Abstract. In the last few years the importance of multiplayer games has seen an immense growth. On pair with that, the virtual environments (VEs) increased in their size. Today there exist more than 120 MMOGs (Massive Multiplayer Online Games) ranging from FPS (first person shooter) to classic RPG (role playing game) settings. Such an evolution leads to the fact that players start to “live” in a virtual world. Thus each player at least partially merges with his character (playing figure) and acts in the virtual world. Nevertheless there can be huge gaps between ones real and virtual behavior. This paper uses a well balanced set of questions based on the psychological big5 model to show the mentioned gaps between real world and virtual world attitude. The underlying online survey models 30 selected questions about online and real world behavior. The results are stored in a database in order to statistically interpret them afterwards. The analysis includes correlations between deterministic values (such as age, nationality and gender) and traits of the big5 model (like surgery, emotional stability and conscientiousness). Furthermore it contains other surprising conclusions about the difference in behavior.

General Terms. Computer supported intercultural, Internet and web technologies for intercultural collaboration

1 Introduction

“I think there is a world market for maybe five computers.”1 - The personal computer market ever since has had an unexpected evolution. Together with it, the gaming market has also grown rapidly. Today, the total revenue of the gaming market already exceeds the filming industry by far, with a still growing trend. Gaming and its social acceptance have fundamentally changed (professional gaming and hardcore gaming behavior became more and more accepted) [2]. The technological evolution of the Internet finally offered the option to create complete virtual environments (pure multiplayer games). From 1996 to 1998 the first MMORPGs (Massive Multiplayer Online RolePlaying Games) were released and with them gaming has drastically changed.

Today, the Internet features over 120 different MMOGs with various settings and scenarios. It includes even new game types like UMMORPGs (Ultra Massive Multiplayer Online RolePlaying Games) or MMOFPSs (Massive Multiplayer Online First Person Shooters). All of them have a common factor: a player always represents a single character (toon) at a time. Thus the identification with ones in-game character is significantly higher compared to more dynamic games like common FPS.

This leads to the question of in-game behavior. With the release of the first MMORPGs both the player community and their way to play games were completely unknown. The so called first generation MMORPGs were played for various reasons (such as the opportunity to play in a persistent online world and new character evolution depth) [4]. Thus the discrepancies of the players lead to their individual game demeanor [3]. 2nd generation MMORPGs that came subsequently featured player guides and dictionaries for in-game behavior and speech to give the new audience an insight about the online worlds. Furthermore, the more experienced players from the first generation MMORPGs also introduced a certain appreciated behavior that influenced newcomers. Like in real environments players needed to find a common way to interact with each other.

The mentioned changes entail the question how much of the real player attitude remains. Therefore, this paper focuses on the gap between real world and virtual world player-characteristics, the so called virtual fragmentation. Section 2 contains important background information, such as the definition of game behavior and an introduction to the big5 inventory; Section 3 describes the research approach, including the

1 Thomas J. Watson, Founder of IBM, 1943
design of the online survey and the database; Section 4 features the statistical analysis; Section 5 shows current related work and section 6 concludes the main statements and gives an outlook.

2 Background

2.1 Definition of gaming behavior

Gaming behavior is closely related to video games and should not be mistaken for game theory (e.g. business science prisoners’ dilemma). However, gaming behavior describes the attitude of a player in the virtual world (or VE). Different game genres have a spectrum of interaction possibilities, but player behavior can be observed in all of them. Even in strictly regulated game environments like Magic the Gathering Online (with chat language filter) there are still possibilities for players to show their bad attitude by refusing to give up/disconnecting on purpose. As a result of this interaction a blacklist (personal blocking list) is a standard feature of nearly any current multiplayer game.

On the other hand also positive behavior has an impact on game design. In-game buddy lists of friendly players help to increase the fun by playing cooperatively with those that one likes most. The complexity of the social interaction between players grows proportional with the complexity of the underlying virtual environment. Nevertheless gaming communities also evolve along games. The interaction relocates to other communication possibilities, like forums or chats. It is difficult to take those interactions into account, although they are obviously game related. Thus the narrower definition of gaming behavior refers to the in-game interaction between two or more players.

