The Interplay Between Artificial Intelligence and Users' Personalities: A New Scenario for Human-Computer Interaction in Gaming

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The interplay between Artificial Intelligence and users' personalities: A new scenario for human-computer interaction in gaming

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Abstract. The latest business reports showed that Augmented Reality (AR) and Artificial Intelligence (AI) are ranked among the top 10 strategic trends for 2018. For these reasons, in this paper, we provide an interdisciplinary focus on design and personality issues, trying to discuss the interplay between games with personality and Artificial Intelligence. First, we describe taxonomy models on personality in games and empirical studies aimed at exploring personality traits of Pokémon GO users. Second, we explore virtual humans employed in investigating chess personalities via simulating human chess players. In this research article, the term virtual human is used to describe a computer program that simulates a human in some aspects such as playing chess. The results of personality and gaming are sparse and mixed. It remains unclear whether personality traits would similarly predict adoption and usage in the context of AR mobile game. On the contrary, results about AI showed that virtual humans have characteristics similar to those of humans and helped researchers explore existing patterns in societies. In our discussion, we try to evidence the importance of personality in gaming also considering that an increasing sale for these technologies is forecasted in 2020 to be 21 times higher than in 2016 (from US $2.9 billion to US $61.3 billion; Superdata Research, 2017).

Keywords: personality, Augmented Reality, gaming, virtual humans, chess, chess personality

1   Introduction

In 2016 Nick Yee wrote on his blog on Quantic Foundry: "Games are often stereotyped as escapist fantasies where people get to pretend to be something they're not. But what the data shows is that gamers play games that align with their personalities. In the same way that people select the news and media that reinforce their worldviews, gamers select the games that reinforce their identities. For example, gamers who are extraverted prefer more social and action-oriented games. Gamers who are more conscientious prefer games with long-term thinking and planning. The games we play are a reflection, not an escape, from our own identities. In this sense, people play games not to pretend to be someone they're not, but to become more of who they really are".

These ideas are quite interesting when applied in today's highly competitive marketplace of gaming. Indeed, coping with shortening product life-cycles and an increasing number of failing gaming innovations, researchers need to quest on efficient strategies for understanding the interplay between users' personality traits and gaming. Game developers are deeply involved in creating a new generation of games that cater to individual users. The aim is to adapt game content and automatically customize it to each player's personality and individual playstyle [8]. For companies, this game hyper-personalization means making games more fun by adjusting them to the taste of each player, so leading users to likely play more and more and spend more and more money. However, for mental health researchers, users may risk developing addictive behaviors. Indeed, the latest version of the Diagnostic Statistical Manual of Mental Disorders [3] included game addictions in the "Emerging Measures and Models" section [27].

In this paper, we provide an interdisciplinary focus on design and personality issues, trying to discuss the interplay between Artificial Intelligence and users' personalities. We report specifically studies about Augmented Reality (AR) and Artificial Intelligence (AI) games. Additionally, we explore the technology of virtual humans programmed using AI techniques and show how they can help us investigate different issues that are personality-related and hard to examine otherwise. For this research, a virtual human can be thought of as a computer simulation that behaves like a human in some conditions. It is essential to note that the latest business reports showed that AR and AI are ranked in the top 10 strategic trends for 2018 [12]. Moreover, an increasing sale for these technologies is forecasted in 2020 to be 21 times higher than in 2016 (from US \$2.9 billion to US \$61.3 billion; Superdata Research, 2017).

AR and AI gaming technologies are cutting-edge research areas for game developers that aim to create sophisticated games that can change and respond to player feedback, and in-game characters that can evolve the more you spend time with them [50]. For instance, the challenge for AR game developers is to assign users a more dynamic and autonomous role in their gaming experiences [41], so that people might assign the highest perceived value to this kind of games [42]. As well, AI research that developed artificial agents able to handily beat a human being at the classic board game, just as IBM's DeepBlue system bested Russian grandmaster Garry Kasparov back in 1997, has accelerated in recent years [21].

2   Personality in gaming: taxonomy models

Studies framed under the human-computer interaction reported that personality is a critical variable for understanding why and how people are immersed in playing games. Indeed, gaming is conscious behavior that requests players to act and make a decision, to feel a different kind of emotion, so scholars have hypothesized that gaming is impacted not only by situational constructs, but also by consistent constructs, such as personality [26]. As defined by Larsen and Buss [36] personality is a stable,

organized collection of psychological traits and processes in the human being that influences his or her interactions with and modifications to the psychological, social and physical environment surrounding them.

