What Makes the Best Computer Game? How Game Features Affect Game Play

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Abstract

Personality has an impact on user's behaviour in information systems, and adaptive systems that model these features can provide better user experience. Adding fun to the mix is making games even more intriguing objects of study. In our project we explore user profiling options of computer games by examining how game features and personality traits affect user (player) engagement and game play. We designed a modular casual browser game which enables us to exhaustively study effects of different game mechanics on game play. We conducted an extensive study in which we collected data on several hundred game sessions. In this paper we describe our approach and present preliminary results.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces—*Evaluation/methodology*; K.8.0 [**Personal Computing**]: General—*Games*

Keywords

game design, personality profile, user modelling

1. Introduction

User modelling is an essential part of adaptive systems. In our project, we are interested in generic user modelling based on personality traits. Our goal is to identify user's personality within information systems in general, and computer games in particular. Traditional methods based on questionnaires hinder smooth user experience especially in games that should provide entertainment. In our research, we explore to what extent the personality-based user modelling can be conducted unobtrusively in computer games (information systems). Games are interaction rich artefacts, and identifying player's personality while he/she enjoys the game provides significant factor for further personalizing the gaming experience according to player's psyche.

In order to study effects of player's personality we designed a feature-rich causal browser game in which different game mechanics can be turned on/off to facilitate experiment design. The game is tracking both the user interface actions and game actions, providing a complete footprint of user's personality in terms of the manifested game play. Correlating the activity logs with personality measure (Big Five) reveals relationships between player's personality and game play, and provides insights into which game mechanics work effectively. In this paper we describe the proposed game design, experiment design, the conducted study and preliminary results of data analysis.

2. Related work

Several independent studies on human personality have identified five major factors that constitute human personality [3]. We employ the Big Five taxonomy which is most widely used in user experience research. The five factors are extraversion, agreeableness, conscientiousness, neuroticism and openness [5]. The five factors can be measured with various precision. We used NEO FFI questionnaire consisting of 60 questions rated on five-point Likert scale ranging from "strongly disagree" to "strongly agree". The measure provides decent measurement reliability with reasonable time to fill a questionnaire, in contrast with miniature 10 question-long or huge 250 question-long measures.

Effect of the personality on the user's activity is not very common topic in game research. The most related project analyses player activity in an RPG game [6]. Authors created custom scenario in an existing RPG game in which user takes action in order to move around, interact with things or persons to begin dialogue. The monitored activity variables are movement represented by visits of an area in the scenario and conversations represented by the

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selected answers. Experimental evaluation consisted of filling out a survey about players' personality and a one hour game play. The results of the data analysis show that players high in openness tend to finish earlier or those high in agreeableness tend to choose more polite answers in conversations. The work shows that user modelling based on computer games is feasible, tough the results cannot be generalized to other games. User interface actions (e.g. mouse usage) can be a useful indicator when modelling one's personality [4]. A study on user activity in operating system was conducted. Applications running in background and keyboard and mouse events were summarized into characteristics such as total count of events, mean time between events, windows switched and more. Evaluation has demonstrated significant correlations, for example, between neuroticism and count of mouse clicks.

In order to systematically study the effects of player personality on any game, the game to study should constitute of generic game design elements. Research in game design provides us with models to design games. MDA Framework [2] is a model used in the process of designing games, defines game mechanism as functional elements of a game. Björk [1] defines almost 400 game mechanics, but a smaller set of most commonly used is provided in Gamification by Design [7]. Authors also theoretically relate them to one of few motivational factors of players. From these we selected points, levels, challenges, leaderboard, nurturing, skills and countdown timer in order to cover various motivational factors so we can sufficiently address the different types of personalities.

3. Modular causal browser game

Browser games are favourite pastime of internet users. Numerous game titles achieved huge success with the wider internet population by incorporating several game design elements. We decided that the game, though featuring generic game mechanics, should do so using simple concepts in an immersing way. In designing a suitable game that would provide us with flexible experimental opportunities we have prototyped some five different game designs arriving at the final design employing some of the simplest visual, auditory and interaction concepts.