2.2 The big5 model

One part of analyzing the differences between in-game and real world behavior is the selection of an underlying model. Human behavior even in terms of gaming can be very complex. Several models aim to define behavior, our approach needed a highly valid and reliable one. Several models have a high degree of complexity and although they are reliable and valid, the gaming behavior might not been measured most accurately with them. Therefore, we choose the big5 model that is both relatively simple and adjustable to gaming.

The big5 model divides the human character into five personality factors. Each of the factors defines a part of the character (and thus the behavior). Based on the 5-factor model of Costa and McCrae [16] the model measures divides the personality into neuroticism (N), extraversion (E), openness to experience (O), agreeableness (A) and conscientiousness (C) (see figure 1). Each of the factors can be considered individually, which will be important to understand differences in behavior later on.

![The Big 5 Personality Factors](image)

Fig. 1. The Big 5 Personality Factors.
2.3 Virtual fragmentation

We define virtual fragmentation as the discrepancy of real-world behavior and virtual-world behavior. The larger the difference is, the bigger the virtual fragmentation (figure 2 illustrates the idea). In order to measure such a difference one must look at the real-world and in-game behavior separately. The underlying questionnaire is described in section 3. Because of the independence between each of the five personality factors one can compare virtual and real world behavior apart for all of them. Together with deterministic values (such as nationality, gender, age, etc.) we will statistically analyze the main reasons for virtual fragmentation.

![Virtual Fragmentation and the Big 5 model](image)

**Fig. 2.** Virtual Fragmentation and the Big 5 model.

2.4 Big5 and player characterization

Computer games feature typical groups of players. The taxonomy of Bartle [7] (a player characterization) divides them into achiever, explorer, socialiser and killer. Each of them show a typical online behavior and thus each player-type has appropriate characteristics. In order to understand the virtual fragmentation we will also account the four player types in the big 5 model. This will especially help to understand if certain game aspects force the players to adopt an expected behavior and thus increase the virtual fragmentation. The first step towards including the player characteristic is to determine how in-game behavior of the typical player types would be characterized. Figure 3-6 illustrate the character-individual average scores. Over average scores in neuroticism show an emotional instability, anxiety, moodiness, irritability and sadness. Both socialisers and explorers will score low on average, achievers will score medium and killers tend to score high. A high score in extraversion indicates a high assertiveness, talkativeness, sociability, emotional expressiveness and a low excitability. The average scores of achievers and killers will be low; explorers score medium on average and socialisers will have a high score on average. The openness trait features characteristics such as imagination, insight and a broad range of interests. High scores on average will be achieved by the explorer and socialiser, achievers score medium and killers score low. A high value in agreeableness indicates attributes like trust, altruism, kindness and affection. Both achiever and killer score low, explorers will score medium on average and socialisers score high. Conscientiousness includes attributes like thoughtfulness, goal-directed, organized and mindful in details. Both killers and achievers score high on average, socialisers have medium scores and explorers have low scores.
3 Research Approach

After the character classification of the player types (Bartle [7]) we will turn to the survey itself. The design of the questionnaire features a set of 30 questions (6 of each type – neuroticism, extraversion, openness, agreeableness and conscientiousness). Furthermore, it includes a deterministic part with values such as age, gender, location, income and occupation to statistically analyze correlations with the virtual fragmentation afterwards. The overall number of questions in the survey is 38, which is basically a tradeoff between a higher reliability of the individual character attributes (6 questions each) and the number of users that are willing to participate. Half of the questions referred to real life attributes and the other half contains in-game behavior. The set is balanced; each subset of 6 questions per attribute contains three questions for virtual and three questions for real life behavior.