Seminal works characterized the profiles of the players based on gaming archetypes. First, the model of Bartle [6] categorizes players into four types based on different motivations, in-game behaviors, and play styles: Achievers, Socializers, Explorers, and Killers. Achievers (10% of gamers) are driven by achievements such as, for instance, collecting as many points as possible and status. Thus, they show their friends how they are progressing, tend to collect badges, and put them on display. This is the type of person who responds particularly well to incentive schemes such as Air Miles, where every additional mile collected is an achievement in its own right. Socializers (80% of gamers) are driven by experiencing fun through the game interaction with other players. They collaborate to achieve bigger and better things than they could on their own. Explorers (10% of gamers) are moved by a curiosity for new things and the discovery of new secrets. Explorers appreciated repetitive tasks as long as they eventually "unlock" a new area of the game, or they deliver some kind of "Easter Egg" (an Easter Egg is a small bonus within a game – sometimes it's as simple as a little joke, whereas in other cases it might be a full extra video sequence regarding what has been accomplished). Finally, Killers (1% of gamers) are similar to Achievers in the way that they get a thrill from gaining points and winning status too. However, they want to see other people lose. They're highly competitive, want to be the best at the game, and winning is what motivates them.

Successively, Bateman and Boon [7] created another model that identifies players into four types: Conqueror, Manager, Wanderer, and Participant, which they later expanded to seven categories: Seeker, Survivor, Daredevil, Mastermind, Conqueror, Socializer and Achiever. Seekers are driven by interest and curiosity; Survivors enjoy fear and terror; Daredevils loves the thrill and risk-taking; Masterminds play usually puzzle games; Conquerors are moved by struggling against adversity and beating other players; Socializers are similar to Bartle's classification and enjoy talking to and helping other gamers, and finally Achievers are motivated by long-term achievements.

In addition to player archetypes, researchers have also used the Five Factors Model [15] to define players' behaviors [11, 13, 35, 53, 55]. Differently from the classifications of Bartle [6] and Bateman & Boon [7], which are based on gameplay elements that the target group would find engaging, classifications based on FFM refer more to users' traits of personality. The Five Factors Model is a well-known psychological model describing personality variations along five dimensions, called the Big Five that are respectively named: Extraversion, Openness, Conscientiousness, Neuroticism, and Agreeableness. Extraversion refers to personality traits such as energy, assertiveness, and sociability. Openness regards the tendency to be informed, creative, insightful, curious, and to have a variety of experiences. Conscientiousness is related to the tendency to be self-disciplined, act dutifully, and aim for achievement. Neuroticism means a tendency to experience unpleasant emotions easily, such as anger, anxiety, depression, or vulnerability. Agreeableness means the tendency to

be compassionate, trusting, and cooperative rather than suspicious and antagonistic towards others [39]. In sum, player type models are more specific and focused at explaining differences in player behavior, experience, and emotions, whereas personality trait models can be seen as a higher-level conceptualization of individual differences (not directed at certain areas or behaviors) [9].

3   Personality in AR gaming: the case of Pokémon GO

In this section, we report a case study about Pokémon GO. This game is a very particular AR game because it offers a very unusual gaming experience in the real setting. Gamers live a mix of real and virtual items that coexist together [33]. This exciting mix of game, sociality, and physical presence [37] is a novelty in the mobile AR game panorama and might be responsible for the worldwide diffusion of the game [5]. Empirical studies aimed at analyzing users' experience about this game have mainly framed the investigations about personality traits under the FFM [39] theoretically. However, the results are mixed and contradictory. On one hand, personality seems not to influence playing Pokémon GO, as showed by Rasche et al. [44]. Authors, indeed, reported no significant differences in personality traits such as extraversion, agreeableness, conscientiousness, neuroticism, and openness in three groups of Pokémon GO gamers (i.e., active users, former users, and non-users). On the other hand, personality traits such as extraversion and emotional stability seem to predict game habits, and the collection of a high number of Pokémon GO creatures and species, respectively [52]. As well, emotional stability predicts time usage, while openness is a positive predictor of the gamers' level of expertise. On the contrary, conscientiousness and agreeableness are negative predictors both of the level of the gamers' expertise and of the number of species they collect. In sum, players who are emotionally stable, but less conscientious as well as those who are less cooperative and open to experience spend more time playing and become more experts in achieving higher levels in the game [52].

Similarly, Mattheis et al. [38] found that people who play Pokémon GO have a significantly lower score in conscientiousness than non-players. In contrast, no significant differences between players and non-players have been found for extraversion, neuroticism, agreeableness, and openness. Personality traits such as introversion, low levels of agreeableness, and conscientiousness describe better Pokémon GO players. Introverted and low consciousness people spend more time in playing Pokémon GO but are people with low scores on agreeableness who have the highest numbers of daily game sessions [10].

