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An analysis of players' personality type and preferences for game elements and mechanics

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ABSTRACT

The personality type of an individual has the potential for influencing the design of gaming experiences. To date, no game or psychology scholars have investigated if a player's personality type aligns with their preferences for game elements or mechanics (GEMs). To this end, an investigation sought to find if a player's personality type (Australian Personality Inventory) can predict a player's preference for GEMs. To explore this, the data from three surveys (n = 279, n = 231, n = 162) assessing a player's API type and preference for GEMs were analyzed. The results confirm that a player's personality type cannot be used to predict a player's preference for GEMs.

1. Introduction

The use of gaming experiences stems beyond the context of entertainment. For some time now, games are entering realms of health, lifestyle, and education. In each case, the use of games aims to offer an engaging alternative to doing ordinary tasks. Given such diverse contexts, many game designers and scholars have considered how to tailor the game's design for players. In these instances, many consider and use tools such as personality tests. Personality is an accepted measure of understanding individuals. As a result, it is not surprising that it is considered as a way to understand player's in gaming experiences [1–7].

The concept of personality (and its assessments) aims to explain human behavior in a categorical approach. These categories synthetize various traits and behaviors into unified models known as "personality types". Similarly, game scholars have attempted to synthesize the way players behave in games and gaming experiences with "player types" [8–15]. With gaming experiences being used in more personal situations through gamification, it is important to understand what players prefer and find appealing in them.

The main contention is that earlier studies that assess the personality type of players and their relationship with their gaming experiences [1,5,7,16,17] tends to (1) focus on how their type influences their behavior within the game and/or reality towards other players and the environment, and (2) how it can be used to model players during gameplay. However, many of these studies do not explore how it could influence the design of a game and in turn, the player's experience.

This paper presents an empirical analysis on the level of impact that a player's personality has on their preference for game elements and mechanics (GEMs). The results are based upon a quantitative study of (in total) 672 gamers, across three surveys, which identified participants personality type *(Openness, Conscientiousness, Agreeableness, Extroversion, and Neuroticism)* and their preferences for various GEMs (on a three and seven-point rating scale). The use of Exploratory Factor Analysis (EFA) and Stepwise Linear Regression aimed to figure out (1) the extent to which GEM factors existed and (2) if a player's personality type could predict GEMs. The results revealed that players preferred GEMs, many different models, and the extent of which their personality type provided a predictor for each. Finally, this paper presents recommendations that are based upon the results from this study for future explorations relating to personality and player's preferences for GEMs.

It should be noted that, the results of this paper are from a larger study involving the assessment of motivation type [54]. Given that the study did not focus on the relationship between personality and motivation, but the relationship between GEMs and personality, and motivation separately, the results are better discussed within their respective fields.

2. Related work

There have been many iterations over centuries to categorize an individual based on the characteristics that they show and how they behave. An overview of personality type models can be seen in Table 1.

Since the early definitions of personality assessment [18], the concept of personality has become more refined and to some extent stable. However, one of the more popular choices when it comes to assessing personality is the "Big Five". The Big Five refers to theories that

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Table 1
Overview of different personality typologies.

Who	Year	What
Hippocrates [18]	~370 BCE	Four Humors: Blood, yellow bile, black bile, phlegm
Galen [19–21]	~200 CE	Four Temperaments: Sanguine, choleric, melancholic, phlegmatic
Gall [22]	1800s	Cranioscopy (aka Phrenology) 27 brain areas that contribute to personality
Galton [23]	1884	The Lexical Hypothesis
Freud [24]	1923	id, ego, superego
Myers-Briggs [25]	1926	Myer-Briggs Type Indicator MBTI
Jung [26]	1930s	Introversion, extroversion
Allport, Odbert [27]	1936	18,000 words to describe human personality
Cattell [28]	1940	16 Personality Factors (16pf)
Eysenck [29,30]	1947	Two dimensions of personality: Extroversion, Neuroticism
Maslow [31,32]	1940–1950s	Hierarchy of Needs
Tupes and Christal [33], Norman [34]	1961	Five recurring factors (from Cattell): Surency, agreeableness, conscientiousness, culture, emotional stability
Lewis Goldberg [35]	1981	Coined the term "Big Five"

categorize individuals into five types of personality. The first "Big Five" categorization began with Donald Fiske [35]. Later, a notable improvement of these five typologies is the Costa and McCrea "Five-Factor Model" (FFM). While Costa and McCrea's model is by far used both within and outside of academia, others also present similar categories. Below, Table 2 presents the developments and variations of the "Big Five".

2.1. The Australian personality Inventory

The Australian Personality Inventory (API) draws on fifty items from Goldberg's International Personality Item Pool [36] to form a publicly accessible measure of personality. Two studies explored the reliability of the API. These studies consisted of a large community (general population) and university-based sample [36]. The results concluded that the API was an accurate measure of personality assessment. Furthermore, there were convergent correlations between the API and NEO-FFI (NEO Five-Factor Inventory) measure of the Five-Factor Model (FFM). Thus, it offers support for the accuracy of the API in measuring the five factors (*Neuroticism*, *Extraversion*, *Openness to Experience*, *Agreeableness* and *Conscientiousness*). Murray concluded the API by stating that researchers can confidently use the scale score from the API as a measure of the FFM [36]. Therefore, researchers can use the API as they would use the FFM and expect to obtain the same result, without the concern of licensing issues or financial deficit. As a result, the use of the API in this study is for this reason.