In order to receive a reliable basis of comparison the survey contains mean opinion score answers; ranging from 1=totally disagree, 2=disagree, 3=neutral, 4=agree to 5=totally agree. Later on the results can easily be used to calculate the average score of each big5 element. In fact the average score contains the 10% trimmed median of all three related questions divided by 3 (number of questions) to exclude potential fake answers. There are similar answering systems; but the MOS features the huge advantage of reliability and comparability. The pre-survey contained a set of over 100 questions with 50 persons answering each of them. However the first results indicated the questions with the strongest correlation to the big5 attributes and thus which questions were supposed to be taken.
On pair with the decisions about the structure of the survey one must look at the accomplishment as well. Using online poll techniques through ASP (active server pages) has the advantage of high user numbers. On the flipside without any system of IP catching or user administration one cannot ensure that a user is recently answering the questions multiple times. Nevertheless the huge advantage of having a large (and thus reliable) survey prevails over the disadvantages. The underlying database model (see figure 7) contains following entities: (1) Survey – holding the different surveys; (2) Questions – the overall amount of questions; (3) Answers – possible answer structures and (4) Users - user ID and related data. As the ER-model (entity relationship model) shows, all entities are connected through a single central relation. Compared to a file system, the database offered various benefits like faster accessibility. Especially the statistical analysis was simplified, even with the huge amount of data.

Although there are certain deterministic values for the typical gamer (male 15-25, solo, high-school or university) the survey should also contain females and a more mature audience, thus we advertised in different gaming forums that specialized on that target group. The advertising part included going to any of the top European gaming forums as well as special clan, guild and player community sides. Overall we made more than 200 forum entries to ensure a game independent, well balanced and large target group.

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| Table 1. ER-model of the underlying database.

4 Analysis

By advertising the survey in the game related forums we scored a large number of replies. Together with our other survey “Distribution of Online Hardcore Player Behavior” [2], more than 30,000 users participated; about half of them were answering the virtual fragmentation questionnaire. The elimination of incomplete answers excluded about 50% of our 14,900 answers, leaving a total of 7,369 data-sets as the result. We used a trimmed median for most of the calculation and thus eliminating the 5% upper and lower boundary. By doing so, one receives more accurate information because unrealistic answers like 110 years old gamers are left away.

Another important aspect was to prove the distribution type of our data-poll; therefore we used the Jarque-Bera test to analyze the deviation from normality. As a result, we managed to show that our data poll is normally distributed (this will be important for correlation analysis in the further sections).

$$JB = \frac{2}{6} \left( \frac{k^2}{n - k} + \frac{(K - 3)^2}{4} \right),$$

Fig. 8. Jarque-Bera formula.

Before analyzing the overall virtual fragmentation, one should first take a look at the deterministic results. In fact it is important to keep them in mind because each of them can have an influence on the
fragmentation itself. The main idea is to model the possible virtual fragmentation via statistically significant deterministic values. Furthermore one should consider how age and location might have an impact on the online behavior. Therefore we will start up by looking at the deterministic section first (4.1), followed by an observation of the virtual fragmentation in different age categories and countries (4.2). Section 4.3 contains the overview about the whole virtual fragmentation and an explanation for the results. Both Sections 4.2 and 4.3 include a comparison with the big5 player-type attributes from the Bartle-taxonomy.

4.1 Deterministic values

Our survey user-group is not homogeneous. Although we tried to receive more answers from non-typical gamers overall their number was relatively small. The gender distribution clearly indicates more male users; 89.2% of the players were male, only 10.8% were female. Compared to our analysis of hardcore gaming behavior [2] however this number was surprisingly high (in some game-types there were less than 1% females). The marital status indicates similar results as in [2], most of the users were single 86% (highly correlating with the age, nearly 98% of the players under 25 were solo); 12.6% were married, 1.1% divorced and 0.3% widowed. The education level turned out to be one of the most important variables (with a high correlation) for hardcore gaming behavior. Contemplating the importance, the user group for virtual fragmentation turned out to have the typical distribution with high values in school and university and low values in worker and no profession areas. A relatively low number of 7.2% are without a job, 4.0% worker/apprenticeship, 38.8% high-school and 50.0% college students.

Resulting from the education level and their current occupation more than 68% admitted to have less than 1000$ a month, however on the other side 61.3% also admitted to have 7 or more hours of leisure time. Both findings were not surprising, but still important to keep in mind for the follow-up statistical analysis.

