Universidade de Aveiro Departamento de Comunicação e Arte

Universidade do Porto Faculdade de Letras

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SAMUEL DE JESUS ALMEIDA

A INTERAÇÃO JOGADOR E VIDEOJOGO NA CONSTRUÇÃO DA EXPERIÊNCIA DE JOGO

THE PLAYER AND VIDEO GAME INTERPLAY IN THE GAMEPLAY EXPERIENCE CONSTRUCT

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Tese apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Informação e Comunicação em Plataformas Digitais, realizada sob a orientação científica da Doutora Ana Isabel Barreto Furtado Franco de Albuquerque Veloso, Professora Auxiliar do Departamento de Comunicação e Arte da Universidade de Aveiro e sob coorientação do Doutor Licínio Gomes Roque, Professor Auxiliar do Departamento de Engenharia Informática da Universidade de Coimbra

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Aos meus Pais;

Lutaram, sacrificaram-se e abdicaram dos vossos sonhos para que nós pudéssemos sonhar um pouco mais alto.

Obrigado.

o júri

presidente

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palavras-chave

Experiência de Jogo, Videojogos, Jogadores, Eye Tracking

resumo

Entre as muitas discussões e estudos relacionados com os videojogos, um dos mais recorrentes, amplamente debatido e importante relaciona-se com a experiência de jogar videojogos. A experiência de jogo - como empregado neste estudo - é o resultado da interação entre dois elementos essenciais: um videojogo e um jogador. Os estudos existentes têm explorado a experiência resultante do ato de jogar a partir da perspectiva do videojogo ou do jogador, mas nenhum parece igualmente equilibrar estes dois elementos.

O estudo aqui apresentado contribui para o debate em curso com um modelo da experiência de jogo. O modelo proposto, que procura equilibrar de forma igual os elementos videojogo e jogador, considera a experiência de jogo como uma experiência interativa (relacionada com o processo de jogar o videojogo) e uma experiência emocional (relacionada com o resultado de jogar o videojogo). A influência mútua destas duas experiências durante o ato de jogar define a experiência de jogo. Para esta experiência de jogo contribuem várias dimensões, relacionadas com o videojogo e o jogador: o videojogo inclui a dimensão da mecânica, da interface e narrativa; o jogador inclui a dimensão das motivações, expectativas e *background*. Além disso, a experiência de jogo é inicialmente definida por uma situação de jogo, condicionada por um ambiente em que o jogo se realiza e uma plataforma na qual se joga.

Para inicialmente validar o modelo e tentar mostrar uma relação entre as múltiplas dimensões do modelo proposto, um estudo multicaso foi concretizado utilizando dois videojogos e amostras diferentes. Num dos estudos, os resultados mostram correlações significativas entre as múltiplas dimensões do modelo, e evidências de que alterações ao videojogo podem influenciar as motivações do jogador e o seu comportamento visual. Numa análise relacionada com características dos jogadores, os resultados mostram que os jogadores, embora possam ser diferentes em termos de experiência e expectativas em relação ao jogo, a sua motivação para jogar não é necessariamente diferente, mesmo que o seu desempenho no jogo seja fraco.

Embora uma validação contínua do modelo seja necessária, este modelo não só contribui para o debate da experiência de jogo, mas também mostra num determinado contexto como as dimensões do jogador e videojogo evoluem durante o ato de jogar.

keywords Gameplay Experience, Video games, Players, Eye Tracking

abstract

Among the many discussions and studies related to video games, one of the most recurrent, widely debated and important relates to the experience of playing video games. The gameplay experience – as appropriated in this study – is the result of the interplay between two essential elements: a video game and a player. Existing studies have explored the resulting experience of video game playing from the perspective of the video game or the player, but none appear to equally balance both of these elements.

The study presented here contributes to the ongoing debate with a gameplay experience model. The proposed model, which looks to equally balance the video game and the player elements, considers the gameplay experience to be both an interactive experience (related to the process of playing the video game) and an emotional experience (related to the outcome of playing the video game). The mutual influence of these two experiences during video game play ultimately defines the gameplay experience. To this gameplay experience contributes several dimensions, related to both the video game and player: the video game includes a mechanics, interface and narrative dimension; the player includes a motivations, expectations and background dimension. Also, the gameplay experience is initially defined by a gameplay situation, conditioned by an ambient in which gameplay takes place and a platform on which the video game is played.

In order to initially validate the proposed model and attempt to show a relationship among the multiple model dimensions, a multi-case study was carried out using two different video games and player samples. In one study, results show significant correlations between multiple model dimensions, and evidence that video game related changes influence player motivations as well as player visual behavior. In specific player related analysis, results show that while players may be different in terms of background and expectations regarding the game, their motivation to play are not necessarily different, even if their performance in the game is weak.

While further validation is necessary, this model not only contributes to the gameplay experience debate, but also demonstrates in a given context how player and video game dimensions evolve during video game play.

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LIST OF ACRONYMS

	Name	Brief Description
FPS	First-Person Shooter	A video game genre focused on weapon-based combat through a first-person perspective
HCI	Human-Computer Interaction	A discipline concerned with the study, design, construction and implementation of human-centered interactive computer systems
NVGP	Non-video game players	Individuals that do not play video games frequently or at all
PC	Personal Computer	A general purpose computer
POR	Point of Regard	The place in the world where a subject is looking at
RPG	Role-playing game	A video game genre in which the player assumes the role of a character in a fictional world
UX	User Experience	Deals with how a person feels about using a product, system or service
VGP	Video game players	Individuals that play video games frequently (may vary according to authors)
HVS	Human visual system	Part of the central nervous system which enables the processing of visual detail; includes (among others) the eyes and parts of the brain

INTRODUCTION

In this introductory section, the study explored in this work is presented, as well as its relevance. This section also presents the research question and objectives which govern the study. The methodology of the study is also presented, in addition to the supporting analysis model and the various study hypotheses. Lastly, the structure of the document structure is presented, as well as the personal motivations behind the development of this body of work.

1. PRESENTATION & STUDY RELEVANCE

Make great video games[1] *and create great experiences.*

The video game panorama is changing. While it still remains a profitable industry of millions of euros, the player segment is in a metamorphosis state. The idea video games are only played and developed for teenage boys and the male market (Gorriz & Medina, 2000) is now a myth, sustained by recent numbers (ESA, 2013). Technology and personal tendencies have changed to a point where any person – young or old – can play a video game and take great pleasure from it.

The premise above is the thought by which those developing video games should govern their motivations. Video games are at the core of an industry that is – and has been – rapidly growing. Video games move millions: millions of *fans*, *gamers*, *money*, *opinions*, and much more. Numbers from the 'Entertainment Software Association' (ESA, 2013) indicate the industry's audience is branching out. Video games are reaching a greater number of individuals, resulting in players with different types of profiles: the average age of a video game player is 30, while 68% of gamers are over 18 years of age. Also, 45% of players are now female. While these numbers are relative to the United States of America (USA), it seems plausible that a similar trend may be occurring worldwide. According to Noah Schaffer (2009), this distribution suggests attention should be focused on universal game design. It is essential games be developed for players not familiarized with existing video game interface paradigms.

Equally important or more so, is the resulting experience from playing games. These experiences – commonly named *player*, *gaming* or *gameplay* experiences – are the outcome of playing a video game. This *experience* related discussion is one of the most widely debated topics in the industry. Extensive work has been developed in order to define the experience, understand how they are formed during the act of game play and how they can be measured (during or after game play). Borrowing from other contexts, the industry has appropriated terms such as *immersion*, *flow*, *presence*, *engagement*, *involvement* and *fun* (Takatalo, Häkkinen, Kaistinen, & Nyman, 2010). Despite the value of these studies, ocassionally these concpets will overlap or are simply extensions of another concept.

The study of the *gameplay experience* – a terminology defended in this thesis – has led to several models and frameworks which reflect the authors' opinions on the experience. However, despite their valuable contributions, these studies commonly focus their attention either on the *player* of video games, or the *video game* itself. It is felt their lacks a study that equally balances these concepts which are considered both important in the definition of the gameplay experience.

As a result of this apparent gap in video game related studies, this thesis seeks to present a *Gameplay Experience Model* proposal, a conceptual framework felt to characterize the multiple elements, dimensions, and characteristics which can play a role in the players' gameplay experience.

[1] In this PhD thesis, the term *video games* will be used generically to represent games developed both for consoles or computer platforms.

In addition to exposing an interpretation on the gameplay experience, it is also important to study alternatives to existing methods for evaluating the experience. Understanding how a player interacts in a game with other players, non-playable characters or objects found in the game world can also provide information on a players' *interactive* experience. However, with exception to direct analysis of game metrics, there is a lack of solutions which visually represent this part of the experience. Therefore, this study also focuses on the work which contributed to the development of an application which visually represents multiple layers of player related data, based on metrics extracted from a video game. Furthermore, this thesis contemplates the use of eye tracking data to further understand the gameplay experience. Eye tracking – considering some of its limitations – has yet to be considered a valuable tool in game-related studies. Despite existing work (Ekman, Poikola, & Mäkäräinen, 2008; Isokoski, Joos, Spakov, & Martin, 2009; Isokoski & Martin, 2006; Jönsson, 2005; Smith & Graham, 2006), these are normally of academic nature. This study looks to further demonstrate the value of eye tracking in a game context, namely in understanding how players visually behave while playing video games.

Lastly, given the context in which this PhD thesis is developed, this study explores the importance of communication theories in everyday communicative acts. C*ommunication* theories and studies can and have made their way to diverse areas, including video games. Nonetheless, much of the existing work binding these two areas mainly reflects communication process that occur between players, through diverse channels. Hence, existing work (Costikyan, 2002; Gardina, 2006; Innocent & Haines, 2007; Peña & Hancock, 2006) is mainly related to computer-mediated communication. However, it is also felt that these studies can go a step further. As a result, this thesis explores how the proposed gameplay experience model can be analysed and its various characteristics initially validated according to multiple communication theories.

2. RESEARCH QUESTION

Bearing in mind the contextualization presented above and criteria[2] for the development of an adequate research question (Quivy & Campenhoudt, 2005), the following primary question was defined to guide this study:

> *Considering a video game and player based model, what possible interplay between respective dimensions and characteristics can contribute to the definition of the gameplay experience?*

As a result of this question, the work presented here looks to explore what *player* and *video game* characteristics can influence the gameplay experience, considering the resulting dynamic connection between these two elements. In addition to this primary research question, other relevant questions to the study are defined:

i. How can players' *interactive behaviour* contribute to the analysis of the gameplay experience?

ii. How can *visual attention* studies and eye tracking contribute to the analysis of the *gameplay experience*?

[2] Quivy & Campenhoudt (2005) defend that a good research question should be clear, executable and relevant

3. STUDY OBJECTIVES

Considering the study context previously described and defined research question, the following objectives were defined which will steer the development of this thesis:

i. Identify the essentials of video games, explore the concept of video games and the development and design of video games (while considering how these are projected to creating satisfying game experiences).

ii. Identify and understand how games are analysed and evaluated, considering existing methods and techniques.

iii. Identify and understand the concept of the *gameplay experience*, focusing on its multiple aspects (construction and measurement) and related concepts (*e.g.* immersion, flow, presence).

iv. Develop a model which represents the multiple facets of the gameplay experience, looking into its possible main elements and supporting characteristics.

v. Characterize the human visual system and understand the potential of eye movement data as a source of behavioural data.

vi. Identify strengths and weaknesses associated to the use of the eye tracking technique as a source of information, and research areas in which it is applied – related or not to video games.

vii. Validate the proposed model through the use of one or more games, analysing how the game(s)' characteristics influence the gameplay experience; explore the gameplay experience using additional information (game metrics, eye movement data).

viii. Explore how the proposed model can be analysed according to multiple existing communication theories, in order to further understand how communication and video games can connect outside of a computer-mediated communication context.

Objective 1 consists in exploring one of the main objects of this study: the *video game*. Here, the objective is to carry out a thorough analysis of video games, namely in historical and conceptual terms. Furthermore, it involves analysing questions related to game and level design, two moments of the development process which define the experience of playing games.

Objective 2 involves reflecting on video game evaluation. This objective involves exploring some of the historical context of game evaluation as well as how games are evaluated within the development cycle. Furthermore, it consists in reflecting on techniques and methods used for game evaluation – namely applied in an academic context – as well as those which are related to eye tracking.

Objective 3 consists in exploring another main concept of this work: the *gameplay experience*. This involves exploring the basics of the resulting experience of playing games, as well as a wide variety of related concepts (e.g. immersion, flow, presence) used to describe this experience. Furthermore, part of this objective consists in understanding how these experiences are visually represented, as well as how they are and can be measured in game-related studies.

Objective 4 involves the development of a gameplay experience model in response to the existing limitations initially presented (*cf.* Presentation & Study Relevance, *p. 3*). In order to carry out this objective, an extensive review of existing studies must be elaborated in order to understand work previously developed and how the proposed model can fill the gaps left by existing work. The development of the model should contemplate the collection of data from multiple sources to fully represent the gameplay experience.

Objective 5 aims to identify the potential of the human visual system (HVS) and eye movements. The HVS is a complex system, including the eyes as well as the brain, which processes the visual information the eyes acquire. The aim of this objective is not only to understand what components and structures make up the HVS, but also the movements the human eye is capable of executing, and therefore, what movements an eye tracker can record. Additionally, another aim of this objective is to understand visual and selective vision.

Objective 6 looks to explore the *strengths* and *weaknesses* inherent to the eye tracking technique as well as its application in various research fields. Eye tracking in usability studies date back more than 50 years (Jacob & Karn, 2003) and since then, the technique – supported on evolving technology – has matured and been applied in the various fields. This objective seeks, therefore, to understand what makes eye tracking such a powerful, promising and used tool, but why some usability specialists fail to adopt it.

Objective 7 consists in validating the model proposal projected in *Objective 4*. In order to validate the model, study objects on which the validation is based must be defined; participants must be recruited; data collection methods must be developed and results must be extracted, analysed and discussed. Furthermore, where possible, the model and respective gameplay experience analysis should contemplate the use of additional information explored in the study, including game metrics and eye movement data, in order to further understand their value in the analysis of the gameplay experience.

Objective 8 consists in reflecting on the extent to which the proposed model and its constituent parts can be interpreted and associated to multiple existing communication theories. Therefore, a thorough analysis of communication theories is necessary. Posteriorly, a reflection on the possible relationship of the model and these theories can be considered.

4. STUDY METHODOLOGY, ANALYSIS MODEL & HYPOTHESES

The terms 'methodology', 'methods' and 'techniques' are used to describe the means through which the researcher seeks knowledge (Coutinho, 2011). A research methodology can be described as a research framework that, when complying with a group of standards, makes it possible to select and articulate techniques designated to aid in the development of the empirical process validation.

The governing research methodology of this work is *Development Research*. This methodology is applied considering the inadequacy of traditional research approaches to answer the problems intrinsic to this study (Akker, 1999). While development research is similar to traditional research approaches in the applied data collection and analysis techniques, they essentially differ in terms of research finalities (Akker, 1999; Coutinho & Chaves, 2001; Richey & Klein, 2005). Also, development research includes several specific activities, including: a preliminary investigation, theoretical embedding, empirical testing; and documentation, analysis and reflection (Akker, 1999). Furthermore, two aspects characterize development research: the production of some form of artefact (*e.g.* tools, products, processes, among others), and the process is indeed research, not to be confused with product development (Ellis & Levy, 2010).

Given the various objectives defined in the study, an adapted interpretation of development research fits the intended research framework, as the development of a *gameplay experience model* (*i.e.* artefact) proposal and its evaluation is central to this work.

Within the development research framework, the range of defined objectives (*cf.* Study Objectives, *p. 5*) resulted in a methodological approach characterized by multiple methods and techniques. Ellis & Levy (2010, pp. 110–111) summarize findings on a 6-phase model of development (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007), including: (*i*) identify the problem motivating the research; (*ii*) describe the objectives; (*iii*) design and develop the artefact; (*iv*) subject the artefact to testing; (*v*) evaluate the results of testing; and (*vi*) communicate those results. While the present study and development of the gameplay experience model loosely follows these phases, they are in general manner present and adapted to this particular study.

The initial phase (*Phase 1*) of this study included identifying the problem. This phase of identification is supported on a *literature review*. The literature review has the purpose of justifying the importance of the research problem and validating the purpose of the study and research questions or hypotheses (Creswell, 2011, p. 80). Within the present work, this is related to the various gameplay experience studies which do not meet our expectations and interpretation of the gameplay experience (*cf.* Section 5.2.1, *p. 137*). As a result of this gap, there is a need to develop a model which equally portrays the player and the video game in the experience.

Once the objectives have been defined (*Phase 2*), the artefact is designed and developed (*Phase 3*). To do so, the development of the *artefact* in this study is also supported on the literature review explored (cf. CHAPTER 1 and CHAPTER 2), as well as the use of data collected from two *focus group* sessions. Both these sources of information are *qualitative* data collection techniques (Fraenkel, Wallen, & Hyun, 2012, p. 436).

Posterior to the development of the artefact, the model is subject to testing (*Phase 4*) through an initial validation. Appropriating and adapting the AIAA[3] definition of *validation* – *"the process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model"* – as explored by Thacker et al. (2004, p. 13); this phase is explored and described in *CHAPTER 6* – Validating the Gameplay Experience Model (*cf. p. 185*). In this phase, the proposed model is submitted to initial validation through *case studies*. Specifically, using a *multiple-case study* approach (Fraenkel *et al.*, 2012, p. 435) – also a qualitative form of research – two samples are studied within the context of the gameplay experience using extensive data collection. In one of the cases studied, a *within-subjects design* is applied for data collection purposes. Within the multiple-case study, qualitative data is collected through the use of questionnaire instrumentation, which is posteriorly analysed statistically. Therefore, the intent of the validation is to attempt to demonstrate within a specific context the extent to which the model accurately represents the gameplay experience.

Lastly, the findings of the empirical study are evaluated in the form of a discussion of results (*Phase 5 and 6*), present in CHAPTER 7 (*cf. p.* 203). From the case study results, a form of *associational research* (Fraenkel et al., 2012, p. 15) is applied in order to further identify the relationships between multiple model variables, which helps test the robustness of the model.

Table 1 summarizes the Development Research Methodology applied in the study according to its several phases (Peffers et al., 2007), including the study chapters in which it they are explored, and the methods and techniques/instruments applied in each phase.

Table 1: Summary of the Development Research Methodology applied in the study

<table>
<tr><th colspan="3">Phase</th><th>Method Applied</th><th>Techniques/Instruments Applied</th></tr>
<tr><td>Phase 1
Identify the Problem</td><td>Exploratory Research</td><td>Chapter 1 – 4, Chapter 5 (Section 5.2.1)</td><td>Literature Review</td><td></td></tr>
<tr><td>Phase 2
Describe the Objectives</td><td rowspan="6">Empirical Study</td><td>Chapter 5</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Phase 3
Design and Develop the Artifact</td><td rowspan="2">Chapter 1 – 5</td><td>Literature Review (Qualitative)</td><td rowspan="2">Content Analysis</td></tr>
<tr><td>Focus Groups (Qualitative)</td></tr>
<tr><td>Phase 4
Test the Artifact</td><td>Chapter 6</td><td rowspan="2">Multi-Case Study (Qualitative)</td><td>Survey by Questionnaire</td></tr>
<tr><td>Phase 5
Evaluate Testing Results</td><td rowspan="2">Chapter 7</td><td>Statistical & Game Metrics Analysis</td></tr>
<tr><td>Phase 6
Communicate the Testing Results</td><td colspan="2"></td></tr>
</table>

[3] AIAA: American Institute of Aeronautics and Astronautics

ANALYSIS MODEL

Regarding the analysis model, its purpose is to clarify and illustrate in a simple manner the multiple concepts present in the research question in order to organize the research process (Quivy & Campenhoudt, 2005). The analysis model is organized into concepts, dimensions and indicators.

Table 2 represents the analysis model of the study, developed primarily considering the research question, but also bearing in mind additional supporting questions.

Table 2: Analysis Model

Concepts	Dimensions	Sub-dimensions	Indicators
Video Games	Game Context		· Concept definition · Historical contextualization
	Game & Level Design		· Level design process · Principles · Visual communication design
Players	Player Profile		· Male *vs.* Female · Playing Experience · Player Background
Gameplay Experience	Experience related Concepts	Immersion Flow Presence	· Source of experience · Development of experience · Characterization of the experience Relation to other experiences · Evaluation and measurement of the experience
Eye tracking	Technology		· History of eye tracking · Strengths and weaknesses · Research Areas
	Data		· Quantitative data log files · Visualization techniques
Video Game Evaluation	Techniques & Instruments		· Problem categories · Problem severity levels · Tests within game development · Metrics
	Studies		· With eye tracking · Without eye tracking

STUDY HYPOTHESES

Considering the defined research question, study objectives and presented analysis model, several hypotheses can be projected regarding the study:

1. [*Hypothesis 1*] The gameplay experience can be defined according to the interplay between characteristics related to video game *mechanics*, *interface*, and *narrative*; and player *motivations*, *skills*, *experience* and *expectations*.
2. [*Hypothesis 2*] Regarding possible interplay, video game characteristics related to *mechanics* and *interface* influence the outcome of the gameplay experience
3. [*Hypothesis 3*] Regarding possible interplay, player *gender* does not play a role in the outcome of the gameplay experience.
4. [*Hypothesis 4*] Regarding possible interplay, players' *video game genre preferences* and *playing experience* influence the outcome of their gameplay experience.
5. [*Hypothesis 5*] Players' interaction behaviour can provide information regarding their level of understanding of the game mechanics and abilities, both part of the gameplay experience.
6. [*Hypothesis 6*] Eye tracking data can provide information regarding how changes in a video game modify players' visual attention patterns.

