inFlow

Adapting Gameplay to Player’s Personality

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Júri

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Abstract

In this document, we present a videogame that adapts its content to the player. Such a game needs to infer the player’s type from his behavior, and then select how content is managed and presented to the player based on that type. In this work we focus on the later aspect, assuming we already know the player type. We also propose how such information can be used to enhance the player’s experience.

After revising the literature on the subject, we decided to use the Demographic Game Design (DGD) model as our player model. Therefore, before playing our game, the player has to fill a questionnaire to assess his Myer-Briggs personality type. From this questionnaire, the game classifies the player according to the DGD model. The game is then adjusted according to this player type, which will influence how the information of the game is presented to the player, in three main aspects: presentation, difficulty management and depth of control over aspects of the game.

To evaluate our approach, we asked different types of players to play our game under different conditions and evaluated the experience using a final questionnaire based on the GameFlow model. The evaluation suggests that the player enjoyment is higher when the game is using our framework to adapt to the player.

Keywords

Flow, Enjoyment, Adaptive game
Resumo

Neste documento, apresentamos um jogo que adapta seu conteúdo mediante o jogador. Tal jogo precisa de inferir o tipo do jogador através do seu comportamento e, em seguida, selecionar como o conteúdo é gerido e apresentado ao jogador. Neste trabalho vamos-nos concentrar no segundo aspecto, e assumimos que o jogo já sabe o tipo de jogador. Também propomos como essas informações podem ser utilizadas para melhorar a experiência do jogador.

Após revisão da literatura sobre o assunto, decidimos utilizar o modelo Demographic Game Design (DGD) como base do nosso trabalho. Portanto, antes de jogar o nosso jogo, o jogador tem que preencher um questionário Myers-Briggs para avaliar o seu tipo de personalidade. A partir deste questionário, o jogo classifica o jogador de acordo com o modelo DGD. O jogo é ajustado de acordo com este tipo de jogador, que irá influenciar a forma como a informação do jogo é apresentada ao jogador em três aspectos principais: apresentação, gestão da dificuldade, profundidade de controlo sobre os aspectos do jogo.

Para avaliar a nossa abordagem, pedimos a diferentes tipos de jogadores para jogar o nosso jogo sob diferentes condições, e avaliamos a experiência através de um questionário final baseado no GameFlow. A avaliação sugere que o divertimento do jogador é maior quando o jogo usa a nossa solução para se adaptar ao jogador.

Palavras-chave

Flow, Divertimento, Jogo Adaptativo
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1 Introduction
1. Introduction

1.1. Motivation

Modern games have evolved greatly in the past few years, with astonishing graphics, amazing sound effects, "flawless" character animation and so on. However, the research for maximizing the player's experience in videogames is still far away from producing a consistent model that can be used in most of the commercial games. This is a very hard feature to achieve, if not impossible, however some research has already been made to understand the player's motivations and experiences so that they can be used for a broader range of games, hopefully leading to more potentially optimal experiences.

Games should be fun to play. Eventually, they are condemned to lose its charm and the interest of the player, but by then the games should already have presented all of their key features. The problem is that many games stop being fun before they have the chance to do that. This happens because either the players don't like the challenges they are being given or they don't appreciate the reward the game is giving them for their effort. (Chen, Flow in Games (and Everything Else), 2007)

The experience a player has from playing a game is always different from another person that plays the same game. Each player is different, looks for different games and enjoys different things within the same game. In order to satisfy different types of players with the same game, the game has to be able to adapt to the preferences of the player. (Chen, Flow in Games (and Everything Else), 2007)

Keeping in mind that the developers and game publishers want the player to play the most of their game, there are a number of other ways in which adaptive games can be advantageous. For example, if the player is constantly losing in a section of the game, the game should detect it, and adapt itself to help the player not to fail – preferentially without the player knowing. Adaptive strategies can also be used to fight winning strategies. When winning strategies are found, the balance of the game is ruined because the players find it easier to succeed. Also, it leads to a lessened enjoyment for players because the challenge that they face is reduced and they are not encouraged to explore the full features of the game, however, players will often repeat a successful strategy over and over again because it leads to a predictable win, even if it is boring. (Charles & Black, Dynamic player modeling: A framework for player-centered digital games, 2004)
1.2. Objectives

- Create a game that has an high quality standard, and allows the player to feel immersed.
- Evaluate the game based on the premises of the GameFlow model. (Sweetser & Wyeth, 2005)
- Design a framework that can be incorporated in a game with the purpose of adapting the game to the preferences of various typologies of players.
- Implement the framework and connect it to the game.
- Measure the Demographic Game Design(DGD) Model type of the player and validate some of the assumptions of this model. The DGD Model classifies the player regarding it's player type, describing its preferences. (International Hobo Ltd., 2004)
- Validate the framework implemented in the game through user tests.

In sum, this research seeks to find a way to maximize the player's experience while playing a videogame. The main objective is to create a game that adapts to the player and leads him to the Flow state. The hypothesis for this study is that the automatic adaption of the game to the player’s preferences will have a positive impact on the enjoyment of the player.

1.3. Main contributions

- A new approach to game adaptation, using the personality of an individual as basis.
- The opportunity for the corroboration of some assumptions of the Demographic Game Design Model, with user tests.
- The chance to verify, in facto, the research made by International Hobo Ltd. In this work, the adaption of the game is made based on the premises of the referred study.
1. Introduction

1.4. Dissertation outline

In order to understand the player’s motivations into playing a game, it is necessary to understand what Flow is, what drives a player to enter, remain and exit the Flow state – the universal state of being involved in an activity where nothing else seems to matter.

In the Related Work section, we will describe the classical work of the psychologist Mihaly Csikszentmihalyi, by covering the topics regarding the flow state and its implications in life, optimal experiences, as well as the conditions that favor and obstruct those experiences. A comprehensive study of player models and its evolution will also be covered in the following section. These models are very important, and a basis to every game adapting technique because they allow for a classification and clustering of players. We will also discuss how flow can be achieved in videogames, and some adaptive game techniques regarding the state-of-the-art on this area.

After that, in the Architecture section, we will present the conceptual model of the solution, and detail how it was implemented.

To finalize the dissertation, we will discuss the methodology and results of this work, and finally, the conclusion that wraps up the solution to the problematic initiated in this introduction.
Related Work
2. Related Work

“Perseverance is probably the most important trait not only for succeeding in life, but for enjoying it as well.”

(Csikszentmihalyi, Flow, the Psychology of Optimal Experience, 1991)

2.1. The Flow State

2.1.1. Flow and Optimal Experience

In 1975, the psychologist Mihaly Csikszentmihalyi introduced the concept of Flow, the feeling of complete and energized focus in an activity, with a high level of enjoyment and fulfillment. (Csikszentmihalyi, Beyond Boredom and Anxiety: Experiencing Flow in Work and Play, 1975) Flow is a result of an extensive study, with several thousand respondents from several different cultures, in an attempt to define happiness. Flow can also be defined as an Optimal Experience, which is an experience that is considered good in accordance to our goals and usually results in a boost of self-confidence. (Csikszentmihalyi, Flow, the Psychology of Optimal Experience, 1991)

These experiences occur at the process of executing an activity that demands a high need of sustained attention. We can only channel attention up to a certain point, and when we are focusing all of our attention into a single activity, we are deeply involved with it, making us unable to think on anything else.

Flow is directly connected with happiness. If one does succeed in achieving true happiness, then it must have come with a great deal of optimal experiences. According to Mihaly, there is no direct route to a happy life; it will come naturally as a side effect of constantly seeking the flow state.

2.1.2. Flow, Pleasure and Enjoyment

We feel pleasure when our consciousness tells us that a biological/social goal is being fulfilled. Contrary to flow, pleasure, by itself, does not bring happiness. This is a fact that can be easily seen in our society. The improvement of external conditions like personal wealth or power gives us unlimited sources for pleasure, but we still can’t see a significant improvement in terms of optimal experiences, and, therefore, enjoyment of life.

Enjoyment is something higher than pleasure, and it is what flow tries to achieve. Pleasure is so easily attainable that it is still possible to be felt, even without the effort of focusing attention into an activity. On the other hand, we enjoy going to our limit to surpass a situation,
because we feel Flow in the process of doing such an activity, thus causing us to emerge with a stronger sense of self. (Csikszentmihalyi, Flow, the Psychology of Optimal Experience, 1991)

Csikszentmihalyi stresses the importance of the fact that enjoyment does not depend on what we do, but rather on how we do it, and rather if we feel flow or not. With this in mind, he defined the eight components that an experience should promote in order to produce flow.

- The enjoyable experience may occur when we are doing a task that we have a good chance of completing.
- We must be able to concentrate on what we are doing, or on other words, we must be able to focus our attention solely on the task, without obstacles in the way.
- The task at hand should have clear goals, either set by us or by the task itself.
- The task should have immediate feedback.
- The task should promote a deep involvement with the person that is doing it. This immersed state should be effortless, often making one forget about everything else that is not relevant to the task.
- The task should give us a sense of control over our actions.
- The concern for the self disappears.
- The task may cause an altered sense of duration of time. This is often associated with the deep involvement that one feels when executing a task.

2.1.3. Conditions of Flow

In Figure 1, we can see the relationship between challenges and skills. If our challenges are greater than our skill, we will be anxious to surpass them, which will make the most of us work harder, translating into a larger allocation of attention into this activity that will, eventually, increase our skills. This will shift the balance between skill-challenge, possibly pushing us towards the Flow Zone. The flow zone represents the area where the inherent challenges of the activity and the person’s skills are balanced. Although, given the same situation where our skills are surpassed by the challenges, some people will simply give up, and won’t be in flow in that activity.

On the other hand, if we have been doing an activity for too long, or if our skills surpass the needs of the given challenge, we will most certainly be able to achieve our goals, although we will be bored and will not be able to enjoy them. This feeling will motivate us to get new and harder challenges that properly match our skills.
2. Related Work

Figure 1 represents a model for the flow zone, and doesn’t illustrate the fact that Flow often occurs when executing an activity that demands above-average challenge. To face this problem, The Experience Fluctuation Model was created in order to explore the relationship – first suggested by Csikszentmihalyi – between perceived challenges and skills, on one side, and the overall quality of experience, on the other side. (Delle Fave & Massimini, 2005) By looking at Figure 2, we can easily see that the top-right half of the circle represents positive emotions and therefore is represented in green. Contrary to Figure 1, we also notice that this model is more permissive than the previous model. If we look at the “Content, Confident, Relaxed” area, we can see that it would correspond to boredom in the previous model, and this may be explained by the human capacity of finding implicit challenges within the task at hand, i.e., “If I’ve managed to do it, now I’ll do it faster and better”
As we have seen, flow is deeply connected with the each person's global view of himself and his experiences. This means that, in order to produce flow, we can only improve external conditions until a certain point, because in the end it is up to a person to really enjoy an activity or not. However, there are ways that can be used to promote the autotelic side of the self, especially in childhood.

An autotelic person is a person who is internally driven and doesn't need external motivation to define their goals in life. This type of person isn't motivated by money, fame, or power, or any other social factors. Basically, the application of the flow theory to a person's personality results in an autotelic personality, which allows this person to:

- Easily set new goals and challenges, never allowing confusion to enter in his mind. In this process, he will grow into a more complex and skilled individual.
- Be involved with any activity, being able to channel attention at his will, causing him to enter a state of immersion.
- Be aware of the environment and take control over it, by constantly giving attention to the activity, filtering the information retrieved from the world.
- Enjoy immediate experiences.
2. Related Work

2.1.4. Obstructions to the Flow State

There are two main obstructions for attaining the flow state: (Csikszentmihalyi, Flow, the Psychology of Optimal Experience, 1991)

*Internal reasons*

Psychically disordered people are unable to channel attention towards an activity. These conditions are often called ‘attentional disorders’ and are one of the main intrinsic obstructions to experiencing flow. The first signs can be seen at childhood, and when children show difficulty in learning, then it is likely they suffer from this condition and will have difficulty experiencing flow in their lives.

*External reasons*

Having a goal is a very important part for attaining flow; however, there are some external conditions that may handicap this ability. An example of this is a situation where we lack the rules to be objective, as it is the case of many people that can’t find a meaning to their lives after they are fired from their job. The opposite is also valid, even if we clearly know our goals, we may not have the chance to be concentrated on them, like waiting 10 minutes for a videogame to load.