4.2 Virtual fragmentation and age/location

By analyzing the correlations between the given deterministic values and the difference between real world and virtual world behavior we started up with a model of a multiple regression. The input variables were the deterministic values (independent variables) and the dependent variable was the difference of each of the five big5 character attributes. Most of them have showed an insignificant (to an error probability of alpha=5%) correlation to the virtual fragmentation. However it turned out that both age and location significantly influence the difference and thus both of them should be analyzed individually. The underlying model was capable of explaining 68% of the total statistical variance, because its overall coefficient of determination was 0.68. Furthermore it turned out that the virtual fragmentation differed between the five character attributes; generally the larger that gap between virtual and real world behavior the more influence age and location have. The relatively high coefficient of determination has two main advantages: first one can show dependences between deterministic values and the virtual fragmentation and
second an underlying model offers the opportunity to explain each of the correlations (age and location) individually.

4.2.1 Age correlation

In order to understand the correlation between age and virtual fragmentation one must first look at the overall age distribution. Figure 10 illustrates a box-plot of the age distribution. The x0 quantile (youngest participant) is 11 years, the median (x0.5 quantile) is 21.2 years and both the x0.25 and x0.75 quantile show a tight age distribution around the median. This means that 50% of the survey-users are between 16 and 25 years and therefore have a significant influence on the result.

![Box-Plot of the overall age distribution.](image)

Fig. 10. Box-Plot of the overall age distribution.

Each of the five character attributes will be analyzed individually, starting with agreeableness. A high value indicates attributes like trust, altruism, kindness and affection. Figure 11 illustrates the findings divided among the age groups.

![Difference in mean opinion score for agreeableness among age groups.](image)

Fig. 11. Difference in mean opinion score for agreeableness among age groups.

The data evidence a noticeable gap between virtual and real world behavior in the age group of 10-20. Both curves start to correspondent more from 20-25 years until they are running similar. The younger age group has a significantly lower score in agreeableness in the virtual world compared to the real world, which means they are showing less attributes like trust and kindness when playing their games. If one keeps in mind the player group taxonomy and their scores then such a behavior is similar to the player group “killer” and “achiever”. Most of the younger players do not seem to follow the pattern of a socialiser or explorer and thus tend to not help fellow players with the same intensity as they would support real life contacts. An opposite result can be observed for the mature audience over 50 years. They have a comparably low score in the real world; meanwhile the virtual agreeableness is significantly higher, which indicates that they tend to have a more helpful online attitude. A possible explanation for that is their need to catch up with the player community in order to gain more contacts. Concluding the general trend of both curves the virtual agreeableness has a positive slope; meanwhile the real agreeableness seems to be constant over age.
Figure 12 shows the difference of the second big5 character attribute: conscientiousness. A high value includes attributes like thoughtfulness, goal-directed, organized and mindful in details.

![Fragmentation Conscientiousness](image)

**Fig. 12.** Difference in mean opinion score for conscientiousness among age groups.

This time a more significantly gap is shown. The virtual conscientiousness is higher for any age group, however especially the younger players under 20 tend to a larger gap. A difference of nearly 1.0 (average virtual C = 4.0 and average real C = 3.0) clearly shows different behavior. The real world conscientiousness has a slightly positive slope towards age; mature users tend to be more goal-directed and mindful. In contrast to that especially young players seem to be definitely well organized in the real world as well as goal-directed. Similar to the finding in agreeableness player groups’ achiever and killer have high values in C and thus seem to be responsible for the major difference among the younger players. Generally the gap is a result of the manageable and straightforward design of the online worlds. Players are instructed and understand causalities better than in the real world.

The third trait is extraversion; a high score indicates assertiveness, talkativeness, sociability, emotional expressiveness and a low excitability. An illustration of the difference is given in figure 13.

![Fragmentation Extraversion](image)

**Fig. 13.** Difference in mean opinion score for extraversion among age groups.

Because of the non-distinct evolution of the gap over the users age one should look at each of the both curves individually. The real world extraversion curve shows a relatively high level in pre-puberty age, which is significantly dropping towards the age of 25. Afterwards it rises again, until it stabilizes for users over 35 years. Obviously middle-aged users around 17-27 tend to focus on more introverted parts of their life. However on the other hand the virtual extraversion remains on a constant level until the age of 25; such a process can be explained by two influencing factors. On the one hand the number of killers and achievers drop, which increases the average extraversion. Opposite to that it seems that the general extraversion of the players during their puberty drops, which compensates the positive effect from player-type change. From the age of 25 the virtual extraversion curve rises simultaneously with the real extraversion curve. Users in the age of 35-50 seem to have problems with socialization because of the significant fall in average virtual extraversion, a possible explanation for that is the reduced interest in game-events due to a larger scope on real life problem. Even midlife-crises possibly could influence the
curve. The value of virtual E stabilizes for mature players, probably going hand in hand with the insight of the large necessity of social contacts that is shown during the analysis of agreeableness and conscientiousness.