The study by Lalot et al. [34] analyzed personality by the HEXACO model [4]. This model is quite similar to Big Five Model [39], but it introduces two more personality traits related to honesty and emotionality. Lalot et al. [34] performed a longitudinal study on a sample of Pokémon GO gamers recruited in English-speaking (i.e., the USA, the UK, Ireland, Canada, Australia, and New Zealand) and French-speaking

countries (e.g, France, Switzerland, Belgium, and Canada). The results of this two-phase longitudinal study showed that only agreeableness was a strong predictor of the motivations for starting to play. Perseverance, premeditation, and agreeableness were more likely to predict the intention to continue playing Pokémon GO after four months.

Other studies analyzed personality dimensions such as self-efficacy [32] and emotional intelligence [45]. However, self-efficacy has a non-significant effect on attitude for playing Pokémon GO [32]. Differently, emotional intelligence is a personality trait that characterizes Pokémon GO players. Comparing with non-players, participants increased their scores at emotional intelligence measures after game sessions with Pokémon GO, and also had better social relationships with peers [45]. Some studies suggested that personality traits are deeply interconnected with motivations for playing. For instance, Mattheis et al. [38] analyzed personality traits of people starting to play, continuing to play, and stopping to play three months later and found that people who quit the game scored higher in neuroticism than those who were still playing the game. No significant differences between people who continued playing the game and those that have stopped playing have found. Results did not change when controlling for personal inattentiveness and time spending on playing. Caci et al. [10] evidenced that recreational needs mostly drive introverted gamers, while personal needs move less agreeable people and social needs low conscientiousness people. Khalis and Mikami [30] found that more extroverted, cooperative, and socially competent players are more engaged in the game, displaying more catching behavior during the gameplay sessions. Additionally, participants high on conscientiousness and social competence displayed more exploration behavior. Differently, players with high levels of social anxiety have less catching behavior.

4   The employment of virtual humans to explore chess personalities: The case of chess games

In this section, we present research studies about personalities and virtual chess players. Chess can play an important role in addressing the issue of exploring personalities over chessboards. An early work that explored chess and personalities was offered by Karpman [28], who showed chess as a fight between different personalities and how players can articulate their actual personalities in their chess games. That is to say, he showed how the life events of some chess players are emulated over the chessboard. Additionally, he compared well-known chess grandmasters and showed particular chess patterns and how they can contribute to chess arrangements.

The findings of Karpman [28] have been essential to future studies in exploring the personalities of chess players via the involvement of virtual humans that represent real chess players ranging from novice players to top-rank grandmasters. Recent research studies have been concerned with exploring the effectiveness of virtual chess players and how they perform while competing against other players. A virtual chess player is defined as a computer simulation that imitates a real player existing in

the chess community such as Kasparov and Polgar [19]. These players exist in different skills and playing styles, and they allow a chess trainer to play against various opponents to sharpen his skill. Each virtual chess player is characterized by a rating and a chess personality. Ratings are assigned by various organizations such as the World Chess Federation and the United States Chess Federation (USCF). The rating is a number that is assigned to each player to measure his skill and compare him against other players in the chess community. Chess personality is defined as the style of the player while he competes against other players. For example, one of the virtual chess players is Anderssen, who simulates Adolf Anderssen (July 6, 1818 – March 13, 1879). The simulation of Anderssen reveals a grandmaster who starts attacking his opponent and goes after his King at an early stage of the game. Another example is the simulation of Leko, who is a defensive and cautious grandmaster. The employment of virtual chess players made it possible to examine the competition between chess players who existed in different time eras. Interestingly, virtual humans have been attractive to medical researchers, as the involvement of software of virtual chess players has been used as a means of surgical training [48].

Virtual humans have emerged as powerful tools for understanding many aspects of the psychology of chess players. In a recent study, Dhou [19] explored the personalities of the grandmasters Anderssen and Leko while competing against less-skilled virtual players by utilizing virtual chess players. In his study, he used different metrics including the errors made by players and the number of moves in their chess games. A follow-up study was conducted to explore the psychology of competition between two groups of chess players: grandmasters and class-A players [22]. While the grandmasters' group involves Anderssen and Leko, who vary in their attack and defense attitudes, the class-A players' group incorporates players who have different preferences to utilizing knights and bishops in their games. Research shows that knights and bishops depict various adjustments in business research and therefore, this makes it essential to investigate them [29]. Overall, the two studies [19, 22] consistently indicate that less skilled players tend to make more mistakes when they compete against a defensive grandmaster (i.e. Leko) as opposed to an attacking grandmaster (i.e. Anderssen). Additionally, the two studies provide strong evidence for the efficacy of a grandmaster's style while competing against less-skilled players. More specifically, a grandmaster with an attacking style tends to have fewer errors than a defensive grandmaster. The findings are linked to the fact that people instinctively recognize the origins of problematic occurrences and how they can be influenced by them [54].