2.2. Player types and personality

Many researchers have been investigating and assessing the relationship between the personality type of the player and its place within the context of games. For example, research by Markey & Markey [42], Tondello [8,14,16], Bateman and Boon [37], Bateman et al. [38] and Yee [39] investigates characteristics of personality and other aspects of gamer culture such as motivation and behavior. These investigations have assessed behavioral, written text, and linguistic correlations of personality. As a result, they have discovered relationships between personality and motivations reflected in behaviors within virtual worlds [40–44]. Moreover, past research suggests that the personality traits of psychoticism and aggressiveness moderate the negative effects of violent video games. For instance, Jeng and Teng [41] confirmed the influence personality traits had on player motivations. Furthermore, Bean and Groth-Marnat [1] explored personality characteristics and gameplay style of World of Warcraft (WoW) [55] players discovering that different personalities favored distinctive styles of play. This was later investigated in more depth by Bean et al. [45]. Further promoting this relationship, Graham and Gosling [46] investigated the personality and motivations of WoW players for playing the Massive Multiplayer Online Role-Playing Game (MMORPG). They saw that it was possible to associate distinct motivations for playing with different personality traits. While the focus of some research is on the motivation of players, investigations of the relationship between personality and video game violence also demonstrated a strong link between personality and individuals drawn to violent video games [42]. In recent times, research done by Cowley and Charles [47] "derive features of play from sequences of actions, which are intrinsically informative about behavior", which they refer to as "*Behavlets*". Based on their research, their methods enable them to characterize play styles. With the intention of developing meaningful and interpretable models of how players approach and engage with a gaming experience. Lastly, VandenBerghe [4], a creative director at Ubisoft, provides a more personality based perspective, where the players (the Big Five) personality type of an individual, in theory, could accurately predict the experiences that a player engages in, to explain their motivations

3. Study design and methods

The study was designed to investigate if: (1) can (and to what extent does) a player's personality type be predictors for player's preferences for GEMs; and (2) if this information could be used to influence the implementation of GEMs in gaming experiences. In this section, each research instrument is explained followed by data collection methods and validation, and lastly the results.

3.1. Development of the surveys

To collect data, a preliminary questionnaire was developed in a software named Qualtrics. To develop the questionnaire many games, game design resources (books, websites, articles) were examined to create and refine a list of GEMs (surveys 2 and 3). The list featured GEMs that were consistent among gaming experiences (e.g. badges, points, leaderboards, etc.). This list is in Appendix A. The survey was then distributed across many online social networking sites such as Twitter, Facebook, Reddit, and LinkedIn, as well as various game related mailing lists.

3.1.1. Analysis techniques of the surveys

3.1.1.1. Scale reliability. To determine the reliability of the GEM

Table 2
Versions of the "Big Five" personality typologies.

Founder	Type 1	Type 2	Type 3	Type 4	Type 5
Costa and McCrea	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Fiske	Social Adaptability	Conformity	Will Achieve	Emotional Control	Inquiring Intellect
Norman	Surgency	Agreeableness	Conscientiousness	Emotionally	Culture
Borgatta	Assertiveness	Likeability	Responsibility	Emotionality	Intelligence
Digman	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Opened to Experience

questionnaires, Cronbach's alphas were calculated for each questionnaire and consequential (EFA) factor. A Cronbach's alpha is a measure of internal consistency. What it does is that it presents a value that indicates the extent that a set of items are related as a group; particularly in results such as factor analyses.

3.1.1.2. EFA. An exploratory factor analysis (EFA) was used to analyze player's preferences for GEMs. The suitability of the data for EFA was checked by also considering the correlation matrix, and the KMO. To figure out the number of factors to keep, parallel analysis, PA-MRFA, was performed [48] using the EFA software package FACTOR [49]. The oblique Promin [49] rotation method was used to aid in factor interpretation, and the Mislevy and Bock [56] reliability estimates were calculated for each factor found. Based on the Parallel Analysis (PA) and Minimum rank factor analysis (MFRA), three factors were kept. Factor loadings that were all above 0.3 retained and are reported in tables below.

3.1.1.3. Stepwise linear regression. The use of stepwise linear regression was used to predictor to foresee the value of the dependent variable in a new data sample in relation to the values of the independent variables. In addition, other advantages that stepwise linear regressions provided were that it simultaneously considered the relationship between independent variables and the dependent variable. However, if the data presented with more significant and conclusive results, then methods such as LASSO (the least absolute shrinkage and selection operator) [50] would replace stepwise linear regression for further analyses. With respect to research, the purpose of stepwise linear regression was to explore the order that certain elements would appear as a factor and later to decide the order that players engage with gaming experiences were based on a range of parameters.

3.2. Survey 1

The distribution of the first survey began on the 13th of May (2014) and remained open until the 13th of June (2014) for a total of one month. Data was collected from an online survey (n = 279). Demographic data is presented in Table 3.