Hypotheses 1 is related to the primary research questions, and is founded on the idea that the gameplay experience can be defined according to the interaction between two key elements – the player and the video game – which are supported by multiple dimensions. Based on previous work, these dimensions and characteristics are related to mechanics, interface and narrative in the case of the video game (Rollings & Adams, 2003); and motivations, skills, experience and expectations in the case of the player (Ermi & Mäyrä, 2005).

Hypotheses 2, *3* and *4* are also related on the primary research question, but focus specifically on the outcomes of the interplay between the player and the video game. *Hypothesis 2* predicts that when playing, changes related to a game's mechanics or the interface will influence a player's attitude towards the game, as well as how they interact within the game.

Hypothesis 3 states that in a game situation, player gender is not a decisive factor in the outcome of a player's experience. Specifically, male and female players will report similar experience (namely in motivations and expectations) and also interact in a comparable way in the game. While studies (Erfani, El-Nasr, Milam, Aghabeigi, & Aileen, 2010; Hartmann & Klimmt, 2006; Lucas & Sherry, 2004; Phan, Jardina, Hoyle, & Chaparro, 2012) suggest differences in behaviour and preferences between male and female players; this hypothesis is formulated considering male and female players are beginning to share similar interests between games, and – given the proper situation and playing context – the two genders can enjoy and perform equally in all types of game genres.

Hypothesis 4 looks specifically at playing experience and player preferences regarding video games. Studies (Erfani et al., 2010; Hartmann & Klimmt, 2006; Lucas & Sherry, 2004; Phan et al., 2012) have shown differences in players according to these variables.

This hypothesis assumes these possible differences, where, for example, playing specific games gives players specific abilities. The hypothesis explores how these two variables influence players' attitude towards the game (and its various dimensions), and moreover, how these differences influence how players interact in the game. Therefore, the hypothesis states that the types of games a player enjoys and the time an individual dedicates to playing video games influences the gameplay experience.

Hypothesis 5 states that by looking at how players interacted with other players, and the results of their interactions, can shed light on the extent to which they understood the game mechanics, as well as their skill levels. However, this does not specifically imply the satisfaction resulting from playing is inferior to those who performed differently.

Hypothesis 6 is founded on the idea that eye movement behaviour may vary according to changes in a video game (El-Nasr & Yan, 2006; Jennett et al., 2008). As a result, eye tracking can provide data regarding players' visual attention patterns and understand how this may have contributed to the gameplay experience.

5. DOCUMENT STRUCTURE

This thesis document consists of three main parts, preceded by an *introductory* section and closed by a *conclusions* section.

The introductory section (*current* section of the document) consists in presenting the reader with a contextualization of the relevance of the current study. Following this contextualization, the research question and study objectives which frame the study are presented, followed by the study methodology adopted throughout this work.

The two main parts of the study are: (*i*) the theoretical framework; and (*ii*) the gameplay experience model proposal and empirical validation.

The (*i*) *theoretical framework* consists of three chapters, related to (*a*) 'Video Games and Game Evaluation', (*b*) 'The Gameplay Experience' and (*c*) 'Eye Tracking & Vision'.

The (*ii*) *gameplay experience model proposal and empirical validation* consists in describing the process behind the development of a gameplay experience model proposal. The model was developed according to a literature review and focus group sessions. Posteriorly, the proposed model is explored considering multiple communication theories in order to further explore and justify the presence of several characteristics in the model. The empirical validation section explore the empirical study used to validate the model, which is followed by the presentation and discussion of results.

6. Personal Motivations

Compared to other forms of media and entertainment (*e.g.* music, literature, and film), video games and their supporting industry have been on a constant rise. Video game related sales have surpassed the music and film industry[4], and are steadily closing in on the literature format.

The topic of video games promotes discussions of all sorts. Nonetheless, on a personal level, the debate related to the resulting experience of playing games is the most appealing. This discussion in particular is more interesting and appealing than discussing what video games are, what constitute video games, how video games can be tested, or others.

Naturally, all video game related discussions are important. But when playing video games, what normally matters is the resulting *fun* from. While the discussion of the *experience* of playing games has returned extensive theoretical work, much has yet to be considered.

It is within this frame of mind that this thesis is developed. While recognizing the extensive value of existing work, it is felt that further research is not only necessary, but also valuable. The motivation behind this work is to find where further research on the gameplay experience can be explored, and to attempt to contribute to bridging this possible gap.

On another personal note, the work explored here also considers several topics which are of personal interest. This is especially visible in the eye tracking section. Having worked with eye tracking for several years, there is a personal motivation in further exploring the potential of eye tracking within the context of this study. Specifically, this involves understanding how eye tracking data can be used to analyse particularities of the gameplay experience.

[4] "All the World's a game" (Accessed December 20, 213; *http://www.economist.com/node/21541164*)

1

Part One
Theoretical Framework

CHAPTER 1
VIDEO GAMES

Video games are a form of entertainment enjoyed by all. Creating satisfying experiences from playing games requires that we understand what games are and the ideas behind the medium. In this chapter, video games are discussed in terms of their origin and the multiple visions on the medium. In order to set the basis for a discussion on the experience of playing games, we look at questions related to game and level design, as well as the various components which build a game. Equally important when discussing video games are players, which are also described in this chapter in terms of their possible profile variations. Lastly, ideas related to video game evaluation are discussed, considering their importance in guaranteeing the quality of a game and the resulting experience from playing.

1.1 THE FIRST VIDEO GAME

Condensing the history of video games is by no means a simple task. Although video games and the industry itself are young when compared to others (*e.g.* music and cinema), the history it has written is extensive. As occurs with other media, pointing the origin of the first video game in the direction of one creator is a difficult task (Maillet & de Mayer, 2005). The period that lasted from 1958 to 1972 is a period of experimentation and of discovery; a period where each inventor contributed to the arrival of a 'new form of popular culture'.

The concepts of 'computer' and 'game' were first associated to each other in 1958, via the work of Willy Higinbotham (Maillet & de Mayer, 2005). That year, Higinbotham presented a converted oscilloscope resembling a pinball game. The machine included a speck of light moving across the screen, where players could control its movement with a couple of push buttons. Considering his invention an abstract simulation of tennis, he called his work 'Tennis for Two'. Higinbotham overlooked the applicability of his invention and did not patent his work. Despite the contributions of Higinbotham, the invention of the first video game is usually credited to one of three men: Steve Russell, Ralph Baer and Nolan Bushnell.

In 1962, Steve Russell, while studying at MIT, developed 'Spacewar'. Contrary to Higinbotham, Russell intended to build an application for entertainment purposes (Hunter, 2000). Russell's 'Spacewar' can be described as a cyclical 'appearing and disappearing' of flashes of light on the screen. Nonetheless, his biggest merit was the incorporation of elements that looked like spaceships which could be controlled by two players. 'Spacewar' can be considered the first computer game because it was the first game to be programmed on a computer (Maillet & de Mayer, 2005). Ralph Baer, an engineer and immigrant from Nazi Germany, designed in 1966 a device that could be connected to a TV which allowed him to play a game similar to Ping Pong. Although Baer's game resembled Higibotham's 'Tennis for Two', Baer's version incorporated a larger number of elements. In 1968, Baer developed a new television game: a hockey simulator. Although Baer did not bring great contributions to the nature of video games, he can be considered the founder of the in-home video game (Maillet & de Mayer, 2005). Finally, Nolan Bushnell, the most famous and also the most controversial of the three, developed 'Computer Space' in 1970, a game based on 'Spacewar'. Despite a reduced level of innovation, it did allow breakthroughs in various areas. Contrary to Russell and Baer's games, Bushnell's video game resembled a machine with similarities to that of a pinball machine. The reduced price of computer hardware at the time allowed him to develop the first arcade video game. 'Computer Space' had an extensive visual layout to make it more attractive and, as Bushnell defended, was developed to make money. His attempts to perfect the game resulted in 'Pong'. Although it was not a new game, it was a big hit and the support for a booming industry (Maillet & de Mayer, 2005). Bushnell's work led video games to leave the scientific research sphere and promoted them as content for the general public. At the light of what was described, Bushnell can be considered the founder of the arcade video game.

1.2 Video Games

"Videogames are now the topic of the nascent interdisciplinary field of game studies" (Tavinor, 2008). Within the field, there are multiple perspectives which converge essentially on the 'narratological', 'ludological' and 'interactive fiction' approaches. The 'narratological' approach considers games are equivalent to – or should be treated as – narratives. The 'ludological' approach highlights the gaming nature of video games. The 'interactive fiction' approach deals with the conflict of being related to either narrative or gaming (Tavinor, 2008). While multiple studies and theories can be scrutinized regarding these approaches, these discussions fall out of the scope of this work.

However, the concept of video games is central to this work and some of its particularities are considered. Still, before video games were first considered, individuals engaged in ludic moments through *play* and *games*, topics which will be considered in the following sections.

1.2.1 Play and Games

In the first half of the twentieth century, Johan Huizinga presented 'Homo Ludens' (Huizinga, 1949) which studied the concept of 'play' within cultures which traditionally treated it as inferior to other 'serious' activities (Egenfeldt-Nielsen, Smith, & Tosca, 2008). Huizinga's work presents the idea of the 'magic circle', a *place* that is apart from the outside world. Huizinga's vision is criticized for being *ideological* and setting the idea of play as untouchable by the outside world. In fact, games do pour into other aspects of individuals' lives. While specific actions carried out within a game may not directly relate to real-life, games do have real-life consequences: for example, games require time and can affect and individual's mood and behaviour (Egenfeldt-Nielsen et al., 2008).

In a different approach, Roger Caillois (2006) presented 'Man, Play, and Games', a critique to Huizinga's vision of play. Caillois' interpretation of 'play' suggests it has six essential qualities (Caillois, 2006, p. 128): it is 'free', 'separate', 'uncertain', 'unproductive', 'governed by rules', and 'make-believe'. Caillois further contributed to the debate by proposing a division of games into four categories, depending on their dominant features: 'agôn', 'alea', 'mimicry' and 'ilinx'. Agôn is *competition* related play where a player's skill can determine if he/she is or not successful. Physical sports and action video games are examples of agôn games. Alea is directed by chance; chance dictates who wins a game of lottery or dice. Many video games include an element of chance. Mimicry relates to imitation and the act of *being* someone or something else. Winning is not the most relevant aspect when playing. Mimicry is commonly found in role-playing and adventure games. Ilinx relates to the possibility of experiencing an enjoyable sensation, normally through physical activities. In addition to the four mentioned categories, Caillois defined games as evolving along an axis that includes 'paidia' and 'ludus'. Paidia reflects play which is not bounded by rules; ludus refers to play with formalized rules (Egenfeldt-Nielsen et al., 2008). Figure 1 represents Caillois' game classification, including examples for each of the four proposed categories.

	AGÔN *(Competition)*	ALEA *(Chance)*	MIMICRY *(Simulation)*	ILINX *(Vertigo)*
PAIDIA ↑ Tumult Agitation Immoderate laughter	Racing Wrestling } Not regulated Etc. Athletics	Counting-out rhymes Heads or tails	Children's initiations Games of illusion Tag, Arms, Masks, Disguises	Children "whirling" Horseback riding Swinging Waltzing
Kite-flying Solitaire Patience Crossword puzzles	Boxing, Billiards Fencing, Checkers Football, Chess Contests, Sports in general	Betting Roulette Simple, complex, and continuing lotteries	 Theatre Spectacles in general	Volador Travelling carnivals Skiing Mountain climbing Tightrope walking
↓ **LUDUS**				

Figure 1: Roger Caillois' classification of games
Adapted from Egenfeldt-Nielsen *et al.* (2008)

Huizinga (1949) and Caillois' (2006) work illustrated the complexity of the relationship between play and games. Depending on the desired interpretation, 'play' or 'game' can assume priority over the other. One interpretation suggests games are a subset of play, while a second suggests that play is a component of games (Salen & Zimmerman, 2003).

1.2.2 Definitions of Video Games

Having presented some initial theoretical research regarding 'play' and 'games', attention is now shifted towards some concrete definitions of (video) games.

David Parlett, a game historian who worked closely with card and board games, suggested games have two defining components: 'ends' and 'means'. The 'ends' of a game refer to the idea that a game is a competition with an objective, and where only one player or team can win; 'means' refer to the equipment and the rules of a game. Parlett's work focused mainly on non-electronic games and therefore, his definition is not applicable to many *common* video games (Parlett, 1999, apud Egenfeldt-Nielsen et al., 2008).

Clark Abt (1987, pp. 6–7) presented an additional definition of games: "*reduced to its formal essence, a game is an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context. A more conventional definition would say that a game is a context with rules among adversaries trying to win objectives.*" Abt's definition highlights several four key terms: activity, decision makers, objectives and limited context.

Considering games from an electronic perspective, Chris Crawford (1984) was a foremost author focusing on the idea of video games. In 'The Art of Computer Game Design' (1984), Crawford puts forth a definition of video games which includes four essential features: (*i*) 'representation', related to the idea of games being about something else – some other idea of *reality*; (*ii*) 'interaction', related to the influence a player must have over the game world while receiving significant responses to his actions; (*iii*) 'conflict', related to the idea that all games have goals which are made difficult by obstacles (human or electronic); and (*iv*) 'safety', related to the idea conflicts present in games do not result in the same consequences they would cause in the real world.

Salen & Zimmerman (2003, p. 80) suggest a *"game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome"*. Another definition comes from Jesper Juul (2003, p. 35), stating, *"a game is a rule-based formal system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels attached to the outcome, and the consequences of the activity are optional and negotiable."* Both these definitions refer to the idea that games are a system with quantifiable outcomes (Egenfeldt-Nielsen et al., 2008).

While both definitions present valuable input on the subject, special reference is made to Juul's contribution and the importance of the 'player' as well as his attitude towards the activity (Egenfeldt-Nielsen et al., 2008). Juul's work also results in an attempt to distinguish *games* from *non-games*. Hence, he proposes a model in an attempt to carry out this differentiation. Figure 2 represents Jesper Juul's 'classic game model'.

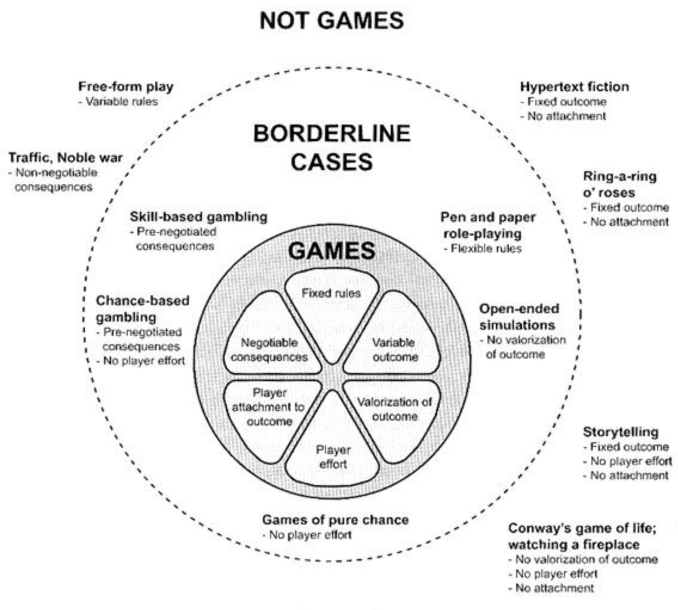

Figure 2: Jesper Juul's 'classic game model'
Adapted from: *http://www.icosilune.com/Research/juul.jpg* [Acessed: June 18, 2013]

Jesper Juul's model considers three levels: (*i*) 'games', based on the classic criteria for a game; (*ii*) 'borderline cases', consisting of examples which are on the border and only slightly follow the classic model; (*iii*) 'not-games' which consists of examples that fall outside of the classic model.

Egenfeldt-Nielsen *et al.* (2008) also consider 'pragmatic' definitions of games. While formal definitions are meant to be a consistent representation, pragmatic definitions seek to be a tool for action rather than solid concepts (Egenfeldt-Nielsen et al., 2008).

Of possible 'pragmatic' definitions, the ideas of Sid Meier are a valuable characterization. Meier states *"a game is a series of interesting choices"* – as presented in Egenfeldt-Nielsen *et al.* (2008, p. 37). However, this definition can be misleading because a game does not stop being a game if it does not having interesting choices (Egenfeldt-Nielsen et al., 2008). Apparently, Meier's approach is most valuable for some genres (strategy) when compared to others (action).

A second approach is embedded within the MDA model, introduced by Hunicke, LeBlanc & Zubek (2004), which divides game into three dimensions: (*i*) 'mechanics', (*ii*) 'dynamics' and (*iii*) 'aesthetics'. Within this model, mechanics refer to the rules and code of the game – the information behind the construction of the game. Dynamics is how the game plays; they are the events that can or do occur during the game. The dynamics of a game are functions of the mechanics. Lastly, aesthetics refer to the emotional responses that arise within the player when playing which can result from, for example, the fantasy of the game, the narrative, challenges, discovery, or others.

1.2.3 A Taxonomy of Video Game Genres

As briefly presented (*cf. p. 19*), games have frequently been classified according to a series of characteristics. A similar strategy has also been adopted with video games. While one vision suggests genre is related to the narrative content of the game (Grace, 2005), other approaches suggest it is related to the gameplay and interactivity (Apperley, 2006; Wolf, 2000). When considering a genre classification according to interactivity, a lack of global consensus still remains.

When video games were still thriving for success, Crawford (1984) proposed an initial classification of video games, divided into *Skill-and-Action* (emphasizing perceptual and motor skills) and *Strategy* (emphasizing cognitive effort) games, each with several subcategories. Crawford included within the Skill-and-Action segment genres such as Combat games, Maze games, Sport games, Paddle games, Race Games and Miscellaneous Games. Crawford classified these games as including real-time play, great emphasis on graphics and sound, and the use of joysticks or paddles rather than a keyboard. Regarding Strategy Games, these included Adventures, D&D Games, War games, Games of Chance, Educational and Children's Games, and Interpersonal Games. This group of games focuses on cognition rather than players' ability to manipulate.

With technological evolution came more assorted video games. Existing categorizations seemed to be unfit for the available diversity and a more diverse classification seemed appropriate. Wolf proposed a total of 42 different video game genres based on *"the dominant characteristics of the interactive experience and the games' goals and objectives, and the nature of the game's player-character and player controls"* (Wolf, 2000, p. 3). Wolf's proposal is extremely widespread, covering specific genres based on almost single characteristics. Wolf's classification presents little concern for categorizing similar game genres, despite indicating there is a relation between multiple genres.

A recent review on video game genres belongs to Rollings & Adams (2003). Contrary to Wolf's categorization, Rollings & Adams limit their proposal to 10 genres (e.g. video game genres: action games, strategy games, role-playing games, sports games, vehicle simulations, construction and management simulations, adventure games, artificial life, puzzle games and online games). A distinctive genre in Rollings & Adams' (2003) categorization is the inclusion of the 'online game' genre, previously not indicated by Wolf (2000). This can be justified considering online video games (in a casual format) expanded after Wolf's initial work. Also, as Rollings & Adams' suggest (2003), some authors may not consider online games as a genre, but rather a technology.

A more recent approach led Lucas & Sherry (2004) to identify – through an analysis of different sources (e.g. literature review, video game magazines, gaming websites and stores) – thirteen different video game genres, namely: strategy, puzzle, fantasy/role playing, action/adventure, sports, simulation games, racing/speed, shooter, fighter, arcade, card/dice, quiz/trivia, and classic board games.

A further theoretical approach on game taxonomies comes from Craig Lindley (2003), who defined several different forms of game classification. One classification is based on a two-dimensional plane, where game genres are related to *simulation*, *ludology* or *narratology*. Another classification introduces *gambling* and a three-dimensional classification space, where simulation, ludology and narratology remain as vertices. A third classification introduces *fictional* and *non-fictional* content, where the original three forms of classification remain. A last form of classification introduces the *virtual* and *physical* components, where the original three classifications also remain.

There are multiple taxonomies and video game genre categorizations. As Crawford (1984) suggests, there is no right or wrong classification. There are various interpretations with differences and similarities, resulting from specific interpretations regarding video games and their characteristics.

1.3 GAME & LEVEL DESIGN

An important part of creating a compelling gameplay experience is the design of the video game. Within the game, the place where the action takes place – the game level – is also a vital component responsible for the outcome of a players' experience. In this section, the concepts of game and level design are considered, while reflecting on their impact on the experience.

1.3.1 Game Design

According to Rollings & Adams (2003), game design is a process of: (*i*) imagining a game; (*ii*) defining the way a game works; (*iii*) describing the elements that make up the game (conceptual, functional, artistic, and others); and (*iv*) transmitting this information to the game development team. While the game development team might be responsible for the development of the game, it is the game designer's job to define these four points. Bateman & Boon (2006, p. 6) present a condensed definition of game design: "*game design is the process of coordinating the evolution of the design of a game*". Bateman & Boon (2006) indicate it is the game designer's task to incorporate the game design components which come from the multiple participants involved in the development of the game (programmers, designers, artists). Additionally, it is their function to incorporate all elements and ensure that together they create the desired gameplay experience.

