	-	-	-
g^1_{friendly}	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09*	-	-0.14*	-	-	-	-0.18**
g^2_{friendly}	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09*	-	-	-	-	-	-
g^1_{group}	-	-	-	-	-	-0.08*	-	-	-	-	-	-	-	-	-	-0.15*	-	-	-	-0.12*
g^2_{group}	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.12*	-	-	-	-
g^1_{gameplay}	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
g^2_{gameplay}	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.18**	-	-

time. This indicates that players with higher extraversion scores tend to reflect their extraversion over time. For instance, rank 4 players with higher extraversion scores have a growing interest in leading other players in group events as we can see in Table I. This phenomenon is reasonable because the players are getting familiar with the game over time, and getting familiar with the game helps them reflect their personality easier. For example, it may take some time for players to learn how to lead other players to join group events, and only after players have learned to lead other players, they have the chance to reflect their extraversion in the group event. This also implies that it would be valuable to assess personality traits over time.

Besides, groups of rank 3 and rank 4 participants show the most significant correlation coefficients among these 4 subsamples in Table II. This implies that players' activeness plays an important role in recognizing the correlation between personality and in-game social interactions. Only enough engagements of social interactions can reasonably reflect the correlation between players' personality and in-game social interactions. This gives us suggestion that while evaluating players' personality score via in-game social interactions, evaluation for players who is more active in-game may lead to a higher accuracy. For future research on the personality of game players, activeness is also an important factor to consider.

VI. CONCLUSION

In this paper, we have investigated whether and how the player personality is revealed in the player social interactions in a massively multiplayer online strategy game. We have conducted an online survey with $50,319$ participants to collect the player personality traits. We then developed proper features to capture the player in-game social interactions, and analyzed correlations between personality and social interactions using these features. Our results have shown that the in-game social interactions are correlated with personality. They offer insights on the relation between personality and social interactions in MMOSGs. We also offer the implication of our results. Our results can help the game companies identify outgoing players, keep a better gaming environment, hence increase the lifetime of the game, and enlarge game company revenue.

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REFERENCES

[1] N. Yee, N. Ducheneaut, L. Nelson, and P. Likarish, "Introverted Elves & Conscientious Gnomes: The Expression of Personality in World of Warcraft," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ser. CHI '11. Vancouver, BC, Canada: ACM, 2011, pp. 753–762.

[2] A. Bean and G. Groth-Marnat, "Video gamers and personality: A five-factor model to understand game playing style," *Psychology of Popular Media Culture*, vol. 5, no. 1, pp. 27–38, 2016.

[3] N. Yee, H. Harris, M. Jabon, and J. N. Bailenson, "The Expression of Personality in Virtual Worlds:," *Social Psychological and Personality Science*, Aug. 2010.

[4] G. van Lankveld, P. Spronck, J. van den Herik, and A. Arntz, "Games as personality profiling tools," in *2011 IEEE Conference on Computational Intelligence and Games (CIG'11)*, Aug. 2011, pp. 197–202.

[5] G. Lankveld, S. Schreurs, and P. Spronck, "Psychologically Verified Player Modelling." in *Neuroscience Letters - NEUROSCI LETT*, Jan. 2009, pp. 12–19.

[6] Z. Wang, A. Sapienza, A. Culotta, and E. Ferrara, "Personality and Behavior in Role-based Online Games," in *2019 IEEE Conference on Games (CoG)*, Aug. 2019, pp. 1–8.

[7] S. Tekofsky, P. Spronck, A. Plaat, H. J. van den Herik, and J. M. Broersen, "PsyOps: Personality assessment through gaming behavior," in *FDG*, 2013.

[8] M. Delhove and T. Greitemeyer, "The relationship between video game character preferences and aggressive and prosocial personality traits," *Psychology of Popular Media*, vol. 9, no. 1, pp. 96–104, 2020.

[9] N. Ducheneaut, M.-H. Wen, N. Yee, and G. Wadley, "Body and mind: A study of avatar personalization in three virtual worlds," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ser. CHI '09. Boston, MA, USA: Association for Computing Machinery, Apr. 2009, pp. 1151–1160.

[10] L. E. Nacke, C. Bateman, and R. L. Mandryk, "BrainHex: A neurobiological gamer typology survey," *Entertainment Computing*, vol. 5, no. 1, pp. 55–62, Jan. 2014.

[11] M. P. McCreery, S. Kathleen Krach, P. G. Schrader, and R. Boone, "Defining the virtual self: Personality, behavior, and the psychology of embodiment," *Computers in Human Behavior*, vol. 28, no. 3, pp. 976–983, May 2012.

[12] "List of highest-grossing mobile games," *Wikipedia*, Feb. 2020, page Version ID: 942824536.

[13] J. M. Digman, "Personality Structure: Emergence of the Five-Factor Model," *Annual Review of Psychology*, vol. 41, no. 1, pp. 417–440, 1990, _eprint: https://doi.org/10.1146/annurev.ps.41.020190.002221.

[14] A. L. Jia, S. Shen, R. V. D. Bovenkamp, A. Iosup, F. Kuipers, and D. H. J. Epema, "Socializing by Gaming: Revealing Social Relationships in Multiplayer Online Games," *ACM Trans. Knowl. Discov. Data*, vol. 10, no. 2, pp. 11:1–11:29, Oct. 2015.

[15] S. D. Gosling, P. J. Rentfrow, and W. B. Swann, "A very brief measure of the Big-Five personality domains," *Journal of Research in Personality*, vol. 37, no. 6, pp. 504–528, Dec. 2003.

[16] G. J. Meyer, S. E. Finn, L. D. Eyde, G. G. Kay, K. L. Moreland, R. R. Dies, E. J. Eisman, T. W. Kubiszyn, and G. M. Reed, "Psychological testing and psychological assessment. A review of evidence and issues," *Am Psychol*, vol. 56, no. 2, pp. 128–165, Feb. 2001.