2.2. Flow in Videogames

Videogames have taken a major role in the entertainment of today. It offers players the opportunity to learn while feeling good at it. Some studies already verified that games can indeed increase some physical and mental skills of an individual, as is the case of a study that verified that action games increase the reaction time of individuals that are in a situation of stress. (Green, Pouget, & Bavelier, Improved Probabilistic Inference as a General Learning Mechanism with Action Video Games, 2010) Another study by the same team, also verified that people who play games develop the natural ability to be totally focused and increase the concentration on a given task. (Green & Bavelier, Effect of action video games on the spatial distribution of visuospatial attention, 2006) Game designers understood the importance of games as a source of enjoyment and, as a result, started to design games that intentionally tried to include the eight components of flow experiences.(Chen, Flow in Games (and Everything Else), 2007)

As we have seen, flow depends largely on the sole will of an individual, and it occurs when our skills match the challenges that we are facing. In game design, this leads to a very large problem because it is very hard to encompass a game designing balance that appeals to a large audience. Usually, a game designer has a vision of what the expected experience is to be
like, and then tries to transform the design into a more user-oriented experience so that players actually feel what he is thinking. Even with that in mind, it is a fact that one person can have an utterly different experience when compared to another person that is playing the same game.

The first thing to worry about when designing a game is to make it user-oriented. In order to do that, we must know what users want. The research in this area is vast, and led to a definition of several player typologies, that try to classify gamers in different classes. (Bateman & Boon, 2005) Player models try to explain the player motivations for playing a game. One of the most basic models is the one who separates the players in terms of game genre preference. For example, there are gamers who enjoy puzzle games, others enjoy sports games, others enjoy strategy games, and so on. Then, the game industry noticed that there was a clear difference in the way that people played. From this fact, a model was created with the differentiation of the hardcore gamers from the Casual gamers. Hardcore gamers play games as a challenge and are well informed about the games and news in the game industry, also due to the fact that they buy and play many games. On the other hand, casual gamers only play as pastimes, therefore playing very few games.

Richard Bartle was one of the first to define a more detailed model of player typologies. Based on the Multi-User Dungeons that were played in that time, four player types were created: Socializers, Achievers, Killers, Explorers. (Bartle, 1996) Socializers enjoy learning and communicating with other players, whereas Killers enjoy manipulating other players. Achievers enjoy interacting with the game world, while Explorers enjoy manipulating it. Further findings suggested that players vary their playing style gradually over time. For example, a killer type may shift between killer and socializer, or it may cycle through all player types until he settles in socializer. (Bartle, 1996)

As means to improve the sales of their games, private game companies also started to define the market of gamers. Electronic arts devised a model that is a little different, which defined three types of players: Hardcore gamers, Cool gamers and Mass market casual gamers. By the same time, International Hobo defined a model that was similar to the one that EA presented, which also had 3 types of gamers: Hardcore gamers, Testosterone gamers and Mass market casual gamers (which was then divided in two, Lifestyle gamer and Family gamer). However, both models stressed out the importance of the hardcore gamers in the games industry, as they spread the word to their friends, influencing them to buy certain games. Both the cool gamers and testosterone gamers are influenced by their hardcore friends, and usually play the games that they suggest. Both the lifestyle and family gamers (casual) only seek the fun in games, and most of them consider the narrative important. They also defined that Family gamers are mostly parents who buy games for their children. The iHobo model made an
2. Related Work

interesting breakthrough in the casual sector, and identified the influence that children have on their parents. (Bateman & Boon, 2005)

In 2004, International Hobo created the Demographic Game Design Model after their initial model in 2000-2003. This new model was based on the Myers-Briggs Type Indicator for classifying individuals regarding their personality preferences. (International Hobo Ltd., 2004) Myers-Briggs Type Indicator (MBTI) dates from World War II, and is known and used worldwide, making this player model very interesting. (Myers, 1976)

Myers-Briggs types are based on four personal traits. Each person is rated by the following four bipolar dimensions:

**Table 1. The description of the four bipolar axis of Myers-Briggs.**

<table>
<thead>
<tr>
<th>Introversion (I)</th>
<th>Versus</th>
<th>Extroversion (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think then act</td>
<td></td>
<td>Act now, think later</td>
</tr>
<tr>
<td>Recharge alone</td>
<td></td>
<td>Recharge by socializing</td>
</tr>
<tr>
<td>Focus on their internal world</td>
<td></td>
<td>Focus on the external world</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensing (S)</th>
<th>Versus</th>
<th>Intuition (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live in the present</td>
<td></td>
<td>Live in the near-future</td>
</tr>
<tr>
<td>Use “common sense”</td>
<td></td>
<td>Like new approaches</td>
</tr>
<tr>
<td>Have rich memory detail</td>
<td></td>
<td>Find patterns/connections</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thinking (T)</th>
<th>Versus</th>
<th>Feeling (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decide logically</td>
<td></td>
<td>Decide emotionally</td>
</tr>
<tr>
<td>Focus on tasks</td>
<td></td>
<td>Focus on consequences</td>
</tr>
<tr>
<td>Act on ‘objective’ opinions</td>
<td></td>
<td>Act on subjective opinion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Judging (J)</th>
<th>Versus</th>
<th>Perceiving (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan then act</td>
<td></td>
<td>Plan as they go</td>
</tr>
<tr>
<td>Focus on single tasks</td>
<td></td>
<td>Multitask</td>
</tr>
<tr>
<td>Stay ahead of deadlines</td>
<td></td>
<td>Work best under pressure</td>
</tr>
</tbody>
</table>
This method for personality typologies was then crossed with the existing notions of hardcore and casual gamers:

**Table 2.** The difference between Hardcore gamer and Casual gamer.

<table>
<thead>
<tr>
<th>Hardcore Gamer</th>
<th>Casual Gamer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buys and plays many games</td>
<td>Buys fewer/popular games</td>
</tr>
<tr>
<td>Plays for long periods of time</td>
<td>Plays for short bursts of time</td>
</tr>
<tr>
<td>Enjoy challenge and skill building</td>
<td>Play for fun</td>
</tr>
<tr>
<td>Tolerate complex controls</td>
<td>Prefer simple, straightforward controls</td>
</tr>
<tr>
<td>Playing as a way of living</td>
<td>Plays to pass time/entertainment</td>
</tr>
</tbody>
</table>

Based on the survey analysis by International Hobo, four main player types were created using only the last two axis of MBTI. The number of each type is directly connected with the proportion of players they found in their research. These types are described below, with the respective personality combinations that are comprehended within each type.

![Image](image.png)

**Figure 3.** The four player typologies from Demographic Game Design Model.
Table 3. Description of the four player typologies defined in DGD Model.

<table>
<thead>
<tr>
<th>ID</th>
<th>Player Type</th>
<th>Axis</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1  | **Conqueror** | Thinking and Judging | ▪ The most important thing is to win.  
▪ They enjoy feeling in control, and be the ones that know everything there is to know about a game.  
▪ They continuously thrive to get stronger and better in the game world.  
▪ Many believe that the story of the game is not of great importance.  
▪ They like competing against themselves and failure only gives them a reason to try harder. (Hardcore – H1)  
▪ They enjoy beating other players. (Casual – C1) |
| 2  | **Manager** | Thinking and Perceiving | ▪ This type of players look for strategic and tactical challenges.  
▪ They seek the mastery of the game, but they may quit if it is too difficult.  
▪ Winning is somewhat non-important, but relevant when it is deserved.  
▪ A good story is important.  
▪ They enjoy open games (with no specific endpoint).  
▪ They enjoy devising new strategies to surpass their challenges, especially when failing. (Hardcore – H2)  
▪ They are usually less imaginative and prefer games that resemble reality. They have considerable lower tolerance to failure. (Casual – C2) |
<table>
<thead>
<tr>
<th></th>
<th>Wanderer</th>
<th>Feeling and Perceiving</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>They play for fun, not for challenge. The moment the game stops being fun, they stop playing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>They need constant feedback and new things to keep playing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The plot may be unimportant. They develop emotional links with characters.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>These players value story and setting above all else. They like to play with style, to see aesthetically pleasing feedback of their actions. (Hardcore – H3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The game must be absolutely easy for them, however, they also want to feel progress and a feeling of accomplishment. (Casual – C3)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Participant</th>
<th>Feeling and Judging</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Generally they only play games in a social context.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>They enjoy having the feeling that they’re part of the story.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>They like defining their own path in the story.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>They attach emotionally to characters.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>They favor collaborative games, where competition is secondary. (Hardcore – H4):</td>
<td></td>
</tr>
<tr>
<td></td>
<td>These players enjoy playing as part of a group. Either by cooperation or by competing in local multiplayer games (i.e. shared physical room). (Casual – C4):</td>
<td></td>
</tr>
</tbody>
</table>

As shown in this model, it is hard to design a game that is enjoyed by everyone. However, we can see clear differences in the way that people play, allowing us to focus our effort when we want to design a game for a certain type of public. If we look in a commercial perspective, it’s obvious that we always want to maximize customers and sales, and towards that end, adaptive techniques may be used to extend the target customers. It is also known that not all of the eight components of flow are needed to give users the experience of flow (Csikszentmihalyi, Flow, the Psychology of Optimal Experience, 1991), and given that a model is never linearly followed, some people may belong to a type of player but also enjoy traits from other player typologies.
2. Related Work

For gamers and game reviewers, one of the most important qualities a game can have is a high sense of immersion. We usually see metaphors related to immersion applied to games like a seal of quality, for instance, ‘Sucks you in’\(^1\). Immersion, as the name indicates, can be described as a loss of self-awareness from the real world and the feeling of being transported into the virtual world. Thereby, immersion can be a precursor of flow experiences. Its description resembles one of the eight major components of the flow model. The main difference when compared to flow is that a game may be immersive, but fail to provide flow experiences. (Seah & Cairns, 2008)

Brown and Cairns study resulted in a more rigorous approach for Immersion, which clearly identified three states: (Brown & Cairns, 2004)

*Engagement*

This is the lowest level of involvement with a game and to enter this level the gamer needs to invest time, effort, and attention. As we have seen, different players enjoy different game styles, and if the player doesn’t like the game, he won’t even try to engage with it.

If the game succeeds in engaging the player, he will become more immersed and lose track of time, which, in result, may cause a feeling of guilt. This feeling is due to the perception that time has passed too fast, and he could have done something else instead of playing. This can be countered by providing the player with rewards of success, which compensate for the invested time in the game and make it worthwhile. An example of these rewards are the achievements and trophies on the gaming consoles.

*Engrossment*

The gamer is already engaged to the game, and wants to keep playing. This is where he will begin to connect with the game at an emotional level, rendering his emotions directly vulnerable to the game. At this stage, the true quality of the game will be thoroughly tested. Visuals, plot, sound, attention to detail, everything will count to suspend the disbelief of the gamer, as he is directing more and more attention to the game and becoming less self-aware and less aware of his surroundings.

*Total Immersion*

In this stage, the game is the only thing that occupy the gamer’s thoughts and feelings.

\(^1\) [http://www.gamespot.com](http://www.gamespot.com): this phrase is often used by the game reviewers as a seal of quality, that indicate that the game is good. It can be found in games like Infamous(SCEA & Sucker Punch, 2009) and Metal Gear Solid 4(Konami & Kojima Productions, 2008), and many others.
The barriers to presence are empathy and atmosphere. Empathy represents not only the emotional attachment to a character, but also the feeling of belonging to that same place for a reason. For example, we may get attached to a character that is a dinosaur, but it is hard to see ourselves as a dinosaur.

Atmosphere is created with a combination of graphics, sounds, art, plot, etc. If we have a rich game atmosphere, a gamer needs to shift more attention in order to assimilate all the information he is given. The more attention and effort invested in a game, the more immersed a gamer can feel.

When talking about flow and immersion, it is almost impossible not to think about addiction. What is the difference between addiction and flow? And when does one become addicted? By looking at the components of flow, one may not be able to differentiate flow from addiction. Csikszentmihalyi gives a clear explanation why these states are different from each other. Addiction has a negative connotation, usually does not lead to a stronger sense of self, and sometimes it is actually the reverse. There are some cases where the experiences don’t even proportionate enjoyment, and these are usually the activities that end up controlling the individual. On the other hand, flow is considered a positive state of mind, created to be a catalyst for optimal experiences and learning to enjoy life.

It has been verified that immersion can lead to addiction, and indeed the degree of immersion while playing videogames is closely related to how addictive a videogame can be. (Seah & Cairns, 2008)

2.2.1. Flow and Game Literatures

Jones researched flow in games, and mapped the eight dimensions of flow as gameplay examples. This mapping serves as a basis that games can be flow-producing experiences, if designed correctly.

