Video Game Satisfaction with Adaptive Game AI

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1 Introduction

In modern times nearly every person in the country knows about video games and the majority of them have played one at least once. Video games as we know them started in the late sixties to early seventies, and ever since then the academic community has striven to find out what makes video games so much fun [Malone, 1980]. In studies done in the infancy of video games, it was identified that there were main factors, challenge, curiosity, and self esteem, which went into the effectiveness of all video games [Malone, 1980]. Since Malones work, a large facet of research done into the computer science of video games is how to make educational games that retain their ability to engage and entertain the user [Zea et al., 2009], and building more robust and adaptive video game AI or Artificial Intelligence [Bakkes et al., 2009]. More recently there have also been studies into the effectiveness of video games based on the player personality type [Liang, 2012]. The purpose of this research is to investigate the benefits of adaptive game AI when compared to personality type. This means testing to see what personality type enjoys what types of adaptive AI. This is based on the premise that a more adaptive game AI will generally improve a gaming experience, and this study worked to find a way to categorize which types of adaptive game AI are most effective for what types of people.

2 Background Info

2.1 General

Because video games represent controlled environments that can be created to mimic real world environments, they are ideal testing spaces for ideas that may be difficult or dangerous when tested in reality. It is for this reason that video games are widely used to test different types of Artificial Intelligence (AI) such as Recurrence Learning Algorithms [Liu et al., 2011], Q-learning a reinforcement learning technique [Patel et al., 2011], Ambient intelligence systems [Sadri, 2011], and what is known as intelligent agent processing [Wickramasinghe and Alahakoon, 2004]. There are an almost innumerable number of different intelligence systems out there, but most have the same basic building blocks.

As mentioned above, there were studies done in the infancy of video games that identified main factors that went into the effectiveness of all video games [Malone, 1980]. Since Malone's work there has been significant research into the computer science of video games are how to make games that entertain and engage the user [Adamo-Villani et al., 2008], how to make useful adaptive game AI [Bakkes et al., 2009], and with the current research we hope to find a relationship between player personality and gaming decisions.

Three of the main research areas in this field are studies into what makes games enjoyable to play (how to build systems with the user's entertainment in mind) and studies in which the goal is to build an adaptive game AI; and the final field is the one in which we hope to do our research; the connec-

tion between game interaction and player personality. Although these subjects are rarely connected in academic papers there is a broad base of research that has been done in both of these previously researched subject areas. One of the few studies that combined these research areas was known as PADS [Yun et al., 2010], which means Profile-based Adaptive Difficulty System. This system focuses on having a game that adapts the overall game difficulty to the users profile rather than having a non-playable character (NPC) whose behavior is based on the actions that the user takes. In this study, the authors used minute by minute data on user interaction and user feedback on the enjoyability of the game. Their data revealed that the game adapting itself to the player's skill level causing each user to believe the game was at a moderate difficulty, and at this level of conquerable challenge the users appeared to be the most engaged within the game (i.e. entirely invested in the fantasy).

2.2   What Makes Games Fun?

Some of the most important early research into what makes a computer game fun to play was done by Thomas Malone at the famous Xerox Palo Alto Research Center. [Malone, 1982, Malone, 1980] Malone lays out three main components that together make up the features defining how enjoyable any particular game is to play. The game must be challenging, this means that the outcome is not predetermined and there is some goal the player must satisfy that takes skill. The game should engage the user's self-esteem by engaging the user in intrinsic fantasies. This means that the main goals of the game are of a morally rewarding nature rather than games where you fight for fame or fortune. This is why in many games; the main goal of the game is to save either the world or humanity from some genocidal threat. The games should also engage intrinsic fantasies by making the player learn new skills and causing them to believe that by finishing the game they had mastered those skills. The last component that Malone describes is the importance of engaging the user's curiosity.