There is no universal manual which illustrates and reduces the game development process to a set of instructions and processes. "*There is no formula that can be followed to produce a perfect game design, ready for your programming team to code into existence*" (Rollings & Adams, 2003, p. 5). Nonetheless, there are a set of principles and guidelines common to almost all successful games – some of which can be extracted from the heuristics developed by the authors presented in *Section 1.6.3* (*cf. p. 61*). Heuristics are not only useful for evaluating games, but can also be used as a set of principles to develop games.

Despite Rollings & Adams' (2003) description of game design, there is no single definition accepted within the industry. In their approach, these authors break down game design into three core areas: (*i*) 'mechanics', (*ii*) 'storytelling' and (*iii*) 'interactivity' – three distinct but complementary elements of a game. Figure 3 represents a depiction of their game design approach.

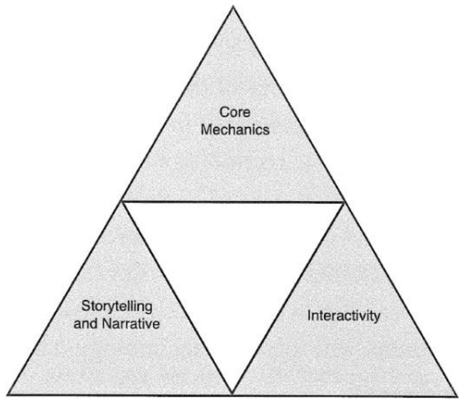

Figure 3: Game Design components: core mechanics, interactivity, and storytelling
Adapted from: Rollings & Adams (2003, p. 9)

The (*i*) core mechanics of the game can be understood as the rules that control the operation of the game world – they are the rules interpreted by the computer, based on a designer's vision for the game. Therefore, the core mechanics are the science part of the game; the way in which the game world works (Rollings & Adams, 2003, p. 9). The core mechanics are the heart and soul of the game, such that if they aren't properly executed, the game will most likely be weak. The (*ii*) story and narrative is also part of game design. Rollings & Adams (2003) suggest all games have a story, and the depth of a story will depend on the game itself. Some games are so 'complex' that they are the story; others, such as Tetris, will have a story created by the player. Narrative, on the other hand, deals with the part of the story told by the designer to the player and is non-interactive. The story is an important part of the game design because without story, or without a way for a story to be created, the player will more likely lose interest in the game. The (*iii*) interactivity of a video game deals with the way the player sees, hears, and acts within the game's world. In other words, it deals with the way the player plays the game. The interactivity component of the game design covers several aspects of the game: graphics, sounds, user interface; that is, the components that together form the gaming experience (Rollings & Adams, 2003).

1.3.2 Level Design

Level Design deals with creating a piece of a greater whole (Bates, 2004, p. 107). Commonly, *level* refers to the 'game world' of side-scroller games, First-person shooters, adventure, and role-playing games (R. Rouse, 2001, p. 408). While early games only had one level, others – including the classic 'Pac Man' – have multiple levels (in the case of 'Pac Man', the various mazes constitute the levels). For specific types of games, levels may refer to different aspects. In a racing game, the level can be considered as the different tracks which are raced; in a sports game, it may be the stadium in which the match takes place.

Lecky-Thompson (2007) categorizes game levels into two types: (*i*) goal oriented and (*ii*) scenario-based. In goal oriented levels, specific objectives (or goals) must be achieved. These goals may be defeating an opponent in a fighting game or finishing a racing game in 1st place. However, finishing a game race may be part of a larger context. If variables such as improving the vehicle, winning a championship or any other goal that goes beyond any immediate goal, then the level is scenario-based. Lecky-Thompson (2007) indicates that "*it is difficult to imagine a complex goal that doesn't become scenario based. These two broad categories do overlap in a gray area, such as in some games that, when many little goals are achieved, culminate in a final goal—and all laid out in scenario fashion."* Regardless of the type, the goal of every game level should be to provide an appealing gameplay experience for the player.

Bates (2004, p. 107) suggests that once a level designer begins to think about his work, he must consider why it is there in the first place, and understand the function it fulfils in the grander scheme of things. In fact, it is the level designer's job to create the game-world in which the gameplay takes place, to build the spaces which are fun for the player (R. Rouse, 2001, p. 407).

Bates (2004) identifies six factors which contribute to a positive level design. Bates doesn't speak exclusively of aesthetic features, but also of how the elements of the game level are presented to the player: (*i*) goals; (*ii*) structure and progression; (*iii*) flow control; (*iv*) degree of difficulty; (*v*) balance; and (*vi*) puzzles.

i. ***Goals***. Player goals – and assuring he/she knows what they are – are an important part of the level design. This can be done by introducing the goals before beginning the level, or by a screen that can be activated during gameplay.

ii. ***Structure and progression***. The game should ease players into the level and build up the difficulty afterwards. The challenges of a game should not be introduced randomly, as there should be a pace at which they occur. "*There should be times when he's frantically trying to stay alive, other times when he's warily exploring, and still other times when he's safe and able to absorb the information he's gathered*". (Bates, 2004, p. 113).

iii. ***Flow control***. Flow control deals with two specific problems that occur with single-player level designs: (*i*) how to contain a player in an area of the level until he completes a given objective; (*ii*) how to close off an area of the level once the player is done with it.

iv. ***Degree of difficulty***. A single-player level should never be so hard that the player keeps dying again and again (Bates, 2004, p. 114). The degree of difficulty is concerned with providing challenges in the level but not making them so difficult only expert players can survive the challenges. Designing for more experienced gamers is one option, but other players should always be considered. While expert players enjoy increased challenges, other players will consider them as frustrating and unfair (Bates, 2004), experiencing a sensation of anxiety because the challenge is difficult and their skills are incapable of responding to the challenge.

v. ***Balance***. A game level should contain a balanced number of resources. For example, a player in a First-person shooter game should worry about 'health' and 'ammunition', but there shouldn't be a scarce quantity of these resources such that the player spends most of the time searching for them and trying to survive. Balancing risk and reward is also important. Using the First-person shooter example once again, a more potent and dangerous weapon should be harder to acquire and a location of greater value for the player should be harder to access.

vi. ***Puzzles***. Puzzles refer to a problem common in many games: players not knowing where puzzles (goals) are. In some games, for example, a player may kill all of his enemies but still be left wondering why he can't continue the game. At this point, the player will either give up or use one of many CMC options (forums, chat with other players) to understand how to continue the game. Only then will he understand the detail that he missed.

Rouse (2001) also presents a list of level components, some of which are similar to those presented by Bates (2004). His list of components includes: (*i*) action; (*ii*) exploration; (*iii*) puzzle solving; (*iv*) storytelling; (*v*) aesthetics; and (*vi*) balance.

i. ***Action*** can be considered one of the main components of game levels, and for many of these, it is the only reason for the level to exist. While some games completely overlook action (*e.g.* puzzle games); the greater portion of video games relies on action, whether it be shooting enemies in an FPS, or racing past opponents in a racing simulator. It is the level designer's job to determine how much action each level contains and at what pace the action occurs. Finally, the amount and pace of the action is also dependent of the type of game at hand. Understanding the type of action that the game will have is important to designing levels that can bring out the best in action gameplay (R. Rouse, 2001, p. 413).

ii. ***Exploration*** is another component and reflects upon what the player does when he is not 'head-deep' in action. Exploring the level can be interesting if the level isn't simply a road between two places of action. Rouse (2001, p. 414) questions: "*How much fun is exploring architecture with which you are already painfully familiar? Always try to keep in mind that for a player experiencing a map for the first time, the thrill of exploring a new virtual world can be quite stimulating. (…) Making exciting exploration a part of your game goes beyond creating exciting architecture for the player. It is also determined by how the level flows (…)*".

iii. ***Puzzle solving*** is another component indicated by Rouse (2001), similar to the ideas presented by Bates (2004).

iv. ***Storytelling*** as part of level design deals with focusing on making the game level and story work together. This is important because, for some games, levels are a central part of telling a game's story. In some games, it may be necessary to interact with a game character in a certain level, and setting up the level to support the appearance of the character is important.

v. The ***aesthetics*** of the level deal with how a level looks and sounds. For many games, "*a level's appearance is crucial to its overall success*" (R. Rouse, 2001, p. 417). However, if a designer dedicates too much time to aesthetics, overlooking gameplay, the game might not be successful. Great quantities of time and money may be spent on the aesthetics component of a level, but it is the level designer's task to understand how the aesthetics influence the gameplay.

vi. Finally, the ***balance*** component deals with simply balancing all the other components mentioned previously.

1.3.3 Gaming Experiences & Level Design

In addition to the factors presented by Bates (2004) and Rouse (2001) on the design of video game levels, these can also be considered in terms of how they can create positive gaming experiences.

Kremers (2009, p. 142) writes extensively on the importance of immersion – one of multiple game experiences – in level design. A level designer can't simply focus on gameplay mechanisms; he/she has to create a connection between the player and the game world in a way that is natural and not overly forced. A game level has to be able to captivate the player and guarantee they want to spend time in a fictional world. This exercise can be done in two ways: positively, by providing an attractive and engaging environment or negatively, by providing – as Kremers (2009, p. 143) defines – a *nightmarish dreamscape.* Providing game experiences through level design can be achieved through many forms. While Kremers' (2009) ideas are essentially focused on immersion, they can also be applied to other gaming experiences.

An important concept which cannot be overlooked when studying gaming experience and level design is the 'zone'; a concept intimately connected to the experience of Flow (*cf.* Section 2.3 – Flow, p. 72). The *zone* is an idea that remits to a state of mind in which players are completely immersed and entertained with a game. In this state, player/game interaction is completely harmonious. In such a state, players might reach the peak of their abilities. However, as Kremers (2009) describes being in *the zone* as being deeply *engaged* with a game; it is a place *where* players are completely immersed in their activity. Keeping players in the zone, which is to say in an immersed state of mind or in *flow*, is key to level design. "*An immersed player is a happy player, and a happy player is much more receptive to what the game has to offer*" (Kremers, 2009, p. 147).

In order to *capture* the player – to lead him/her into a state of immersion or into 'the zone' – Kremers believes players should be given *what they want*. This idea is intimately connected to game genres; *i.e.*, when an individual plays a First-person shooter, he/she wants to 'shoot' enemies; when an individual plays an adventure game, he/she wants to 'explore'. Understanding what a player wants is a first step in developing both a successful game and game level.

Another element of value to the player is 'historical grounding' (Kremers, 2009, p. 149). Kremers speaks of the importance of a player's history when *analysing* an environment. A connection between the game and the player may occur when the player is in the presence of a *natural* environment, rather than 'man-made'. When the (game) environment doesn't feel natural or leads the player to notice that something is missing from it, there is a greater chance of disconnection. Therefore, immersive experiences can benefit from the creation of game worlds that connect to the player and feel natural. If designers play other games of a similar genre or talk with fellow game designers – two ideas suggested by Licht (2003) – they'll have acquire a greater understanding of what can help solidify a historical grounding.

A level's game logic is also essential in the creation of an immersive experience. *Believability* is a key word here (Kremers, 2009). While a game has its share of imaginative requirements, a level designer cannot arbitrarily design and incorporate ideas if they don't follow a certain game logic. As Kremers (2009, p. 151) puts it, "*there are certain conceits that an audience is willing to put up with, even if they are not realistic in the real world, as long as they link into the game's reality in a logical and consistent manner*."

The value of information within a game level is also discussed by Kremers (2009). Level designers need to understand that every 'scene or shot' contains information, despite its level of interest. The important question to be considered is: what information do they want to convey to the player?

In theory, every visual decision made by the designer will make an impact, even the most basic decisions related to the placement of items in the level. Other information in the form of 'cut scenes' can convey information related to what the player might encounter throughout the level. For example, the use of a night/day cycle might inform the player that at night, danger is imminent and that when the sun rises, danger levels will decrease. The use of darkness and light can also transmit different types of senses. Using darkness is normally associated to creating fear while light is used to create safety.

The visual style of the game is not merely aesthetics related, but influences gameplay as well. Realism and stylized expression are two ideas related to a game's visual style. A realistic style is something that feels real. Information towards the development of this style can be found in the 'real world'. However, representing a real world can be problematic. In a real world, the player creates expectations and these must be met so that the environment is convincing. For example, in realistic worlds, the player expects doors to open and swing. The same idea is applicable to the artificial intelligence of game characters. The use of a stylized level requires less detail. This type of level is faster to create and easier to change which is a positive aspect in the prototyping phase.

In addition to the mentioned elements, ambience and atmospherics also play a role in creating immersive experiences. In fact, these components can take levels that feel *boring* and make them deeply engaging environments. Kremers (2009, p. 154) distinguishes ambience with atmospherics, indicating that ambience is related to 'location spots' while atmospherics deals with mood amplification.

Regarding ambience, examples which can contribute towards this element are (Kremers, 2009): (*i*) ambient sounds; (*ii*) ambient lighting; (*iii*) particle effects; and (*iv*) props.

i. ***Ambient sounds*** are common within game levels, where in certain places and spaces; the game presents the player with sounds. On a mountain one might hear wind while in a cave, water drips are heard. Kremers (2009, p. 155) indicates that these recorded sounds don't merely have a documentary quality but also, have psycho-acoustic qualities, indicating that they have an effect on the player's psychological interpretation of sound. The (correct) selection of ambient sounds gives level designers a way to manipulate a player's experience.

ii. ***Ambient lighting*** in game levels is of relevance because it is all artificial. However, there are tricks to make artificially created light and make it appear natural. The goal of lighting, in addition to illuminating a space, is to support it. In some cases, this means making sure the gameplay works well but it can also relate to enhancing the level's ambience (Kremers, 2009). In most cases, this is done by making sure that when and wherever possible, lighting is being emitted by *natural* sources, such as the sun, light bulbs or computer monitors.

iii. ***Particle effects*** can contribute to the natural feel of an environment. These effects can be rain, smoke and fire or steam coming from vents. When these effects are part of the gameplay and not simply decorative elements, a more immersive experience may be felt.

iv. ***Props*** serve to populate a space. In any natural environment, objects can be found almost everywhere. In game levels, the use of props as decorative items is important. However, if they are incorporated into gameplay, there is a deeper impact.

In terms of atmospherics, these deal with enhancing the mood of the level and the experience as a whole. These can be divided into additions or enhancements. Atmospheric additions are elements foreign to the game world which are added to create the desired atmosphere. There are many types of additions which can vary among game genres. Kremers (2009) suggests: (*i*) *music*; (*ii*) *voiceover*; (*iii*) *cut scenes* and *scripted events*.

i. The inclusion of ***music***, an element very uncommon and foreign to game worlds can deepen immersion. As occurs with movies, the use of music in game levels can create a deeper connection with the level.

ii. The use of ***voiceover*** is not something uncommon in games and is thought to be very effective. Its application can in fact turn a common game into a more exciting experience. For example, in a sports game, the use of voiceover in commentary can lead to a greater sense of enjoyment. Commentary associated with ambient sounds (applauses, supporter chants) can even be more rewarding.

iii. The use of ***cut scenes and scripted events*** in video games has become a commonly applied atmospheric addition. In video games, cut scenes are normally cinematic sequences over which the player has no control. Despite the lack of control may cut away from immersion, the use of interactive cut scenes can have the opposite effect. Interactive cut scenes have been used, for example, in later First-person shooter games (*e.g.* Call of Duty: Modern Warfare 2), where players have some interactive control during a cut scene.

Atmospheric enhancements deal with selecting previously existing elements and enhancing them to create a more atmospheric experience. 'Lighting' is one example of an enhancement, and can assume two functions: (*i*) determine what the player can see; and (*ii*) colour the perception of what players see. The second function has a greater role in the creation of immersion.

1.4 BUILDING BLOCKS OF VIDEO GAMES

According to various authors (Hunicke *et al.*, 2004; Rollings & Adams, 2003; Takatalo *et al.*, 2010), a video game is made up of different components. A game may consist in the mechanics, dynamics and aesthetics (Hunicke *et al.*, 2004) – or interface, according to Takatalo *et al.* (2010). Rollings & Adams (2003) indicate a video game includes mechanics, storytelling and interactivity. Across interpretations, these elements commonly have a similar definition.

Mechanics include the goals of a game, the rules by which players play and rewards given, as well as choices given to players. In a digital game context, mechanics have a stronger relation to the algorithms and rules interpreted by the computer regarding how the game world operates (Hunicke *et al.*, 2004). Taking into account this interpretation; the concepts of *goals*, *rules* and *rewards* are presented in further detail.

GOALS

Video game *goals* is a broad term contemplating the *objectives*, *tasks* and *challenges* a player encounters when playing a video game. Björk & Holopainen (2006, p. 417) state "*the aim of players' plans and actions in a game are usually described as trying to complete goals.*" A player can only fully play a game if he knows what the goals are. Therefore, the goals of a game and all supporting objectives, tasks or challenges should be clear to the player.

Furthermore, the difficulty of the goals is relevant and may influence a player's experience. An excessively easy goal may leave the player uninterested and unmotivated to continue to play the video game. The same occurs for excessively difficult goals, which may frustrate the player. In either case, a lack of *balanced* difficulty may lead the player to quit the game. The balance can be found in situations where goals are challenging and incrementally difficult. As Rouse (2001) defends, during the act of game play, a player will expect to fail, but will also expect a fair chance to complete the goals.

Once a player understands the goals which must be completed in the game, it is important the player be informed on his progression towards accomplishing those goals. One way to do this is through the use of *sub-goals* (*e.g.* tasks, challenges), communicated to the player in the same manner as the main goal (R. Rouse, 2001). Naturally, main goals can be sub-divided into as many smaller objectives, challenges or tasks as necessary. However, it is important they help the player understand he is on the right track towards completing the main goal, rather than overwhelming the player and disrupting his experience. These sub-goals are a form of *feedback*, as they guide the player in the proper direction, but also inform him he is on the proper route towards that goal. Without these sub-goals that help the player maintain course, he may lose track and become frustrated (R. Rouse, 2001). Additionally, the execution of these sub-goals should be rewarded, just as the main goal would be, but with a reward of proportional dimension.

RULES

Of all video game related components, *rules* are arguably the most significant. In a formal manner, *game rules* are *"an imperative governing the interaction of game objects and the possible outcome of this interaction"* (Egenfeldt-Nielsen et al., 2008, p. 100). Rules are shared by everything commonly understood as a game, and set games apart from other forms of media (Egenfeldt-Nielsen et al., 2008). Relevant to game rules is the fact that these are not connected to one single type of material. Therefore, game rules are *transmedial* (Egenfeldt-Nielsen et al., 2008; Juul, 2011).

For many games – as exemplified with 'Chess' (Egenfeldt-Nielsen et al., 2008) – the game does not rely on specific coloured pieces moving on a physical board game. The chess pieces can be played using figurines or other representative elements, and played upon some other type of board. As a result, it does not matter how and where you choose to 'represent the chess conflict'; as long as the rules are followed, chess is still being played. However, this idea does not suggest a game and its rules can be transferred to any medium. The transmedial nature of games only suggests that while a game cannot be played on any medium, a game is not tied to one specific medium (Egenfeldt-Nielsen et al., 2008, p. 99).

While players will debate how rules confine the enjoyment of a game, an indispensable quality of rules is they necessarily limit players' actions (Salen & Zimmerman, 2003). Rules are often frowned upon, and in some cases players will look to find ways to bend or avoid game rules. Nonetheless, game rules should be accepted as a valuable game characteristic. As Egenfeldt-Nielsen *et al.* (2008) defend, these *limitations* are what shape the game; they aid in challenging the player and enable the player to feel satisfaction when goals are completed.

Video game rules have been interpreted according to several views. Borrowing the work of Roger Caillois (2006), Frasca (2003) divided rules into two categories: (*i*) *ludus* rules, relating to the conditions in which a player wins, and (*ii*) *paidia* rules, relating to the game procedures.

A second interpretation comes from Jesper Juul (2011), with a classification of rules into three levels, and summarized as follows (Egenfeldt-Nielsen et al., 2008, p. 100): (*i*) *game state* rules, referring to those that cover the basic aspects of games; (*ii*) *outcome valorization* rules, referring to rules which define outcomes considered positive and those considered negative; and (*iii*) *information rules*, which determine what information a player receives during play about the game. In both interpretations, there is a separation between rules dealing with game *processes* and those related to a game's *outcome*.

A third interpretation of rules is Salen & Zimmerman's (2003), with three types of rules, summarized as (Egenfeldt-Nielsen et al., 2008, p. 101): (*i*) *operational* rules, typically described as the rules of the game (these are a combination of Juul's (2011) 'game state' and 'outcome valorization' rules, which manage a game's processes and the conditions for victory); (*ii*) *constitutive* rules, which are the underlying formal structures of a game which define its basic dynamics; and (*iii*) *implicit* rules, which are all the unwritten rules taken for granted when playing a game.

Salen & Zimmerman's (2003) interpretation of rules work well with *non-digital* games, but must be approached with caution for digital games. As Egenfeldt-Nielsen *et al.* (2008) exemplify, with games of complex nature, the idea of *constitutive* rules is not easily applicable. Egenfeldt-Nielsen *et al.* (2008) summarize rules in two categories: (*i*) *interplay* rules, which determine the relations and properties of elements in a game; these correspond to the physical laws of the game space and determine what can be done and what happens upon player input; (*ii*) *evaluation* rules determine what occurrences are rewarded and which are punished.

REWARDS

Rewards are what players receive when they completes game goals, specific objectives, tasks or challenges. *Rewards* can come in the form of lives, money, or objects which can be used throughout the progression of the game, for example.