The character trait with the lowest virtual fragmentation is neuroticism; high scores indicate an emotional instability, anxiety, moodiness, irritability and sadness. First of all one can see that the trait scores relatively low, which underlines findings from similar psychological studies about a lower sadness level of videogame users. As illustrated in figure 14, both curves show a similar pattern. Furthermore, age did not have any significant impact on the small gap between them. One can explain the existing small fluctuation as a result of the limited number of participants. However, both curves are not flat; generally they have a slightly negative slope until the age of 40-50, where the curves significantly rise again. The slightly negative slope is statistically not significant enough, because the difference between the highest point (2.95 and the lowest point 2.55) are not large enough. The only notable change is a strong increase in neuroticism score for mature player (50+). As a reason for that one can assume the general high level of sadness and depression for older people. The common player types like socialiser and explorer for the mature users that both have relatively low scores in neuroticism do not seem to outweigh the general trend for sadness in higher age.

![Figure 14. Difference in mean opinion score for neuroticism among age groups.](image1)

Finally the last character attribute openness is shown in figure 15. A high score in openness includes a good imagination, insight and a broad range of interests of the user. Over all age classes there is a notable gap between virtual and real openness; both curves are flat and show no significant fluctuation. The age independent higher score in virtual openness has several causations. On the one hand virtual environments provide a wider range of impulses, especially visual game play supports the users imaginativeness. On the other side most games (especially MMOGs) offer a wide variety of content that encourages the player to explore it all. Traits like insight and understanding score are significantly higher because the players tend to understand the underlying game mechanisms and thus realize game causalities. On pair with that it is also shown that people are more willing to adopt new knowledge in a playful way (such as edutainment).

![Figure 15. Difference in mean opinion score for openness among age groups.](image2)
Table 1. Virtual Fragmentation in each of the five character-attributes divided among countries.

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4.2.2 Location correlation

Besides looking at the correlation between age and different behavior one must also keep in mind that the origin also has a significant influence (strong correlation at our multiple regression model). Overall we supported 28 different countries in Europe. Several of them had only a very limited number of participants; therefore, they were excluded for the analysis among countries. Only countries with more than 40 users were taken into account; leaving the 16 listed countries from table 1. Although each of the countries has its individual social culture and even subculture that can possibly influence the behavior, one should look at the problem from a wider focus. The 30 questions and few deterministic values would never provide enough background information to sub-split the countries into smaller sections. Therefore, we choose a general approach and categorized each of the European countries with respect to their geographical location. The resulting groups were northern Europe (Finland, Norway and Sweden), western Europe (UK and Ireland), southern Europe (Spain, Italy and Greece), eastern Europe (Bulgaria, Hungary and Romania) and central Europe (Denmark, France, Germany, Netherlands and Switzerland). As one can see in table 1 each of the country-sets show a similar behavior, which should be individual for each of the five attributes. On pair with the construction of the country-sets we verified possible differences in deterministic values of the sets; however the large number of replies from every participating country ensured that overall there were no significant differences found in between them.

In terms of agreeableness the country-sets show an unequal behavior. Southern and eastern European countries tend to have a negative gap, by noticing a significantly higher real agreeableness than virtual one. On the other hand the western and northern European countries tend to have a positive gap (virtual exceeds real agreeableness). The deterministic structure of the country sets is similar, so age is not responsible for the observed inequality. A possible explanation for such a difference can be found in the social acceptance and general gaming importance in between the given countries. Both UK and Scandinavia accept gaming even as a sport (Scandinavia has the biggest European pro-gaming scene). Compared with geographical circumstances like cold weather and a lower density in infrastructure a result will be a higher level of indoor activities and more gaming time/importance (similar findings can be observed in [2]). As a logical consequence of this higher indoor and virtual world focus the virtual communication between peer-groups (groups of people with similar education/age) receives a key-role. Thus people from northern European and the UK tend to have a general higher level of communication and kindness in online games.