"Curiosity is the motivation to learn, independent of any goal-seeking or fantasy-fulfillment. Computer games can evoke a learner's curiosity by providing environments that have an 'optimal level of informational complexity.' In other words, the environments should be neither too complicated nor too simple with respect to the learner's existing knowledge. They should be novel and surprising, but not completely incomprehensible." [Malone, 1980]

Examples of later studies on what makes video games enjoyable have revealed other motivations that may be responsible for the entertainment of video games. A 2002 study on general design tactics for creating and testing the fun of video games outlines two more direct general causes for enjoyment in video games [Federoff and Federoff, 2002]. The first cause being that video games provide an escape from reality that is more compelling than other forms of entertainment because of the participatory nature of video games. This escape from reality is noted in the study by psychologists as something that is essential to human mental health from time to time, and the effectiveness of video games at creating this escape is part of what makes them so popular. The second form of enjoyment from games is the chance to learn a skill in order to accomplish some sort of challenging goal. This is enjoyable for the user because it satisfies their need for intrinsic stimulation and intellectual growth.

Overall this shows that there are a series of different aspects of game design and style that can contribute to the enjoyability of the gaming experience. By making games challenging, intrinsically satisfying, intellectually stimulating and interesting enough to engage the users curiosity, one can create a game that is very enjoyable for the player and provides an escape from reality. By doing this one can increase overall consumption of their games and effectiveness in holding the players attention in the game.

2.3   Adaptive Game AI

There is a large amount of work that has been done in the field of adaptive game AI [Yau and Teo, 2006]. There are a number of techniques used to mimic what we perceive as intelligence. The most common of these is an adaptive machine learning algo-

rithm that is generally tailored around some goal. There are three main types of adaptive video game AI. [Charles et al., 2005] The first of these, which is the most common and the most simple type of adaptive AI is one that increases or decreases difficulty of the game based on how much of a challenge the user is experiencing. This means that if the player is struggling, the game will get a little easier, and if the player is just pushing through with no challenge then the game will increase the difficulty without the player having to change any settings. The second type of game AI which has become popular in modern Role Playing Games (RPGs) such as the 2004 game Fable is an environmentally adaptive AI. This means that the environment and the game world will change based on the actions that the player takes. For instance if a player decides to take an evil action the world may get darker and if the player decides to be a hero the people may seem friendlier. The final type of adaptive game AI is by far the least common and the hardest to build; behaviorally adaptive game AI. This means that the NPC in the game will change it's behavior based upon how the user plays the game. This means specifically the NPC will be correcting it's mistakes and creating new behaviors designed specifically to defeat the user currently playing the game. This is the hardest because it involves a large amount of data and processing, which is why it is used mainly in RPGs and turn based strategy games such as chess [Liu et al., 2011]. These are inherently iterative games and that is why it has been successfully implemented in games such as Baldur's Gate and Neverwinter Nights, which are two of the most popular RPGs of the past decade. [Spronck et al., 2003]

Arguably the most important recent work in this field has been done by Professor Pieter Spronck, the author of Adaptive game AI [Spronck, 2005b]. Spronck identified the core development pieces and structures required to make an adaptive game AI in a recent paper A Model for Reliable Adaptive Game Intelligence [Spronck, 2005a]. Spronck said that adaptive game AI has two main objectives, namely to enhance the agents with the ability to learn from their mistakes, to avoid such mistakes in future play (self-correction), and to enhance the agents with the ability to devise new behavior in response to previously unconsidered situations, such as new tactics used by the human player (creativity). The core problem with the system's ability to learn however is finding a balance between its exploration and exploitation behaviors. Exploitation is when the adaptive game AI does not learn, but uses its learned knowledge. Exploration is when the adaptive game AI attempts to learn new behaviors. When brought down to the lowest level though, Spronck says that adaptive game AIs are necessarily based on two concepts [Spronck, 2005a]. The first concept is domain knowledge of the game environment. The reasoning behind this concept is that, to meet the four computational requirements, adaptive game AI must be of high performance. The two main factors of importance when attempting to achieve high performance for a machine learning algorithm are the exclusion of randomness and the addition of domain specific knowledge [Spronck, 2005b]. Since randomness is inherent in most games, it cannot be completely excluded. Therefore, it is imperative that the learning process is based on domain-specific knowledge. The second concept is an opponent model. The task of an opponent model is to understand and mimic the opponents behavior, to assist the game AI in choosing successful actions against this opponent. Without an opponent model, the game AI is unable to adapt adequately to human player behavior [Spronck, 2005a]. Using these concepts and the processes outlined in Spronck's work, it should be possible for any interested researcher to be able to build their own adaptive game AI.