**Table 4.** Mapping between Flow Elements and Gameplay Features. (Jones, 1998)

<table>
<thead>
<tr>
<th>Elements of Flow</th>
<th>Gameplay Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task that we can complete</td>
<td>The use of levels in games provides small sections that lead to the completion of the entire task.</td>
</tr>
</tbody>
</table>
### 2. Related Work

<table>
<thead>
<tr>
<th>Ability to concentrate on task</th>
<th>Creation of convincing worlds that draw users in. The dungeons and labyrinths in Doom II help suspend your belief systems for a time.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task has clear goals</td>
<td>Survival, collection of points, gathering of objects and artifacts, solving the puzzle.</td>
</tr>
<tr>
<td>Task provides immediate feedback</td>
<td>Shoot people and they die. Find a clue, and you can put it in your bag.</td>
</tr>
<tr>
<td>Deep but effortless involvement (losing awareness of worry and frustration of everyday)</td>
<td>The creation of environments far removed from what we know to be real helps suspend belief systems and takes us away from the ordinary.</td>
</tr>
<tr>
<td>Exercising a sense of control over their actions</td>
<td>Mastering controls of the game, such as a mouse movement or keyboard combinations.</td>
</tr>
<tr>
<td>Concern for self disappears during flow, but sense of self is stronger after flow activity</td>
<td>Many games provide for an environment that is a simulation of life and death. One can cheat death and not really die. People stay up all night to play these games. It is the creation of an integration of representation, problem, and control over systems that promotes this.</td>
</tr>
<tr>
<td>Sense of duration of time is altered</td>
<td>Years can be played out in hours. Battles can be conducted in minutes. On the other hand, hours in a gaming session may feel just like a few minutes to the player.</td>
</tr>
</tbody>
</table>

Sweetser and Wyeth’s GameFlow was created as an evaluation tool for games, mainly to understand if a game is enjoyable or not. Similarly to Jones, this model creates a mapping between some elements of Flow and elements of game literature, however, GameFlow model is a more generic and formal mapping than the one represented in Table 4, and therefore much more useful as an evaluation tool for any game. In Table 5, there is a short version of the model showing the basic relation between the elements.
Table 5. Mapping between flow elements and the game’s player-oriented prerequisites. (Sweetser & Wyeth, 2005)

<table>
<thead>
<tr>
<th>Elements of Flow</th>
<th>Game Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task that we can complete</td>
<td><strong>The Game</strong></td>
</tr>
<tr>
<td>Ability to concentrate on task</td>
<td><strong>Concentration</strong></td>
</tr>
<tr>
<td>Games should require concentration and the player should be able to concentrate on the game</td>
<td></td>
</tr>
<tr>
<td>Task has clear goals</td>
<td><strong>Clear Goals</strong></td>
</tr>
<tr>
<td>Games should provide the player with clear goals at appropriate times</td>
<td></td>
</tr>
<tr>
<td>Task provides immediate feedback</td>
<td><strong>Feedback</strong></td>
</tr>
<tr>
<td>Players must receive appropriate feedback at appropriate times</td>
<td></td>
</tr>
<tr>
<td>Deep but effortless involvement (losing awareness of worry and frustration of everyday)</td>
<td><strong>Immersion</strong></td>
</tr>
<tr>
<td>Players should experience deep but effortless involvement in the game</td>
<td></td>
</tr>
<tr>
<td>Exercising a sense of control over their actions</td>
<td><strong>Control</strong></td>
</tr>
<tr>
<td>Players should feel a sense of control over their actions in the game</td>
<td></td>
</tr>
<tr>
<td>Perceived skills should match challenges and both must exceed a certain threshold</td>
<td><strong>Challenge</strong></td>
</tr>
<tr>
<td>Games should be sufficiently challenging and match the player’s skill level</td>
<td></td>
</tr>
<tr>
<td><strong>Player Skills</strong></td>
<td></td>
</tr>
<tr>
<td>Games must support player skill development and mastery</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td><strong>Social Interaction</strong></td>
</tr>
<tr>
<td>Games should support and create opportunities for social interaction</td>
<td></td>
</tr>
</tbody>
</table>

Cowley et al suggests in his paper that GameFlow has an unneeded extra game dimension representing Social Interaction, which was already implicit in the direct mapping between the original flow model and games literature. It is true that social experience can disrupt the deep involvement/immersion the player should feel in order to experience flow, and that some players don’t even value it as an important factor for enjoyment. (Cowley, Charles, Black, & Hickey,
2. Related Work

2008) However, studies such as Pereira *et al* indicate that a slight change in the Social Interaction can indeed make a difference in the overall enjoyment. In this study, chess players that played against a physically embodied robotic agent reported a higher enjoyment rate than those who played versus a virtually embodied agent. (Pereira, Martinho, Leite, & Paiva, 2008)

2.2.2. Adaptive Games

Developing a game that has different levels of difficulty is probably the most commonly used method for adapting a game for players with different levels of skill. This is usually done by asking the player which is his skill level, right at the beginning of the game. With this technique, players might be correctly placed in their flow channel (Figure 4). There are innumerous ways to apply the different difficulty in the game: using different behavior from the opponent non-playable characters (Charles, et al., 2005); limiting the access to resources such as life or ammo; creating additional puzzles, etc.

This type of system is one of the most basic, since it only receives the input from the player regarding his preferences. This is just a scratch on the surface of the possibilities for adaption that a game may offer. Asking a player of his skill can be disastrous because he may not be aware of his real skill. This is why some games devise strategies to help balancing the game according to the real skill of the player. For example, the highly acclaimed game Call of Duty: Modern Warfare 2, uses a training camp to test the skill of the player, and in the end of the training session, the game suggests a difficulty setting according to player statistics such as accuracy, total time, civilians killed, etc.

In Yannakakis and Hallam study, they try to create a metric model of the degree to which a child has ‘fun’ and enjoys the game they developed. (Yannakakis & Hallam, 2007) The game is played on a platform with 6x6 square tiles. During the game, different colored lights appear on the game surface and disappear sequentially after a short period of time by turning a tile’s light on and off respectively. The player has to step on top of the tile to turn off the light on that square, winning points. Each child played the game in two different settings: One with higher challenge and unpredictability of where the lights would light up, and other with less challenge and higher predictability of where the light was going to light up. They verified that children with faster response preferred the more challenging and unpredictable version of the game, whereas the lower response children preferred the less challenging and more predictable game, therefore concluding that this can be used to adapt the game in realtime. (Yannakakis & Hallam, 2007)

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2 [http://modernwarfare2.infinityward.com](http://modernwarfare2.infinityward.com)
Figure 4. Example of subjective Flow Channels. (Chen, Flow in Games (and Everything Else), 2007)

The recent installment by id Software\(^3\), Quake-Live, requires a player to register on the website in order to be able to play for free. After the registration, each user is required to enter in a portal, out of three portals available: Beginner, Intermediate, Expert. You have the Beginner portal available at start, but in order to reach the Intermediate portal, you have to perform a Rocket Launcher jump, which only a quake familiarized player should know. For the Expert level, you have to make a series of fast jumps in order to reach the portal in time, and only an expert player of Quake 3(id Software) should be able to do it on time. After you enter the portal, you have to duel a non-playable character. If, for some reason, an expert player happens to enter in the beginner portal, the opponent AI will re-classify the player as he plays and automatically adjusts the difficulty setting in order to correctly face the player’s skills. This process serves as a trial in order to match the real players by their skill, creating more balanced games.

An approximation of this technique has been used on other games and studies. For example the Auto-dynamic Difficulty is a adaptive game system that retrieves several metrics from the player’s performance. Using that information, this system adjusts many attributes in the player’s character and the other non-playable characters, to make the game harder or easier. In their study, they also suggest that the dynamic modification in the level design might also be relevant for the successful adaptation of a game. (Bailey & Katchabaw, 2005) The system

\(^3\) [http://www.idsoftware.com/](http://www.idsoftware.com/)
2. Related Work

functions in a framework that is similar to the one represented in Figure 5. (Charles & Black, Dynamic player modeling: A framework for player-centered digital games, 2004) Bailey & Katchabaw also stressed the fact that a simple testbed/mini-game might not be enough for testing an adaptive game system, and it is necessary to have a complete gaming experience to fully explore the results of the adjustments. (Bailey & Katchabaw, 2005)

Dynamic Difficulty Adjustment is a probabilistic game adaption system, that uses the performance of the player to calculate the transition probabilities between game states. This game system is designed to keep the player in the flow channel by encouraging certain states, and discouraging others. Effectively, the goal is to keep the players in engaging interaction loops, for the most appropriate period of time, given their level of overall skill and game-specific experience. (Hunicke & Chapman, 2004)

Another technique that allows for the game to be continuously adapted to the player type, is by giving different paths from which the player may choose from. These decisions may come in form of distinguished paths in the physical world, where one is shorter and harder, or longer and easier; different moral choices, which usually leads to different courses in story line and ending; creation of side quests that help the player gain skills to face harder challenges in the game, etc. (Figure 6)

This tree-like directed graph (Figure 6) is a traditional representation of the story decisions of a storytelling game, which is made long before the release of the videogame. Considering that a videogame is a highly interactive application, especially if it is a storytelling game, the game should take the opportunity to retrieve information from the player and adapt to him. Thue et al developed an interactive storytelling system (PaSSAGE) that uses dialogues to
automatically learn the player's preferred style of play, and then uses those preferences to dynamically select the content of the game. The game has different types of quests that can be offered to the player depending on his preferences. Results from this study indicate that adapting the game based on (supposed) player preferences can increase the enjoyment of playing a computer role-playing game for certain types of players. (Thue, Bulitko, Spetch, & Wasylishen, 2007)

![Figure 6. The graph of different paths. (Chen, Flow in Games (and Everything Else), 2007)](image)

In some cases, adaptive systems can also be a trouble if they are not made carefully. The award-winning The Elder Scrolls IV: Oblivion (2K Games & Bethesda Software) had a simple adaptive game system that caused the enemies to be at the same level of the player's character. Usually in a RPG game, if we fail at a boss encounter it means that we need to gain more experience and skills in order to defeat him. In Oblivion, the entire world evolves at the same rate as the player. This means that the next time you retry a previous failed boss encounter; the boss will also be stronger. In top of this, the game had some level design problems which allowed players to finish the game in less than 5 minutes. This situation is only possible because when the game starts all enemies are also level 1, and this is why the player is able to progress against supposed high-level enemies and finish the main story quest.

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4 [http://elderscrolls.com/games/oblivion_overview.htm](http://elderscrolls.com/games/oblivion_overview.htm)

5 Here are two ways of completing oblivion in less than 5 minutes:

[http://www.youtube.com/watch?v=ioKyj-EK3P0](http://www.youtube.com/watch?v=ioKyj-EK3P0) (PC version, disabling collision)

[http://www.youtube.com/watch?v=pwKtkTtmb-o](http://www.youtube.com/watch?v=pwKtkTtmb-o) (X360, making a staircase of paintbrushes)
2. Related Work

2.3. Summary

In this section, we presented the work of Mihaly Csikszentmihalyi regarding the flow state – the feeling of complete and energized focus in an activity, with high level of enjoyment and fulfillment – and how the challenges given by an activity relate with the skills of the individual, and that flow stands in the equilibrium between both variables. Then, we discussed how flow influenced videogames over the years, and the important role it plays nowadays. Games should be fun, and flow is all about optimal experiences, fun and enjoyment. (Csikszentmihalyi, Flow, the Psychology of Optimal Experience, 1991)

The notion of fun is not the same for everyone. The creation of player typologies represented a significant breakthrough in the games industry, as it allowed for the classification and segmentation of players. We analyzed several player models that defined different segments and tried to approximate the preferences of those player types. The most important for this dissertation is the Demographic Game Design Model. As we have seen, this model defines four player typologies (Conqueror, Manager, Wanderer, Participant) by using the last two bipolar axis of the Myers-Briggs Type Indicator (Thinking-Feeling and Judging-Perceiving), and also defines the gaming preferences for those four types. (International Hobo Ltd., 2004)

After this, we stressed the importance that Immersion has in the enjoyment of a game. (Brown & Cairns, 2004) We also spoke of how the GameFlow model was created, based on flow theory, to serve as an evaluation tool for games. With this model, it is possible to infer the game’s propensity to enjoyable experiences – and flow. (Sweetser & Wyeth, 2005)

Finally, we covered some topics regarding techniques for adapting games. The most common method for adapting a game is the inclusion of different levels of difficulty. Yannakakis & Hallam developed a game that analyzed the performance of the player(response time), and concluded that the game could be successfully adapted by using this variable in real-time. (Yannakakis & Hallam, 2007) A different approach to game adaption is by retrieving information about the player from his choices in dialogues. PaSSAGE is an interactive storytelling system that analyzes the responses of the player and automatically selects which quests are best suited for the player. (Thue, Bulitko, Spetch, & Wasylishen, 2007)

In the following section we will specify our approach to the game adaption, starting with the conceptual model. After that, we will describe how the solution was implemented and connected to the game we developed.
3
Architecture
3. Architecture

3.1. Conceptual Model

As we have seen in the previous section, there are many ways in which a game may be adapted. In this section, I will describe a possible solution that has the purpose of being integrated in a videogame. This solution is responsible for collecting information about the player, and transform it into usable knowledge, and adapt the game to try to stimulate the player’s transition into the flow state.