The core principle of the game (as presented in Figure 1) is to collect reward by eliminating shapes using the mouse cursor. The shapes appear on the grid in batches in regular intervals. The interval is a linear function of the size of the batch. The shapes come in different sizes and different rewards. Special shapes are: a) bombs which blow off when eliminated and destroy surrounding shapes, and b) mines which can be placed on a tile to prevent new shape to appear on the tile. Other gaming features, which correspond to the game mechanics we are studying in our research, enrich this core game play.

The whole game has several levels starting with a tutorial level that introduces the player to the game. We hand coded 10 levels providing specific patterns of tiles and bombs while others are auto generated endlessly. The difficulty of the level rises with its number by gradually increasing the number of appearing shapes and the layout of bombs. Each level has a time limit with duration usually 40 to 60 seconds.

The core of the game is enriched by following game mechanisms and their corresponding implementations:

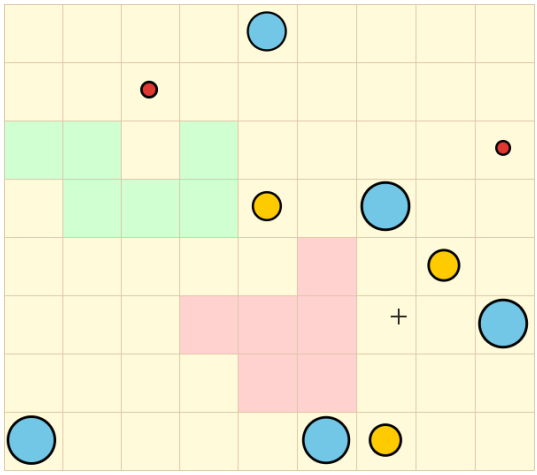

Figure 1: Example of a game play.

- Points - rewards for eliminating shapes; smaller ones are rewarded with more points than bigger ones (which are consequently easier to hit)
- Leaderboard - list of players with score similar to the current user and his/her position in the list
- Countdown timer - time remaining in level
- Challenges - objectives to fulfil, specifically, sequences of shapes to be eliminated
- Skills - two characteristics that player can improve in: fast hits (eliminating shapes immediately after their come up) and sniper hits (eliminating small shapes in row)
- Nurturing - managing shapes on red and green tiles of the grid; player is rewarded with additional points if shapes are nurtured on green tiles and (s)he loses points rapidly if shapes are neglected on red tiles

4. Experiment design and evaluation

The aim of our experiment is to collect relevant data from the game, process and analyze it and then construct a model to predict player's personality. For data collection, mouse usage and game events are traced. The data is aggregated into 10 indicators that are then correlated with five personality measures (five Big Five factors).

The first groups of indicators hold characteristics of mouse controller usage. For each user we calculate average movement speed, percentage of time inactive, straightness of mouse movement, reactions and total count of interactions with active elements (shapes). The second group of characteristics deals with game mechanisms and it holds user's interests/preferences on them. A characteristics representing one game mechanism should be as independent of others as possible. We represent preferences on points, leaderboard, challenges, skills and timer respectively as normalized number of achieved points, position in the leaderboard, number of completed challenges, number of achieved skills and ratio of mouse speed in the last five seconds of a level to average speed in the level. As our implementation of nurturing is tightly dependent on points we do not hold separate indicator for this mechanism.

One part of our experiment is to explore how different game mechanisms influence engagement of players of different personalities. A single game containing all of the game mechanisms might be insufficient as some mechanisms such as points might be dominant and we would not have possibility to explore those which are recessive. We derived 19 different games - that is players are divided into 19 experimental groups (with each group playing a slightly different game defined by the specific combination of game mechanisms). Total number of possible combinations is $2^5 = 32$ in our case, though we omitted some of the games which lack consistency (such as having a leaderboard without any measure of success such as points). We do not perform analysis of game elements within one group. Instead, we focus on one mechanism and compare the participants that differ in this one game mechanic (regardless of the other mechanisms).