An EFA was performed with the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy being 0.75, and the Bartlett's test was significant, $p < 0.001$. The results of the EFA are presented in, with loadings less than 0.30 omitted to improve clarity. A reliability analysis was carried out on the game element list comprising of 21 items. Cronbach's α showed the questionnaire to reach a weak yet acceptable reliability, $\alpha = 0.68$. Most items appeared to be worthy of retention, resulting in a decrease in the alpha if deleted. The one exception to this was "Permadeath", which would increase the α by 1%, to = 0.69. Considering the low alpha, it is possible that is a result of the 3-point Likert Scale. In addition, each Game Element (and subsequent game mechanic) Model (*GE-M* for elements and *GM-M* for mechanics) is titled with a corresponding number: 1, 2, or 3. The choice to use this naming convention instead of more descriptive titles was to classify the factors in a more simplistic way, which would be identifiable when discussing them among literature and avoid confusion among other similar game terms. For example, giving a type that is defined as Achiever would cause confusion among elements such as Achievement and other typologies who refer to the player type "Achiever". In saying this, adjectives are presented to provide context for each GEM model (see Table 4).

Table 4
Factor loadings of game elements in Survey 1.

Element	GE-M1	GE-M2	GE-M3
Story	0.86		−0.42
Quest	0.84		
Currency	0.52		
Item	0.42		
Difficulty	0.42		
Unlockables	0.42		
Avatar	0.39		
Chance	0.32		
Badge		0.83	
Achievement		0.77	
Bar		0.64	
Rewards		0.55	
Points		0.50	
Level		0.49	
Collectable		0.41	
Status			0.86
Timer			0.73
Leaderboard			0.73
Combo			0.60
Bonus			0.53
Permadeath		−0.59	0.43

3.2.1. Stepwise linear regression with API personality type and game elements of Survey 1

3.2.1.1. GE-M1 (adventure). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted *GE-M1*. The results suggest that the personality type Extroversion [$F(1, 277) = 5.95$, $p = 0.15$] with an R^2 of 0.021, accounted for 2.1% of variance; and *Extroversion* and *Openness* [$F(2, 276) = 5.56$, $p = 0.004$] with an R^2 of 0.039, which accounted for 3.9% of variance. These results suggest that the personality types *Extroversion* and *Openness* were weak predictors for *GE-M1* and thus not indicating a player of these types would be drawn specifically to a gaming experience containing these elements.

3.2.1.2. GE-M2 (quantifiable). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted the *GE-M2*. There was a significant effect of the personality type *Extroversion* [$F(1, 277) = 11.634$, $p = 0.001$] with an R^2 of 0.040, which accounted for 4.0% of variance; and *Extroversion*, and *Neuroticism* [$F(2, 276) = 8.301$, $p = 0.029$] with an R^2 of 0.057, which accounted for 5.7% of variance. Given that these personality types were higher predictors than the remaining personality types, one can consider a potential rationale for why this may be the case. It is reasonable to consider that players who find *Achievement* game elements more appealing may fall higher on the *Extroversion* type to feel a sense of domination/mastery that can be found associated with elements such as

Table 3
Demographic information in Survey 1 (n = 279).

Demographic information	Result
Gender	**Females** (46%), **males** (56%)
Age	**18–25** (51%), **26–35** (38%), **36–45** (6%), **45–54** (4%),**55+** (1%)
Frequent players of	**Role-Playing** (46.24%), **First Person Shooter** (38.71%), **Strategy** (70.25%), **Puzzle** (61.29%), **Adventure** (66.31%), **Action** (63.08%), **Massively Multiplayer Online First-Person Shooter** (38.71%), **Massively Multiplayer Online Role-Playing game** (30.07%), **Other** (15.05%)
Location	**North America** (28%), **South America** (4%), **Asia** (3%), **Europe** (42%), **Oceania** (23%), **Africa** (0%)
API Personality Type	**Openness** (63.44%), **Agreeableness** (15.41%), **Conscientiousness** (11.47%), **Neuroticism** (5.73%), **Extroversion** (3.94%).

Notes: N = 279. Genres have been highlighted in bold to improve table readability.

Badges, Points, and *Achievements*. While, for those who fall on the lower side of *Extroversion* may avoid these kinds of experiences because they prefer to engage with more passive gameplay that is not achievement orientated. In terms of high scoring *Neuroticism* type players, they may prefer *Achievement* orientated game elements because they may have certain levels of insecurity. Where, *Achievement* elements somehow offer some sort of validation.

3.2.1.3. GE-M3 (dexterity/skill). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted *GE-M3*. There was a significant effect of the personality type *Extroversion* [F(1, 277) = 4.568, p = 0.033] with an R^2 of 0.016, which accounted for 1.6% of variance. Considering that the analysis revealed that only the *Extroversion* personality types were predictors for *GE-M3*, it is likely that such elements are related to games that can give short-term stimulation or games that are played within a social setting.

3.3. Survey 2

The distribution of the first survey was on the 6th of January (2015). The survey remained open until the 14th of February (2015) for a total of one month. Data collected from the second online survey (n = 231), was quite skewed (30% more) towards males (62%) than females (38%). Participants scored highest, like Survey 1, in the API type *Openness* (68.0%), followed by *Agreeableness* (16.5%), *Conscientiousness* (8.7%), and scoring equally lowest on *Extroversion* (3.5%), and *Neuroticism* (3.56%). Similarly, to Survey 1, there is a level of consistency between API types of players who have taken the survey (see Table 5).