The solution is composed of two main components: Offline and Online.

**User model component (Offline information)**

In this context, offline means that the information in this component is always available and ready to be accessed. This component serves as a knowledge base, in which the Online component of the solution can rely to fetch information about the player’s typologies, their preferences, and metrics for distinguishing the player between these typologies.

As discussed in the related work section, many studies have already been made to identify the different types of players and their corresponding preferences. Some players prefer the main story, others prefer the component of character development, others prefer the social component, and others prefer knowing everything of the game. This component is based on the study that originated the Demographic Game Design Model(International Hobo Ltd., 2004) and the classical work that led to the creation of the Myers-Briggs Type Indicator(Myers, 1976), and allows for the creation of a knowledge base with the following requisites:

![Figure 7. The Solution's Overview.](image)
- Information about the four bipolar axis that classify an individual regarding his MBTI Personality Type.
- Information that allows for a correlation between the MBTI Personality Type of an individual, and the preferred player typology defined in the Demographic Game Design Model.
- Information regarding preferences of each player typology, also defined in the Demographic Design Model.

In order to move to the core of this adaptive system, we must have a knowledge base with the requisites that were presented above, plus the standard requisites for any consistent database. Naturally, for the solution to work we need a solid background, so that, in general, the solution can be fast, effective, robust and efficient. (Spronck, Sprinkhuizen-Kuyper, & Postma, 2003)

**Game tuning component (Online information and adaption)**

In this part of the solution, we have five states that function in a cycle during the execution of the game. These states are listed and described below:

- ‘Retrieve player data and performance’: When the game starts, this may be the starting point of the cycle. This state is comprised of a learning module that takes advantage of the highly favorable platform for learning: the game itself. With this, the player’s performance can be tracked, classified and analyzed. The collected data may also include actions performed by the player, which is continuously saved for further analyzing.

- ‘Situate player in Experience Fluctuation Model (EFM)’: In this state, the goal is to approximate the player’s experience while playing the game. In Figure 2 we can see the intersection between challenges and skills, and allows for the inference of the player’s feeling. A rough approximation of the model can be achieved only by analyzing the player’s performance in a certain situation. More advanced methods for extracting information may be used to increase the significance of the approximation, such as measuring the skin impedance and perspiration.

- ‘Re-define player personality’: When the game has sufficient data, this module will try to approximate the player’s personality based on the analysis of the collected data. This approximation is based on the concepts of the Myers-Briggs survey, and requires a correlation between the survey and the behavior the player may have. The concept is to apply the Myers-Briggs survey implicitly, instead of explicitly
3. Architecture

asking the questions. Basically, what this module does is detect the behavior patterns on the data collected automatically by the game.

- ‘Re-assign player type (DGD) and preferences’: Once the system has the approximate personality of the player, the preferred player type can be inferred by checking the knowledge base present in the offline component. The mapping between each Myers-Briggs Type Indicator and the player typology is described in the section 2 of this document. At this moment, the game gains access to the supposed preference list of the player and is ready to advance to the next state, the adaption of the game.

- ‘Adapt game according to player type preferences and state in EFM’: At this point, the system has all the information it needs to complete this cycle. The system knows what content and challenges to give to the player, based on his personality and his player preferences, and it also knows how to balance the game, by analyzing the player state in EFM.

In sum, the most important thing in this section is the capability of learning from the actions of the player, and transform those actions into usable knowledge. In another work, Thue et al explicitly asks the player about several key subjects that influence the player’s model. (Thue, Bulitko, Spetch, & Wasylishen, 2007) In our solution, we propose a different approach that learns by monitoring the behavior of the player, and then approximates a personality based on that behavior. The game presents several challenges to the player that can be done in different ways. The player may see – or not – the choices he is given to solve a situation, however he is not asked explicitly to take a given action, contrary to dialogues where you are forced to think logically and answer in a more controlled manner. This information is useful for inferring the personality of the player, which later can be used to select the content of the game, based on the preferences of the individual. Also relevant to the adaptive system is the information regarding the performance, because it helps weighting the referred preferences of the player, and regulate the Artificial Intelligence with the appropriate skill level. Moreover, it also helps to situate the player in the Experience Fluctuation Model, so that the game has an idea of the player’s current game experience, and what can be tuned to change it.

Next, we will present the platform and the main concepts about the game we created to be the testing platform for this solution.
3.2. Platform

In the beginning, the idea was to create a simple game, with simple mechanics and graphics, which adapted to the player's personality. However, we considered it pertinent to evaluate the feasibility of this work in a game that with an high standard of quality and complexity.

For this reason, we started considering several platforms in which to base our game, including: Unity3D, Microsoft XNA, Unreal Development Kit (UDK). We ended up choosing UDK, a very powerful engine with several state-of-the-art tools, such as a visual level editor, and several other modules to create particle effects, materials, sounds, animations, cutscenes, etc. (Epic Games Inc., 2009) This engine has the advantage that it can create games for several distinct gaming platforms, and was already used to create several of the best and most popular games in the market. In this list figure names such as: Gears of War (Microsoft Game Studios & Epic Games, 2006, 2008, 2011), Mass Effect (Microsoft Game Studios & BioWare, 2007, 2010, 2011), Batman: Arkham Asylum (Eidos Interactive & Rocksteady Studios, 2009), BioShock (2K Games, 2007, 2010), the new Medal of Honor (Electronic Arts & Dice, 2010), and much more.6

3.3. Game Concept

Figure 8. Grim Business Logo.

Grim Business7 is the name of the game we created to be able to test the proposed solution. In the game, you shoot your way through enemy packed levels using a top down 360°


[7](http://grimbusiness.webs.com/)
3. Architecture

shooting with futuristic action scenes. You have three types of weapons at your disposal: Chainsaw, Sub-Machine Gun and a Shotgun. You also possess a flashlight which allows you to find your way and aim your shots on darker levels. The game was inspired by the increasing violence and gore thematic.

Figure 9. Screenshot of gameplay.

In the game, the player takes control of Lt. Darren Fletcher, a retired operative looking to avenge his family. The main objective is to kill everyone, plain and simple. The player possesses three distinct weapons: Chainsaw, Sub-Machine Gun, Shotgun; as well as a flashlight, and the ability to use two powerup items. As we can see in Figure 9, the camera is not completely top-down, but something between third person camera and top camera. The only limitation in movement is that the player cannot aim upwards or downwards. However, in a case where the enemy is on an higher plane than the player is, the game automatically adjusts the aim up or down, to hit the desired enemy. In the figure below, we can see the controls, which we tried to keep simple and intuitive.
For the testing of our solution, we designed and created a straightforward level. In the beginning of the level, the player has the opportunity to familiarize with the controls and has the first contact with a pretty harmless enemy, where he can test his weapons. After that, the player has to walk through a thin bridge that requires some expertise in the controls. The player then starts to see a camp with some enemies engaging in their daily affairs. The player’s objective is to kill everyone in this camp and escape the base alive. The crescent number of enemies and emergent chaos gives the opportunity for the player to learn the gameplay mechanics in a steady curve. After he kills everyone in the base, he must escape the base. The player has to venture through dark woods where enemies are lurking in the dark. The flashlight plays a crucial role in this part of the level, as it allows for early detection of the sneakier enemies. Finally, when the player reaches an illuminated area, he may be tricked by the safer looking ambiance, but a large scale ambush is waiting for him. If the player survives, he successfully completed Grim Business.
3.4. **Implementation**

In this section, we will explain the process of implementation, how the process was managed and why some of the choices were made.

After devising the solution’s architecture, it was clear that there were several difficult challenges to be undertaken:

- Create a game from scratch that tries to reach the high standards of quality imposed by modern games.
- Create a mapping between the Myers-Briggs Type Indicator Survey and corresponding Actions that can be executed and analyzed in gameplay. This approach of automatically detecting the player’s personality is a difficult route to take, and needs to be validated with user evaluation.
- Implementation of a module that manages and changes content in the game, depending on the personality of the player. This also needs to be validated with user tests.

After the game was ready for the next phase of the solution’s implementation, a choice needed to be made. Due to the limited time for implementing the solution, the decision was either to implement the second point or the third point of the list above. We decided to focus our efforts on the third component, while using a static and reliable method for collecting the personality of the player, i.e., by presenting a verified Myers-Briggs Type Indicator Survey. (Larson, 2005) This means that in this first implementation of our work, the game’s perception of the player’s personality is static and does not change over time. This fact is important because a player can By starting our implementation upside-down, we can perform a preliminary verification of the feasibility of the work. Even if we had the time to implement all the work proposed in the solution’s architecture, the implementation had to be split in two, and then tested individually.

Throughout this section, we will not address details on the implementation of the game itself, given that it is not the focus of this dissertation. However, it is important to have the notion of the game mechanics, and the overall gameplay and challenges. By looking at the Demographic Game Design Model preferences for each player type, we determined a set of variables and content that may change depending on the personality of the player. In the following table we can see the overall changes of the game, depending on each player type.
Table 6. Overall game changes depending on the player typology

<table>
<thead>
<tr>
<th></th>
<th>Conqueror</th>
<th>Manager</th>
<th>Wanderer</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Presentation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Story</td>
<td>None</td>
<td>World-oriented</td>
<td>Character-oriented</td>
<td>Character-oriented</td>
</tr>
<tr>
<td>Objectives</td>
<td>General + Specific</td>
<td>Exploratory</td>
<td>General</td>
<td>General</td>
</tr>
<tr>
<td>Misc</td>
<td>--</td>
<td>--</td>
<td>Kill Cam</td>
<td>Different Paths</td>
</tr>
<tr>
<td><strong>Difficulty</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enemy Difficulty</td>
<td>Hard</td>
<td>Normal</td>
<td>Easy</td>
<td>Easy</td>
</tr>
<tr>
<td>Starting Weapons</td>
<td>Chainsaw and SMG only</td>
<td>All with low ammunition</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Death Punish</td>
<td>Yes</td>
<td>Yes</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammunition</td>
<td>Buyable only</td>
<td>Buyable only</td>
<td>On the floor only</td>
<td>On the floor only</td>
</tr>
<tr>
<td>Powerups</td>
<td>Buyable only</td>
<td>Buyable only</td>
<td>Automatic</td>
<td>Automatic</td>
</tr>
<tr>
<td>Shop</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

From Table 6, five main modification points may be identified:

- **Story**
  - General difficulty – the modification of enemy difficulty, starting weapons and death punish, all contributes to the general level of difficulty of the game.

- **Objectives**
  - Resource Management – the modification of how upgrades and powerups are given, how ammunition is managed, all contributes to the resource management. This is one of the main and most significant modifications in the game.

- **Miscellaneous** – this includes the incorporation of a special killing camera that focuses the dying enemy, and the different physical paths in the level.
3. Architecture

3.4.1. Story

To adapt the story, we looked at the preferences for each player type in the DGD Model and decided the following:

- Conqueror: Disable the story. The DGD model clearly states that most of these players don’t value the story.

- Manager: Most of these players value a world-oriented story. They enjoy stories that engulf the player into a world full of detail and scale. Rather than knowing what makes the character move, it is more important to know what is happening in the world that requires the character to move with it.

- Wanderers and Participant: According to the DGD Model, these players develop emotional links with characters, and they enjoy character-oriented stories. This type of story focuses on the feelings of the characters, and its goal is to make the player identify himself with the character.

We developed a story manager that dynamically changed the content of the story depending on the player type. In the figure below, we can see an example of the character-oriented story(left) versus the world-oriented story(right). The full script of each story can be seen in Appendix C, in the page 79 of this document.

![Figure 11. Story comparison. Character-oriented(left) and World-oriented(right).](image-url)
3.4.2. General Difficulty

One of the most important factors for differentiation in the DGD Model is the difficulty. Each player type enjoys different settings in the overall difficulty of a game.

The Artificial Intelligence used by Grim Business agents was completely developed by us, and consists of the union between a reactive AI and a deliberative AI – an hybrid architecture.

Below, we can see the rules used by the reactive AI, which clearly identifies three states: Attack, Hold and Patrol.

1. Sees the player alive* → Attacks player.
2. Sees player dead* → Stop shooting; Start patrol.
3. No longer sees player* → Stop shooting; Start patrol
4. Reaches patrol node* → Moves to the next patrol node.

The deliberative AI is a bit more complex than the reactive AI, and consists on the execution of the following cycle:

- **Update Beliefs**: This function retrieves the agent perceptions of the outside world and converts them into the agent's beliefs – the symbolic representation of the world.

- **Options**: This function generates a list with all the current desires of the agent, based on his current beliefs. After this, the priority desire is selected from this list.