Rewards can vary in multiple ways and should be adapted to specific situations. Within a learning period, rewards are important because they let the player know that he is establishing progress within the game, and consequently, encourages continuous playing: "*The player of a video game is happy to face the challenges the game offers – if there are rewards for doing so*" (Kremers, 2009, p. 113). Establishing a correct balance between what a video game requires from a player and how the game rewards that effort is important. If a game insufficiently rewards a player after requiring great work to complete a challenge, the player may feel cheated and unsatisfied. Contrary, if the game rewards in excess for an insignificant task, the player may begin to expect this type of reward throughout the entire game. Furthermore, an excess in rewards for completing certain tasks may lead to a loss of interest or motivation. Paradoxically, excessive rewards may become a barrier to a more rewarding experience if the player is constantly given rewards and his skills are not 'put to the test'. In a shooting game, for example, if a player is constantly being rewarded with extra ammunition or if the ammunition is always accessible, the level of challenge is limited. In such a case, the effort required to play becomes reduced and the player is unable to explore his skills and potential.

The ***Interface*** of a video game refers to the most visible of game components, including what players see and hear in the game, as well as the interface through which they interact with the game world (Takatalo *et al.*, 2010). Taking into account this interpretation, the concepts of *visuals*, *audio*, *input*, and *feedback* are presented in further detail.

VISUALS

The *visuals* of a game are related to how the game *looks*. Video game visuals can be two (2D) or three-dimensional (3D); they can be more or less similar to the real-world and real-world objects or stylized according to a certain theme. Also, the visuals of a video game can be related to both the *space* (game world or level) in which all the action takes place, as well as the additional layer of information found within many games: the *Heads-up display* (HUD).

The visuals of a game have been given a growing importance throughout the years due to the technological progression of computers, consoles, handhelds and mobile devices. However, the importance of game visuals depends on players' preferences and the game itself.

Almost all games today are bounded by a visual component, developed to a greater or less extent, more or less a copy of the *real world*, more or less capable of making the player feel he is an actual part of the game. However, the game visuals will not normally assume a primary importance in the game, when compared to other characteristics such as those from the *Mechanics*. A visually appealing video game will be simply that, if it is not accompanied by motivating *goals*, clear *rules* and balanced *rewards*. A player may be seduced by the beauty of the game, but if it the visuals aren't *consistent*, they may become lost within the confusion of its mechanics. This detail is evident when video games such as 'Tetris' are considered. These games are limited in terms of *visuals*, but are capable of creating a compelling experience, based on their mechanics and the attention they require from the player.

With advances in technology, developers have been able to invest in multiple forms of attracting the players' attention towards the game and create a more visually captivating experience. The use of different visual styles is one technique through which this is done, normally through the use of a *realism* approach or a *stylized* approach (Kremers, 2009). With a *realistic* style, the real world is used as inspiration. Here, a player can easily connect with the game because the visuals correspond to what is part of the gamer's everyday life. Simultaneously, a *realistic* style has its disadvantages, namely related to the level of detail. A *realistic* style requires a bigger concern for detail. When a video game attempts to replicate a real life scenario, players may tend to be more demanding for a convincing environment. If this is not met, players may feel disappointed and lose motivation. A *realistic* style can be applied to both the scenario as well as its characters. With a realistic approach, players may look for more realistic characters, with human-like emotions and behaviours. If a game is based on a *stylized* approach, it benefits from the possibility of extra creativity. The game is not limited to 'real life' imitations, but rather to the designers' imagination. However, stylized games can also suffer from players not being able to find any type of reference within the game. A stylized game may become so abstract that the player finds himself lost and without knowing how to interact with this type of game world.

The visual design of a game can also play a role in the quality of the player's experience (Kremers, 2009). The use of darkness and light can help create the *feeling* of the game as a whole or a specific scenario. Darkness is commonly used to create a sense of fear and unease. The use of darkness implies that a player loses the capacity to see all that is around him. As a result, the player can also lose a sense of *control* which may be important to him. When darkness is combined with adequate sound effects and even a complementary music score, a true sense of *fear* may arise within the player. Darkness can also be used for gameplay itself, serving as a means of cover in games where exploration is important. Contrary to darkness, the use of light creates a sense of safety and calmness.

In addition to how the game visually looks, the perspective through which the players look at the game can also play a role in how the game is experienced. Here, the type of camera used is worth discussing. The camera system of a game is the medium through which the player views the game and provides the visual data the game wants the player to receive (Kremers, 2009). There are essentially two types of camera approaches: (*i*) First Person and (*ii*) Third Person.

In a First Person (FP) camera perspective, the game world is seen from the view of the character being controlled, as if the player's eyes were those of the character. In a *FP* perspective, two variations can be considered (Kremers, 2009): (*i*) *on rails*, where the camera moves on a predetermined course and the player has reduced control over the direction it looks at; and (*ii*) *player controlled*, where the player controls the movement and direction of the camera. Many popular shooting games today are played from this First Person perspective, hence the designation 'First-person shooter' (*e.g.* 'Doom', 'Wolfstein 3D', games from the 'Battlefield' series, the 'Call of Duty' series, among many others). The *player controlled* perspective allows greater control and possibilities to the player, which requires the game environment to be prepared for all these possibilities.

A Third Person (TP) camera perspective can be seen as a camera which floats around the player. From a TP perspective, several variations can be considered (Kremers, 2009): (i) *side-on*, where the camera tracks the player from a 2D plane; (ii) *third person free-cam* and *follow-cam*, where the player can freely move the camera from multiple angles (free-cam) or where the camera follows the player around, without being limited to a single plane (follow-cam); and *placed*, where the camera is fixed in a 3D space, but doesn't move around with the player's position.

Focusing on a different aspect of the visuals, the *Heads-up display* (HUD) can play an equally important role in how a player experiences the game. The HUD is an important layer of visual information found in the majority of games, and presents – depending on the game – information regarding 'player health', 'resources', 'time', and 'game progression', among others. The importance of the HUD is undeniable as it contains important information and provides feedback. However, many will criticize the fact that the game HUD will interfere with the gameplay and serves as a distraction. As a result, strategies to minimize the HUD or embed it into the actual game have been developed. An example is that of 'Far Cry 2'[5], where much of the information you would find on a traditional HUD is placed on actual objects that the player carries around (*e.g.* the player's position in the world is seen on an actual map the character opens up). Other games are HUD free or may allow a player to customize the information he wants to see.

[5] Far Cry 2 is an open world First-Person shooter developed by 'Ubisoft' and released in 2008. Official website: *http://www.ubi.com/US/Games/Info.aspx?pId=5925* [Accessed: October 21, 2013]

Independently of these player preferences, the HUD is a primary source of information and gives *feedback* regarding the player's progression. A well developed and integrated HUD can be important in keeping the player focused on the game and always aware of his progress. However, an intrusive HUD may distract the player from his objective of playing and leave him wondering about his in-game state.

AUDIO

The audio of a game are the *sounds*, *sound effects* and *music* of a game. The audio is a game characteristic which may be considered second to the visuals of a game in value. However, in many scenarios, it is comparable in terms of its importance in creating an atmosphere and for player feedback (Rollings & Adams, 2003).

Audio has always been an important part of video games (Alves, 2012). Either through specific sounds or music, audio has contributed to the way in which the player experiences the game. Some of the most memorable games are so because of their music. For example, 'Super Mario Bros.' contains some of the most recognized music and sounds, namely its theme song[6]. Another example is the theme song of 'Sonic the Hedgehog'[7]. However, through the years, these theme songs played in loop are being replaced and complemented by complete soundtracks and scores composed originally for the purpose of the game (*e.g.* Hans Zimmer composed an original score for 'Call of Duty: Modern Warfare 2'[8]).

The way in which a game's audio plays a role in the experience of playing a game requires a more thorough look at the multiple types of audio. A first division is *diegetic* and *non-diegetic* sound (Kremers, 2009). *Diegetic* sounds refer to those originating from the "*actions visible onscreen, or when the sound is explained by the implied sources coming from the film environment*" (*e.g.* dialogue, objects in the set, the weather). *Non-diegetic* sound refers to those originating outside of the *world* and without direct connection to onscreen action (*e.g.* voiceovers, mood music).

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[6] 'Super Mario Bros.' theme song available to hear at: *http://www.youtube.com/watch?v=uhscMsBhNhw* [Accessed: January 18, 2013]

[7] 'Sonic the Hedgehog' theme song available to hear at: *http://www.youtube.com/watch?v=UEannNh8ih* [Accessed: January 18, 2013]

[8] Information page from Hans Zimmer's official site: *http://www.hans-zimmer.com/index.php?rub=disco&id=962* [Accessed: October 21, 2013]

Another possible division is *music* and *non-music* (Kremers, 2009). *Music* includes (*i*) 'mood music', (*ii*) 'original score' and (*iii*) 'soundtrack': (*i*) *Mood music* is music that is created to enhance specific moments within the game; (*ii*) an *original* score is music that is specifically written and recorded for the work, as exemplified with the score for 'Call of Duty: Modern Warfare 2', among many others; a (*iii*) soundtrack is a number of songs used in the game, not necessarily having been specifically written for the game (*e.g.* the soundtrack for 'Grand Theft Auto: San Andreas'[9]). *Non-music* refers to sound that doesn't consist in music and includes (*i*) *sound effects*, (*ii*) *incidental sound* and (*iii*) *ambient sounds*: (*i*) *sound effects* are sounds used to emphasize actions on physical things (*e.g.* in the case of 'Super Mario Bros.', when 'Mario' jumps and breaks a brick, the noise heard is a sound effect); (ii) *incidental sounds* are sounds designed to give power to certain states of the viewer – they are not natural, but created for the incidental purposed; (*iii*) *ambient* sounds are related to the game's environment, and help define the environment in which the player is inserted.

While no hierarchy can be made on the importance of these types of sounds and music in a game-context, undoubtedly sound effects are one type of audio that cross across almost all games and play an important role in each. A game's sound effects can have multiple uses and will vary from genre to genre and from game to game. An essential function of sound effects is to *communicate* some sort of information and to give *feedback* regarding a player's actions in the game world.

As occurs in nature, within a game context, sound effects and changes in music may be the first sign that something is about to happen; the sound will communicate an incoming event the player should pay attention to. For example, in a shooter game, the sound of gunfire or explosions in the game environment can be a sign of an imminent enemy attack. Some games use changes in music – *adaptive* music (Rollings & Adams, 2003) – to indicate the mood of the game-environment. The use of adaptive music is to play a varying tune which anticipates the player's actions as well as the upcoming events, accentuating the player's actions.

Furthermore, if the player is able to act upon the event, sound effects may be used to give feedback regarding the outcome of the player's actions. Returning to the shooting game example, the type of sound effects a gun makes can serve as feedback regarding the state of the player's ammunition: while a player is shooting, the sound the gun makes is of one type; when the gun has no ammunition, the gun makes a different sound, indicating the player must *reload*. Another example of sound effects as feedback is from racing games, where the sounds of the engine can indicate the player should change gear.

[9] Information on the Grand Theft Auto: San Andreas soundtrack at official website *http://www.rockstargames.com/sanandreas/* [Accessed: October 21, 2013]

The design of a game's audio can play an important role in how a player experiences a game. As occurs with other media – such as movies – music and sound effects can help make a game more realistic; they can help absorb the player and set the mood, making the player feel he is embedded within the game he is playing. Naturally, this is only applicable to some games. In less complex games or those played on mobile devices, sound effects are an important layer of information, giving life to the game and making it more enjoyable to play, as long as they are framed within the nature of the game. Lastly, and contrary to visuals – which are what we see – a game can be played and create a satisfying experience without audio. Many games distributed for one or more platforms can be played without sound and still have the capacity to create a pleasant experience.

INPUT

The *Input* of the game relates to how a player physically interacts with a game through technological support: using a keyboard and/or mouse, a joystick, a gamepad, direct interaction with a device, physical movements that are captured, or others.

The input system of a game should be designed for a player to be able to control and understand the game effortlessly. Effortless input should not be confused with simplified input. While, many games can be played with a single input device (*e.g.* a game controller), other games require the use of multiple input devices (*e.g.* mouse and keyboard). A well designed input system can be a first step towards a satisfying experience such that the player may feel the input process as something natural. However, poorly designed input systems may lead to a frustrating experience. Rouse (2001, p. 136) states, "*nothing is more frustrating than, as a player, knowing exactly what you want your game-world character to do but being unable to actually get him to do that because the controls will not let you.*" He adds to this thought by referring that for a player to have an immersive experience, the player should be able to manipulate the game world in an intuitive manner, without thinking about what button should be pressed to complete a specific action.

Successful input design can easily lead to a more satisfying experience. Many video games of comparable genres will commonly use a similar input design which a player will easily learn, and posteriorly use in future games. When playing a new game of an equal genre, a player may also *expect* a certain type of input for that game. For example, for many First-person shooters, input design has been steered toward the use of the 'WASD' keys for primary character movement: W/S for forwards/backwards and A/D for left/right. The use of these keys over the traditional arrow keys has the advantage of: (*i*) they are more comfortable to use when input with a mouse is necessary; and (*ii*) the 'WASD' keys are close to other keys which can be used for additional player functions.

As referred, and within the same example, it is frequent for surrounding keys to be used for other game functions: 'R' for reloading a weapon; 'C' for crouching; 'Left Shift' for running/sprinting; 'Space bar' for jumping; number keys (*e.g.* 1,2,3) for weapon selection; 'Tab' for additional game information and 'T' for talking. Many of these key combinations have been standardized within this game genre and often are expected. For many, these combinations are natural and require no effort. They are rooted within the player's memory and become a personal preference when playing.

The input of a game can also be influence by a player's ability in multiple cases. Many games only require the use of one or two key inputs; more complex games require the simultaneous use of multiple key and mouse inputs. Other *physical* video games, such as those developed for 'Nintendo Wii' or 'Kinect' require a different type of ability, as the input is different from traditional mechanical devices.

FEEDBACK

As occurs with almost any action carried out in an individual's day-to-day process, within a game context, *feedback* assumes an important role in creating and maintaining a positive gameplay experience. Just as important as being able to *control* and take *action* on the game world, is the game-world's response to these actions. A well designed output system that communicates essential information to the player is important for a good experience (R. Rouse, 2001). The depth and relevance of feedback may vary from game to game but is, nevertheless, important in maintaining the player conscious of his progression, his current state or other valuable information (depending on the type of game being played).

In the simplest of games, such as classic 'Pac-Man'[10], feedback regarding player progression is presented with the *disappearance* of the 'pac-dots' when the character Pac-Man passes through them, indicating they have been eaten. In a different game, such as the other classic 'Doom', important feedback is related to, for example, a player's *remaining ammunition* and *health*. Without this information, a player is unable to manage his style of play and know what type of actions to do in the game-world. Figure 4 represents an image from the 1983 shooter game 'Doom', where feedback related to the player's remaining 'ammo' and 'health' are visible in the game interface (HUD).

[10] Pac-Man is a 1980 arcade game developed by 'Namco'

Figure 4: Screenshot from the 1983 First-person shooter 'Doom'
Retrieved from: *http://www.gamespot.com/doom/summary/* [Accessed: January 4, 2014]

Rouse (2001) further exemplifies with the case of a strategy game, where a player may have several units scattered over a large map which is not completely visible to the player. He refers that if non-visible units to the player are attacked and the player isn't informed of that occurrence by the game, the player will possibly become frustrated. Rouse (2001, p. 141) questions, *"Why should the player have to guess at such game-critical information?"* Rouse (2001) acknowledges, however, that all games will conceal information from the player because it is not possible for the game to communicate everything about the game-world. In many games, the player himself is incapable of dealing with all possible information regarding the game. Nonetheless, the game "*must communicate what is reasonable for the player's character to know, and communicate that data effectively*" (R. Rouse, 2001, p. 141).

The complexity of games will define the *quantity* and *type* of feedback the game can offer the player. Most games will present the player with a view of the game world as the dominant part of the output system. In such a case, the player can see multiple levels of information regarding the object or character he is controlling and its state in the game-world. Without overwhelming the player with information, Rouse (2001) considers the game should communicate as much information as possible. In some games, such as those played from a third person perspective, the character being used to play can be a form of presenting feedback regarding the state of the character. Changes in the colour of the clothes, the way the character moves and others can be an indication of the character's state. This information can be communicated visually through the HUD, but communicating it through the actual game world can reinforce the information and make it a more realistic experience. In such a case, using the potential of the *visuals* to maximize the authenticity of the game and display in-game feedback can, for many players, be an important factor towards game satisfaction.

Information and feedback which can't be represented through the game world will commonly be presented in the Graphical User Interface (GUI) which is a layer of information above the game-world view. The GUI or Heads-Up Display (HUD) can also influence the quality of the experience depending on its intrusiveness. A HUD requiring too much attention, dragging player's attention from the game-world to this layer of information, will more likely break a feeling of immersion and concentration.

While visual feedback assumes a predominant role in the feedback sphere, audio output is another form of communication, providing feedback regarding the player's state and actions in the game. The use of audio feedback has assumed importance as a complementary source of information. In many action games with a fighting or shooter theme, audio feedback will complement visual feedback when a player is being hit or shot in the form of sounds related to pain. In shooter games, the sound of a gun being fired will complement or predominate over visual cues.

Narrative is a video game component which refers to the story a game tells, whose depth depends on the game itself. In some cases, the game may be the story; in others, the player tells the story through playing (Rollings & Adams, 2003).

NARRATIVE

All video games can tell a story. The complexity and extent of a game's story depends on the game itself. At one extreme, in adventure games for example, the game can be the actual story. At the other extreme, the player is responsible for the story through the act of playing. While some might disagree (Jenkins, 1999), even a simple games such as 'Tetris' has a *story* – a story created by the player while he plays. Figure 5 represents the 'Story Spectrum', demonstrating the importance of story in gameplay for different types of game genres.

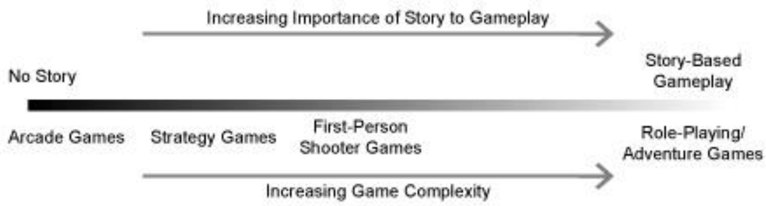

Figure 5: Representation of the Story Spectrum
Adapted from: Rollings & Adams (2003, p. 90)

Narrative refers to the part of the story told (by the author and designer) to the player. Narrative is the noninteractive, presentational part of the story. Returning to the example of 'Tetris', it also has a story, but contains no narrative. If a game does not have a story, or does not allow the player to implicitly form his own story, the game may simply not interest the player (Rollings & Adams, 2003).

Games will normally have some sort of story attached to them. This story may be a one paragraph backstory or a fully integrated story, where the game is the actual story (Rollings & Adams, 2003). Stories will vary depending on the complexity of the game. Simple games, such as 'Space Invaders' – and exemplified by Rollings & Adams (2003, p. 89) – have a story that can be summarized as *"Aliens are invading the Earth, and only you can stop them"*. In more complex games, such as Half-Life – and once more exemplified by Rollings & Adams (2003, p. 90), the story is an important aspect of the game, functioning not only as a form to create a more compelling experience, but also plays a role in the actual gameplay.

Egenfeldt-Nielsen *et al.* (2008, p. 172) reproduce a definition of narrative as a "*succession of events*", consisting of several components: the chronological order of the events (*story*), their verbal or visual representation (*text*), and the act of telling or writing (*narration*). Although story is one ingredient of narrative, it is also responsible for describing a succession of events. "*When we talk of stories, plots or narratives in video games, we are referring to a scripted succession of events that the player has to perform in a specific order*" (Egenfeldt-Nielsen et al., 2008, p. 178).

In addition to narrative, the concepts of fiction and fictional worlds deserve consideration. Fiction can be described as "*events that have not occurred in 'real life*" (Egenfeldt-Nielsen et al., 2008, p. 173) and non-fiction as "*documentation of events that have occurred*" (Egenfeldt-Nielsen et al., 2008, p. 173). When considering video games, almost all are fictional, with some exceptions (*e.g.* Battlefield 1942, which is based on historical events and real battles that occurred in World War II – as exemplified by Egenfeldt-Nielsen *et al.* (2008).

"*Fictional worlds are imaginary constructs that are created by the description of text*" (Egenfeldt-Nielsen et al., 2008, p. 173), and given visual life by the graphics and visuals of a game. Many games are built around fiction worlds to a greater or less degree, and the elaboration of these worlds in many cases can influence how a player will enjoy the act of playing. When fictional worlds are built upon 'real-life' representations or other fictional-worlds previously represented in another medium (*e.g.* cinema), this representation can be unsuccessful if the player does not find a connection between the two. For example, if playing a game is set in medieval times and the player must fight against an enemy, introducing modern weapons such as guns would easily break an immersive state. Fictional worlds are also important even if they are somewhat transparent or of a simple nature. A gratifying experience is not dependent of complex fictional worlds, but dependent of how the player connects to the fictional world the game offers and all its elements and characters. The balance and consistency, however, can be an important factor on the type of experience the player takes from the game.