It seems likely that this use of adaptive AI will be effective at improving the games enjoyability because it has already been shown in recent studies that games which are less predictable are more enjoyable. In 2011 at the University of Derby there was a study done using recent award winning games such as Borderlands, which used item randomization to make the game a slightly different experience each time you played it [Snowdon and Oikonomou, 2011]. In the study, it was seen that re-playability and initial enjoyment of the game was improved when the player did not know what was coming next. This suggests that by increasing the adaptive abilities of most

games will improve overall player enjoyment. Our research is conducted under the assumption that it is true that giving a game an adaptive element will inherently make it more enjoyable to the players.

2.4 The Video Game - Personality Connection

The research into the correlation between personality types and the players video game experience is slightly more recent and thus, less research has been done into the topic. There is a significant source of information on the interaction between personality and video games, although the vast majority of it is focused on whether video games cause violence or aggression. The research into personality that is more relevant to this research is discussed here. These research areas include adapting the game to the player using personality, testing for or improving user enjoyment in games, and testing user personality types.

An article from last year in New Zealand by Bakkes showed how games could be made more suitable to the players personality type [Bakkes et al., 2012]. This article on personalized games describes games that utilize player models in order to adapt the game experience to the individual player. One of the main important motivating concerns for the study was the psychological foundation of personalized games and their effect on player satisfaction. In his article Bakkes says his "Research has suggested that game personalization raises player loyalty and enjoyment, which in turn makes gaming experience a (commercial) success. This supports the overarching thesis that an appropriate it between characteristics of the player and gaming technology results in greater enjoyment." [Bakkes et al., 2012]. Bakkes studied different games in his research which adapted everything from space adaptation, to the music in the game, to the opponent player matching, to one of the more common adaptations, which is difficulty scaling [Bakkes et al., 2012].

Different genres each have their own fan bases, which are likely based in different types of peoples personality. There is an article on this relationship between game genre enjoyment and personality, which finds a number of interesting correlations [Johnson and Gardner, 2010]. In the article the subjects' personality was assessed by the five sub scales of the Ten-Item Personality Inventory (TIPI): extraversion, agreeableness, conscientiousness, openness to experience and emotional stability. The subjects' game experience was assessed by the four modified sub scales of the Player Experience of Need Satisfaction (PENS): presence, competence/control, relatedness and autonomy. High scores in these facets of the PENS will result in player enjoyment and engagement. Their results suggest that people with heavy openness to experience or agreeableness enjoy games that promote choices and freedom such as role playing games. The results also suggest that players with higher emotional stability are more likely to enjoy shooter and other violent games. It was also showed that if a player's current favorite game was a shooter or sports game then they generally scored lower on autonomy. This connection shows a strong link between personality and gaming behavior, which is important to future research into the enjoyment of video games based on personality.

There has certainly been a significant amount of research into the topic of game enjoyment based on ones personality and that is the research that is most relevant to this experiment. One author identified key elements that encapsulated the heuristics they discovered in research that led to player enjoyment [Sweetser and Wyeth, 2005]. They created a model called GameFlow, which consists of eight elements: concentration, challenge, skills, control, clear goals, feedback, immersion, and social interaction. Each element includes a set of criteria for achieving enjoyment in games. Their tests showed that GameFlow is a reliable tool for testing real time strategy games for player enjoyment and future work with it could help in providing design tools for these types of games.