- **Filter**: Using the selected desire achieved in the previous function and the beliefs that the agent has the world, this function generates a list with all the intentions that can contribute to the satisfaction of the desire. Finally, a intention is selected with the highest preponderance to the fulfillment of the desire.

- **Build Plan**: This function of the cycle serves as a manager of the state machine of each agent. Each state has an associated intention, and define a plan to be generated and executed for the current situation. Some states run once and terminate, while others auto-update by generating a new plan (and execute it) in each cycle of the state.

When linked together, the reactive architecture has priority over the deliberative architecture, which does not execute when the reactive AI reaches an important decision. This takes advantage of the rapid processing of the reactive AI on certain situations, and the ability to generate more complex plans by using the deliberative AI.
3. Architecture

On top of this AI, we also incorporated the ability for them to communicate with each other, based on a squad system. Each agent has the ability to call for help and order a teammate to flank the player when in combat.

Given this, we had total freedom to change the difficulty of the enemies. In result, we created three different settings for the enemies:

- Hard: The enemies use the hybrid AI described above and are organized into squads. Each enemy has the ability to communicate with his teammates, which creates a feeling of chaos in the level. Once the player is spotted, they won’t stop coming unless they lose track of the player. Each enemy will try to flank the player for maximum effectiveness.

- Normal: In this mode, the enemies are much more pacific than in hard mode, since they don’t possess the ability to communicate between them. The beliefs that they have are their own, which lowers the emergent chaos that happens when enemies called for help. However, they are still able to listen and see the player, and won’t rest until they get him.

- Easy: In this mode, enemies have their life reduced to 75% of the normal value, and they are moderately less accurate than in normal/hard. Except for these details, the other features mentioned for normal/hard still apply.

Other factor that also contributes to the general difficulty of the game is the way that player’s deaths are punished. To reflect the preferences of each player type, Conquerors and Managers are punished when they die, while Wanderers and Participant aren’t. Given that both Conqueror and Manager have manual resource management through the shop, the punish each time the player dies is: loses half his money; loses half his ammunition; his money multiplier returns to the initial value.

Yet another factor that influences the difficulty of the game is the amount of ammunition that is given to the player at the start of the level. This is a major factor in the beginning of the level, because it is much harder to kill with the Sub-Machine Gun, and even more with the Chainsaw, than with the Shotgun. A player that starts without a shotgun has a much lower survivability and is probable to die more easily if he isn’t careful. A detailed description of the three different weapon setups, with the corresponding ammunition for each ammo, can be found in the Appendix C, in the page 79 of this document.
3.4.3. Objectives

For the adaption of the objectives, we created three types of objectives:

- Georeferenced objectives: These objectives must be completed so that the player can advance in the level and complete the game. These objectives may also be known as “georeferenced” objectives, since they show up in the minimap as a cross and in the game world as a large blue beacon. An example of this objective would be “Reach the Inner Base”, where the point where the objective can be completed is clear, and can be shown in the minimap and in the game world.

- Plain objectives: These objectives must be completed so that the player can advance in the level and complete the game. These are plain objectives and require the understanding/exploration of the objective so that it may be completed. An example of this objective would be “Kill Everyone”, where there is no specific point for completing this objective.

- Specific objectives: They are secondary and serve as a bonus challenge for the player. These objectives may also be known as accomplishments, which rewards players with an item for their efforts. An example of this objective would be “Kill 30 enemies with the chainsaw”, which would then reward a player with an item, and a special badge.

The specific objectives are specially tailored for the Conqueror players, whom enjoy challenges and to be in control of the game. These objectives require the mastering of certain aspects of the game, which is supposed to attract the attention of these players. The Georeferenced type of objectives (shown below) are much easier to detect, and their purpose is to try to minimize the occasions where the player doesn’t know what to do, or where to go. Wanderers and Participant lose interest in a game that doesn’t provide feedback about the progression, and not having clear objectives at all moments is one of those factors. On the other hand, Managers enjoy exploring and finding things by themselves, which is why plain objectives are much more appellative to this type. A complete list of objectives can be found in the Appendix C, in the page 79 of this document.
3.4.4. Resource Management

This is probably the modification with more impact in the game. The way that the ammunition, upgrades and powerups are managed completely change the experience of the game. By shifting the control from the player to the game, we have two differentiated ways to manage the resources:

- **Manual** (left): The player gains money by killing enemies. The more enemies the player is able to kill without dying, the more he receives for each kill. The player then has the responsibility to manage his money, and to choose where to spend it. The buying strategy influences the playing strategy and vice versa. The different items are divided into three sections: Weapons & Ammo (Shotgun and Sub-Machine Gun); Upgrades (Bonus Regeneration and Improved Flashlight); Special Care (Double Damage, Adrenaline Rush, Ultimate Strike). The player may see the detailed description of each item, the price and the current money inside the shop. The player may access the shop anywhere on the map, and while the player is buying, the game is paused. A full list of the items can be seen in Appendix C, the page 79 of this document.

- **Automatic** (right): The game takes full control of the resource management. Each enemy that the player kills has a 75% chance of dropping a random amount of ammunition for the Sub-Machine Gun or the Shotgun. In truth, the money system
still works behind the scenes, and the game uses that to know when to reward the player with the upgrades and items. The game starts by giving the health and flashlight upgrades to the player, and then starts to give a random powerup every time the player has the money for it. We verified from diverse gaming sessions with users, that by giving the upgrades first, the player benefited for an higher rate of survivability throughout the rest of the level.

Figure 13. Resource management comparison.

3.4.5. Miscellaneous

Although Wanderers and Participants have different preferences in the DGD Model, the preferences of the Participants are much more social than the rest. Because this game is single player, social components are much more difficult to change. So, for our testing, Wanderers and Participants are much alike and these changes/additions were the solution to disengage the two types from each other.

- Slow-motion Kill Camera: On a 10% kill basis, the game automatically applies slow motion for 2 seconds and shows the enemy dying up close. Adds incredible depth to the game, given that the regular game camera is a far-away third person camera.

- Different paths: The player has the option to choose between physical paths in the game world to advance in the level. Depending on the path that he chooses, the number of enemies may vary. For instance, if the player chooses left, he will face a more obscure path with less enemies, however, in the end he will have to fight two
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enemies that have more health than usual. On the other hand, if he chooses the regular path, he will have to face more enemies, but will have no surprises. The player is free of returning back to where he chose one path, and decide to experiment the other one.

Figure 14. The stylish slow-motion kill camera!
3.5. Summary

In this chapter, we have seen the full extension of the proposed architecture, with detailed information about each of its components. The solution includes two main components: offline and online component. The offline component plays the role of a static knowledge database with the information regarding the classification and preferences of each player type, based on the DGD Model. The online component retrieves and analyzes information regarding the player, and tries to infer the personality of the player. This personality is used to classify the player regarding his type in the DGD Model. The game system retrieves the preferences of that player type from the offline component, and uses that information to adapt the game.

Following the explanation of the model, we introduced the game that we developed to be the test platform for this solution: *Grim Business*. This game was developed in Unreal Development Kit and consists of a top-down shooter that explores the intense gore thematic, where you control a man seeking his revenge on his enemies. The main objective is to kill everyone that stands in his path, and survive in the end.

We have also seen the detailed process of implementation, where we explain how the game adapts to each player typology. There are three main categories that were explored for the adaption of the game: Presentation (includes adapting the story, the objectives and other the incorporation of other special features, like a slow-motion kill camera); Difficulty (which includes adapting the enemy AI, the player’s starting resources and the way that player’s deaths are punished); Control (which includes incorporating an automatic system to manage the items and rewards that the player gains, or allowing the player to choose what to do with the money he gains by killing enemies).

The next chapter will start by detailing the methodology followed to testing our solution. After that, we will report our results, and analyze them.
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4 Evaluation
4. Evaluation

4.1. Methodology

The idea for the verification of the hypothesis was to select a representative population for each four player types, and then randomly split the sample in two groups. The first group experiment the game with the game adapting to his player type, while the second group played the game adapted to a player type that was not his. Each participant was asked to fill in a survey with 34 dichotomous questions, which enabled for the preliminary inference and classification of each individual. This survey was created and hosted in Google Docs\(^8\), and can be seen in more detail in the Appendices section, in page 74 of this document. In addition to the survey, we had to create a script that on each form submit, we would instantly and automatically receive the resulting player type(Conqueror, Manager, Wanderer, Participant) of the respondent. For the purposes of retrieving the player type, we only needed the questions regarding two of the four axis(Thinking-Feeling and Perceiving-Judging) of the Myers-Briggs Type Indicator. The questions and their respective factors were retrieved from the Larson study, which verified this questionnaire with over ten thousand tests. (Larson, 2005)

After this first evaluation, the next step was to try the game. The game was then set up in a isolated environment, with high quality headphones and a gamepad, giving the player the opportunity to focus completely on the game without external distractions. Before each participant started playing, we would explain the basics about movement and character controls. At this point, we would select the test group for this participant, and he would either experiment the game that tried to satisfy the preferences of his personality, or play the game that did the “opposite”. In this context, opposite is not in the full sense of the word, since the adaptations are not necessarily opposed. However, we identified that the changes between the first two types(Conqueror-Manager) and the second two types(Wanderer and Participant) are the nearest to opposite, as can be seen in Table 6. The following table shows for each player typology the corresponding opposite.

---

\(^8\) https://spreadsheets.google.com/viewform?hl=en&formkey=dHJYTExMLVdxS1d2NEtzR1dlbk0wSiE6MQ#gid=0
Table 7. Mapping of the opposite types.

<table>
<thead>
<tr>
<th>Type</th>
<th>Opposite Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conqueror</td>
<td>Wanderer or Participant</td>
</tr>
<tr>
<td>Manager</td>
<td>Wanderer or Participant</td>
</tr>
<tr>
<td>Wanderer</td>
<td>Conqueror or Manager</td>
</tr>
<tr>
<td>Participant</td>
<td>Conqueror or Manager</td>
</tr>
</tbody>
</table>

Each playing session lasted for 15~20 minutes, depending on the pace of each player. During the test session the game produces detailed logs of the player’s performance. the following information can be found in these logs:

- The moments the player takes damage, and where.
- Number of times the player dies, how, when and where.
- Each hit with each weapon, when and where.
- The times the player is near-death, and where.
- The accuracy and number of kills for each weapon.
- The preference for each weapon, in percentage.

After the testing session, each player was required to fill a final feedback form, that can be seen in the Appendices section, page 78 of this document, and also online in Google Docs⁹. This form is much smaller than the first, and its purpose is to verify the preferences of the player, as well as the experience he felt while playing. The survey focuses on the five modification points discussed in the previous section (story, difficulty, objectives, resource management, misc), plus some questions regarding the overall game experience, which were based on the DGD model and GameFlow Model.

In the next section, we will present and discuss the results, where we aim to verify the following:

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⁹ https://spreadsheets.google.com/viewform?hl=en&formkey=dEZEaGgwUVlveWhzSzFPM3Awc2JMdVE6MQ#gid=0
4. Evaluation

- Corroborate the preferences of each player typology with the assumptions of the DGD Model.
- Confirm the main hypothesis which states that test group 1 (those who played the game adapted to their inferred preferences) had an improved experience than test group 2 (those who played the game adapted to the contrary of their inferred preferences).
- We expect an high rating in the questions regarding the game experience, allowing us to conclude, based on the GameFlow model, that the game meets the requirements that allows the player to experience enjoyment and flow.

4.2. Population

The data for this study was collected from twenty one male individuals. These tests were collected always using the same machine and game release. Some participants realized the test using keyboard and mouse for control, while most used a gamepad.

4.3. Normality of Independent Variables

In order to understand which statistical tests can be used to analyze the collected sample, a test for normality has to be made for each independent variable that is relevant for analysis. In the treatment of the results we have two grouping variables that are relevant:

- Test Group: dichotomous variable (Group 1 and Group 2). This variable divides the population that tests the game adapted to the preferences of their inferred player type (Group 1) from the ones that tested the game adapted to the preferences of a player type that was not the inferred.
- Inferring Player Type: (Conqueror, Manager, Wanderer, Participant). This variable is the result of the survey applied prior to the game testing. It situates the player in the Demographic Game Design Model.

Table 8. Population Frequencies, grouped by variable Test Group.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>15</td>
<td>71.4</td>
</tr>
<tr>
<td>Group 2</td>
<td>6</td>
<td>28.6</td>
</tr>
</tbody>
</table>
We applied a Kolmogorov-Smirnov test to check for the normality of distribution of the sample, and the results are shown below:

Table 9. Tests for normality of Test Group variable

<table>
<thead>
<tr>
<th>Kolmogorov-Smirnova</th>
<th>Statistic</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test_Group</td>
<td>.446</td>
<td>21</td>
<td>.000</td>
</tr>
</tbody>
</table>

a. Lilliefors Significance Correction

With the Kolmogorov-Smirnov test for checking the normality of the distribution of the variable, we may conclude that this dichotomous grouping variable does not have a normal distribution, because the significance level is not high enough ($p < 0.05$) to assume normality of data. Given that the distribution of the Test Group variable is not normal, we may only use Non Parametric statistic analysis, such as Kendall’s tau-b and Spearman correlations.