Egenfeldt-Nielsen *et al.* (2008) believe narratives always occur within fictional worlds, although some fictional worlds don't contain a structured narrative, consisting of an organized sequence of events. As the authors state (Egenfeldt-Nielsen et al., 2008, p. 174), "*narratives are made of events, and usually contain settings and characters, but both these ingredients can appear on their own, without being tied to a specific narrative, so that players can imagine how setting or characters fit in the fictional world, refer them to an external story (…) or simply use them in order to narratively thematize their enjoyment of the game.*"

The use of narrative in video games is responsible for one of the most interesting discussions in the industry (*i.e*. narratology *vs.* ludology). One primary discussion relates to how a player's experience can be built around the constraints a narrative may impose on a game, *i.e.* "*the problem of letting players act freely while ensuring that their actions produce an interesting story*" (Egenfeldt-Nielsen et al., 2008, p. 174).

Storytelling is an element of narrative deserving special attention, and can be divided into three categories for further analysis (Egenfeldt-Nielsen et al., 2008): (*i*) the *who* and the *what* (related to the fictional world, including the story setting and actors); (*ii*) the *how* (related to the mechanics of the narrative, which corresponds to the organization of the story); and (*iii*) the *why* of a narrative (related to the reception, which deals with how the player experiences the story).

WHO & WHAT

The *fictional world* is about the setting in which the game is played; it helps frame the player's actions but may also be sufficiently appealing that it itself has some value (namely through the visuals). Both older and recent games are built upon scenarios that are capable of absorbing the player. The relationship between these worlds and the resulting gameplay experience can be found in the work of Lisbeth Klastrup (2003) – summarized by Egenfeldt-Nielsen *et al.* (2008) – as relating to the fact a game world's objects are organized around the act of play. In several game worlds, many which replicate real-life scenarios, a player is tempted to interact with existing elements as he would in real life. However, many are present in the world merely to be seen and not to be used. Some games will normally communicate which objects present in the world are relevant; others will be more proximate to a real world scenario, allowing the player to interact with almost all available objects (*e.g.* 'Grand Theft Auto: San Andreas'[11], where throughout the various cities, the player can interact with all non-playable characters, interact with cars, bicycles, among others), even if these are not directly related to the objectives of the game.

The most important component of a game is the 'game space', corresponding to the setting for the actual gameplay. These spaces are not realistic; rather, they are reductive – as defined by Egenfeldt-Nielsen *et al.* (2008) – and while they reproduce parts of the real world, they are designed to facilitate gameplay.

[11] Grand Theft Auto: San Andreas is a 2004 action-adventure game developed by Rockstar North. Official site: http://www.rockstargames.com/sanandreas/, Accessed: February 18, 2013

The use of *cut scenes* within fictional worlds has also been debated. Cut scenes are cinematic sequences used to communicate information to the player. While even some older games have used cut scenes (*e.g.* Pac-Man), more complex games use cut scenes to place the player within a fictional world and to create narrative in multiple ways (Egenfeldt-Nielsen et al., 2008): (*i*) they introduce a central narrative tension; (*ii*) they drive the narrative in a certain direction, ensuring the player takes certain actions; (*iii*) they make up for missing game narrative; (*iv*) they communicate information to the player, either regarding the gameplay, to establish an idea of the location in which the player is, among others.

In addition to the game setting and how it can be presented through cut scenes, the characters that act within these worlds are another important element. In a game scenario, a gamer can both play a character and interact with characters that respond to us. "*Characters in games are not just the people that the game is about, but also the people who are making action happen and thus producing different stories*" (Egenfeldt-Nielsen et al., 2008).

Considering this overview, an entertaining gameplay experience is most possible not when the fictional world directly represents the real-world; rather, "*a combination of good cut-scenes that situate the game world effectively, simple but responsive non-playing characters and integrated story elements in the game spaces that the player can explore herself can do the trick*" (Egenfeldt-Nielsen et al., 2008, p. 181).

Related to the fictional world and game setting, Henry Jenkins (1999) explores how storytelling associated to the environment in which the game takes place – environmental storytelling – can create an immersive narrative experience in one of four ways: (*i*) *evocative spaces*; (*ii*) *enacting stories*; (*iii*) *embedded narratives*; and (*iv*) *emergent narratives*.

i. *Evocative spaces*: evocative spaces evoke stories that are known to an individual, allowing him/her to visit and enter spaces they have been before in their fantasies. Games that pick up on stories are fruitful when they convey new narrative experiences through the creative manipulation of environmental details, allowing a player to recall memories, and creating an immersive world in which they can interact.

ii. *Enacting stories*: enacting stories are related to games which allow players to perform or witness narrative events. Narrative in games can be analysed in terms of broadly defined goals or conflicts and in terms of localized incidents. Some authors indicate all stories must be connected to the plot. Spatial stories, however, consider that each episode can be individually significant and even reordered without affecting the experience. Spatial stories are not poorly developed stories. Rather, they privilege spatial exploration over plot development, based on broad goals and conflicts that push the player forward. In terms of localized incidents, Jenkins (1999) reflects on the concept of micronarratives – a series of short narratives units that last a few seconds (*e.g.* a cut-scene), but may be prolonged through multiple incidents.

iii. *Embedded narratives*: embedded narratives refer to how game related information is placed and distributed across the game space. As Jenkins (1999) describes, *"within an open-ended and exploratory narrative structure like a game, essential narrative information must be redundantly presented across a range of spaces and artifacts, since one cannot assume the player will necessarily locate or recognize the significance of any given element."* A game designer can develop two kinds of narratives: an unstructured narrative controlled by the player allowing for exploration; and a pre-structured narrative embedded within the *mise-en-scene*[12] that awaits discovery.

iv. *Emergent narratives*: emergent narratives are not pre-structured or pre-programmed narratives. Some games offer an individual the possibility of defining his own goals and building his own stories; these games offer multiple narrative possibilities. Games with emergent narratives contain elements with large narrative potential. Characters may have desires and needs which conflict with other players; and they might be affected by changes in the environment. A player's choices have consequences on the character(s). In addition to characters, the environment itself is rich in possibilities and the elements of the environment can promote multiple narratives.

HOW

The next part of narrative deals with the mechanics: how narrative action is organized and implemented. For video games with a deep narrative involvement, a crucial task is developing a game that guides a player through the game in a compelling manner. It is agreed that forcing the player to move through a fictional world will not result in an engaging experience, even if the narrative is appealing. On the other hand, forcing the player to do things and to take action helps create the plot. This balance is a central point in the question of narrative mechanics.

'Branching' is the term used to organize narrative actions, describing the existence of multiple paths. However, this also leads to the problem of the multiple paths that are created. The balance lies with "*moderate branching while implementing plot bottlenecks, through which all players have to go in order for the story to advance*" (Egenfeldt-Nielsen et al., 2008, p. 181). In adventure games and other similar games, the non-linearity of games which avoids the possibility of a player ending up doing nothing, is overcome with the existence of puzzles for the player to solve, the interaction with characters, the flexibility in the order in which tasks are solved, resulting in a sense of freedom (Egenfeldt-Nielsen et al., 2008). As Egenfeldt-Nielsen *et al.* (2008, p. 183) suggest, "t*he key to successful mechanics is to make players feel that they are contributing to creating a plot; the most successful narrative experiences happen in games where our actions have noticeable plot consequences*".

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[12] *Mise-en-scene*, of French origin, refers to the arrangement of all the elements that appear on the stage/screen – actors, lighting, props and others

In some game genres, *quests* are used as a means to build a game's plot. Quests are small 'missions' (comparable to challenges and tasks) a player must perform, aiding in the structuring of the game's action and creating opportunities for storytelling (Egenfeldt-Nielsen et al., 2008). As described by Egenfeldt-Nielsen *et al.* (2008, p. 183) *"(…) a quest is a set of parameters in the game world (making use of the game's rules and gameplay) that creates a challenge for the player."* From the player's point of view, quests are specific instructions on the actions they must take, in the form of a main goal, or specific task (as described for the *goals* characteristic (*cf.* Section 5.3.3.1 – Mechanics, *p. 159*)). Quests structure the game at two levels. First, on a *semantic* level, they indicate how and why players' actions are connected to each other and the game's story. Second, on a *structural* level, quests embody the "*cause and relationship between a plan of action and its results, or between the interaction of objects and events*" (Egenfeldt-Nielsen et al., 2008, p. 183).

Although *quests* (or specific game goals) are important for the narrative of a game, they should be developed in order to have a purpose. When quests fail, it may be related to the fact that they are disconnected from the plot, the game-world or the characters we play or interact with (Egenfeldt-Nielsen et al., 2008). Meaningful quests are imperative in order to maintain a consistent game that a player can believe in.

WHY

How a player absorbs and experiences the narrative into which he inserted can be explored using the ideas of the *reception theory*. Egenfeldt-Nielsen *et al.* (2008) argue that the *reception theory* can explain how narrative and gameplay can determine the player experience in games. In their analysis, Egenfeldt-Nielsen *et al.* (2008) use the example of 'Resident Evil: Code Veronica X'. For the purposes of this characterization, a brief look at the concepts used in the *reception theory* is explored.

A reception theory based analysis begins with a look into the concept of *literary repertoire*, which helps understand how players can begin to successfully interpret a story. Wolfgang Iser describes a *literary repertoire* – summarized by Egenfeldt-Nielsen *et al.* (2008) – as "*the familiar territory within the text*" and can enclose anything that a player knows (*e.g.* references to earlier works, social norms and historical events). This information repertoire adds to the game framework – the player *actualizes*[13] what is implicit in the text. Depending on the game, the repertoire can include knowledge on the type of genre and common conventions regarding the genre; if the game being played is based on a game, knowledge can be retained from these on how to act within the game.

If the player is unable to recall the proper repertoire – *e.g.* the player has never played a similar game, not having formed necessary connections – the game may not properly be enjoyed. Nonetheless, a player is free to call upon the repertoire of choice, acting contrary to the game's *normal* mechanics.

[13] *Actualizes* refers to understanding the cues provided by the text and call for the relevant repertoire, in other words, make the appropriate projections (IBM, 2011)

In summary, Egenfeldt-Nielsen *et al.* (2008, p. 188) ask, "*can narrative games be played without paying attention to the story at all?*" Based on their work, it is possible to play games while overlooking story components. However, the player might not get very far, easily losing interest because he doesn't understand the game's global context. Also, while the player may find interest in completing the game – even having overlooked these elements – the game will end up being a summary of game parts, rather than a complete story, which could have contributed to a greater game experience.

1.5 VIDEO GAME PLAYERS

Video games are a media enjoyed by all. The idea that video games are exclusively a young boy's hobby (Chan, 2008) is becoming a myth. According to the 'Entertainment Software Association' (ESA, 2013) – reporting numbers related to the American context – the average age of today's video game player is 30; more than two thirds (68%) are aged 18 or older; and 45% of video game players are female. Moreover, not only is the demographic changing, but the platforms on which individuals are playing is also becoming more diverse. When developing video games, these facts are important. Developers can no longer develop only considering their interests, but must also consider a wider and more diverse target group. These target groups differ in terms of their gender, video game genre preferences, their previous experience, expectations and motivations to play video games (Carr, 2006; Chan, 2008; Erfani et al., 2010; Hartmann & Klimmt, 2006; Ivory, 2006; Lucas & Sherry, 2004; Phan et al., 2012; Terlecki et al., 2010).

1.5.1 Player Gender in Video Games

Phan *et al.* (2012) examined differences in player gender and found multiple differences in terms of average hours played per week, preferred gaming platform and genre, and the extent to which male and female players feel guilty when playing games, among others. Male players classified themselves as frequent or expert players, playing almost 17.5 hours per week, compared to females 6.5 hours of playing per week. Male players indicated preferring desktops and laptops, while female players indicated consoles and handheld devices.

Lucas & Sherry (2004) summarized a series of studies revealing male and female players are uneven in different game related tasks. For example, men are better at navigating through mazes and target-directed motor skills, while women are more skilled at landmark memory, object displacement and perceptual speed. Furthermore, it seems the majority of developed video games favour these male related skills, and differences in game genre preferences may be related to these gender *limitations.* Lucas & Sherry (2004) suggest male and female players both enjoy Massively Multiplayer Online Games (MMOG), racing and simulation games; but male players enjoy sports, fighting and shooter games, while female players enjoy puzzles, quizzes or board games. Also, casual on-line games are also a favourite among female players (Jansz, Avis, & Vosmeer, 2010). Given women also tend to enjoy social interaction more than men; it is understandable that 'The Sims' is one of the games which attract female players. However, with exception to current online social games, 'The Sims' is an exception among many other games, mainly steered towards the male audience (Hartmann & Klimmt, 2006).

Hartmann & Klimmt (2006) summarize studies related to violence, suggesting male players enjoy violent games more than female players. Similarly, females reveal little interest in observing or participating in conflict which are resolved through violence. Erfani *et al.* (2010) found that playing experience influenced players' activities within a game, and that male and female players assumed different types of tasks within a game.

However, possible differences in *innate* skills may not be the only motive behind different video game genre preferences between male and female players. Ivory's (2006) summary of authors shows a tendency for video games to target a male audience and that video game content sexually objectifies female characters. As Ivory (2006) suggests, while some men may find this type of content interesting, the same interest will unlikely be shared by women. The social role theory can also help justify differences in game play and preferences among men and women. According to the theory, males and females are attributed gender roles according their physical capacities. In turn, this division reflects in stereotypes and norms which each gender should follow, as well as in dualities between the two genders (Jansz et al., 2010).

In summary, it appears that most of the differences between male and female players are related to the content and context of video games, which commonly favour male role stereotypes and normally do not appeal to the majority of women (Carr, 2006).

1.5.2 Player Background: Preferences, Ability & Knowledge

In addition to gender, player background is a decisive factor in how video games are experienced. Both gender and background help determine what preferences a player may have for games and the abilities to play games based on a history of playing a certain video game genre. In parallel, players' knowledge may also play a role in how video games are experienced. This is possible because of mental connections made or because of past experiences which are useful during the act of play. Based on these considerations, several player background concepts can be highlighted and detailed. These are: 'preferences', 'ability' and 'knowledge'.

PREFERENCES

Preferences relate to the aspects of games players enjoy the most. Player preferences may be related to video game platforms, genres, game visuals, or others. These preferences are normally dependent of players' past experiences with other games, through the definition of games, genres and style of gameplay enjoyed most and least. As Zammitto (2010, p. 20) states, "*gaming preferences is a proposed construct for referring to the aspects of video games that players enjoy the most.*"

Player preferences may be manifested based on a favourite type of game genre, which is defined according to a set of characteristics (*cf.* Section 1.2.3, *p. 21*). Many players will manifest a preference for a single type of genre, such as the *action* genre, where Rollings & Adams (2003) include *shooter games*. Other players may only enjoy playing *sports games*, such as those from the FIFA and Pro Evolution Soccer Series (soccer games), or a basketball or hockey game. It is also possible for players to enjoy all types of video game genres, finding motivation to play and learn every type of game.

Considering the importance of personality in the definition of gaming preferences, we can look at the work of Bateman & Boon (2006), having grouped players according to four basic playing styles, based on the 'Myers-Briggs Type Indicator' and respective sixteen personality types. These four playing styles are: (*i*) *Conqueror*, (*ii*) *Manager*, (*iii*) *Wanderer*, and (*iv*) *Participant*.

i. **Conqueror:** based on a *thinking* and *judging* personality, players that are *conquerors* welcome challenges and are essentially concerned with winning, against the game or their opponents. *Conquerors* believe the in-game story is secondary.

ii. **Manager:** based on a *thinking* and *perceiving* personality, *Managers* are motivated by learning and optimizing strategies and tactical techniques. Managers require a steady build-up of difficulty, such that too great of a difficulty may lead them to stop playing. The story of a game is relevant as a tool for setting the plot.

iii. **Wanderer:** based on a *feeling* and *perceiving* personality type, *Wanderers* are motivated by enjoyment, in the form of fun and novelty. *Wanderers* want the game to amaze them or else they won't continue playing it. The characters of the game are valuable to the narrative and help in building emotional connections.

iv. **Participant:** based on a *feeling* and *judging* personality type, a *Participant* style of play is somewhat vague but possibly open to different styles. The two main possibilities are related towards motivations for game narrative and social experience.

Player preferences can also reflect on players' motivations to act and demonstrate a specific attitude within the game. Similar to Bateman & Boon (2006), Bartle (2006) explored a variety of player profiles which can assist in explaining the motivations for a specific type of attitude within a game. While Bartle (2006) focussed on the MUD (Multi-user dungeon) genre, his work is also transversal to almost all game genres. Bartle considers players belonging to the following categories: (i) *Achievers*; (ii) *Explorers*; (iii) *Socializers*; (iv) *Killers*.

i. **Achievers – *Achievement within a game context***: *Achievers* define for themselves game-related goals and take pleasure in pursuing them. For achievers, the motivation and objective is to collect points and advancing through the game. Exploring the game is a means to find new resources and accumulate points; socializing serves as a form of discovering how other players accumulated points; killing serves to eliminate players who interrupt the course of the player or to collect another players points.

ii. **Explorers – *Exploration of the game***: the motivation for *Explorers* is to find out as much as they can about the world they are playing. Initially, this may imply exploring the actual space, but may evolve to explore and experimenting with the physics of the world. Explorers take pleasure in discovering all aspects of the game world and understanding how the world works. Collecting points or rewards (achievements) is only carried out if it necessary to jump into a further level of exploration; killing might be a useful exercise, but might bear unnecessary conflicts in the long run; socializing can serve as a means to learn new things to try out, but removes from the fun that is found in discovering the world solely.

iii. **Socializers – *Socializing with others***: *Socializers* use a game's communication channels to communicate and interact with other players. Socializers are motivated by what other players have to say, and feel the relationships among players are more important than the game. Empathizing, joking, entertaining, listening or even observing can be socially rewarding for the socializer. Exploring and collecting points or rewards may be necessary to open up communication channels and be able to interact with others; killing is a last resource. The only meaningful action for socializers is to get to know people, understand them and form relationships.

iv. **Killers – *Imposition upon others***: killers are motivated by using game resources to cause distress to other players or, in exceptional situations, to help others. This act normally involves the use of weapons and applying it on another player. The more distress a killer imposes on another player, the more enjoyment he takes from the act. Collecting or scoring points is important to become sufficiently powerful to cause extensive distress; exploration is necessary to discover new forms of killing other players; socializing is valid to taunt victims or discuss tactics with other players.

As each *profile* description reveals, these player motivations and objectives crossover and can combine. It is common for players to assume all four identities, depending on their mood or objective. However, Bartle (2006) believes most players assume a primary style, passing to another if necessary to advance to their main interest.

A player's motivation can also be defined by the distribution of their interests over two axes, forming four quadrants: the *x-axis* goes from *players* to *environment* (world); the *y-axis* goes from *acting with* to *acting on*. Each of the four described playing styles is placed in one of the four quadrants. Figure 6 represents the distribution of the four types of players (Bartle, 2006) according to their interest in *players* or the *world* and preference for *acting* or *interacting*.

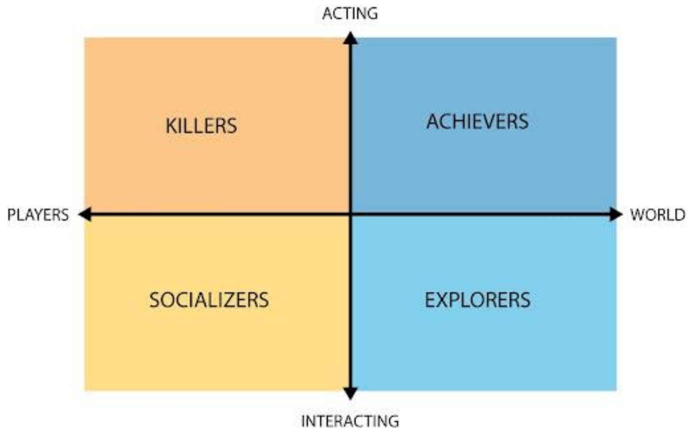

Figure 6: Representation of Bartle's four types of players interests
Adapted from: *http://www.tstoryteller.com/the-audience-ecosystem-ensuring-the-longevity-of-transmedia-experiences* [Accessed: January 6, 2014]

Achievers: Achievers are motivated in doing things to the game – *acting on the world*. Players pay great importance to the environment, while the existence of other players is secondary.

Explorers: Explorers enjoy when the game surprises them – *interacting with the world*. Players enjoy the feeling of wonder that the game offers; players may add depth to the game but are not crucial.

Socializers: Socializers are motivated by connecting with other players – *interacting with players*. This commonly involves communicating: talking and getting to know other players. The world is secondary; what makes the game compelling is the players.

Killers: Killers are motivated in doing things to other players – *acting on players*. This does not imply that other players consent to this interaction; killers want to demonstrate their superiority in relation to others.

A player's personality is shaped through his daily routine and consequently, his preferences may eventually reflect these different attitudes. Considering the aforementioned, a player may find preference in playing certain types of games because of assuming tendentiously a certain type of 'profile'. A *conqueror* or *killer* player will likely show preference for action games, with emphasis on shooting and combat games. A *wanderer* or *explorer*, however, will likely show preference for a role-playing game or an adventure game.

ABILITY

Abilities refer to a player's collection of learned skills: *motor*, *cognitive* or *perceptual* (Mackenzie, 2001). A player may have and demonstrate *motor* skills in the agile use of gaming controllers – *input* (mouse, keyboard, gamepad); *cognitive* skills in thinking about game situations and strategies; and *perceptual* skills when perceiving and interpreting information from the game.

All games provide goals, tasks and objectives that a player must complete. These goals are completed by the use of player abilities, also known as *skills*. While the character or characters in a video game have their proper skills that evolve throughout the game, these character skills are manifested and enhanced through the player's own skills. Independently of the quantity of skills the character has, if the player does not have the ability to put them to use, they have no value.