EFA was conducted twice for the game element and mechanic questionnaires. For the game mechanic questionnaire, the Bartlett's test was significant, $p < 0.001$. and the KMO statistic, 0.77 presented as fair. Table 6 displays the game elements and their component loadings, with loadings less than 0.30 omitted to improve clarity. *Currency* was the only game element that presented with a loading below 0.3, and therefore was excluded. The highest loading was Achievement (0.90), which also presented with a lower loading in Survey 1 (0.77). The lowest loading game element in Survey 2 was *Collectable* (0.31), which presented with a slightly higher loading in Survey 1 (0.41) Whereas the lowest loading element in Survey 1 – *Chance* (0.32), produced a higher loading in Survey 2 (0.53). Game elements also appeared to be evenly distributed across the factors. Similarities appeared to exist between the factors of Survey 1 and those of Survey 2. Not only were three factors extracted, but elements that loaded into their respective factor were the same if not for slight differences (e.g. elements loading in another factor. Table 7 presents the loading scores of each game mechanic.

A second reliability analysis was carried out on both the game element and mechanic questionnaires. Cronbach's α showed the game element questionnaire reached a more acceptable reliability than Survey 1, α = 0.76. Further reinforcing the assumptions in Survey 1, with respect to the removal of the game element "*Permadeath*". All

Table 6
Factor loadings of game elements in Survey 2.

Element	GE-M1	GE-M2	GE-M3
Quest	0.68		
Item	0.63		
Avatar	0.63		
Story	0.62		
Rewards	0.61		
Difficulty	0.51		
Level	0.5		
Bonus	0.37		0.44
Unlockable	0.36		
Bar	0.34		
Status	−0.55	0.35	0.83
Leaderboard	−0.64	0.60	0.67
Achievement		0.90	
Badge		0.87	
Points		0.41	
Permadeath		−0.31	0.58
Collectable		0.31	
Timer			0.56
Chance			0.53
Combo			0.51
Currency	–	–	–

Table 7
Factor loadings of game mechanics in Survey 2.

Mechanics	GM-M1	GM-M3	GM-M3
Creating	0.78		
Making	0.77	0.33	
Finding	0.72		
Using	0.71		
Building	0.69	0.30	
Obtaining	0.66		
Collecting	0.61	−0.34	
Keeping	0.60		
Sorting	0.50		
Repairing	0.36		
Collaborating		0.71	
Communicating		0.77	
Trading		0.55	
Sending	0.39	0.45	
Targeting			0.71
Punishing			0.68
Shooting			0.65
Disabling			0.63
Enabling			0.59
Revealing			0.52
Voting			0.50
Winning			0.49
Customising			0.42
Celebrating			0.40
*Losing	–	–	–
*Scheduling	–	–	–

Table 5
Demographic information of participants for Survey 2 (n = 231).

Demographic information	Results
Gender	**Females** (38%), **males** (62%), **other** (0, 0%)
Age	**18–25** (56%), **26–35** (30%), **36–45** (10%), **45 – 54** (2%), **over 55** (2%)
Frequent player of	**Action** (41.36%), **Action-Adventure** (53.70%), **Adventure** (53.09%), **Board** (35.80%), **Card** (32.72%), **Casual** (40.12%), **Educational** (12.35%), **Fighting** (18.52%), **FPS** (41.36%), **Indie** (43.83%), **MMO (Other)** (12.96%), **MMOFPS**, (18.52%), **MMORPG** (30.86%), Platform (29.63%), **Puzzle** (46.30%), **Racing** (19.14%), **RPG** (66.67%), **Serious** (17.28%), **Shooter (Third Person)** (27.16%), **Simulation** (42.59%), **Sports** (9.88%), **Strategy** (56.79%), **Survival** (25.31%), **Other** (9.88%)
Type of Gamer	**Casual** (29.8%), **Hardcore** (23.38%), **Bit of Both** (42.42%), **Other** (0.87%), **Not applicable** (3.46%)
Location	**North America** (46%), **South America** (3%), **Asia** (1%), **Europe** (39%), **Oceania** (11%), **Africa** (0%)
API personality type	**Openness** (68.0%), **Agreeableness** (16.5%), **Conscientiousness** (8.7%), **Extroversion** (3.5%), **Neuroticism** (3.56%).

Notes: N = 231. Genres have been highlighted in bold to improve table readability.

Table 8
Demographic information of participants for Survey 3 (n = 162).

Demographic information	Result
Gender	**Females** (79, 48%), **males** (83, 52%)
Age	**18–25** (52%), **26–35** (36%), **36–45** (9%), **45 – 54** (2%), **over 55** (1%)
Frequent player of	**Action** (41.36%), **Action-Adventure** (53.70%), **Adventure** (53.09%), **Board** (35.80%), **Card** (32.72%), **Casual** (40.12%), **Educational** (12.35%), **Fighting** (18.52%), **FPS** (%), **Indie** (43.83%), **MMO** (12.96%), **MMOFPS**, (18.52%), **MMORPG** (30.86%), **Platform** (29.63%), **Puzzle** (46.30%), **Racing** (19.14%), **RPG** (66.67%), Serious (17.28%), **Shooter** (Third Person) (27.16%), **Simulation** (42.59%), Sports (9.88%), **Strategy** (56.79%), **Survival** (25.31%), **Other** (9.88%)
Type of Gamer	**Casual** (31.48%), **Hardcore** (17.90%), **Bit of Both** (45.68%), **Other** (4.32%), **Not applicable** (0.62%)
Location	**North America** (39%), **South America** (1%), **Asia** (4%), **Europe** (42%), **Oceania** (14%), **Africa** (0%)
API Personality Type	**Openness** (63.6%), **Agreeableness** (22.8%), **Conscientiousness** (8.6%), **Neuroticism** (3.7%), **Extroversion** (1.2%).