Now that we know about the normality of the first variable, it is time to check the normality of the second variable: Inferred Player Type.

Table 10. Population Frequencies, grouped by Inferred Player Type.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conqueror</td>
<td>6 28,6</td>
</tr>
<tr>
<td>Manager</td>
<td>5 23,8</td>
</tr>
<tr>
<td>Wanderer</td>
<td>4 19,0</td>
</tr>
<tr>
<td>Participant</td>
<td>6 28,6</td>
</tr>
</tbody>
</table>
4. Evaluation

Figure 15. The distribution of Inferred Player Type compared to a normal distribution.

By looking at Table 10 and Figure 15, the data suggests that this variable has a normal distribution, however, a Kolmogorov-Smirnov test is needed to be certain.

Table 11. Tests for normality of the Inferred Player Type variable.

<table>
<thead>
<tr>
<th></th>
<th>Kolmogorov-Smirnov$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
</tr>
<tr>
<td>Inferred_player_type</td>
<td>.182</td>
</tr>
</tbody>
</table>

a. Lilliefors Significance Correction

As expected, if we use the Inferred Player Type grouping variable, we can assume the normality of data. In the Kolmogorov-Smirnov test for normality, we can see that the significance level is 0.068, which is above the threshold necessary for normality($p > 0.05$). From this test, we can extrapolate the fact that Parametric analysis can be used to work with this variable.
4.3. Validating Demographic Game Design Model

Since our work is based on the Demographic Game Design Model, we incorporated some questions in the final survey so that we could verify some aspects of the same model. We consider that the following variables are significant to corroborate the validity of the DGD Model:

- Is game story important?
- Preference for receiving items automatically or manually.
- Are different paths important?
- Are stylish visual effects important?

4.3.1. Variable ‘Is the story important’ grouped by ‘Inferred player type’

![Graph showing the mean of the variable 'Is the story important', grouped by 'Inferred player type'.]

Figure 16. Mean of the variable 'Is the story important', grouped by 'Inferred player type'.

In Figure 16, we can see a plotting of the set of means of the variable ‘Is the story important’, grouped by the ‘Inferred player type’ variable. This graph indicates that the Conqueror type gives less importance to story, Manager gives a bit more importance, while Participant and Wanderer give the most importance. These facts suggest the confirmation of the assumptions in the DGD Model.

We have previously verified that the distribution of the variable ‘Inferred player type’ is normal, meaning that now we can test for the Pearson Correlation. The results are shown in the table below.
### 4. Evaluation

#### Table 12. Pearson Correlation result for 'Is the story important'.

<table>
<thead>
<tr>
<th>Inferred_player_type</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.637**</td>
<td>.002</td>
<td>21</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

This clearly verifies that with a significance level of 0.002 ($p < 0.05$) a positive correlation exists ($r = 0.637$) between the grouping variable 'Inferred Player Type' and 'Is the story important'. This result strongly suggests that the assumptions of the DGD Model are accurate. If we look at the variable 'Inferred player type' as ordinal (Conqueror is 1, Manager is 2, Wanderer is 3 and Participant is 4), we can confirm that the importance of the story is increasing in concurrence with the player type, hence the positive correlation. This makes sense because many players of the Conqueror type believe that story is not of great importance, while Managers consider the story important. On the other hand, Wanderers and Participants consider the story crucial, as they develop emotional links with the characters, and enjoy defining their own path in the storyline.

#### 4.3.2. Variable ‘Preference for receiving items automatically or manually’ grouped by ‘Inferred player type’

**Figure 17.** The distribution of the variable 'Prefer Automatic or Manual' grouped by 'Inferred Player Type'.
If we look at the preferences for each player type in the DGD Model, the distribution of the variable shown in Figure 17 is very interesting. The graph clearly shows a preference for the manual control in the Conqueror and Manager types. On the other hand, Wanderers prefer not to be troubled with resource management, while Participants are divided in their preferences. This suggests that the choice to manage the resources of the game is somehow connected to the player type.

Table 13. Chi-square test for 'prefer automatic or manual'.

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>7.125a</td>
<td>3</td>
<td>.068</td>
<td>.064</td>
</tr>
<tr>
<td>Fisher's Exact Test</td>
<td>6.444</td>
<td></td>
<td></td>
<td>.072</td>
</tr>
</tbody>
</table>

a. 8 cells (100.0%) have expected count less than 5. The minimum expected count is 1.33.

To further verify the validity of the apparent association shown in Figure 17, the Chi-Square test was used. The Pearson Chi-Square cannot be used because the expected count in the cells are less than 5. Given this, we have to apply the Fisher’s Exact test to verify for an association. The value for the Fisher’s Exact Test is 6.444, with a significance level of 0.072, which means that in this sample there is no significant difference (p > 0.05) between the typologies of players regarding the preference for resource management. However, the significance level almost meets the threshold of the Chi-Square test, which means that there is a high probability that this would flag for significant in a larger sample similar to this one. Furthermore, Hill & Hill states that observational studies are necessarily less exquisite, and in such cases, it may be reasonable to accept a lower significance level (p < 0.10). (Hill & Hill, 2002) Based on this, a suggestion is found in this data, that states that Conquerors and Managers prefer Manual control, while Wanderers prefer Automatic control. The association in the Participants group is not clear.

4.3.3. Variable ‘Are different paths important’ grouped by ‘Inferred player type’

In Figure 18, we see the crescent tendency in the importance of the different paths in a game. These paths may be physical choices in the game world or different choices in the storyline. This graph suggests that the preferences of the DGD Model are accurate, and when compared to the Figure 16, we can see the resemblance in the results, because the two variables are connected to some degree (one who values story may also value different paths in the same story). The table below shows the results of testing this variable for a significant Pearson Correlation.
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![Graph showing the mean of 'Are different paths important' by inferred player type.]

**Figure 18.** Mean of the variable 'are different paths important', grouped by 'inferred player type'.

**Table 14.** Pearson Correlation result for 'Are different paths important'.

<table>
<thead>
<tr>
<th>Inferred_player_type</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>,527*</td>
<td>,014</td>
<td>21</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed).

This verifies that with a significance level of 0.014 ($p < 0.05$) a positive correlation exists ($r = 0.527$) between the grouping variable ‘Inferred Player Type’ and ‘Are different paths important’. This result further confirms the suggestion, that the assumptions of the DGD Model are accurate.
4.3.4. Variable ‘Are stylish visual effects important’ grouped by ‘Inferred player type’

![Graph showing the distribution of the variable ‘Are Visual Effects Important’ grouped by ‘Inferred Player Type’.

Figure 19. The distribution of the variable ‘Are Visual Effects Important’ grouped by ‘Inferred Player Type’.]

In Figure 19, we can see the importance that each player type gives to stylish visual effects. As expected, this graph suggests that Conqueror give fewer importance to these effects, while Wanderer and Participant give the most importance. This suggests that Conquerors might enjoy a game with good mechanics and poor visual effects, whereas Wanderers and Participants might not.

To further verify the validity of the apparent association shown in Figure 19, we used the Chi-Square test. Again, the Person Chi-Square cannot be used, and we used the Fisher’s Exact Test instead. The Fisher’s Exact Chi-Square value is 11.275, with a significance level of 0.028, which suggests a significant different \( p < 0.05 \) between the typologies of players regarding the importance of stylish visual effects. The result is consistent with the assumptions of the DGD Model, which clearly states that Conquerors give more importance to game mechanics/efficiency than visual effects, while Wanderers give higher importance to these effects.
4. Evaluation

4.4. Tests for the Main Hypothesis

The main hypothesis: Enjoyment of the player is higher in Test Group 1 than in Test Group 2. From the sample, we consider that the following variables are significant to determine the enjoyment of the player:

- Is the game difficult?
- Feeling about the objectives.
- Is the story adequate to the game?
- Amount of control when buying items.
- Feeling about the game pace.
- Level of immersion.

4.4.1. Variable ‘Is the game difficult?’ grouped by ‘Test group’

The first variable is the answer to a question that asks explicitly the player if he felt the game was difficult. It was measured in a scale between 1(Very Easy) and 7(Very Hard) and can be seen as a basic extrapolation of the flow model: If the player felt his skills were being matched by the difficulty of the game, then he was in the flow channel.

![Figure 20. The mean and std. deviation of the variable 'Is the game difficult'.](image-url)
By looking at Figure 20, we can see that the means are close to each other, however, the value for standard deviation in test group 2 is much higher than the value for test group 1. This signifies that the mean for test group 1 is composed of a set of values that are close to the mean. On the other hand, the mean for test group 2 is composed of a set of values that are farther away from the mean. This can be explained because some player types like Wanderer and Participant enjoy easy games, while Conqueror enjoy hard games. Each individual from test group 2 played the game adapted to the preferences of a player type that was not his, which means that some players who enjoy harder games played in an easier setting, while the others who enjoy easier games played in a harder setting.

To further verify the validity of the apparent association shown in Figure 20, we used the non parametric chi-square test. The Fisher’s Exact Chi-Square value is 3.391, with a significance level of 0.339, which means there is no significant difference ($p > 0.05$) between the test group 1 and 2 regarding the difficulty of the game.

4.4.2. Variable ‘Feeling about the objectives’ grouped by ‘Test group’

The next variable derives from the question where the player is asked if the he considers there are too few or too many objectives. We can see the mean and standard deviation for both groups in the figure below.

![Figure 21. The mean and std. deviation of the variable 'Feeling about objectives'.](image)

By looking carefully at Figure 21, we can conclude that this is not what was expected given that the test group 2 shows a better result than test group 1. This can be explained by one or the combination of the following factors: the small sample; the fact that the test level is designed in a straightforward way, and objectives are not crucial for the progress in the game world; the
4. Evaluation

The fact that game has an high workload, may cause a lack of time for the player to stop and think about the objectives.

4.4.3. Variable ‘Is the story adequate to the game’ grouped by ‘Test group’

![Graph](image)

Figure 22. The mean and std. deviation of the variable ‘Is the game story adequate to the game’.

In Figure 22, we can see the mean and standard deviation of the ‘is story adequate to the game’ grouped by the variable test group. Once again, this result is not as expected since it shows that the mean for test group 2 is higher than the mean for test group 1. In this case, the question was formulated in a scale of 7 points, between Inadequate(1) and Adequate(7). The lack of good results in this case may be due to the same reasons that were mentioned for the variable ‘feeling about the objectives’. In general, the score for the adequacy of the story to the game is positive, which suggests that the adjustments in the story were not significant enough to register a difference between groups.

4.4.4. Variable ‘Amount of control’ grouped by ‘Test group’

The next variable is relative to the amount of control that the player felt was given to him. Using the assumptions from Demographic Game Design Model, some players received items automatically, while others had to do the item management manually. The amount of control for buying items was measured in a 7 point scale between Too Few(1) and Too Many(7).
In Figure 23, we can see that the mean for test group 1 is much closer to the median of the scale(4), than the mean for test group 2. Moreover, we can see a clear difference in the standard deviation between groups, which is the most relevant fact, because if a player who enjoys having control receives items automatically, then he would respond that he felt he had few control over the buying of items. The vice-versa is also eligible.

To further verify the validity of the apparent association shown in Figure 23, we used the non parametric chi-square test. The Fisher’s Exact Test Chi-Square value is 6.554, with a significance level of 0.211, which means there is no significant difference ($p > 0.05$) between the test group 1 and 2 regarding the amount of control when buying items.

4.4.5. Variable ‘game pace’ grouped by ‘Test group’

![Figure 24. The mean and std. deviation of the variable ‘Game pace’.](image)
4. Evaluation

In Figure 24 we can see that the mean and standard deviation of the variable ‘game pace’ is slightly lower in test group 1 than in test group 2. The result makes sense, but it is too weak to flag for a significant association. In general, it seems the question is not well formed and may be ambiguous. Given that it was measured via scale ranging between 1 (Very Low) and 7 (Very High), some people consider that a very high game pace is ideal, while others consider that the ideal is a medium game pace. We verified that this leads to conflicting results because participants who felt the game pace was as it should be, answered two different values (4 or 7) depending on their opinion of what the ideal game pace is.