There has also been research into how emotions and mood come into play during gaming experiences. In Callele's work back in 2008 they tested for emotional responses in games based on stimuli. Personality, culture, and life experiences have a strong affect on the players emotional response to the stimuli [Callele et al., 2006]. A stimulus is any scene or interaction that the player sees, hears, and feels during the game. They proved in this work that there is

a strong correlation between how a player emotionally responds to the stimuli and their personalities. If causality could be found then positive emotional responses could be tested for against personality and then games could be tailored to the player's personality types by adapting the stimuli to what gives their personality type a positive reaction according to these hypothetical future tests.

A study from the Netherlands with second author, Pieter Spronck, the authority on Adaptive Game AI, tried to see if a video game could be used to create a personality profile of an individual [van Lankveld et al., pt 3]. They decided to use the Big Five Factor Model of personality, which is a well accepted model for personality that uses the OCEAN acronym for traits [John et al., 1991]. The traits that make up the OCEAN acronym are openness to new experience, conscientiousness, extraversion, agreeableness, and neuroticism. The authors attempted to test personality types using a model that integrates a Five Factor Model questionnaire into the game play of a popular role playing game. After they tested their game model on 44 participants across 275 game behavior variables it was concluded that the model was sufficient to assess player personality. This integration being able to test for personality based on behavior in game means that if we want to improve or change the game play for a certain type of player, then we can use these traits to find the personality type, and adjust the game accordingly. This research shows that games can identify personality through gaming decisions, and could be used for important future work such as adjusting the game to the players personality and discovering whether these game environments could eventually be the most effective use for testing for personality [van Lankveld et al., pt 3].

Most of this work is still in a phase where researchers are finding connections between players and game types and seeing what can be done with them. There is a lot of compelling work in this field that has been done, as can be seen above; however what is most compelling is the future work that is implicated in these studies. The previous research has shown how adaptive games can improve gaming experiences, what makes games enjoyable, and even that mood and personality has played a role in how a player experiences the games. This research all builds upon the idea that games which adapt to personality have the potential to improve the global enjoyment of games and even increase the market for their consumption by attracting a broader range of consumers. In the current work, we hope to demonstrate a concrete connection between personality types and what types of adaptive AI are most effective for different types of people.

3 Research Question and Methods

How much does personality affect user's enjoyment of game play with an adaptive game AI?

This question will be answered using this simple game type: a version of *Ms. Pacman* that is a public version called *Mrs. Pacman*. This is a classic game type that is well known across nations and age groups. This particular version was obtained from http://www.pacman-vs-ghosts.net/ where the open source versions are used for a competition where programmers compete to create the most capable game AI for either Pacman or the Ghosts. This game was chosen because of its availability as open source code, it provides code for swapping the ghost AI, and because it represents a very simple environment with a relatively small range of behaviors that can be taken. A simple game of this type is ideal for testing the effectiveness of adaptive AI because there are few variables to potentially influence the results and because it is easy to create different types of adaptive game AI, that do not have too much variance in behavior, thus making them essentially the same game. In the study, users will be randomly assigned to play one of two adaptive game AI variants first, but every participant will play every game type. Before play the users will be asked to take a short personality test, and then play the control version of the game for a short period. At the end of the game they will be asked to fill out a form which asks them for user feedback on how much they enjoyed or found pleasure in the game, their skill in the game and how likely they would be to replay the game. The survey will be done

using a number of seven point likert scales (strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, strongly agree) so that the feedback can be easily transferred to numeric data. This method is effective because it evaluates how well the player played, how much they liked the game and how likely they are to play the game again; which are several different aspects of how well the game accomplishes its goals. Using these different aspects and with how easy it is to gather data in this format; this method was deemed highly effective for gathering data on the relationship between personality and game type preference.