Notes: N = 162. Genres have been highlighted in bold to improve table readability.

items appeared to be worthy of retention, resulting in a decrease in the alpha if deleted.

3.3.1. Stepwise linear regression with API personality type and game elements of Survey 2

3.3.1.1. GE-M1 (adventure). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted *GE-M1*. There was a significant effect of the personality type *Openness* [F(1, 229) = 12.104, p = 0.001] with an R^2 of 0.050, which accounted for 5.0% of variance. Like Survey 1, the reoccurring personality type might explain that explorative games are preferred by players who are more willing to try new adventures and accept the conventions of alternate worlds. The correlation with this type again, appears to reflect a more stable association between the personality type and *GE-M1*. Games that may relate to this combination are online role-playing games. However, it is also possible that such games attract users based on the vast nature of their worlds in contrast to the social or competitive elements. Players who rate high on *Openness* are likely to enjoy the curious affordances that games with explorative elements have. They may also enjoy from the creative elements that may be present such as Story, Avatar, and Items. For those who rate low on *Openness* may prefer the practical elements of *GE-M1* such as *Currency*, *Progress Bars*, and *Levels*.

3.3.1.2. GE-M2 (quantifiable)and GE-M3 (dexterity/skill). The analysis revealed that there were no predictors, suggesting that there was no discernible linear relationship between the personality types and each of the GE-M2 or GE-M3.

3.3.2. Stepwise linear regression with API personality type and game mechanics of Survey 2

3.3.2.1. GM-M1 (efficacy). The analysis revealed that there were no predictors, suggesting that there was no linear relationship between the personality types and *GM-M1*.

3.3.2.2. GM-M2 (activism). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted *GM-M2*. There was a significant effect of the personality type *Neuroticism* [F(1, 229) = 5.291, p = 0.022] with an R^2 of 0.023, which accounted for 2.3% of variance. Considering that the analysis revealed the *Agreeableness* personality type as a sole predictor *GM-M2*, it may suggest that both high and low *Agreeableness* personality types reflect different elements within the factor. For example, players who rate high on *Agreeableness* may be considered submissive and therefore succumb to Voting in a way or be influencing to *Enable/Disable* certain parts of the gaming experience for various reasons. Whereas, players who rate lower on *Agreeableness* tend to be competitive and challenge other players. This reflects mechanics such as *Winning*, *Punishing*, *Disabling*, and even *Targeting* if it means that they might get an advantage.

3.3.2.3. GM-M3 (social). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted *GM-M3*. There was a significant effect of the personality type *Neuroticism* [F(1, 229) = 10.223, p = 0.002] with an R^2 of 0.043, which accounted for 4.3% of variance. While the analysis revealed that the *Neuroticism* personality was the only predictor *GM-M3* – Social this may relate to individuals who score lower on the *Neuroticism* personality type and show secure/confident traits. In fact, the inclination of the regression line is negative. For example, game mechanics such as *Communicating*, *Collaborating*, and even *Trading* all require that a player actively engages with other players or even NPC's thus needing a certain level of calm, and comfortability in such experiences. Players who rate higher on the *Neuroticism* personality type may relate to these experiences on a more emotional level and find them intimidating and even uncomfortable.

3.4. Survey 3

Survey 3 was used to confirm the results of Survey 2. The survey structure, questions, and rating scales remained the same as Survey 2 to further validate the survey. The distribution of the first survey was on the 16th of August (2015) and the survey remained open until the 16th of September (2015) for a total of one month. The demographic data is presented in Table 8.

EFA results for the game element questionnaire revealed the Bartlett's test was significant, p < 0.001 and the KMO statistic, 0.75 being again, fair. Tables 6 and 9 presents the loadings for Survey 3, with loadings less than 0.30 omitted to improve clarity. Moreover, the results of the third EFA for game elements contained many, in total seven,

Table 9
Factor loadings of game elements in Survey 3.

Element	GE-M1	GE-M2	GE-M3
Story	0.90	−0.50	
Quest	0.85		
Avatar	0.66		
Level	0.45		
Points	0.41	0.40	
Item	0.41		
Difficulty	0.39		
Unlockable	0.37		
Badge		0.87	
Achievement		0.85	−0.31
Status	−0.53	0.82	0.34
Leaderboard	−0.58	0.78	
Rewards	0.40	0.56	
Bonus		0.44	
Collectable		0.41	
Currency	0.34	0.36	
Combo		0.32	0.31
Bar		0.30	
Permadeath		−0.35	0.78
Chance	0.35		0.57
Timer			0.46

Table 10
Factor loadings of game mechanics in Survey 3.