The gap between virtual and real conscientiousness showed no significant difference towards countries. All countries display a higher virtual value, although the eastern countries evidence a comparable stronger positive difference. One can observe similarities in the character-trait extraversion, which generally has a slightly negative gap. Again eastern and northern European countries demonstrate a stronger negative value
(compared to the relative difference of the others). Concluding both findings the differences are statistically not significant enough, because overall every country-set shows a similar trend towards the two attributes.

The national difference concerning neuroticism indicates an uneven pattern. It can be observed that the values for virtual and real neuroticism in the southern and eastern European countries tend to be clearly negative (real N value exceeds the virtual N value). Unlike that the values in the western European countries are slightly positive; also central European countries show even values in both virtual and real neuroticism. One possible reason for that can be the social circumstances, both UK and central European countries have a higher social standard (compared with southern and eastern Europe). Thus the amount of real depression and sadness tends to be higher. One should keep in mind that the virtual world offers even circumstances to every player, which is a large discrepancy compared to the real world.

The last remaining trait openness has a positive gap in all of the countries (virtual openness is significantly higher compared to real openness). Nevertheless one can observe an increased effect in central European countries and the UK. Similar to the findings for neuroticism, the social structure and the available network connections of these countries offer the inhabitants an easy opportunity to access games. Especially the gaming acceptance in the UK provides virtual environments and thus the motivation to explore them.

4.3 Overall virtual fragmentation

Finally one must look at the overall virtual fragmentation for each category of the big5 model. Figure 16 illustrates the difference in the mean opinion score between virtual and real behavior among all five attributes. One should keep in mind that the underlying data is not normalized by aged or nationality and thus the dominating group (males between 15 and 25) has a huge impact on the results.

Overall there was no significant difference found for agreeableness and neuroticism. This means on average players do not tend to change their online behavior much in those two categories. Trust, kindness and loyalty as well as the standard level of depression, anger and sadness seem to be constant overall. However one can observe differences between certain age groups and nationalities.

A more significant difference can be found in conscientiousness; the virtual value for the trait is 0.6 points higher on average. This massive difference in goal-direction, straightforwardness and logical orientation results can be explained by the underlying game mechanisms and the reduced complexity of the online world. Additionally the online “work” for the character is supposed to be fun and thus creates more enthusiasm by doing it.

There is also a 0.3 overall difference in extraversion, the general higher value in talkativeness and sociability can be explained by the similar interests of the online community. The game itself offers enough topics to talk about and gives the players an opportunity to find a common ground. Also the inhibition threshold for online chatting is comparable lower than real world interaction, which gives even shy players a possibility to talk to others.

![Figure 16. Difference in mean opinion score for openness among age groups.](image-url)
environment the users show a strong focus towards the game and game-related material [2]. Overall this leads to a higher willingness to adopt new changes and explore possible new content. Also each individual player always has the opportunity to end his gaming contact in order to focus on another activity. With that in mind, people tend to accept foreign changes (by game developers) better. Furthermore, a lot of games either feature a large customization option (like mod-kits) or have a tight customer support to balance the in-game content; both supports the willingness of the players to gain a deeper insight of game mechanisms in order to let the developers change common dislikes.

5 Related Work

User behavior has a large impact on computer gaming. There exist numerous research approaches since 1990 ranging from impact of gaming up to real world behavior and computer games. Not all of them are necessarily related to our approach; however there are four major research fields with high importance:

5.1 Computer games and real world behavior

Since the growing importance of computer entertainment (especially video game section), psychology and computer science has shown significant interest in their impact on real world behavior. The trend is shifting towards a deeper analysis of real world aggression motivated by playing action video games [12, 13]. Different measurement techniques are used underlining that both media and computer games can have a certain impact but are not responsible for aggression. Another idea is to compare similar real world and virtual activities [14] in order to understand the impact of video games better.