4 Hypothesis

It is my belief that the correlations between game enjoyment and personality type will reveal that more personality types enjoy a difficulty adaptation than those that enjoy the emotional or event based adaptation. I predicted that those who were very agreeable would be moved by the ghosts change in emotions because they are more prone to empathizing with others feelings than others and would connect with the ghosts and the ghosts mood. This would tip the scale in the emotional adaptations favor; however in most cases I believed that people would enjoy the difficulty adaptation more. I believed that there would be an exception in terms of neurotic individuals since they do not respond well to stressful situations and would be frustrated with a game that got more difficult every time the player tried to master it. I believe this because difficulty adaptation is currently one of the most widely accepted type of adaptive game AI and a challenging but beatable game is one of the most classic marks of a well liked game. Having the game adapt its difficulty to the users skill level makes it so that the user will always be experiencing this challenging, but beatable state, which is instrumental in holding the game players engagement. I also believe that there could be an effect that those who eat less ghosts on average will enjoy the event adaptation variant more because this way the action of choosing to be non-aggressive will have a positive effect for their chances of survival during game play

rather than this choice having no consequences. For these reasons I believe that preference for the difficulty adaptive AI will be more prevalent, however there will be outside variables and factors that may cause participants to enjoy the event based adaptive game variant more such as high levels of neuroticism, or a non-aggressive game play strategy.

4.1 Materials

The materials to be used in this study include three different versions of Mrs. Pacman that the participants will be playing, a personality test and a satisfaction survey. The personality test will be issued in order to assess personality and it will follow a standard Big Five Factor Personality Scale as was used in the study by Spronck [van Lankveld et al., pt 3]. We chose to use the Big Five Factor Personality Scale because it was easily available, and a classic personality measure with extensive research to back up its validity [John et al., 2008, John et al., 1991, Benet-Martínez et al., 1998]. The satisfaction survey will be a simple list of likert scales asking the user how well they did in the games, how much they enjoyed them, and how likely the user would be to replay each version of Mrs. Pacman. The game of Ms. Pacman, which Mrs. Pacman is a close copy of, is very well known which makes the changes in the game types more prevalent, since the original form of the game is so common. The three different versions of Mrs. Pacman are: the control, which is the original version of the game; the difficulty AI, which is Mrs. Pacman with a ghost AI that adapts to increase or decrease difficulty, based upon the players skill level; and the event AI, which is Mrs. Pacman with a ghost AI that has game adaptations based on in-game events. Subjects in this study will be exposed to all three game types for varying periods of time.

The difficulty AI adapts to the player skill level by changing the speed of the game to be faster and reducing maladaptive ghost behavior if the player is doing well, and reducing speed and increasing maladaptive behavior if the player is doing poorly. The overall game speed of both Pacman and the ghosts is what is manipulated when the game speed is increased or decreased by changing the delay, measured in mil-
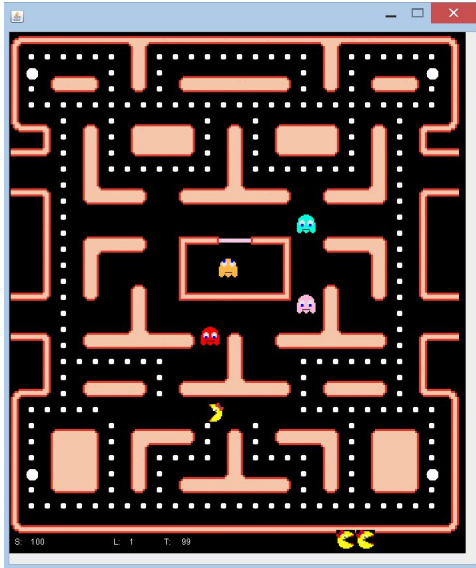
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Figure 1: A screenshot of the event adaptation variant during game play

liseconds, between game updates because changing the speed of Pacman relative to the ghosts was seen in trials to change the inherent game mechanics. The maladaptive behavior that was increased or decreased based upon player success was the rate of ghost reversals, where all ghosts randomly reverse direction without reason or notice, and the likelihood of finding the shortest path to Pacman from the ghosts location. The success of the player is measured using the length of their lives, increasing difficulty as the game is played, but decreasing difficulty after every death. This allows players who die frequently to enjoy a lower difficulty that will allow them to advance further in the game than they normally would, but also allows for skilled players who normally find the game without difficulty to experience a rapidly more formidable gaming experience to challenge them.