Some games will almost exclusively require motor skills, others cognitive or perceptual. Games from the 'Dance Central'[14] or 'Just Dance'[15] series are essentially games that require motor skills to complete game objectives. Many other games require essentially cognitive skills. Cognitive skills can be subdivided into 6 other main skills (Rawool, 2013): attention skills, memory skills, logical and reasoning skill, audio processing skill, image processing skill, and speed of processing. Considering this approach, almost all games require or promote the use and learning of cognitive skills. Many mobile games – due to the limitation of the platform on which they are played – such as the popular 'Tetris' or 'Angry Birds' require one or more of these subset of cognitive skills. 'Angry Birds', for example, requires the skill of logic and reasoning in order to use birds (playable characters) with different skills to knock down structures and eliminate the pigs that are being protected. Logic and reasoning is used to find the most efficient approach in order to obtain maximum points. Simultaneously, the player uses learned memory skills in later levels, in order to correct his actions within the game to obtain a better score. Many fast paced and action games will require a great deal of attention skills. Modern First-person shooters, role-playing games and others that are filled with visual information require that a player have the necessary attention skills to focus on the relevant information found within the game.

[14] Dance Central is a 2011 music rhythm game using the *Kinect* motion peripheral, developed by Harmonix Music Systems (*http://www.dancecentral.com*)

[15] Just Dance is a 2009 rhythm game developed for the *Nintendo Wii*, developed by Ubisoft. In Just Dance, players use the Wii Remote to mimic the moves of the on-screen silhouette dancer (*http://just-dance-thegame.ubi.com/jd-portal/en-AU/home*)

Some players will begin playing with the necessary skills to easily succeed in the game. Other players may find themselves without the ability to successfully complete the game objectives. The lack of ability to complete game goals is a primary reason for player demotivation. If a player lacks skills to complete the proposed challenges, he may become anxious, eventually giving up on the activity. In order to combat this eventuality, many games provide different strategies to build up players' skills. In many games, tutorials are used to introduce players to the basic gameplay of a game and to help them acquire the basic skills used in the game. Some games will offer simple suggestions in the beginning or throughout the game to teach players how to do specific actions or use specific items.

'Call of Duty 4: Modern Warfare', for example, dedicates an entire initial scenario to teaching the players how to move (run and jump) and use the game controls to shoot and kill enemies. Furthermore, the game will propose an adequate difficulty level based a player's performance during this tutorial. This approach not only provides a player with an immediate grasp of what the game will require from him, but also suggests a level of difficulty in which the player can eventually play without being demotivated for not having sufficient skill to play.

Another technique common in many games is to consistently increment the difficulty of goals throughout the game. In many puzzle-styled games that are played on mobile devices, initial game levels are easier when compared to later levels. This allows players to learn the mechanics of the game and learn the basic skills used in more difficult levels. If a player is bombarded with difficult goals in the beginning of the game, he may lose motivation to continue playing because he may feel the game is too difficult. Furthermore, an incremental difficulty is also important because the player can steadily acquire and apply his abilities in these challenges. Just as important as providing a build-up of the task difficulty; if a game provides many difficult tasks in the beginning and the remainder of the game consists of simple tasks, than the player may still lose motivation. In such a case, the player may become bored because he feels the challenges are insufficient for his level of ability. Here, the balance between the perceived difficulty of the game challenges and the player's actual abilities can define the extent to which the player enters a state of *flow* and enjoys the activity: excessive skills for unchallenging tasks may lead to boredom; excessively challenging skills for insufficient skills may lead to anxiety and the desire to quit.

Lastly, the importance of a players' abilities in games is reflected in the ideas of Sweetser & Wyeth (2005, p. 7) that state, "*for games to be enjoyable, they must support player skill development and mastery*". The importance of learning and motivation is clear for this characteristic. Rarely will a player play a game with the right set of skills to complete the game without problems. This does not include, however, cases where players have learned skills while playing other games of the same or similar genre. A player that has played a FPS game before will have a greater skill set than a player which has not. In any case, the player must be motivated to learn a set of skills which can be used throughout the game. If this initial motivation is not present, the possibility of enjoying the game is reduced because he may eventually reach a point where he is incapable of completing specific tasks.

In summary, games that provide incrementally challenging goals and steadily require skills beyond those possessed by players can provide a more satisfying experience. This is important because it allows players to learn to develop skills in order to master the tasks and challenges of the game. When the player manages to overcome the challenges, there is a greater sense of enjoyment resulting from the experience.

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Through the act of play, and while forming preferences and abilities for and in games; a player also creates *knowledge*. Any individual has knowledge about an unlimited number of things. An individual may know how to drive, how to play a certain sport, or how to dance; he may know about war strategies or about fighting tactics. An individual's existing knowledge regarding these things may be valuable in several gaming scenarios. For example, in a shooter game, a player may know that when assuming a crouching position, he will be less visible to his opponents. In a driving game, he knows that riding behind a car creates a *draft* which can be used to later overtake that car.

This knowledge comes from real-world scenarios, but is also shaped and complemented with new knowledge gained from playing other similar games. If a gamer has previously played shooter games from the 'Call of Duty' series, he can use the knowledge gained from these games and apply it in other shooting games. This is also possible because game genres share a certain consistency of gameplay and overall mechanics. A player can apply his knowledge because the expectations he deposits in a certain game are met.

A player's knowledge may not be decisive towards defining the quality of the player's experience, but in certain situations can contribute towards it. Furthermore, existing knowledge is valuable in some games rather than others. In some games – developed based on television, film or a literary source – a player can benefit from having knowledge from these other sources that served as a basis for the game. Knowledge acquired from these other sources can help solve challenges that arise within the game, but can also help the player anticipate how the game will progress. Essentially, knowledge can help form expectations for a game.

Knowledge can however be fundamental in many games where general culture is the essence of the game. Digital versions of 'Trivial Pursuit' or 'Jeopardy' are games that require knowledge regarding multiple areas: culture, sports, history, geography or other topics. A gamer that plays these 'knowledge-based' games is more likely to enjoy the experience if he does in fact have some knowledge that can be used to solve questions or puzzles within the game.

1.5.3 Player Expectations

As briefly introduced above, a players' knowledge can help form certain expectations regarding a video game. Specifically, *expectations* can refer to the collection of *things* a player anticipates and hopes to find in a game. Expectations can be made regarding the game as a whole; specific rules or goals; the feedback or the audio and visuals of a game. Rouse (2001) presents a list of several items regarding where players place their expectations when playing a game.

Players will expect a consistent world, resulting from the *knowledge* (memory) gained on what actions they can perform in the game-world and the results of those actions. A player's enjoyment is easily ruined when a player expects and anticipates a result from a specific action and the game-world does not respond accordingly. Even more damaging is a situation when the game-world responds in a completely unpredictable way, such that a player cannot form any type of expectation. "*It is the consistency of actions and their results that must be maintained, for an unpredictable world is a frustrating one to live in*" (R. Rouse, 2001, p. 8).

Naturally, this point must be understood in the light of different games and specific situations. In a sports simulation game such as those from the 'FIFA' series, a player cannot expect that every time he shoots the ball that it will result in goal. The existence of other elements in the game-world and the game's artificial intelligence plays a role in making the linear consistency this action could take more difficult. If the player shoots the ball and it does not result in a goal, it should be because the goalie saved the shot, a defender intercepted the shot or some other reason the player can understand (*feedback*). In such a scenario, a player's response will commonly be to accept with satisfaction the challenge and wish to continue to play. In the same case, if this slight *randomness* did not exist, a player would easily become bored without the challenge.

Another expectation worth mentioning relates to *direction*: players expect direction. While players will commonly enjoy the freedom to explore according to their own will, players will also expect the game to show them what they are supposed to do. Being in a game-world without knowing where to go can easily lead to a frustrating experience. When a game defines its *goals*, a player may want to know how they can achieve that goal. As explored when referring to *goals* (*cf.* Goals, *p. 29*), a game may use sub-goals as a mechanism to direct players towards the main goal. Expecting direction can also be understood as wanting help on choosing the right path. In some games, the game will explicitly show the direction a player should follow to reach their goals, through the use of arrows, audio and visual feedback or another technique. While this may be important in order for a player not to lose track of his place in the game-world, abusive help and indication can hamper a player's desire to be able to explore on his own the game-world.

In a somewhat contradictory fashion, players expect to *fail*, but simultaneously expect to have a fair chance. This can occur, for example, in a game that can be played for a first time entirely without a single problem. This would probably be considered a game without a challenge; a game which doesn't test a player's abilities and skills. Gamers play games because they are normally looking for and want a challenge. This expectation implies that a player will not succeed at his first opportunity, but only after several attempts. Completing goals without a challenge will normally not fulfil the player with satisfaction. However, as occurs in *real life*, when an individual fails, it is important to know why, so that our actions can be corrected. With games, the same idea can be applied. A player needs *feedback* (*cf.* Feedback, *p.* 38) regarding why his actions did not lead him to successfully complete a certain action. While a game should not be completable in a first attempt, allowing a player to *easily* win in the beginning can help motivate the player and maintain him *hooked* on the game. If a game is too difficult in the beginning, a player may stop playing the game entirely. On the other hand, even though a player wants a challenge, he also expects a fair chance. A player will accept defeat, but also wants to learn how he can overcome the obstacles and challenges placed by the game in the quest to complete the game's goals.

Rouse (2001) states that players also expect to be *immersed*. This is another expectation which can be generally applied to a majority of the situations, but with some exceptions. The desire and expectation of being immersed can be largely dependent of the player's motivation to be playing. A player beginning a big, complex game, and with no time constraints, will possibly expect such a sensation. However, players that are on their way to work and on their mobile devices will possibly be looking to have fun while passing the time. Of course, and as previously presented, immersion is a complex term and can be interpreted in multiple ways (*cf.* Section 2.2 – Immersion, *p. 69*). Therefore, even if a player is just looking to pass the time to have fun, he will expect to be immersed in some way, even if just *engaged* in the experience.

Lastly, Rouse (2001) explores another topic: players expect to *do*, not *watch*. This is an interesting point, considering the path many games of today have taken. The importance of narrative, while undeniable, has shaped the nature of many games. With the progressive introduction and importance paid to narrative, "*games became less and less interactive, less, in fact, like games"* (R. Rouse, 2001, p. 18). The use of *narrative*, while it introduced a new form of playing and looking at games, also introduced a new problem: players want *to do* (they want to play) and don't want to just watch. Of course this idea is only applicable in a general manner: each player will enjoy to a greater or less extent the use of narrative components in games. Cut-scenes, for example, help communicate a game's story; they may also convey the goals of a game, specific objectives or tasks that are required to progress in the game. However, each player will react differently to such elements, which in turn will influence how he experiences the game. As Rouse (2001, p. 18) affirms, "*the reason people play games is because they want something different from what a movie, book, radio show, or comic can provide.*"

1.5.4 Player Motivations

When engaging in any type of activity, an individual is normally characterized by a set of motivations to do so. An individual who plays a specific video game or games in general are characterized by a set of motivations. From this assumption, it is important to understand the nature of motivations in a video game context.

With video games, motivation can refer to the single or multiple incentives for a player to initially play a specific game. However, a player's *motivations* can influence how the gamer plays, why certain choices are made during the act of game play and in the game environment; how and why the player interacts with game objects and other characters (playable and non-playable); and others. A player's motivation(s) can influence his actions in the game and his willingness to play. Non-motivated players will unlikely have a satisfying experience.

When reflecting on questions related to players' background (*cf.* Section 1.5.2, *p. 47*), a thorough overview of how a player's personality can affect his preferences was presented. It is acceptable to believe that in certain situations, a player's motivations are in part a reflection of his preferences. A player may be motivated to play a new shooter game because his preferences are driven towards that type of game; a player may be motivated to spend his time within the game communicating with other players because he prefers a style of play where a heavy component of communication and socialization is present.

Early studies by Crawford (1984) presented a list of basic motivations for an individual to play: *learn*; *fantasy/explore*; *nose-thumbing*; *prove-oneself*; *social lubrication*; *exercise* and *need for acknowledgement*. Crawford (1984, p. 17) states that the *"fundamental motivation for all game-playing is to learn"*, even if the player is unconscious of that motivation. For example, in many games, the way in which a player discovers how to complete goals or objectives, how the player learns to defeat enemies or find a hidden object in a game scenario; is through learning by trial and error. Also, players gain skills during a game through learning, and many of these are later used in many other games that may be played. The motivation behind *fantasy/exploration* is related to the possibility of escaping to a place where a player can forget his problems (connected to the characteristic of *control* and *visuals*). A motivation for *nose-thumbing* is related to the possibility of players disregarding social restrictions, assuming roles, behaviours and actions frowned upon in society (*e.g.* driving recklessly in a car game). *Proving oneself*, as the name suggests, is a motivation related to the idea of showing superiority in an activity, when compared to others. This type of motivation is transversal to a wide variety of games: in early arcade games, a player wanted to have their 3-letter name in first place; in online social games, powered by their integration into social networks such as 'Facebook', players want to appear in the ranking above their friends. The motivation for *social lubrication* is related to playing games for social reasons (*e.g.* many 'party' games for the 'Nintendo Wii' or 'Sony PlayStation'). Many games also provide motivation for *exercise* and desire to keep in shape – mentally or physically. Lastly, the motivation for *acknowledgment* is the desire to be acknowledged and recognized by other people.

As previously referred, a player can have multiple motivations to play a game. In his work related to the *Flow* theory, Csíkszentmihályi (1990) proposed the idea of *emergent motivation*, resulting from the dynamic interactions which occur between a player and the environment: *"what happens at any moment is responsive to what happened immediately before within the interaction, rather than being dictated by a preexisting intentional structure located within either the person or the environment. Here, motivation is emergent in the sense that 'proximal goals' arise out of the interaction"* (Nakamura & Csíkszentmihályi, 2002, p. 91). Therefore, a player's interactions and actions, and posterior consequences, can lead to new motivations arising within the player.

With this in mind, it must be acknowledged that a player's motivations can easily collide with the *goals* and *rules* of a game. Exemplifying, a gamer may be playing a shooter game and suddenly be motivated to shoot his team members. This will normally conflict with the game rules. The same can be said for a driving game, where the player decides to drive around the track in the opposite direction; or a soccer simulation game where the player finds motivation in scoring against his own team. In some cases, going against the game *rules* and *goals* is a motive to create a bigger challenge. Returning to the soccer game example, a player may score several own goals so the challenge to win is more difficult. The challenge will require the player to use more *abilities*, apply more *effort* and pay greater *attention* to the game. In such a case, the player goes against the game's typical logic to seek out a more satisfying experience by creating his own challenges.

1.6 VIDEO GAME EVALUATION: STRATEGIES & RESEARCH

During or posterior to the design and development of video game, the testing and evaluation moment is important to discover possible problems in the game. Only with a flawless and problem free video game can a player truly anticipate a compelling gameplay experience. In the following sections, a brief look at video game evaluation is presented.

1.6.1 Video Game Evaluation Approaches

Video game evaluation has evolved with the advancement of video games and the industry itself. As Levy & Novak (2010, p. 6) suggest, during the 1970s "*the person who developed the game was naturally the one to test it. A few hours every night was more than enough. (…) the developer tested his own games on his own time*". With the advent of more powerful consoles in the late 70s and early 80s, there was an increase in the number of poorly developed games, and it became difficult for quality games to stand out. Video game sales fell and additional events led to the 'Video Game Crash of 1983' (Levy & Novak, 2010).

However this *dark period* remained contained within the United States. In Japan – the other powerful game market at the time – the Nintendo Entertainment System (NES) [originally Famicom in Japan] survived and began to thrive. The technical novelties of Famicom/NES were "*lightyears ahead of anything in the market*" (Levy & Novak, 2010, p. 9) leading to more complex games which then required game testing teams. For the first time, games with the quality of Super Mario Bros.[16], for example, required professional testing teams. The previous *one developer/one tester* paradigm was insufficient for new demands. Game publishers also began to set minimum standards of quality. Nintendo, for example, developed a 'Seal of Quality' that led to compliance testing, requiring that Nintendo have its own testers to comply with their 'Lot Check' (a type of game checklist). Specifically, Nintendo imposed a series of strict game quality standards for developers. Games submitted to Nintendo were screened according to a 10 element checklist, including elements related to nudity, violence and improper language (Levy & Novak, 2010, p. 11).

Some of the first video games were developed specifically for game consoles. Today, video games are developed for multiple platforms which imply that testing video games running on one platform is different from testing those running on a different platform. Levy & Novak (2010, p. 21) refer to 6 items unique to PC games that should be considered when testing, including: (*i*) mouse/keyboard interface; (*ii*) need for install; (*iii*) multiple OS; (*iv*) minimum requirements; (*v*) video/graphics card issues; and (*vi*) connection issues.

Levy & Novak (2010) also speak of 'testing disciplines' or areas of knowledge as opposed to testing techniques. They define the following six disciplines: (*i*) balance testing; (*ii*) compatibility testing; (*iii*) compliance testing; (*iv*) localization testing; (*v*) playtesting; and (*vi*) usability testing.

i. **Balance Testing:** Balance testing deals with guaranteeing gameplay is equal for both human and Artificial Intelligence (AI) players. This discipline ensures the 'easy' level is not too easy or that the 'hard' level is not too hard. It also ensures the 'medium' level offers a gradual rise in difficulty. Multiplayer games must be balanced as well. Game maps need to be neutral, weapons equal in power and spawn points should be placed fairly. If a game isn't balanced, challenges aren't fair and the game isn't fun.

ii. **Compatibility Testing:** Compatibility testing is exclusive to PC games and is intimately related with some of the PC testing items aforementioned. This discipline ensures that PC games are fully compatible with the parts and peripherals sold in the market.

iii. **Compliance Testing**: Compliance testing deals with certification. Before a game is sold on the market, it must be certified by the hardware developers (*e.g.* Sony, Microsoft or Nintendo), ensuring a game follows a series of established guidelines. For example, Sony has a 'Technical Requirements Checklist' (TCR); Microsoft has a 'Technical Certification Requirements' (TCR); Nintendo has a 'Lot Check'.

iv. **Localization Testing:** Localization testing deals with converting a game from one region to another and commonly involves translation. It also deals with ensuring that these translations are correct, as well as socially and culturally contextualized.

[16] Super Mario Bros. is a 1985 platform video game developed by 'Nintendo'. It is the second biggest selling video game of all time (more than 40 million copies).

v. **Playtesting:** Playtesting guarantees that independently of the path one takes in the game, it remains fun. Playtesting itself is *fun*, but requires special attention to details such as navigation, aiming, interaction, physics and artificial intelligence, for example.

vi. **Usability Testing:** In a game context, 'usable' is considered as, for example, intuitive to interact with characters, use items or drive a vehicle. If a certain mechanism in the game makes *no sense at all*, then it might be a possible usability bug. During usability testing, a game's visual interface is inspected for usability issues. In general, all testers end up having to work with usability issues.

1.6.2 Video Game Testing within the Development Cycle

Several authors (Brown, 2010; Levy & Novak, 2010; McAllister & White, 2010) divide the game development life cycle into distinct stages. Some propose a more discriminated cycle with a large number of stages; others propose a more condensed cycle. Emily Brown (2010) indicates there are four distinct phases in the development process: (*i*) concept; (*ii*) pre-production; (*iii*) production; (*iv*) launch. McAllister & White (2010) propose a five stage development cycle: (*i*) concept; (*ii*) prototyping; (*iii*) pre-production; (*iv*) production; (*v*) alpha-beta-gold. Levy & Novak (2010) also suggest a five stage cycle, which presents a mixture of the two aforementioned cycles: (*i*) concept/design; (*ii*) production/prototype; (*iii*) alpha; (*iv*) beta; (*v*) gold. In each of these phases, informal and formal methods can be applied by game designers to test their product.

To understand the process inherent to some of these phases, a summary is presented according to Brown (2010), referring some of the methods commonly used in each phase.

i. **Concept:** The concept phase is where the game is born: where ideas are generated, a game idea is defined and where a concept document is written. During the concept phase, various groups within a team will work on specific areas: artists draw up characters; programmers explore existing technologies and tools to develop the game; and designers research the industry to understand how their game can be something new.

   Methods applied in the ***Concept*** *phase*:

   Paper prototyping is common during the concept phase, with the objective of representing on paper the game and its mechanics to see how it works. However, not all video game genres can be *prototyped* in the same manner. When the prototype is ready, it can be given to other individuals to be played. Here, designers can easily find problems with a game and understand what does and doesn't make sense to the player.

ii. **Pre-Production:** Posterior to an approved game concept, the goal of pre-production is to build something that is playable and represents the core *feel* of the game. At this point, playable elements of the game are produced. Game features such as menus, game physics or others can be developed to get an initial idea of the game. Interactive or non-interactive prototypes can be developed. In this phase, testing is mainly peer and based on expert evaluations. Informal *heuristics* and *personas* may also be applied for general evaluation or gaming experience purposes.