In last phase we construct a model to predict one's personality using the above gameplay indicators. Firstly, we explore relationships between personality traits and summarized indicators using correlation analysis. For each trait we construct a linear regression model which independent variable is estimated i-th personality trait q_i and dependent variables are indicators correlating with the trait. Formally the linear model is represented as

$$q_i = ind_i \beta_i \tag{1}$$

where vector ind_i holds indicators correlating with i-th trait and parameters β_i are calculated using method of least squares on measured dataset.

We conducted a study collecting data on 65 players (university students), totaling cca. 600 game levels played. The number of users that achieved each level has a long tail. The first level was played by 65 players, second 52, third 45. Level 10 was achieved by 11 players; the highest reached level was Level 30. We include some of the observations about the variability of Big Five personality traits among participants: mean percentile of score in population on openness is 40.78 (SD: 29.78), conscientiousness 50.52 (SD: 27.95), extraversion 35.17 (SD: 30.91), agreeableness 43.22 (SD: 21.75) and neuroticism 45.46 (SD: 30.69). This shows high variability of personality traits in the population of university students.

We conducted a preliminary analysis of the data. In the first analysis we examine differences between groups of participants having specific game mechanism visible/invisible. The purpose is to find out which game mechanism draws attention as well as to verify design of the mechanism. We performed t-tests for each of the game mechanisms to calculate the differences and the results (statistics t and corresponding p-values) are summarized in Table 1. The most preferred game element in our game is mechanism of challenges. Points are not attractive as expected within all participants. We also performed t-tests on specific subsets of players and we found significant difference (p-value <0.05) within those high in extraversion. Similarly, leaderboard is popular among players high in neuroticism and low in agreeableness. Challenges significantly draw attention almost within all examined subsets. As the mechanism of skills did not resulted in meaning change of player's behaviour (neither within any specific subset) we found out that its design was not done correctly and we will omit it in further analyses.

Table 1: Results of testing difference between groups having game mechanism visible/invisible.

Game mechanism	t	p-value
Points	-1.8	0.08
Leaderboard	2.0	0.06
Timer	-1.8	0.08
Challenges	-3.4	<0.01
Skills	-0.1	0.80

5. Conclusions

In our work we propose a method to predict user's personality traits according to his/her activity in a computer game. We designed and implemented a modular browser game which enables to create multiple game derivations by adding or removing game mechanisms. We designed an experiment allowing us to study the effects of the mechanisms on players' engagement having different personality traits. In our study we have collected game logs of 65 players, playing around 600 levels in total. Preliminary data analysis shows that challenges draw attention in our game the most, the mechanism of points heavily changes behaviour of players high in extraversion only. As our next step, we plan to explore correlations of summarized indicators (both UI interaction and game events) and personality traits and consequently construct and evaluate linear regression model to predict player's personality profile.

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References

[1] S. Björk and J. Holopainen. *Patterns in game design*. Charles River Media, 2005.

[2] R. Hunicke, M. LeBlanc, and R. Zubek. MDA: A formal approach to game design and game research. *Proceedings of the Challenges in Games AI Workshop*, 2004.

[3] O. John and S. Srivastava. The Big Five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of personality: Theory and Research*, 1999.

[4] I. Khan and W. Brinkman. Measuring personality from keyboard and mouse use. *Proceedings of the 15th European conference on Cognitive ergonomics: the ergonomics of cool interaction*, (1984), 2008.

[5] R. R. McCrae and O. P. John. An introduction to the five-factor model and its applications. *Journal of personality*, 60(2):175–215, June 1992.

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

[7] G. Zicbermann and C. Cunningham. *Gamification by Design*. O'Reilly Media, 2011.