The event AI adapts in a similar way, but does so based on environmental factors. The event AI has two scales which start at zero at the beginning of every level. Increasing the activity scale increases the speed of the game and it occurs as the player becomes closer to the end of a level. Increasing the

strategy scale decreases the chances that the ghosts will not be able to find the shortest path to Pacman and decreases the chances that the ghosts will have a global ghost reversal. The strategy scale increases every time the player eats one of the ghosts. The games emotional adaptation is associated with the images of the ghosts. This version of the Mrs. Pacman game has different faces or moods for the ghosts based upon the current levels of the activity and strategy scales. The ghosts start out in the chill mood and change when the two scales increase their scores beyond the third increase. The ghosts are in the happy mood when the player has a high score in the activity scale but not the strategy scale. The ghosts are in the sad mood when the player has a high score in the strategy scale but not the activity scale. The ghosts are then in the angry mood when the player has a high score in both the strategy and the activity scales. When the ghosts are in these moods their images change to reflect the mood in question. The indication that the ghosts have emotion will hopefully give the user a more lifelike feel from the game and spark their emotional curiosity.

4.2 Participants

In this study we used 15 students currently enrolled at Union College who participated in the study with no more reward than the gratitude of the researcher. Ages ranged from 18-23 years old. I did not record gender of our participants. Participants included people of all ranges of computer gaming skills and college experience.

4.3 Procedure

Participants in the study were first given a randomly assigned participant number and asked to fill out an informed consent form. Next all participants were asked to take a paper copy of the Big Five Factor Personality Test. After taking the personality test, the participants were asked to play the control version of Mrs. Pacman for three full minutes. After finishing the control, those participants whose number is an even number played the difficulty adaptation variant of Mrs. Pacman first and the participants

whose number is an odd number played the event adaptation variant of Mrs. Pacman first. Each of the adaptive variants were played for ten minutes each by the participants. After the participants play the adaptation variant that they started with, then they switch to the other version to play for the same period of time. The same data; which is their ghosts eaten total, score and levels died on, is recorded while they play. The order that the participants played the game in was randomized to ensure that the order the game types are played in does not affect satisfaction reports. When participants finish their playing they were asked to take a short satisfaction survey on the computer, which will ask their enjoyment of the entire study and their preference between the different game types as well as how likely they are to replay the game types again. This data will be associated with the participants assigned number, which will also have a personality type associated with it. After collection, the data will be used to find correlations between personality type and game preference.

4.4 Evaluation and Results

To evaluate the players personality I used the Big Five Factor Personality Test [John et al., 2008, John et al., 1991, Benet-Martínez et al., 1998], which is made up of the factors of openness, extroversion, agreeableness, conscientiousness, and neuroticism. People who score high in openness tend to be very creative and imaginative and are more curious than other people. People who score high in extroversion tend to be very talkative and active people who are generally more affectionate than other people. People who score high in agreeableness tend to be very kind, easy going and are more trusting than other people. People who score high in conscientiousness tend to be very well organized, punctual and hard working compared to other people. Finally people who score high in neuroticism tend to be more worried and have higher stress levels than other people [John et al., 2008, John et al., 1991, Benet-Martínez et al., 1998]. These scores were evaluated each on a scale between zero and five that was obtained by averaging their responses to each of the factors questions on the personality test that
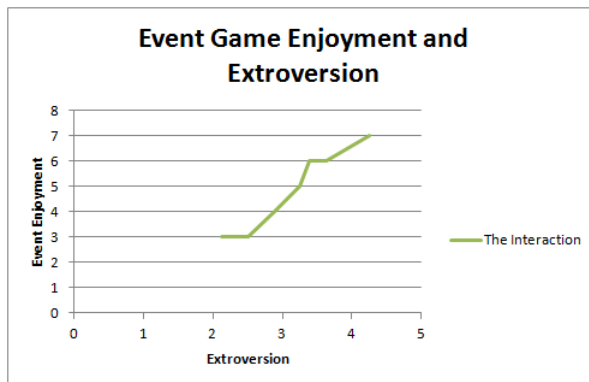

Figure 2: This chart gives a visual representation of the relationship between Extroversion and Event Adaptation Variant enjoyment scores

the participants completed. The survey responses were all on a likert scale between zero and seven ranging from highly unlikely/unskilled/unenjoyed to highly likely/skilled/enjoyed. The players total levels completed, number of ghosts eaten, and points scored were also computed for each game type. These values were all explored to find significant relationships between the variables.