Methods applied in the ***Pre-Production*** *phase*:

Heuristics can be described as an aggregation of rules that define key aspects of design, allowing any interface to be assessed with simple questions (Brown, 2010). Heuristics serve as a reference for designers to know what game aspects to keep intact and where they can *bend* the rules and innovate (*cf.* Section 1.6.3, *p. 61*). *Personas* are described as *archetype* (model) users, representing the target audience of a determined product (Brown, 2010). These model users (players) serve as a reference whenever user needs and preferences are discussed. Personas assist in understanding how *nontraditional* players would react and enjoy a game being developed. Throughout the pre-production phase, they serve as a reference for the introduction and implementation of new features as well as allow the designer to evaluate game concepts and decisions.

iii. **Production:** In the production phase, the development team proceeds to develop the game. Game characters, objects and menus are designed, levels are implemented, and the interaction is programmed, among other steps. During production, in addition to the various development teams, a Quality Assurance (QA) Team is responsible for testing. This team is responsible for detecting bugs as well as playability issues. *User-testing* is also applied during this phase for testing purposes.

Methods applied in the ***Production*** *phase*:

User-Testing comes in many forms. It may be as *small* as single participant 'think aloud'[17] sessions, or as *big* as many users playing a game while their progress is recorded. Importantly, user-testing should have representative users play the game. User testing may take place outside the development team in consultancies or rented labs. User-testing may involve a mixture of think aloud and post-play interviews.

[17] Think aloud method is a usability evaluation method used to gain insight into how people work with a product or interface

Data collected from these sessions is then analysed in order to solve problems users mentioned. Commonly, two distinct ideas can be extracted from gathered data: (*i*) game usability problems, such as areas where players struggle, get lost or if players play the game faster than expected; (*ii*) whether players had fun, where in the game they had fun and how much fun it was. Designers can better understand these aspects when they watch users play the game.

iv. **Launch (posterior to Alpha/Beta/Gold)**: The Alpha/Beta/Gold phases are three milestones during the game development process and lead to the game launch. The *Alpha* phase typically requires that all game content be represented, even if not completely finished. The game should be playable from beginning to end, even if with temporary assets. This phase is essentially about finalizing specific features rather than having a bug-free game. The *Beta* phase is possibly the most important milestone, where all game assets should be placed and the game should be basically finished with room for final corrections. Before final approval, the QA team will test the game. Once approved, the game hits the *Gold* phase. Here, the game is ready to be placed in the market. After a game has been launched on the market, eventual bugs may be fixed through patches. These post-launch bugs can commonly be found through resources such as *reviews* or *online forums*, among others.

Methods applied in the **Production** phase:

Reviews are an important measure of a game's quality and are an expert's view on the experience of playing the game. While reviews don't always have enough detail do complete redesigns, they offer insight into certain aspects of a game. *Online forums* are where gamers meet and discuss their experiences and thoughts with gamers. In some cases, they are a powerful communication tool between the developer and the gaming community. Occasionally, a dialogue may begin with these two agents and specific game-related questions might be discussed.

1.6.3 Video Game Evaluation Studies

In addition to some of testing and evaluation strategies mentioned regarding the game development cycle, several authors (Desurvire, Caplan, & Toth, 2004; Federoff, 2002; Korhonen & Koivisto, 2006; Pinelle, Wong, & Stach, 2008; Schaffer, 2007) have elaborated studies which resulted in video game specific heuristics. Nonetheless, video game evaluation is not limited to heuristics as other methods have also been developed (Järvinen, Heliö, & Mäyrä, 2002; Kim *et al.*, 2008). We briefly look at the input of some of these authors on the progression of game evaluation.

Melissa Federoff (2002) was one of the first to develop a group of guidelines which could be used to create *fun* in video games as well as evaluate them. Her study was divided into two main phases. Initially, she carried out an extensive literature review uncovering existing heuristics for game usability. In a second phase, she conducted a study at a video game development company were she collected heuristics through questioning and observing 5 members of the company. After uniting the heuristics gathered in the first phase with those gathered in the second, she defined a final list that included 40 heuristics, divided into the categories of game *interface*, game *mechanics* and game *play*. Federoff concluded her study with suggestions for more formal usability procedures, indicating, for example, prototyping and expert evaluations.

Desurvire *et al.* (2004) also cantered their research on heuristics for game evaluation. They developed the "Heuristic Evaluation for Playability" (HEP), a set of heuristics to evaluate both computer and board games. Similar Federoff's (2002) approach, HEP derives from an extensive literature review on existing heuristics. Nonetheless, while Federoff grouped her heuristics into 3 categories, Desurvire *et al.* (2004) grouped HEP into 4 categories: game *story* (plot and character development); game *play* (problems and challenges a player faces through the game); game *mechanics* (game code that is responsible for the manner in which units interact with the environment); and game *usability* (the game interface and the methods through which the player interacts with the game: keyboard, game pad). The HEP list is composed of 43 heuristics which – according to the authors – are useful for evaluating general game issues in the early stages of game design and development.

Pinelle *et al.* (2008) also developed a set of heuristics which can be used to identify usability issues in video games. Contrasting with the approach used by Federoff (2002) and Desurvire *et al.* (2004), Pinelle *et al.* developed a set of heuristics by analysing 108 different PC games. Analysing the game's reviews, they extracted 12 categories of usability problems. Based on those categories, they proposed a final list of 10 heuristics describing how usability problems can be avoided. The authors also defend that heuristics such as those proposed by Federoff and Desurvire *et al.* while useful, focus mainly on engagement and fun, and do not concentrate on usability in detail.

Korhonen & Koivisto (2006) also developed a set of heuristics for game evaluation. Nonetheless, their efforts focused on mobile games. Their model is divided into three parts – game *usability*, *mobility* and *gameplay* – and is applicable in the pre-production and production phases as well as, eventually, in the post-production phase. Just as video games are unique when compared to other products, mobile games are just as much in the gaming context. The authors developed their model as a result of the inadequacy of existing game heuristics or tools proposed by other authors (Desurvire *et al.*, 2004; Federoff, 2002) to conduct their desired game evaluations.

Paavilainen (2010) presented a preliminary list of design and evaluation heuristics for social games which emerged from the domain of social media. These heuristics for social games were developed according to existing game heuristics and through the analysis of social game design frameworks. Paavilainen presented a critical review on some of the aforementioned studies (Desurvire *et al.*, 2004; Federoff, 2002; Korhonen & Koivisto, 2006; Pinelle *et al.*, 2008). Paavilainen indicates that many of these heuristic proposals lack validation, but suggests Korhonen & Koivisto's (2006) methodology is recommended in the development of social heuristics. Paavilainen also reviews two social game design frameworks introduced by Ventrice (2009) and Järvinen (2009). Based on the analysis, Paavilainen presented a list of 'initial high level social game heuristics for design and evaluation' that can be used as a basis for future research on the subject. This initial list is composed of 10 points: spontaneity, interruptibility, continuity, discovery, virality, narrativity, sharring, expression, sociability and ranking.

Finally, while heuristics are a rapid and cost-friendly method of evaluating video games, 'TRUE – Tracking Real-Time User Experience' (Kim *et al.*, 2008) is a different approach to uncovering usability issues or assisting in game evaluation. TRUE is a model that combines the analysis of user-initiated events (UIE) with other HCI methods. In their work, the authors elaborate on the value of logging UIE (*e.g.*: number of errors) so that determined errors can be analysed. The TRUE system, which is capable of logging sequences of events (system events as well as contextual information related to the event; for example, in a racing game, contextual information related to weather, the car being driven, the race track, ...) in addition to including a time stamp for each; also includes attitudinal data acquired through inquiring participants on their feelings about the game or the difficulty of the game tasks. The combination of these data sources – behavioural data (data related to UIEs) and attitudinal data – results in a far greater understanding of how users experience products, games included. Since its development, TRUE has been applied in the improvement of more than 20 games.

1.7 FINAL CONSIDERATIONS ON THE CHAPTER

This chapter has introduced one of the core concepts of this body of work: video games. Furthermore, it has detailed the concept from several perspectives. Initially, a historical overview of the first video game is presented. This is followed by several considerations regarding play and games; and definitions of video games according to various authors. Also, an analysis on video game genres is presented. Game and Level Design issues are also discussed, followed by a reflection of how level design works towards creating experiences.

Based on Game and Level Design reflections, an analysis of some of video game related components is presented, related to the Mechanics, Interface and Narrative (Hunicke *et al.*, 2004; Rollings & Adams, 2003; Takatalo *et al.*, 2010) of a video game.

Equally important are video game players, which are also considered and analysed in this chapter. An analysis of players according to differences in gender, background, expectations and motivations is introduced. These are all variables which may influence a player's interaction with a game, and the resulting experience from playing.

Lastly, this chapter also focuses on video game evaluation, while focussing on applied evaluation strategies and existing research.

This initial chapter is a valuable framework for understanding two vectors of the gameplay experience: *video games* and *players*. The gameplay experience results from how players interact with video games, therefore, it is important to comprehend what elements make up each of these two larger concepts. Understanding what components are at the heart of video games, and what player specificities can play a role in the creation of the experience is important in understanding what specific video game and player characteristics can shape the experience. This knowledge can later be used and contribute to conceptualizing and defining a gameplay experience model.

CHAPTER 2
THE GAMEPLAY EXPERIENCE

Having introduced the concept of video games, it is important to understand the reasons why games are played according to the possible outcomes of game playing. Described as user, player, gaming or gameplay, the resulting experience from game playing is at the centre of extensive work focused on video games. One approach suggests the user experience is a term that considers concepts such as immersion, flow, presence, among others. The following chapter looks to describe the gameplay experience, considering some of the referred concepts. Furthermore, a look at how these experiences are measured and relate to one another will also be considered.

2.1 FROM USER EXPERIENCE TO THE GAMEPLAY EXPERIENCE

The concept of 'gameplay experience' can be understood as part of a bigger theory – the 'user experience' – which focuses on making products *provide* experiences (Hassenzahl, 2003, p. 31). In the video game context, an analysis of the gaming and playing experience is more adequate. However, this analysis requires an initial introduction on the concept of 'experience'.

According to Preece *et al.* (2002), *experience* can be described as "*how the interaction feels to the users.* Gámez *et al.* (2010, pp. 49–50) state: "*an application is concerned with experience when during the interaction process, factors such as fun, enjoyment, pleasure or aesthetics have an influence on the player*". Additionally, Dewey (1938 apud Gámez *et al.*, 2010, p. 50) defined experience as "*both the process and the outcome of the interaction of a user with the environment at a given time*". In an interaction process, the environment is formed by the goal to be achieved, the tool to be used and the domain in which the interaction is taking place (Gámez *et al.*, 2010).

Forlizzi & Battarbee (2004, p. 261) note there are various aspects in an experience that result from the interactions between product and people: physical, sensual, cognitive, emotional and aesthetic experiences. The authors group existing models and theoretical approaches from areas such as design, business, philosophy, cognitive and social sciences into three categories: (i) *product-centered*, (ii) *user-centered* and (iii) *interaction-centered* models (Forlizzi & Battarbee, 2004, p. 262).

In recent years, the concept of 'user experience' (UX) has begun to make its way into the field of 'Human-computer Interaction' (HCI). While traditionally HCI and usability was about making a product functional, user experience now *requires* that products provide experiences (Hassenzahl, 2003, p. 31). Additionally, Hassenzahl (2003) states "*user experience can be seen as an umbrella term used to stimulate research in HCI to focus on aspects which are beyond usability and its task-oriented instrumental values*". While in the past, the idea of 'user experience' was rarely used in the gaming industry (Federoff, 2002), as of late, both the HCI and gaming fields have learned from one another (Bernhaupt, 2010).

User experience evaluations in interactive entertainment systems, or more specifically in video games, have always been a matter of preoccupation in game development. "*Programmers of the first computing systems started to develop the first versions of digital games and already established a very basic form of user experience evaluation by simply trying to play the game – and trying to understand why it was not fun in the end*" (Bernhaupt, 2010, p. 3).

Because player enjoyment is crucial for video games (Sweetser & Wyeth, 2005), it is acceptable to admit that playing video games should produce positive experiences (Gámez *et al.*, 2010). Ermi & Mäyrä (2005, p. 2) suggest human experiences in games are built of the same elements found in other experiences, and the gameplay experience can be defined as an "*ensemble made up of the player's sensations, thoughts, feelings, actions and meaning-making in a gameplay setting*". A 'gaming experience' isn't something a player jumps into; rather, it is something that he actively constructs. These experiences are built when desires, anticipations and previous experiences are brought in, interpreted and reflected upon (Ermi & Mäyrä, 2005).

In a video game context, the user experience – or the more specific 'gameplay experience' – is associated to a grouping of concepts such as immersion, flow, presence, fun, involvement, and engagement (Bernhaupt, 2010). Consequently, it is a difficult task to effectively describe the gameplay experience for several reasons (IJsselsteijn, Poels, Jurgelionis, & Bellotti, 2007). The same authors suggest that there is no *single* gameplay experience, but various. The distinct number of gaming genres and games will influence the type of experiences players have when engaged in a game. They question (2007, p. 1), "*is the fun you can have from blasting your way through a 3D village full of zombies the same kind of fun that may result from managing a soccer team? And of course, my idea of fun may not be another person's idea of fun, as is testified, for instance, by individual differences in play styles, differences in game preferences between men and women, or differences between (…) cultures*". Describing the gameplay experience is additionally difficult because 'being entertained' is an unconscious process (IJsselsteijn et al., 2007). Therefore, if a player is asked to analyse his gaming experience while *experiencing it*, the experience itself will not continue. Even if the analysis is done afterwards, describing the experience continues to be difficult because of the lack of common vocabulary to designate the experiences.

Bruce Phillips, user research engineer with Microsoft Game Studios, describes the difficulty in defining game related experience as follows (Phillips, 2006, pp. 22–23):

> *As a user-experience professional working within the video-game industry, I often find myself uncertain about what experiences we are trying to provide our users. Similarly, I often find myself unsure of what users are experiencing when they play our games. (...) The video-game industry does not have a broadly accepted, generally agreed upon framework for describing the experiences our products are intended to create. (...) It is not only for lack of trying that a good vocabulary for describing game experiences does not exist. It is downright hard to describe video games and the experience of playing them (...).*

Difficulties in describing these experiences have led researchers to alert on the problem of considering user experience as only a personal outcome within the scope of scientific knowledge (Gámez *et al.*, 2010). They state, "*Scientific knowledge allows us to generalize about our understanding of the world. If we identify the phenomenon being studied as personal, then it would not be possible to provide a general description of the phenomenon*" (Gámez *et al.*, 2010, p. 48). Consequently, they believe that through the analysis of the experience process, it is possible to objectively study and generalize about 'experience'.

As suggested by Bernhaupt (2010, p. 4), the gameplay experience has been analysed within the scope of several concepts including immersion, flow, presence, engagement, flow and fun. The concepts of 'immersion', 'flow' and 'presence' are considered in the following sections.

2.2 Immersion

> *"Sometimes people find a game so engaging that they do not notice things around them, such as the amount of time that has passed, or another person calling their name. (...) all of their attention is focused on the game, even to the extent that some people describe themselves as being 'in the game'."*
>
> *Jennett et al., 2008, p. 641*

According to Jennett *et al.* (2008), the description above refers to the concept of 'immersion', a term used by many game players, and seen as a critical element in a greater game enjoyment and gaming experience. Coomans & Timmermans (1997) spoke of immersion as a "*feeling of being deeply engaged and entering a virtual world as if it were real*". Alison McMahan (2003) suggests Janet Murray's (1997, pp. 98–99) definition of immersion is the most accepted:

> *"A stirring narrative in any medium can be experienced as a virtual reality because our brains are programmed to tune into stories with an intensity that can obliterate the world around us. (…) The experience of being transported to an elaborately simulated place is pleasurable in itself, regardless of the fantasy content. We refer to this experience as immersion. Immersion is a metaphorical term derived from the physical experience of being submerged in water. We seek the same feeling from a psychologically immersive experience that we do from a plunge in the ocean or swimming pool: the sensation of being surrounded by a completely other reality, as different as water is from air, that takes over all of our attention, our whole perceptual apparatus (…) in a participatory medium, immersion implies learning to swim, to do the things that the new environment makes possible (…) the enjoyment of immersion as a participatory activity."*

However, despite the description above and other definitions, there is still uncertainty around the concept of immersion, namely what is meant by it as well as what causes it (Jennett *et al.*, 2008). In an analysis of video games, McMahan (2003, pp. 68–69) indicated three conditions that may create a sense of immersion: (*i*) the user's expectations of the game or environment must match the environment's conventions fairly closely; (*ii*) the user's actions must have a non-trivial impact on the environment; and (*iii*) the conventions of the world must be consistent, even if they don't match those of 'meatspace'.

Brown & Cairns (2004) conducted early research in an attempt to define immersion and its qualities. This research was done through the development of a *grounded theory*[18] in which information was collected through interviews with gamers and their described experiences. At the time of the study, immersion was a term used with greater incidence in virtual reality and game related studies. The authors' background work led them to identify that occasionally, immersion was related to the realism of the game world or even the sounds of a game. In fact, the experience of immersion can be made or destroyed by these or other game characteristics. However, despite the fact that game characteristics could be part of the immersion experience, there are cases in which games have realistic worlds where immersion is not achieved (Brown & Cairns, 2004). They also concluded that there is no clear definition of immersion and therefore, proceeded to inquire gamers on what they felt immersion was.

Their results led them to state that, initially, immersion deals with the degree of *involvement* with a game (Brown & Cairns, 2004, p. 1298). The idea of involvement varies along time and is dependent of the barriers a player encounters. The authors identified three levels of involvement: (*i*) engagement; (*ii*) moving on to a greater involvement in 'engrossment'; (*iii*) total immersion. The barriers are intimately related to the level of immersion and involvement with the game.

i. 'Engagement' is identified as the lowest level of involvement with a game and occurs before any other of the remaining two levels. For a player to feel *engaged* he must invest time, effort and attention to the game.

ii. 'Engrossment', the second level of involvement, results from the player becoming further engaged in the game. A barrier to engrossment is game construction which is related to game features combining such that the player's emotions are affected by the game. Features identified by the authors at the base of this quality are the game visuals, interesting tasks as well as plot.

iii. 'Total immersion' which the authors identify as 'presence', is described by players as level of involvement where they are "*cut off from reality and detached to such an extent that the game was all that mattered*" (Brown & Cairns, 2004, p. 1299). Two of the identified barriers for presence are empathy (where a player feels attached to a character or a team) and atmosphere (related once again to elements such as graphics, plot and sounds).

Still related to Brown & Cairns' (2004) three levels of involvement, the authors indicate that *attention* is an important aspect of the experience. During the act of game play, attention must initially come from players. Players must be willing to dedicate their concentration and focus to the game – and invest *attention* in order to potentially become engaged with a game. Normally, the attention a game requires will be greater in games which provide more absorbing experiences, when compared to others that provide a more rapid experience. However, as the video game progresses, the element of attention must shift from the player to the game.

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[18] A *grounded theory* is a form of qualitative research that emphasizes analysis from raw data with continual interplay between data and researchers' interpretations. The purpose of a grounded theory is to develop a theory from data (Creswell, 2011; Fraenkel et al., 2012).

Therefore, the game itself should provide the player with something worth attending to (Brown & Cairns, 2004). The game can accomplish this through the use of *narrative*, *goals* and *specific objectives*; or the game world itself – several of the concepts previously explored (*cf.* Section 1.4 – Building Blocks of Video Games, *p. 29*) The type of game being played can also define the extent of the attention required, and may demand it on three types of levels: *visual*, *auditory* and *mental* attention. Also, Brown & Cairns' (2004) suggest that the more attention sources used, and the extent to which each attention level is used, can determine the degree to which a player becomes immersed.

Jennett *et al.* (2008) believe immersion is tightly linked to some of the other concepts that will be discussed – flow and presence – as they involve similar states such as temporal dissociation and awareness from their surroundings. However, they believe that immersion is concerned with "*the specific, psychological experience of being engaged with a computer game*" (Jennett *et al.*, 2008, p. 643), whether or not it is a fulfilling experience. Additionally, they state that immersion isn't necessarily a player's objective, something they play games to achieve; but rather, is an experience that occasionally just happens. In addition to these findings, Jennett *et al.* defend immersion can be measured subjectively (through tasks) and objectively (through task completion time and eye movements). Their study was presented as an introduction to ongoing research in the definition of immersion which, despite the existing ambiguity, can be said to be the result of a good gaming experience (Jennett et al., 2008).

Ermi & Mäyrä's (2005) research led them to propose the SCI-model which contemplates three dimensions of immersion: (*i*) sensory immersion; (*ii*) challenged-based immersion; and (*iii*) imaginative immersion.

i. Sensory immersion deals with the audiovisual component of games. Nowadays, many developed video games are rich and exciting 3D, audiovisual worlds that easily captivate players. These videogames are able to take over other sensory information found in the 'real-world', leading the player to focus his attention exclusively on the stimuli coming from the game.

ii. Challenged-based immersion is related to the feeling that arises when a player is able to achieve a satisfying balance of challenges – either motor or mental – and abilities.

iii. Imaginative immersion deals with possibility of a player becoming absorbed with the game world or stories, or establishes a connection with a game character. As the authors exemplify, each one of these dimensions of immersion may be found with greater incidence in one or another type of media. Virtual reality environments might trigger sensorial immersion while absorbing a book might lead to imaginative immersion.

Nacke & Lindley (2010) note that the dimension of 'imaginative immersion' indicated by Ermi & Mäyrä (2005) is similar to 'presence', the last of the three levels of immersion specified by Brown & Cairns (2004). In both 'imaginative immersion' and 'presence', ideas related to being absorbed by the game or the possibility of establishing a connection with the character of the game is shared. The same authors (Nacke & Lindley, 2010, 2008) refer the dimension of challenge-based immersion (Ermi & Mäyrä, 2005) is closely connected to an experience Mihály Csíkszentmihályi (1990) defines as the 'flow experience'.