5.2 Player (behavior) characterization

Most of the work in this section is based on the initial player categorization of Bartle [7] into achiever, explorer, socialiser and killer. The aim is to understand how the motivation of an individual player can influence the game. Once one has a deeper insight in motivation and impulses of their player-community, the game-content can be improved to better support the desideratum. The different approaches extend Bartles basic classification and model the player behavior in various multiplayer games [5, 6 and 10]. One of the most important evolutions for player characterization was the creation of MMO(RP)Gs (Massive Multiplayer Online Role-Playing Games). Those virtual worlds (or VE = virtual environment) create complex social structures; several papers aim to understand their social impact [3, 8].

5.3 Player (-group) interaction

Similar to the player characterization the player-group interaction becomes more and more important. Most of the current games feature a multiplayer support with a team-option. Thus there is a need to analyze how group behavior varies from individual one. There are several approaches; most of them are depending on the game-type [5]. Another part includes next generation places, such as “third places” (virtual areas like pubs, where players can meet up and enjoy their leisure time). Besides commercial interest those areas feature completely new ways of interaction [9].

5.4 AI construction based on player behavior perception

The design of AI ever since has been a large topic in computer games. By creating virtual worlds with own economic systems (money system, inflation and merchants) one must closely look at the NPC (non player character) behavior. The goal is to model NPCs that act naturally (for instance having a daily routine like going to the grocery store) and still serve the players needs. Therefore, newer AI-models aim to improve their own behavior by learning from players [8, 11]. Another approach is to use differences in player and NPC behavior to identify automated players (so called bots) [15].
Concluding the different sections that are related to our current work one can understand how important the impact of player behavior for game-development is. There are strong relations between our approach and the section of player game world behavior; especially it is interesting, how long sessions of gaming can blur the perception of reality. Furthermore, there are strong relations to the player characterization; hardcore players (from our interviews) most often fit either the killer or achiever archetype. The parallels to AI and group behavior yet are not that significant; nevertheless both definitely influence the way hardcore players approach their games.

6 Conclusion

In this paper we focused on the potential difference between online and real world behavior, so called virtual fragmentation. Therefore we used a database with ASP support to create a large and reliable online survey, which contained a set of 30 well balanced questions plus deterministic values. On pair with that, we used the player characterization taxonomy of Bartle [7] combined with the big5 model [16].

Concluding our findings one can see that the total number of 7369 normal distributed data-sets ensures the necessary reliability. The statistical analysis included three main approaches: (1) age-correlation, (2) origin-correlation and (3) overall virtual fragmentation. As one can clearly observe, age and nationality have a large impact on the virtual fragmentation. One of the main findings was that especially young players tend to follow the achiever and killer player-type and therefore show significant differences in agreeableness and conscientiousness. Meanwhile more mature players more often correlate towards explorer and socialiser character-patterns. Beside that the nationality analysis has shown several statistically weak differences between European regions; although one could find significantly differences between northern and eastern/southern Europe in neuroticism. The most important finding in the origin section was the high acceptance towards gaming in the UK and Scandinavia. Finally the overall analysis of the virtual fragmentation has shown significant differences in conscientiousness, extraversion and openness.

After analyzing the findings one should think about resulting consequences. Especially younger players tend to be more competitive and needs a challenge; meanwhile the mature audience prefers social contacts. With that in mind community structure and game design can reach a new level, especially by designing so called third-places. The national analysis gives a good insight about the individual national preferences and therefore they can improve product placement and customization of PR. Finally the shown discrepancy between virtual and real world can be used to improve current games. If one is interested in entertainment (games with learning content), then the general virtual fragmentation could be used to give the user positive impulses to improve his/her the real-life social behavior. In combination with the game-related activities [2] it is also possible to create better community support by keeping in mind which attributes each of the players usually have.

The current player behavior analysis has not come to an end yet. Although the presented survey contains vital information about the motivation and current game behavior, there is still a lot more to understand. In our upcoming work we will focus more on the hardcore player aspects and the effects of long lasting game-sessions (12+ hours a row). As a part of that we will observe game-activity and game-orientation of the test players during the period as well possible physical effects like vision blurring.

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