Among the variables for personality factors, survey response, and in game data there were four main significant interactions that were identified. There was an effect of extroversion scores on enjoyment of the event adaptation variant ($r=.88$, $p¡.01$), such that the higher a persons score in extroversion the more they will enjoy the event adaptation variant. There was then an effect of neuroticism on enjoyment of the difficulty adaptation variant ($r=-.82$, $p¡.01$) such that the more neurotic the individual the less they will enjoy the difficulty adaptation variant. There was also an effect of player skill on enjoyment of the difficulty adaptation variant ($r=.68$, $p=.04$) such that the more skilled the player is, the more likely they are to enjoy the difficulty adaptation variant and such that more skilled players enjoyed the difficulty version ($M=6.2$) than the event version ($M=5.6$). Surprisingly, there was also an effect found of conscientiousness on enjoyment of the control version of Mrs. Pacman ($r=.78$, $p=.01$) such that people high in con-
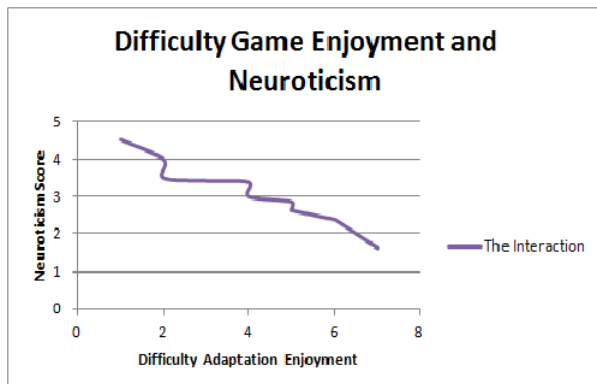
Figure 3: This chart gives a visual representation of the relationship between Neuroticism and Difficulty Adaptation Variant enjoyment scores

scientiousness were more likely to enjoy the control version than those low in conscientiousness. I found that the number of ghosts eaten did not have a significant correlation with any of the other variables despite the hypothesis that it would be significant. I found that Skill also had no correlation with overall game enjoyment scores. The results did, however, support the hypothesis that the adaptive game variants (M=5.8) would be more effective overall than the control variant (M=4.2).

5 General Discussion

5.1 Discussion

The research into video games is a constantly increasing field because of the possibilities it represents. Major areas of research in the field include what makes the games fun [Malone, 1982], how games can be used more effectively in education [Zea et al., 2009], and building adaptive game artificial intelligences [Spronck, 2005a]; among other exciting fields, including those in testing machine learning algorithms and training with new skills. These areas of research have shown a number of important aspects of video games including what makes them enjoyable, how to build adaptive game AI, and how mood and personality affect video game experiences.

It was found that video games are most effective when they engage the users self esteem, when they engage the users curiosity and when the user is challenged [Malone, 1982]. It was found that some of the most common types of adaptive game AI, due to how simple and effective it is, are ones that adapt the difficulty of the game to the players skill level [Spronck et al., 2003]. Using these aspects of previous research I decided to examine whether the type and personality of the player had an effect on which types of adaptive game AI are the most effective in improving game play enjoyment

In the current research, I used the Big Five Factor Personality Test [John et al., 2008, John et al., 1991, Benet-Martínez et al., 1998] and several versions of the simple open source game Mrs. Pacman to assess the relationship between personality and adaptive game AI preference. I had participants take the personality test, play the control version and then the adaptive difficulty variant and the adaptive event based variant in order depending on their participant number. The participants all answered questions of enjoyment, skill, and re-playability of each of the game types. I hypothesized that there would be strong correlations with personality and game type, and that conscientious and extroverted people will be highly likely to enjoy the difficulty adaptation, while only very agreeable and neurotic people would enjoy the event adaptation as much or more than the difficulty adaptation. This hypothesis was proven to be very off the mark by the data. The data most supported the assertions that extroverted people enjoyed the event adaptation variant the most, that skilled players would prefer the difficulty based adaptation, and that neurotic people would not enjoy the difficulty based adaptation due to its stressful nature.