Mechanics	GM-M1	GM-M2	GM-M4
Making	1.03		
Creating	0.94		
Building	0.89		
Obtaining	0.72		
Keeping	0.66		
Using	0.57		
Finding	0.57		
Sending	0.55		
Trading	0.43		
Collecting	0.39		0.39
Collaboration	0.33	1.03	
Shooting		0.87	
Punishing		0.80	
Targeting		0.71	
Disabling		0.61	0.30
Communicating		0.60	
Winning		0.53	
Voting		0.43	
Celebrating			0.77
Scheduling			0.77
Customising			0.76
Enabling			0.63
Repairing			0.51
Sorting			0.49
Revealing			0.41
Losing	–	–	–

cross loading items. Suggesting that there may be additional underlying components at play or ways that the elements relate to the factors. A third reliability analysis was carried out on the game element questionnaire. Cronbach's α showed the game element questionnaire reached an acceptable reliability, α = 0.70. All items in the questionnaire appeared to be worthy of retention, resulting in a decrease in the alpha if deleted.

3.4.1. Stepwise linear regression with API personality type and game elements of Survey 3

3.4.1.1. GE-M1 (adventure). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted *GE-M1*. There was a significant effect of the personality type *Openness* [F(1, 160) = 6.891, p = 0.010] with an R^2 of 0.041, which accounted for 4.1% of variance. Like surveys 1 and 2, the type *Openness* was the only consistent personality type associated with *GE-M1*. This endorses the proposed relationship between the *GE-M1* and the characteristics of the *Openness* personality type.

3.4.1.2. GE-M2 (quantifiable). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted *GE-M2*. There was a significant effect of the personality type *Agreeableness* [F(1, 160) = 5.036, p = 0.026] with an R^2 of 0.031, which accounted for 3.1% of variance. The analysis revealed that the *Agreeableness* personality type was a predictor for *GE-M2*. However, unlike Survey 2, the inclusion of the *Agreeableness* personality type may suggest that players tend to prefer gaming situations where there is little room for interpretation; or at least the opportunity to alter the experience to something that they are more comfortable with. For players who rate high on the *Agreeableness* personality type, trust that the scoring system used for *Achievements, Badges*, and even *Rewards* is reliable. For players who rate lower on the *Agreeableness* personality type may view gaming experiences high in elements from the *GE-M2* as being harsh or even difficult. For example, they may feel that *Rewards* and *Experience Points* are not given out fairly or that some players are gave with more suitable or even greater rewards than others.

3.4.1.3. GE-M3 (dexterity/skill). Stepwise linear regression analysis was used to test if the personality types of the API significantly predicted *GE-M3*. There was a significant effect of the personality type *Neuroticism* [F(1, 160) = 5.981, p = 0.016] with an R^2 of 0.036, which accounted for 3.6% of variance; and *Neuroticism* and *Agreeableness* [F(1, 160) = 5.710, p = 0.004] with an R^2 of 0.067, which accounted for 6.7% of variance. It is important to consider the later because players who fall into this category may do so at an emotional level. For example, for such players, it could be that their willingness to persevere with elements such as *Chance* or *Timers* because there is a certain level of excitement that they find attractive.

3.4.2. Stepwise linear regression with API personality type and game mechanics of Survey 3

3.4.2.1. GM-M1 (efficacy). There was a significant effect of two API personality types: *Agreeableness* and *Openness*. A significant regression equation was found for the first model: $[F(1,160) = 9.187, p < 0.003]$ with an R^2 of 0.054, which accounted for 5.4% of variance. A second regression equation was found for the second model for predicting *Agreeableness* and *Openness*: $[F(2,159) = 7.036, p < 0.001]$ with an R^2 of 0.081, which accounted for 8.1% of variance. Both API types: *Agreeableness* and *Openness* were slightly significant predictors for *GM-M1* in Survey 3.

3.4.2.2. GM-M2 (activism). There was a significant effect on one API personality type: *Openness*. A significant regression equation was found for the first model: $[F(1,160) = 16.277, p < 0.000]$ with an R^2 of 0.092, which accounted for 9.2% of variance. Therefore, the API type: *Openness* was only a slightly significant predictor for game mechanic *GM-M2* in Survey 3.

3.4.2.3. GM-M4 (organizational). This factor was named *GM-M4* as there was only one consistent factor from *GM-M3* in survey 2, As a result, a new name was deemed appropriate. There was a significant effect of two API personality types: *Neuroticism* and *Agreeableness*. A significant regression equation was found for the model: $[F(1,160) = 5.232, p < 0.023]$ with an R^2 of 0.0.32, which accounted for 3.2% of variance. A second regression equation was found for the second model for predicting *Neuroticism*: $[F(2,159) = 5.556, p < 0.005]$ with an R^2 of 0.065, which accounted for 6.5% of variance. Only API type *Neuroticism* was a slightly significant predictor for game mechanic *GM-M4* in Survey 3.

4. Discussion

This section discusses the theoretical and practical relevance of this research, both within current literature surrounding player and personality types and their use during the design and development of gaming experiences.

4.1. Impact of player's personality type on gaming preferences

In response to the first research question "*what kind of impact does a player's personality type have on their preference for game elements and mechanics?*" there is little evidence to suggest that their personality type is an influence. Of all the game element and mechanic factors, not one presented with a result that could be used to predict that a player was going to prefer a game with one combination of game elements over another. Therefore, it presents itself as not an adequate tool for developing personalized gaming experiences based on a player's personality type only. While in some cases, the combinations did offer similarities to what certain player types might respond highly to (e.g. achievement driven players are attracted to elements relating to status and prestige), personality types that had shown similar or the same characteristics) as these player types (e.g. Killer types with *Neuroticism* appeared to not demonstrate any form of relationship or predicting factor. In which case, one can assume that similar player types are not key indicators for

preferences within gaming experiences, but models for classifying behavior; something that they aim to encapsulate.