4.4.6. Variable ‘Level of immersion’ grouped by ‘Test group’

![Graph showing the mean and std. deviation of the variable ‘Level of Immersion’](image)

**Figure 25.** The mean and std. deviation of the variable ‘Level of Immersion’.

Similarly to the variables ‘Is the game difficult’ and ‘Amount of control for buying items’, the variable shown in Figure 25 suggests that there is a relation between the ‘Level of Immersion’ and the group variable ‘Test Group’. The mean for the test group 1 is nearly 1 point higher in the 1-7 point scale, than the mean for test group 2. Given that 1 signifies ‘Not Immersed’ and 7 signifies ‘Totally Immersed’, this suggests that test group 1 felt more immersed than test group 2.

To further verify the validity of the apparent association shown in Figure 25, we used the non parametric chi-square test. The Fisher’s Exact Test value is 5.863, with a significance level of 0.083, which means there is noticeable difference ($p > 0.10$) between the test group 1 and 2 regarding the level of immersion. (Hill & Hill, 2002) However, in this case, it makes sense to see if the two variables can be correlated in any way. Since the distribution of the grouping variable
is not normal, I may only use Non parametric analysis. I used the Spearman Correlation to test if the two variables are correlated, and the result is shown in the table below.

**Table 15.** Spearman Correlation result for 'Level of Immersion'.

<table>
<thead>
<tr>
<th>Spearman's rho</th>
<th>Test_Group</th>
<th>Correlation Coefficient</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level_of_immersion</th>
<th>-0.452*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sig. (2-tailed)</td>
<td>.040</td>
</tr>
<tr>
<td>N</td>
<td>21</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed).

This confirms the previous result of the Chi-Square, that indicated an association between the two variables. The correlation test indicated a significance level of 0.04 ($p < 0.05$), which means that a negative correlation exists ($r = -0.452$) between the grouping variable ‘Test Group’ and ‘Level of Immersion’. This result strongly suggests a validation of the hypothesis, i.e., test group 1 felt more immersed than test group 2, and they are indeed differentiated.

4.5. **GameFlow Variables**

These variables descend directly from the GameFlow Model and serve as an important validation to check if the created game is able to stimulate the transition of the player to the flow state, and if it is capable of producing enjoyment to the player.

- Game difficulty
- Feel about the objectives
- Game Pace
- User Interface
- Ease of understanding of the Objectives
- Amount of control when buying items
- Level of Immersion

The following table shows the score for each of the components listed above, which allows us to derive the level of enjoyment that the game can stimulate. The variable ‘game pace’ was not integrated in this analysis because of the same reasons previously stated in this section (the question was ambiguous).
4. Evaluation

Table 16. GameFlow descriptive variables.

<table>
<thead>
<tr>
<th>Total</th>
<th>Is the game difficult</th>
<th>Feel about the objectives</th>
<th>Game user interface</th>
<th>Objectives easy to understand</th>
<th>Level of immersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3,95</td>
<td>3,62</td>
<td>5,38</td>
<td>6,76</td>
<td>6,10</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>1,024</td>
<td>1,740</td>
<td>1,024</td>
<td>1,539</td>
<td>1,831</td>
</tr>
<tr>
<td>Minimum</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Maximum</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

In the Related Work, we presented the GameFlow model and the components that it describes as flow-stimulating. In the model, the first component states that players should concentrate on the game without any external distractions. Since the game was tested in a controlled environment, we can assume that this component is fulfilled. Secondly, the game must have clear goals, and that can be proved by looking at Table 16, where the ease of understanding of the objectives has a mean of 6.76 in a scale of 7. The model also states that feedback to the player is very important. In a game, feedback is given through the user interface, and we can see in Table 16 that the game interface had an expressive score of 5.38 in a scale of 7. Immersion is another component of the model, and we can see from Table 16, and from previous results, that the level of immersion is high in our game. The mean of the variable game difficulty is 3.95, which is near to ideal difficulty (median in the seven point scale) for the game. This also contributes to the good score of the GameFlow model. Last but not least, another important component of the game is the amount of control that the player feels, and by looking at Figure 23, we can see that the amount of control when buying items is almost 4, which is the ideal control for each player.
4.6. Summary

The results from this study suggest a corroboration of the DGD Model. We verified that a positive correlation exists ($r = 0.637$, $p = 0.02$) between the importance of the story and the type of player, as shown in the DGD Model. We also indentified a tendency ($p = 0.072$) that is consistent with the original model regarding the manner in which player type prefers to exert control over certain aspects of the game. We see a clear preference of the Conquerors and Managers for the manual control, while Wanderers show a preference for automated management. We also verified that a positive correlation exists ($r = 0.527$, $p = 0.014$) between the importance of having differentiated paths in the game world/storyline and the type of player. We found a significant difference ($r = 11.275$, $p = 0.028$) between groups when asked about the importance of stylish visual effects. The result is consistent with the assumptions of the DGD Model, which clearly states that Conquerors give more importance to game mechanics/efficiency than visual effects, while Wanderers give higher importance to these effects.

The results we obtained for the GameFlow classification of our game, suggests that Grim Business provides enjoyable experiences. The overall score for the GameFlow evaluation was high, with the near-ideal values for the questions regarding the game difficulty and the number of objectives. Similarly, the values that represent the ease of understanding of the objectives, and the level of immersion are both above 6 in a scale of 7 points.

By looking at the mean and standard deviation results, it suggests that the game difficulty was better adjusted for test group 1 than for test group 2, however, we did not find a significant difference ($p = 0.339$) between the responses of the two groups when asked about the game difficulty. We also found a suggestion that the adjustment regarding the amount of control when buying items was more accurate in the case of group 1 than in the case of group 2, but we did not find a significant ($p = 0.211$) difference between the responses of two groups regarding this variable. We found a significant correlation ($r = -0.452$, $p = 0.04$) between the level of immersion and the test group. This means that test group 1 felt more immersed than subjects from the test group 2. This result may be influenced by the non-linear contribution of the other variables, such as the adapted objectives and game story.

In the next chapter, we will finalize this dissertation by wrapping up what has been said until here, clarify the contributions and limitations of this work, and state what can be done in the future.
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5

Conclusions
5. Conclusions

A good game is one that can deliver all of the features to its player. Given the amount of games in the market, the modern gamer can easily discard a game when it starts giving him contents that he has no interest in. An excellent game is one that delivers all the content with interest to that individual while he still is focused in the game.

In the Related Work section, we started by describing the work of Mihaly Csikszentmihalyi regarding the flow state – the feeling of complete and energized focus in an activity, with high level of enjoyment and fulfillment. He verified an important relationship between the challenges given by an activity and the skills of the individual – flow stands in the equilibrium between both. We have also seen how flow influenced videogames over the years, and the important role it still plays nowadays. Games should be fun, and flow is all about optimal experiences, fun and enjoyment. (Csikszentmihalyi, Flow, the Psychology of Optimal Experience, 1991)

The Game Industry also realized the importance of fun in videogames, and that a fun experience is not necessarily the same for different individuals. The creation of player typologies represented a significant breakthrough, as it allowed for the classification and segmentation of players. We analyzed several player models that defined different segments which tried to approximate the preferences of those player types, but the most important for this dissertation is the Demographic Game Design Model. As we have seen, this model defines four player typologies (Conqueror, Manager, Wanderer, Participant) by using the last two bipolar axis of the Myers-Brigs Type Indicator (Thinking-Feeling and Judging-Perceiving), and also defines the gaming preferences for those four types. (International Hobo Ltd., 2004)

Based on the Brown & Cairns study, we have seen the important part that Immersion plays in the enjoyment of a game. (Brown & Cairns, 2004) In 2005, the GameFlow model was created, based on flow theory, to serve as an evaluation tool for games. With this model, it is possible to infer the game’s propensity to enjoyable experiences – and flow. (Sweetser & Wyeth, 2005)

Currently, the most common approach to game adaption is based on different levels of difficulty. These predefined difficulty sets are created in the game development stage, long before the release of the game. For these sets to work in practice, extensive quality assurance tests have to be made to the game for it to be tuned to the nearest perfection. Even so, flaws or exploits are always found after a game reaches the shelves, which in most cases totally ruins the experience the game should transmit. Furthermore, the content and features that the game has is always the same in any of the predefined difficulty sets.

In the Architecture chapter, we have seen the full extension of the proposed architecture, with detailed information about each of its components. The solution possesses two main components: an offline component and an online component. The offline component plays the
role of a static knowledge database with the information regarding the classification and preferences of each player type, based on the DGD Model. The online component retrieves and analyzes information regarding the player, and tries to infer the personality of the player. This personality is used to classify the player regarding his type in the DGD Model. After this, the game system retrieves the preferences of that player type from the offline component, and uses that information to adapt the game. Note that the automatic detection of the personality is not integrated in this work and remains as future work. For the testing of this part of the solution, we measured the personality of the player with the help of a verified Myers-Briggs Type Indicator survey. Using the DGD Model, we then inferred the player typology of the participant. (Larson, 2005)

Following the explanation of the model, we introduced the game that we developed to be the test platform for this solution: *Grim Business*. This game was developed using the Unreal Development Kit and consists of a top-down shooter that explores the intense *gore* thematic, where you control a man seeking his revenge. The main objective is to kill everyone that stands in his path, and survive in the end.

We have also seen the detailed process of implementation, where we explain how the game adapts to each player typology. To recapitulate, there are three main categories that were explored for adaption: Presentation (includes adapting the story, the objectives and other the incorporation of other special features, like a slow-motion kill camera); Difficulty (which includes adapting the enemy AI, the player’s starting resources and the way that player’s deaths are punished); Control (which includes incorporating an automatic system to manage the items and rewards that the player gains, or allowing the player to choose what to do with the money he gains by killing enemies).

To verify the hypothesis that players who played the game adapted to their preferences would experience an higher enjoyment rate, we selected a representative population for each four DGD types, and then randomly split the sample in two groups. The first group experiment the game with the game adapting to his player type, while the second group played the game adapted to a player type that was not his. The test has three distinct phases: 1. Fill in a survey to infer the player’s Myers-Briggs personality type – this would automatically output the corresponding DGD player type as well; 2. Test the game with the solution adapted, or not, to his player type; 3. Fill in a final survey to evaluate the experience that the player felt while playing the videogame.

The results from this study suggest a corroboration of the DGD Model. We verified that a positive correlation exists ($r = 0.637$, $p = 0.02$) between the importance of the story and the type of player, as shown in the DGD Model. The Conqueror type finds story is not to be of great importance, while Managers consider the story important. On the other hand, Wanderers and
Participants consider the story crucial, as they develop emotional links with the characters, and enjoy defining their own path in the storyline. We also identified a tendency ($p = 0.072$) that is consistent with the original model regarding the manner in which player type prefers to exert control over certain aspects of the game. We see a clear preference of the Conquerors and Managers for the manual control, while Wanderers show a preference for automated management. We also verified that a positive correlation exists ($r = 0.527, p = 0.014$) between the importance of having differentiated paths in the game world/storyline and the type of player. This result also validates the assumptions in the DGD Model, and can be connected with previously shown correlation between the importance of the story and the player type (one who values story may also value different paths in the same story). We found a significant difference ($r = 11.275, p = 0.028$) between groups when asked about the importance of stylish visual effects. The result is consistent with the assumptions of the DGD Model, which clearly states that Conquerors give more importance to game mechanics/efficiency than visual effects, while Wanderers give higher importance to these effects.

To verify the main hypothesis, we tackled the problem in two fronts. The results we obtained for the GameFlow classification of our game, suggests that Grim Business provides enjoyable experiences. The overall score for the GameFlow evaluation was high, with the near-ideal values for the questions regarding the game difficulty and the number of objectives. Similarly, the values that represent the ease of understanding of the objectives, and the level of immersion are both above 6 in a scale of 7 points. Also, the 5.38 score of the game’s user interface leaves room for improvement, but can be considered as a good result. The other variable that was supposed to contribute to the GameFlow evaluation was the game pace, but we decided to rule it out because we found the question to be not well formed, and therefore ambiguous.

The other front was the verification that test group 1 had better results than test group 2. By looking at the mean and standard deviation results, it suggests that the game difficulty was better adjusted for test group 1 than for test group 2, however, we did not find a significant difference ($p = 0.339$) between the responses of the two groups when asked about the game difficulty. We also found a suggestion that the adjustment regarding the amount of control when buying items was more accurate in the case of group 1 than in the case of group 2, but we did not find a significant ($p = 0.211$) difference between the responses of two groups regarding this variable. However, the previous verification of the DGD model regarding the manner in which player type prefers to exert control over certain aspects of the game further confirms this suggestion. When asked if the story was adequate to the game, it is hard to see a differentiation between test groups. The same happened when asked about their feelings about the objectives, where the mean and standard deviation is basically equal in both groups. This may
be explained by one or the combination of the following factors: the small sample; the fact that the test level is designed in a straightforward way, and that story and objectives are not crucial for the progress in the game world; the fact that game has an high workload, may cause a lack of time for the player to stop and think about the objectives or story. However, we found a significant correlation ($r = -0.452$, $p = 0.04$) between the level of immersion and the test group. This means that test group 1 felt more immersed than subjects from the test group 2. This result may be influenced by the non-linear contribution of the other variables, such as the adapted objectives and game story. Overall, results suggest that our solution is a valid approach to player adaptation, at least in certain types of games, such as Grim Business.