The results from my study show some interesting relationships between game preference and player type. The results suggest that the most important factor in determining game satisfaction is the games inherent challenge. More skilled players were looking for something that challenged them and they found it in the difficulty adaptive variant. Less skilled players were already challenged and they enjoyed having a more storied and life like feel to the game because they were not as concerned with performing

well. The most significant factors of personality in determining game satisfaction were the extroversion and neuroticism factors. People who are more outgoing and affectionate, like the less skilled players as a whole, tended to enjoy the storied and life like feel of the event adaptation variant compared to those who were more introverted. People who were more stressed and tended to worry compared to other people were put on edge by the constant challenge of the difficulty adaptation variant and the more neurotic the individual the less likely they were to enjoy the difficulty adaptation variant. If one can determine what types of people are the common consumers for each game type such as RPG or shooter, then these factors can be used to adapt the way future games are developed so that they are more effective for their target audience.

5.2 Limitations

There were two great limitations of this study that make the results less compelling and powerful than I had wanted them to be. The first of these is that the results do not generalize very well because there were only fifteen total participants in the study and I used several different factors with a small standard deviation, meaning that the possibility of committing a Type-1 error was highly likely. With more participants it would be more likely that the study will find relationships between personality factors and game type enjoyment since there were a low variety of different peoples personalities that were tested here. With a larger sample of the population and a sample that is not specific to a college campus the results will more effectively represent the population as a whole and hopefully give more significant results. The second limitation was that the variance of answers on the satisfaction survey was very low. Nearly every score for enjoyment for each version was between 4 and 6, and with the exception of the control there was never less than moderate enjoyment of the game that was reported. In the future to get more significant interactions I would want to use a larger scale for game type enjoyment, which would hopefully result in more varied and specific responses for game type enjoyment.

5.3 Future Work

This research has a large number of directions that it could be taken in from here. As I previously stated, I would enjoy redoing this same study with more participants, a new satisfaction survey and more identifying information to find relationships between, such as age, gender, and years of game playing experience. More exciting directions for the research to go in from here includes using personality to determine what players should be marketed to for what games, using an in-game personality test to determine game play formats, and determining what types of players are the general consumers for different game types and then adapting those games to the personality of their audience. These are important avenues of research because they have a significant effect on the marketing and sales of the video game industry, which generates over forty billion dollars every year. Determining traits that make games more fun for specific users or finding ways to adapt the game to the users personality type can aid in making games more enjoyable as a whole. This specifically can be used to make educational games more enjoyable and effective for different personality types, giving the potential for increased use of games in the class room. I expect that the ability to adapt games to players personality types could and would lead to increased video game satisfaction and a greater range of consumers as a whole; because games would be more specific to the person playing them, it is likely that more people would be interested in engaging in video game oriented activities.

6 Conclusion

The fact that personality affects game type enjoyment is important because it supports the allocation of more funding and research into types of adaptive AI for video games. This would allow video game manufacturers to improve their marketing to specifically target the personalities that are most prone to enjoy their game. I explored how much personality can affect the user enjoyment of game play with an adaptive game AI and which personality types have

a preference for what types of adaptive game AI. The research showed that adaptive game AI improves the user enjoyment across the board, and that the personality factors of extroversion and neuroticism predicted which type of adaptive game AI the user enjoyed playing more. Extroverted people enjoyed the event based adaptation variant and highly neurotic people were put off by the difficulty based adaptation variant. My findings suggest that we are able to discover a preference for adaptive game AI types based upon the players personality type and that the type of adaptive game AI type that the player prefers can have a large amount to do with the skill of the player. These findings can improve marketing by targeting video game consumers for each game by their personality type and level of gaming experience or skill; which is important for insight into how best specific games should be presented to the public.

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