4.2. Impact of the personalization of gaming experiences

In response to the second research question, *"how can a player's personality impact the design of more personalized gaming experiences?",* a low relationship between game element and mechanic factors shows that is not possible to consider personality type as an influencing part. However, it is not ideal to use when the aim of personalizing a gaming experienced is by implementing key game elements or mechanics. This is not to suggest that personality type does not affect some players experience and vice versa (i.e. a gaming experience influences personality type(s)), and that it is these unknown relationships where personality type does affect or influence the design of personalized gaming experiences.

4.3. In relation to existing work

It is clear, that for a long time many scholars have tried to categorize human behavior in varying contexts from psychology to game design. The development of player typologies, to categorized players based on the behaviors that players show during gameplay, indeed bare similarities to personality typologies. Yet, unlike many personality typologies, they lack empirical evidence or general practicality and use outside the context upon their conception.

Firstly, the results of this study are surprising, to the extent that API type appears not to highly impact a player's preferences for GEMs. Moreover, even if the results did prove meaningful, it would have had very little use at a larger level. For example, players who had scored higher in the type *Conscientiousness* would not benefit from a model that uses API types to predicted GEMs. Mainly because *Conscientiousness* was not a predicting type in any of the regression analyses. Furthermore, while the API type *Extroversion* was the most common predicting type for GEM factors, it was the *lowest* type that participants scored on. In this way, it would suggest that only a low percentage of survey participants could benefit from having their personality type used as a way to predict GEM factors.

Secondly, many studies look at personality to predict or explain player's behavior, or at least give context as to why a behavior is exhibited during gameplay. Yet, many of these studies are theoretical. For instance, on the one hand, VandenBerghe's [4] theory that the five types of personality align to domains of play offers potential when it comes to designing more tailored experiences, yet on the other hand such a theory neglects the actual *design* of the game and *how* the player (and personality type) relates to it. In a comparable way, Marczewski [14,15] does not focus specifically on what parts of gamified experiences players are drawn to in the context of GEMs; which could also *explain* why his "user types" act the way they do rather than how they are perceived to; or why other typology models are not adapted to other contexts. Even though current research [14] has focused on aligning Marczewski's user types *with* personality types, the potential for these relationships (along with many others) rests upon two questionable assumptions that (a) these types *do* exist within their classified behavior and are not as a result of *fundamental attribution error*, and (b) the user types behavior can be used to inform the game's design; of which would require additional information about how a game's design can facilitate it. This appears to be a common issue, with others such as Busch et al. [51] exploration of player types (instead of personality types) to predict a players experiences. This research drew on two types of the BrainHex player type model [52]: Mastermind and Seeker. From their results, there was nothing that could significantly predict players' experiences. It is likely that the claims made by Bateman, Lowenhaupt, and Nacke [38] asserting that personality typologies should focus on trait rather than type theories provide some insight into the lack of predictability that this research offers for players preferences. Yet on the other hand, many researchers [2–4,14,45,53] are still opting for type theories as opposed to traits, suggesting it is still very much common practice.

Lastly, while the results do not show the existence of a meaningful relationship between GEMs and API type, it does not suggest that one cannot exist elsewhere. For example, the results may align or relate to theories in areas such as social psychology that suggest attitudes (i.e. in the way of survey responses to the API questionnaire) and players actual behavior may not have correlated or predicted GEMs for other reasons. For example, given the nature of psychometric testing, it is possible that participants were answering the questions to drive results that represent their "best self" rather than their actual self. As a result, entertaining a cognitive bias. That is why it is important that decisions for continuing research that uses psychometric testing considers this and exercise ways to mitigate this issue.

The significance in discovering that personality types did not affect nor could be used as a predictor for GEMs, is novel. It may be that personality/motivation types of players may account for very little when it comes to preferences towards GEMs, thus suggesting that other parts of game design and gaming experiences can be designed/altered based on personality and motivation assessment.

4.4. Limitations and future research

This research sought to assess the impact that personality type had on a player's preferences for GEMs, and how game designers can use this to design and develop more personalized gaming experiences; yet this is not without its limitations. One limitation is related to the sample size of participants. The decision not to combine the data from the three surveys into one dataset was due to the varying dates that the data was collected on and for its use to present replicable results. In each survey, the sample size was indeed quite small, and it is possible that the results may have yielded more refined conclusions. Therefore, it is likely that the results would benefit from a larger number of survey participants to further refine any GEMs that do not present themselves consistently within a factor (GEM model).

Given the statistical nature of this research, personality models do not necessarily define an individual. In fact, certain characteristics that are related to a personality type may not entirely reflect the general characteristics of the individual who has taken the test. Therefore, it can only be a general measure, and not a definitive one to any specific individual. In addition, while the "Big 5" personality types are the most commonly used, they are not the only personality types in existence. Consequently, relationships between a player's preference for GEMs may be present in other personality typologies. Thus, need further studies with other personality types using the same methods as used within this research. In this way, the long-term goal and overall aim of this research is to inevitably understand and design for a player in a way that can give a more personalized experience for them, of which starts with the design and is refined during interaction.