5.1. Future Work

One of the main limitations of this study was the small sample of participants. We have verified the feasibility of the work, and for future references, we think it would be important to test the solution with more participants.

In this work, we also validated the DGD Model, which lets us conclude that some adaptations that did not work were probably some misinterpretations of the original model. For example, our intuition about the adjustment of the objectives was not correct. Also, it may be beneficial to improve the way that the objectives and the story are presented in the game, because it does not seem to have a very significant impact on the experience of the player. The problem may also lie in the genre of game that we decided to use for the implementation of the game, and it would be interesting to have it tested on another, completely different type of game.

Obviously, we cannot forget that there is a “prequel” work that still needs implementing. Now that we seen the feasibility of the solution, it is necessary to implement the first part of the solution, that extracts the personality of the player based on his behavior while playing. This presents a very hard challenge, and one that needs to be thoroughly tested with users.
5. Conclusions

5.2. Scientific Publications

A scientific paper describing a preliminary version of this work was published and presented at the conference Videojogos 2010 under the title “inFlow: Adapting Gameplay to Player Personality”.

A demonstration of the game used for this work was presented at the conference Videojogos 2010 under the name “Grim Business”. The demonstration was voted by the media as the second best demonstration in the category of the “Best Demos Presented in Videojogos 2010”.

References
6. References


International Hobo Ltd. (2004). Head First: Demographic Game Design: How to make game design as valuable as marketing. Manchester: International Hobo Ltd.


Myers, I. B. (1976). Introduction to type. Center for Applications of Psychological Type.


6. References
Appendices
7. Appendices

A. Myers-Briggs Partial Survey

Thinking – Feeling Scale *(If the sum is greater than 0, Thinking, else, Feeling)*

Which word in the pair appeals to you more?

a. Thinking (+0.585)

b. Feeling

Which word in the pair appeals to you more?

a. Speak (+0.579)

b. Write

Which word in the pair appeals to you more?

a. Firm-minded (+0.561)

b. Warm-hearted

Do you usually:

a. Value sentiment more than logic

b. Value logic more than sentiment (-0.507)

Which word in the pair appeals to you more?

a. Compassion

b. Foresight (-0.503)

Which word in the pair appeals to you more?

a. Gentle

b. Firm (-0.447)

Is it a higher compliment to be called:

a. A person of feeling

b. A consistently reasonable person (-0.404)

Which word in the pair appeals to you more?

a. Benefits (+0.378)

b. Blessings

Which word in the pair appeals to you more?

a. Uncritical

b. Critical (-0.344)

Do you more often let:

a. Your heart rule your head

b. Your head rule your heart (-0.327)
Which word in the pair appeals to you more?
   a. Determined (+0.323)
   b. Devoted

Do you feel it is a worse fault to be:
   a. Unsympathetic
   b. Unreasonable (-0.303)

Which word in the pair appeals to you more?
   a. Wary
   b. Trustful (-0.281)

Which word in the pair appeals to you more?
   a. Justice (+0.271)
   b. Mercy

Would you rather work for someone who is:
   a. Always kind
   b. Always fair (-0.184)
Judging – Perceiving Scale (If the sum is greater than 0, Judging, else, Perceiving)

Which word in the pair appeals to you more?
 a. Scheduled (+0.640)
 b. Unplanned

Does following a schedule:
 a. Appeal to you (+0.558)
 b. Cramp you?

When you go somewhere for the day, would you rather:
 a. Plan what you will do and when (+0.547)
 b. Just go

When you have a special job to do, do you like to:
 a. Organize it carefully before you start (+0.498)
 b. Find out what is necessary as you go along

Does the idea of making a list of what you should get done over a weekend?
 a. Appeal to you (+0.492)
 b. Positively depress you

Do you prefer to:
 a. Arrange dates, parties, well in advance (+0.478)
 b. Be free to do whatever looks like fun when the time comes

Do you:
 a. Rather prefer to do things at the last minute
 b. Find doing things at the last minute hard on the nerves (-0.470)

Which word in the pair appeals to you more?
 a. Systematic (+0.453)
 b. Spontaneous

When it is settled well in advance that you will do a certain thing at a certain time, do you find it:
 a. Nice to be able to plan accordingly (+0.445)
 b. A little unpleasant to be tied down

Which word in the pair appeals to you more?
 a. Who (+0.445)
 b. What

Which word in the pair appeals to you more?
a. Punctual (+0.411)
b. Leisurely

When you start a big project that is due in a week, do you:
   a. Take time to list the separate things to be done and the order of doing them (+0.409)
   b. Plunge in

Do you find the more routine parts of your day:
   a. Restful (+0.395)
   b. Boring

Is it harder for you to adapt to:
   a. Routine
   b. Constant change (-0.389)

Are you more successful at:
   a. Dealing with the unexpected and seeing quickly what should be done
   b. Following a carefully worked out plan (-0.387)

Which word in the pair appeals to you more?
   a. Orderly
   b. Easygoing (-0.377)

Which word in the pair appeals to you more?
   a. Systematic (+0.355)
   b. Casual

Which word in the pair appeals to you more?
   a. Quick
   b. Careful (-0.352)

In your daily work, do you:
   a. Rather enjoy the emergency that makes you work against time
   b. Usually plan your work so that you won’t need to work under pressure (-0.346)
B. Final Survey

Do you consider the story of a game important?
   (Not important) 1 2 3 4 5 6 7 (Important)

Did you found the story adequate to the game?
   (Inadequate) 1 2 3 4 5 6 7 (Adequate)

Did you found the game difficult?
   (Very Easy) 1 2 3 4 5 6 7 (Very Difficult)

How do you feel about the objectives?
   (Too Few) 1 2 3 4 5 6 7 (Too Many)

How do you classify the ease of understanding of the objectives?
   (Hard) 1 2 3 4 5 6 7 (Easy)

What do you prefer:
   a. To choose which Weapons/Upgrades/Powerups to buy manually
   b. Automatically receive the best Weapons/Upgrades/Powerups when available

What do you think about the amount of control when buying Weapons / Upgrades / Powerups?
   (Too Few) 1 2 3 4 5 6 7 (Too Much)

How did you use the 'Shop'?
   a. Didn't use 'Shop'
   b. Used but only the essential.
   c. Used and read everything in it.

Do you think it's important to have the ability to decide which way to progress in the game world?
   (Not important) 1 2 3 4 5 6 7 (Important)

Knowing that 'Stylish Visual Effects' slow the game, what would you rather do?
   a. Never use them.
   b. Only use them the first times you play.
   c. Always use them.

How do you feel about the game pace.
   (Very Low) 1 2 3 4 5 6 7 (Very High)

Classify the game user interface
   (Very Bad) 1 2 3 4 5 6 7 (Very Good)

Classify your level of immersion while playing the game.
   (Not Immersed) 1 2 3 4 5 6 7 (Totally Immersed)
C. Detailed Modifications

**Story:**

**None:**

Story never shows.

**World-oriented story:**

“A long time ago, the year was 2419, nearly 37 years after the war, all the habitable places\non earth were under the control of the Mockers. They pillaged and destroyed everything in their path.” [Speaking: Unknown] [After first kill]

“As the Mockers influence grew larger, so did their arrogance. That was when doom came to those who sinned against humanity, for those are the ones without repentance.” [After first camp is clear]

“Several of the Mockers bases went ghost before they even knew who he was. The same pattern repeated over and over: Everyone dead, no survivors.” [Speaking: Unknown] [At “Reach the Inner Base Objective”]

“And who was the man behind all the massacre and bloodshed? No one ever knew his story, and no one will ever know. I am Lt. Darren Fletcher, a dead heart in a dead world.” [Speaking: Lt. Darren Fletcher] [After killing everyone and escaping]

[End]

**Character-oriented:**

“They killed my wife and my son. They buried my entire village. Their time to pay has come. I will not rest until the last single one of them is dead.” [Speaking: Lt. Darren Fletcher] [After first kill]

“So much death…I vowed I would never kill again after the end of the last war. And still I wonder...Will the bloodshed ever end?... Will I ever have peace again?” [Speaking: Lt. Darren Fletcher] [After first camp is clear]

“Die meat bags!” [Speaking: Lt. Darren Fletcher] [At “Reach the Inner Base Objective”]

“These were just rotting maggots. Miserable pawns of a game they didn’t understand. No... I shall find the ones truly responsible, and cleanse the world of their presence.” [Speaking: Lt. Darren Fletcher] [After killing everyone and escaping]
Objectives:

General with Specific Objectives:

[Beginning]
>> Add new objective[geo]: Find their base!

[Before First Camp and after First Kill]
>> Complete objective[geo]: Find their base!
>> Add new objective: Kill Everyone in the Camp.
>> Add new objective[special]: Veteran Badge: Score 25 SMG Kills.
>> Add new objective[geo]: Find the Gate Key.
>> Complete objective[geo]: Find the Gate Key.
>> Complete objective: Kill Everyone in the Camp.

[After First Gate/Camp]
>> Add new objective[geo]: Reach the Main Base.
>> Complete objective[geo]: Reach the Main Base.
>> Add new objective: Kill Everyone in the Base.
>> Add new objective[special]: Merciless Badge: Score 30 Chainsaw Kills.
>> Complete objective: Kill Everyone in the Base.
>> Add new objective[geo]: Escape the base.

[After Last Gate/Before Car]
>> Complete objective[geo]: Escape the base.
>> Add new objective[geo]: Hijack the vehicle.
>> Complete objective[geo]: Hijack the vehicle.
>> Add new objective: Survive the ambush.

Exploratory Objectives:

[Beginning]
>> Add new objective[geo]: Find their base!

[Before First Camp and after First Kill]
>> Complete objective[geo]: Find their base!
>> Add new objective: Kill Everyone in the base.
>> Complete objective: Kill Everyone in the base.
>> Add new objective[geo]: Escape the base.
[After Last Gate/Before Car]
>> Complete objective[geo]: Escape the base.
>> Add new objective: Survive the ambush.

**Starting Weapons:**

*First set: Chainsaw and SMG only*
- Chainsaw – infinite
- SMG – 45 rounds
- Shotgun – 0 bucks

*Second set: All weapons with low ammunition*
- Chainsaw – infinite
- SMG – 45 rounds
- Shotgun – 20 bucks

*Third set: All weapons*
- Chainsaw – infinite
- SMG – 75 rounds
- Shotgun – 45 bucks

**Items:**

*Manual upgrades/items*
Player has to buy them via the Shop Menu. The Grim Business Shop is separated in three categories: Weapons & Ammo, Upgrades, Special Care.

**Weapons & Ammo:**

>> Shotgun (Price: $2800)

“This weapon is most effective against moving targets. The numerous projectiles that spread from the shot allows the user to point the Shotgun close to the target, rather than having to aim precisely as in the case of a single projectile. As a consequence, the shot also has limited range and limited penetration, which is why the Shotgun is best used at short range. This package includes 25 Shotgun Shells.”

>> Sub-machine Gun (Price: $1500)

“This light and versatile weapon can fire nearly 600 rounds per minute. Widely used by military forces over the years, it has been continuously upgraded and, despite its high
rate of fire, is considered precise at medium range. This package includes 45 SMG Rounds.”

Upgrades:

>> Flashlight Upgrade (Price: $4500)
“The Flashlight is essential for easily detecting and targeting enemies that may be hard to see. You start off with a common light bulb flashlight powered by a high capacity electromagnetic induction generator. This upgrade replaces the light source of your Flashlight with LEDs, which are much more power efficient. This results in longer battery life and higher range and power.”

>> Health Upgrade (Price: $6000)
“Your suit is able to incorporate two modules that stimulate the regeneration of your body. With this upgrade, you will be able to regenerate twice as faster, when not in combat.”

Special Care:

>> Double Damage (Price: $6500)
“During a short period of time you are able to completely focus on your foes, quickly identifying their weak spots. By carefully and effectively aiming your shots, you are able to strike at those weaknesses, dealing double damage with any weapon you yield.”

>> Adrenaline Rush (Price: $15000)
“Your suit was developed for a unit of elite soldiers, and incorporates a module of adrenaline stimulants that are injected directly into your veins. This results in increased speed and superior perceptiveness of the surroundings. While in the influence of this drug, the whole world seems to move slower in time.”

>> Ultimate Strike (Price: $25000)
“A powerful and devastating attack in your vicinity. No further description available.”

Automatic upgrades/items

Player may pick up ammo from enemies that die.

Player is automatically rewarded with upgrades and powerups.