A similar study in this area is the work explored the personality of Kasparov by using virtual humans to simulate Kasparov and three proposed opponents [21]. The importance of this work is that it offers an understanding of Kasparov's personality, which has attracted much attention among psychologists and artificial intelligence researchers. Kasparov is known for being able to calculate quickly, employing original openings, and sacrificing with pieces to gain rapid advantage and allow mobility. In the last few years, there has been a growing interest in

investigating the personality of Kasparov for many reasons. That is to say, there is evidence that the personality of Kasparov plays a crucial role in designing chess-playing programs [31, 51]. Additionally, recent research shows the psychology of competition between different opponents against Kasparov and the differences in their performances according to their chess personalities [21]. Together the three studies in virtual chess humans [19, 21, 22] provide important insights into chess personalities and using them in analyzing chess outcomes. Overall, these studies highlight the need for more studies that link chess personalities to behavior in real-life scenarios and exploring the relationships between them. Such studies might also provide further insights into different aspects of business such as personalities at the workforce and different strategies within organizations such as aggression and defense.

5   Future studies in AR and AI gaming

The existing studies on personality and the gaming are sparse at best, and the few results are often discordant, and cannot be used to define personality traits [49]. Hence, it remains unclear whether personality traits would similarly predict adoption and usage in the context of AR mobile game. Similarly, other personality dimensions such as self-efficacy [32] and emotional intelligence [32] have been analyzed, but actually, there are very few studies in the context of AR mobile game for corroborating reported findings. Moreover, scholars used, in prevalence, self-report measures for the assessment of all the independent and dependent variables alternatively focused in the researches (e.g., personality, game habits). We have to remember that self-report measures are particularly affected by social desirability bias [14], so the use of these types of measures might be affected by participants' disclosure of some sensitive information, and therefore, causing mixed results. Most of the studies examined are also cross-sectional and did not control for multiple comparisons, which explicitly limit the possibility of establishing causal links between specific personality traits and gaming technologies.

In future investigations, it might be possible to utilize virtual chess humans in exploring new aspects in strategic management and competitive advertising. Further studies, which take different characteristics into account, will need to be undertaken. However, more research on this topic needs to be undertaken before the association between chess personalities and terms in management and marketing is more clearly understood. For instance, further investigations are needed to shed light on the personalities of virtual humans and how they can be mapped to business strategies. These investigations can probably help other researchers better understand how to conduct new experiments that utilize virtual humans to better investigate real business scenarios. However, to develop a full picture of virtual chess humans, additional studies will be needed that explore different personalities, investigate how the parameters overlap, and how they lead to different outcomes. For example, recently, two studies investigated attack vs. defense in chess grandmasters and how it could influence other less skilled players [19, 22]. Although these results revealed interesting findings, it is important to note that they only

explore two grandmasters and how they perform while competing with other players. We believe that we need to explore different types of attackers to be able to comprehend their behavior and understand the full picture before mapping it to other fields of research.

6   Conclusion

This study has examined a versatile background on game design including personality issues, while discussing different models that classify players into distinct groups. In particular, we report studies in Pokémon GO and chess that are related to Augmented Reality (AR) and Artificial Intelligence (AI). On one hand, it evidences that personality may potentially affect gameplay behaviors. Such results might be promising and useful for the personalization of games. We underline the possibility to use personality factors for planning new or adapting existing games to target audiences for improving the player experience and facilitating long-term engagement with the games. Moreover, because of the increasing tendency to develop gaming applications that use AR in combination with AI [43], the findings of personality traits may also useful for developing criteria for the clients' segmentation in the marketplace of mobile technologies and applications. Designing, developing, and publishing a game is not a simple process, rather a considerable effort. Although it is intriguing to use personality for game development, we need to be sure it can predict player experience. As follows, the evidence from this paper suggests that the employment of virtual humans can be used as a means to explore the personalities of players. As shown for chess, since this game symbolizes a war between two groups, we believe that this work can be eventually extended to investigate new patterns in business and marketing where competition between strategies exist.

This research has thrown up many questions in need of further investigation. First, it would be interesting to compare real players with particular personalities along with their equivalent virtual players. We believe that this can help to investigate a relationship between virtual humans and real players. Second, it will be essential to further explore the decision-making process under different time constraints between players with different personality traits or of different genders. Third, more studies can be conducted to investigate the relationship between actual personalities and chess personalities [1, 2, 46, 47]. Finally, further research can investigate relationships between bio-inspired behaviors and chess personalities [16, 18, 20, 23, 40]. These behaviors proved their effectiveness in many fields including coding binary information utilized in many aspects such as visualization research [17, 24, 25].

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