5. Conclusion

In summary, the results of this study can confirm that it is not possible to use (API) personality types to predict a player's preference for GEMs. Given the various approaches to research surrounding personalized and user-centered game design, no other exploration or assessment of personality types and GEMs, with respect to player's preferences, exists. Thus, this research was entering uncharted territory and offers the first step into this area of work. It is predicted that further research related to personality types within a gaming context are better applied to other areas of game research as there is very little evidence to suggest that API types impact or influence player's decisions for their gaming experiences at this level.

Appendix A

See Table A1 and A2.

Table A1
Game element table.

Rewards	Rewards
Avatar	Representation of the player. This can be virtual, physical, or even the player herself. Examples of virtual avatars can be an image in the player's UI or HUD, or their actual playable character.
Achievements	Virtual (digital) or physical items that represent some type of accomplishment. The process of obtaining achievements may be through varying challenges of varying levels of difficulty, exploration – as with the case of hidden achievements, or locked achievements that require you to have obtained something prior to unlock the achievement. Achievements can be considered outcomes that are built around different behaviors. For example, a player may be asked to check-in with the application five times consecutively.
Badges	Visual representations or icons that a player can obtain for doing an action(s) and/or completing objectives. Examples include Steam holiday badges.
Bars	Indicators for various factors such as health, mana and experience levels.
Bonuses	Like achievements, but generally not with the objective focus that achievements possess. Bonuses act as an "extra" to contribute towards other rewards. They may come in the form of additional items, more experience, aid in completing an achievement (e.g. extra coins)
Chance	The supposed luck for the player. Examples would include the likelihood that a rare item is dropped after killing a boss enemy or obtaining a certain amount of gold after opening a chest.
Collectables	Items that you can collect but not necessarily use.
Combo	Grouping items together to perform certain behaviors or obtain items.
Timer	A way of limiting how long it takes a player to complete an objective. They usually push a player to improve so that the time they take to complete an objective becomes more efficient. A time restriction in which the user must perform a/or set of objectives.
Currency	Virtual or real currency that can be used to obtain items (in the real and virtual world).
Difficulty	Allowing the user to select a level of difficulty before they engage with an experience. Common levels include easy, medium, and hard.
Points	Points are a numerical value, whether numerical in the sense of our own systems or of that within the game world.
Feedback	Providing information about the user's interaction. This can be after an action, duration or series of actions and behaviors.
Items	Useful objects that you receive (physical and/or digital) for performing an action or through exploration.
Leaderboard	Your rank among other users based on a parameter(s) such as points.
Levels	A way of providing a sense of progress to a player. They can be in the form of varying levels of difficulty, locations that reveal more aspects of the games narrative and so forth.
Permadeath	The death of the user in the experience is permanent. If the use wants to continue, they must start from the beginning.
Quests	A part of a player's journey that may include various obstacles and challenges that they are required to overcome.
Rewards	An item that the player obtains after completing something that they are supposed to do, or by assisting another player.
Status	Defines a player's hierarchal status within a world. It is usually a good indicator to represent how much time they have committed to the game (e.g., they are a high-level warrior). Status can also be important in allowing players to enter various parts of a level or engage in certain challenges. This is seen to be the case with many online massively multiplayer games (MMO's).
Story	The narrative that accompanies the design of an experience. It can provide the context and meaning for actions, quests and objectives.
Unlockable	Items, levels and other aspects that are not available until they are "unlocked". Often requiring completion of objectives.

Table A2
Game mechanics table.

Element	Description
Aiming	Having to direct an object to interact with another.
Build	Having the user construct parts of the interactive experience.
Celebrate	Celebrating the completion of an outcome.
Collaboration	Communicating with other users of the interactive experience to achieve an objective.
Collect	Being able to collect items for use later. Collecting items may be seasonal (e.g. Christmas) and have expirations (e.g. can only collect items for one week).
Create	Allowing users to create their own content. This may be within defined parameters or unrestricted.
Customize	Allowing the user to customize elements of their experience. Customization may be simple (e.g. name change) or extensive (e.g. name, aesthetics, features, etc.).
Disable	Being able to disable features in an interactive experience (e.g. location settings, profile privacy).
Enable	Being able to enable features in an interactive experience (e.g. location settings, profile privacy).
Find	Encouraging the user to locate items to further the interactive experience.
Gift	Giving another user an item in the form of a gift.
Keep	Having the user construct parts of the interactive experience.
Lose	A losing condition for the user to experience.
Make	Allowing the user to make items. For example, providing the user with parts of an item incrementally to make a whole item.
Obtain	Obtaining items during the interactive experience from other users, during events, through performing behaviors, etc.
Organize	Organizing items in an order (e.g. color, shape, size, weight, etc.).
Punish	Punishment for failing to complete an action correctly. Being able to receive, give (to others) punishment.
Repair	Repairing items for use at a later stage during an interactive experience.
Reveal	Elements of the experience are revealed or can be revealed if conditions are met. For example, a user will reveal the next level only once they have finished the current one.
Send	Allowing the user to send (e.g. items, messages, etc.).
Shooting	Hitting another object with a projectile.
Sort	Sorting items in order based on a certain parameter (e.g. size, color, weight, shape etc.).
Trade	Trading items between individuals or groups.
Use	Allowing the user to use a feature(s).
Vote	Being able to have a say that directs future experiences/interactions with the process of voting. Voting may influence the experience of a single user or all users.
Win	A winning condition for the user to experience.

Appendix B. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.entcom.2018.03.003.

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