2.3 FLOW

Mihály Csíkszentmihályi's (1990) work is a foremost reference on the concept of 'flow', namely his research on the 'optimal experience of flow'. Flow research began with the desire to understand the phenomenon of intrinsically motivated – or 'autotelic' – activities, regardless of the product or outcome that might result from the activity (Nakamura & Csíkszentmihályi, 2002). The essential hypothesis of his work is that in certain mental states we feel a complete and energized focus in an activity, accompanied by a high level of enjoyment and fulfillment in what we are doing. The term flow derives from the manner in which his participants described the state, indicating it as "*going with the flow*" (Csíkszentmihályi, 1990, p. 64).

Csíkszentmihályi's (1990, p. 4) studies have led him to describe flow as the "*state in which individuals are so involved in an activity that nothing else seems to matter*". As occurs with immersion, when in the flow state, individuals may become so absorbed in their activities that irrelevant thoughts are filtered out.

Csíkszentmihályi suggested there are 8 major components at the core of the 'flow experience'. Furthermore, when flow occurs, participants indicate at least one, and occasionally, all of the 8 components (Csíkszentmihályi, 1990, p. 49):

- The subject confronts a task they believe they can complete;
- The subject is able to focus their concentration on the activity they are doing;
- The activity has clear goals;
- The activity has direct feedback;
- The subject senses that he is in control of the activity;
- The subject loses self-consciousness;
- The sense of duration of time is altered.

Bateman & Boon (2006, p. 81) suggest inquiring individuals who play games will likely result in the indication that many of these components are common to the act of playing video games, and the state of flow can be correlated with a highly enjoyable (and immersive) play experience. Additionally, certain activities can result in a flow experience because they are designed to make optimal experiences easier to achieve through the promotion of rules which require learning skills, the setup of goals, and provide feedback. These elements are commonly present in almost all video games (Bateman & Boon, 2006). What Csíkszentmihályi's ideas suggest, and considering a video game context, is that to provide an enjoyable experience, a video game should seek to place the player in an optimal experience or, at minimum, provide a support so this optimal experience may occur (Bateman & Boon, 2006).

Csíkszentmihályi (1990) also discusses the 'psychology of optimal experience', elaborating on what happens when an individual leaves the state of optimal experience – flow – as well as how the individual can return to the state. Two feelings may occur when the flow channel is left: 'anxiety' or 'boredom'. When an individual faces a challenge for which they have insufficient skills, they'll usually experience anxiety. However, if they face a challenge for which they have excessive skills, they'll commonly experience boredom. Figure 7 illustrates this relationship.

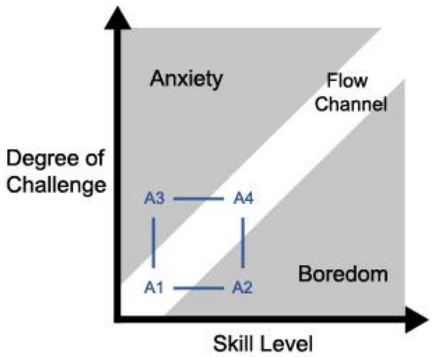

Figure 7: The Flow Channel, as defined by Csíkszentmihályi (1990)
Adapted from Bateman & Boon (2006)

Csíkszentmihályi (1990, pp. 74–75) describes the particularities of the flow channel (Figure 7), and the relationship between challenges and skills as follows:

> *(...) The figure represents a specific activity – for example, the game of tennis. The two theoretically most important dimensions of the experience, challenges and skills, are represented on the two axes of the diagram. The letter A represents an individual who is learning to play tennis at four different points in time. When he first starts playing (A1), the player has practically no skills, and the only challenge is hitting the ball over the net. This is not a very difficult feat, but he is likely to enjoy it because the difficulty is just right for his skills. At this point he will probably be in flow. After a while, if he keeps practicing, his skills are bound to improve, and then he will grow bored just batting the ball over the net (A2). Or it might happen that he meets a more practiced opponent, in which case he will realize that there are much harder challenges for him than just lobbing the ball – at that point, he will feel some anxiety (A3) concerning his poor performance.*

> *Neither boredom nor anxiety are positive experiences, so the individual will be motivated to return to the flow state. How is he to do it? (...) Increase the challenges he is facing. By setting himself a new and more difficult goal that matches his skills – for instance, to beat an opponent just a little more advanced than he is –he would be back in flow (A4). If the player is anxious (A3), the way back to flow requires that he increase his skills. The diagram shows that both A1 and A4 represent situations in which an individual is in flow. Although both are equally enjoyable, the two states are quite different in that A4 is a more complex experience than A1. It is more complex because it involves greater challenges, and demands greater skills from the player. However, A4, although complex and enjoyable, does not represent a stable situation, either.*

In a video game context, for a game to maintain players inside this 'flow channel', the video game must offer the right balance between challenge and skills. Nonetheless, designing for this objective is challenging due to the size, diversity, and different levels of experience the potential audience have. Figure 8 represents the different variations of the flow channel for different types of players.

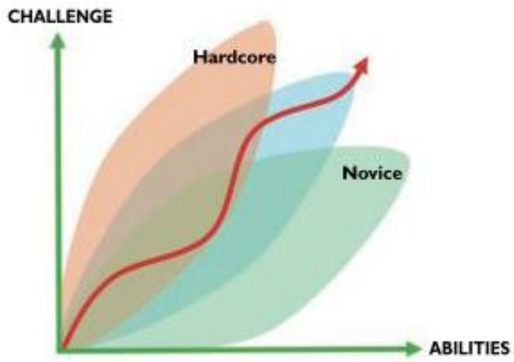

Figure 8: The variations in the flow channel for different types of players
Adapted from Chen (2007, p. 32)

Chen (2007, p. 33) indicates that a big problem in designing a commercial user-oriented experiences is no two individuals experience a product in the same way. With video games, players with different abilities expect different challenges. Many video games only offer an intermediate experience, neither satisfying more experienced players or inexperience players, which can cause a frustrating experience for either group. Chen (2007) notes that designing for a broader audience requires the experience not be the same for all players. This is possible by offering different choices according to a player's personal flow channel. However, this task is not as simple as populating the experience with countless choices, as excessive choices may also overwhelm the player and lead to disinterest. Also, asking players to constantly make choices leads to disrupting gameplay. In either situation, two components of the flow experience are disrupted – sense of control and concentration on the task – leading to disruption of 'flow'.

Chen (2007) suggests a four-step methodology in order to provide enjoyable interactive experiences for the widest variety and number of users: *(i)* mix and match the components of flow; *(ii)* keep the user's experience within the user's flow zone; *(iii)* offer adaptive choices, allowing different users to enjoy the flow in their own way; *(iv)* embed choices inside the core activities to ensure that the flow is never interrupted.

The flow model proposed by Csíkszentmihályi includes the concept of 'interactionism', which remits to the idea of a dynamic system composed of an individual and the environment which surrounds him. Because the flow experience is shaped by these two vertexes – person and environment – Csíkszentmihályi speaks of 'emergent motivation' in an open system, which he describes as: "*what happens at any moment is responsive to what happened immediately before within the interaction, rather than being dictated by a preexisting intentional structure located within either the person or the environment*" (Nakamura & Csíkszentmihályi, 2002, p. 91).

In addition to interaction, attention is also a key factor in the flow experience. "*Entering flow is largely a function of how attention has been focused in the past and how it is focused in the present by the activity's structural conditions*" (Nakamura & Csíkszentmihályi, 2002, p. 92). This idea suggests that attention processes directly influence flow. The passing of time, another quality of flow, becomes distorted because a person's attention is completely focused in another place (Nakamura & Csíkszentmihályi, 2002). Flow, just like the feelings of boredom and anxiety, function according to the manner in which attention is being structured at a given time.

Based on the ideas above – and similar to immersion (*cf.* Section 2.2, *p.* 69) – within the Flow theory, attention also assumes a significant importance. Within flow, attention is a comparable term to *concentration*, one of the eight major components of the theory. While the work of Csíkszentmihályi on Flow is rooted in *everyday* activities, the theory can also be interpreted in the light of video games. The idea of concentration is based on the notion that when an individual is in a concentrated state, he is able to forget all unpleasant aspects of life. However, this idea does not imply that an unhappy individual is likely to be a more concentrated individual. From a video game perspective, occasionally a gamer will play video games not specifically to forget about unpleasant problems, but as a way of clearing his mind from everyday concerns. In such a case, a player may be more motivated to play and will likely also become easily concentrated during the act of play.

In gaming situations, concentration – or the possibility of becoming concentrated – is dependent of the player and can be achieved in various situations. From the *Flow* theory, concentration is described as an important by-product or result of the fact that *"enjoyable activities require a complex focus of attention on the task at hand"* (Csíkszentmihályi, 1990, p. 58). What this suggests is that for games to be enjoyable, they must require attention and the player must be able to concentrate on the game (Sweetser & Wyeth, 2005). Furthermore, the more concentration a task requires from a player in terms of his attention, the more absorbing the game will be (Sweetser & Wyeth, 2005).

While it is acceptable that a player who is paying more attention to a game can indicate he is enjoying the game; a video game can still be enjoyed without the player having to be completely focused and concentrated, and abstracted from the world. For example, many mobile games are enjoyable but do not require a complete focus of attention to complete the goals or individual tasks. The very nature of many mobile games is to deliver immediate and enjoyable experiences of playing without requiring excessive attention from the player.

Lastly, as a result of this shifting of an individual's concentration to a specific task, one of the most common and specific features of flow may occasionally take place: individuals become so involved in the activity they are performing that the activity and their actions become spontaneous and almost automatic. As a result, individuals stop being aware of themselves as separate from the actions they are performing (Csíkszentmihályi, 1990, p. 53). This loss of awareness is what Csíkszentmihályi (1990) designates *loss of self-consciousness*. Within *Flow*, there is a loss of self-consciousness when an activity requires attention to an extent that an individual is unable to consider and respond to other relevant stimuli outside of the activity (Csíkszentmihályi, 1990). This is visible with video game players in cases where attention was placed with such *intensity* into the activity being carried out that they don't notice someone calling out for them; the phone ringing, but wasn't heard; or some other relevant stimuli exterior to the activity.

Returning to the Flow model (*cf.* Figure 7, *p.* 73), in later research, the original model was considered insufficient, as the act of balancing *skills* and *challenges* does not optimize the quality of the flow experience. Massimini & Delle Fave (2000 apud Nakamura & Csíkszentmihályi, 2002) suggested that *skill stretching* is inherent in the flow concept. Based on these assumptions, the flow model was redefined as the "*balance of challenges and skills when both are above average levels for the individual*" (Nakamura & Csíkszentmihályi, 2002, p. 95).

This translates into the idea that flow will occur when an individual perceives a greater opportunity for action than they might encounter on average in their day-to-day lives, and have skills adequate to engage them. This idea then defined a state of 'apathy', where low challenges meet low skills; a state opposite of flow and where attention is absent. Further research led to a more extensive breakdown of the challenge *vs.* skill equation, leading to the definition of eight different flow channels. Figure 9 represents a revised model of the flow state, with eight different channels based on the challenges and skills binomial.

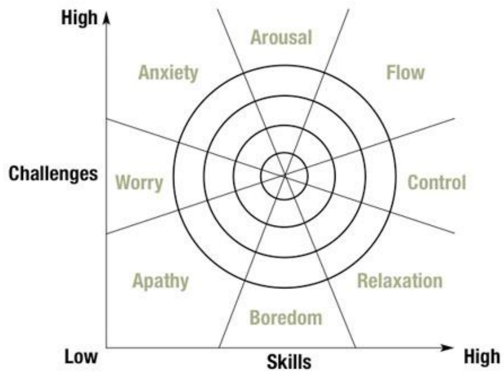

Figure 9: Current model of the Flow state
Adapted from: *http://www.ideafit.com/files/flow-model.jpg* [Accessed: October 25, 2013]

Sweetser & Wyeth (2005) conducted research in an attempt to determine how the various elements of flow could be applied in video games. Their work resulted in the 'GameFlow' model, a model based on the combination of the flow elements and their application in video games. This model consists of eight elements, each with a varying number of points related to Csíkszentmihályi's elements of flow: (*i*) 'concentration'; (*ii*) 'challenge'; (*iii*) 'skills'; (*iv*) 'control'; (*v*) 'clear goals'; (*vi*) 'feedback'; (*vii*) 'immersion'; and (*viii*) 'social'. Table 3 represents the connection of game elements with the elements of flow.

Table 3: Connection of elements from games with the elements of flow (Sweetser & Wyeth, 2005)

Games Literature	Flow
The Game	A task that must be completed
Concentration	Ability to concentrate on the task
Challenge player skills	Perceived skills should match challenges and both must exceed a certain threshold
Control	Allowed to exercise a sense of control over actions
Clear goals	The task has clear goals
Feedback	The task provides immediate feedback
Immersion	Deep but effortless involvement, reduced concern for self and sense of time
Social interaction	N/A

Sweetser & Wyeth (2005) indicate that the first element of flow – a task that must be completed – is not represented in their 'GameFlow' model because the task is the video game itself. However, the remaining elements are closely interrelated and interdependent. The authors summarize the relationship of these elements in the following manner:

> *(…) games must keep the player's concentration through a high work-load; but the tasks must be sufficiently challenging to be enjoyable. The player must be skilled enough to undertake the challenging tasks, the tasks must have clear goals so that the player can complete the tasks, and the player must receive feedback on progress towards completing the tasks. If the player is sufficiently skilled and the tasks have clear goals and feedback, then he or she will feel a sense of control over the task. The resulting feeling for the player is total immersion or absorption in the game, which causes them to lose awareness of everyday life, concern for themselves, and alters their sense of time. The final element of player enjoyment, social interaction, does not map to the elements of flow, but is highly featured in the literature on user-experience in games. People play games to interact with other people, regardless of the task, and will even play games they do not like or even when they don't like games at all.*
>
> *Sweetser & Wyeth, 2005, p. 4*

Visible in the eight components of the Flow Theory, and iterated by Sweetser & Wyeth (2005), the concept of control is also an important factor and can be furthered detailed because of its applicability in a video game context. Previously, Csíkszentmihályi (1990) focused on many activities outside the realm of video games and explored the concept of control in multiple everyday life situations. For example, Csíkszentmihályi (1990) explores how control is linked to enjoyable activities that involve risks which many people would find dangerous. There is some enjoyment in the possibility of controlling these dangerous situations.

Within the video game context, control relates to the possibility of being in a situation where there are no preoccupations regarding the outcomes of one or more *actions* (Sweetser & Wyeth, 2005). This perspective of control can be seen in the light of many video games. Shooting games, fighting games, many role-playing games, racing and flying simulation games, are examples where a player assumes the role of one or more characters and must complete actions they wouldn't normally exercise in their 'real lives'. In 'real life', an individual (normally) will not go around shooting terrorists and throwing grenades; fight off individuals while jumping in the air; organize an attack on a local village while riding a horse; fly an airplane or drive at 300 km/h. All these situations afford considerable risk. However, in a game, a player can carry out all necessary *actions* to complete his goals without worrying about the risks resulting from these actions. In any one of these scenarios, the player is in *control*.

In a more specific analysis, control is also related to the freedom the game gives the player to manipulate his characters or playable objects (*e.g.* racing car, airplane). As some authors state, *"players must be allowed to exercise a sense of control over their actions"* (Sweetser & Wyeth, 2005, p. 8); feel control over their characters' movements and the way in which they explore the game environment (Federoff, 2002); and, the player should be able to manipulate the world's objects which may be used to carry out the player's goals (Gee, 2004 *apud* Sweetser & Wyeth, 2005). Exemplifying with a racing simulation game, the typical actions a player can carry out are to drive the car and to overtake other cars. However, if the game only allows the player to steer left or right – while the game automatically accelerates – the player loses a sense of full control over his actions.

Still looking into control, a game should provide player with control rather than creating a sense of being controlled. As a result, a game should not force players to make decisions which are not important or do not have a direct impact on the outcome of the game (Fullerton, Swain, & Hoffman, 2004). This idea is somewhat related to the characteristics *actions*: just as the game should ensure that a player has a control over his actions and their impact on the outcome of the game (*control*), these actions should not have a trivial impact on the environment (*actions*).

Lastly, other considerations on *control* suggest that games should hide they are linear in structure and create a feeling of control for the player (Pagulayan, Keeker, Wixon, Romero, & Fuller, 2003); and video games should not be based on a single optimal strategy for winning, allowing players control over how he wants to win (Federoff, 2002). In summary, *"the player should feel like they are playing the game, not being played by it"* (Kane, 2003 apud Sweetser & Wyeth, 2005, p. 9).

As mentioned earlier, flow and immersion touch on several points, as both are responsible for creating a sense of time distortion and providing challenges that involve a person doing a task (Jennett *et al.*, 2008). Jennett *et al.* (2008) defend immersion is a precursor for flow because the idea of 'being involved that nothing else matters' is equally applicable to immersion. Nonetheless, flow is a particular sort of experience – an optimal and therefore, extreme experience. The same can't be said for immersion, which is not always an extreme experience.

As Brown & Cairns (2004) suggested, immersion is an experience defined by levels of involvement. Hence, a player may be highly involved in a game but still be aware of his surroundings. Therefore, despite being in an *immersed state*, they are not such that they exclude everything around them, and therefore, are not in flow. This suggests then, that flow is the 'extreme end of immersion' (Jennett *et al.*, 2008). However, there are games that contradict this possible definition, as they do not live up to the basic criteria of flow presented earlier. Some games do not have clear goals, others don't have proper feedback; additionally, some games challenge players beyond their abilities and will most likely create anxiety rather than flow. These ideas would indicate that a game with those particular characteristics is incapable of generating a flow state; however, they don't necessarily indicate that the game wouldn't still be a satisfying and immersive experience (Jennett *et al.*, 2008).

2.4 PRESENCE

The idea of presence became a popular research area when virtual reality technologies emerged in the 1990s (Jennett *et al.*, 2008). As verified with 'immersion', a consensual definition for the concept of presence is unclear. Additionally, Zahorik & Jenison (1998) indicate that the method of measuring presence is also dependent of how the concept is defined.

According to Lombard & Ditton (1997), in addition to games, 'presence' has been studied in several other media, namely virtual environments (VE), television and movies. Lombard & Ditton's (1997) literature review led them to find 6 distinct but interrelated conceptualizations of presence: *presence* as (*i*) social richness; (*ii*) realism; (*iii*) transportation; (*iv*) immersion; (*v*) social actor within medium; (*vi*) medium as social actor.

i. **Presence as social richness:** Here, "*presence is the extent to which a medium is perceived as sociable, warm, sensitive, personal or intimate when it is used to interact with other people*". It is also related to two important concepts originally applied to nonmediated interpersonal communication: 'intimacy' and 'immediacy'.

ii. **Presence as realism:** Presence as realism relates to the degree which a medium is able to accurately produce representations of objects, events or people; that is, representations that look, sound and/or feel like the 'real' thing.

iii. **Presence as transportation:** With the idea of presence as transportation, three types of transportation can be defined: (i) 'you are there', where a user is transported to a different place; (ii) 'it is here', where another place and objects within that place are transported to the user; and (iii) 'we are together', where two or more individuals are transported together to a place they share.

iv. **Presence as immersion:** Here, perceptual and psychological immersion is discussed. In many virtual reality experiences, an individual's senses are *immersed* in a virtual world. Perceptual immersion can be measured by counting the user senses that are *enhanced* as well as the degree to which inputs from the surrounding environment are cut off. Psychological immersion deals with states of involvement, absorption, engagement and engrossment.

v. **Presence as social actor within medium:** This type of presence deals with the treatment of mediated entities as social actors. Specifically, with this type of presence, an individual's perceptions and resulting psychological processes lead them to irrationally overlook a mediated entity within a medium and attempt to interact with it.

vi. **Presence as medium as social actor:** The last conceptualization of presence relates to the social responses of media users not to entities – people or computer characters – within a medium, but to cues provided by the medium itself.

Jennett *et al.* (2008) suggest that one method of defining 'presence' is according to the rationalistic tradition, where Slater *et al.* (1994) indicate that it is a psychological sense of being in a virtual environment. Zahorik & Jenison (1998, p. 87) suggested presence is most likely to occur when an environment responds to a user's action in a way which is perceived as lawful. Based on this idea, these authors argue that presence should be measured by investigating the relationship between perception and action, and analysing the extent to which there is a correspondence between the virtual and real world.

Nunez & Blake (2006) also looked into presence and video games by making a distinction between two types of games: presence games (*e.g.* role-playing games, first-person shooters) and non-presence games (*e.g.* puzzles, real-time strategy). Jennett *et al.* (2008) defend however, that despite certain games with simple graphics do not create a sense of presence, these can still be immersive as they can lead the player do stop noticing things around them. Furthermore, Jennett *et al.* (2008) also state presence doesn't necessarily imply that immersion must exist. For example, a person might feel a sense of presence inside a virtual world, but if they are carrying out a less interesting task, they won't experience a 'loss of time', and therefore, won't feel immersed.

2.5 ADDITIONAL MODELS & FRAMEWORKS

In addition to specific *immersion*, *flow* or *presence* related research; additional work has been developed in terms of models which characterize the dynamics of game related experience.

Gámez et al.'s (2010) 'Core Elements of the Gaming Experience' – CEGE – Model reflects on the necessary conditions to provide a positive experience while playing video games. By looking at the process of the experience, the authors believe it is possible to objectively study the experience of playing games. As a result, they present the *core* elements of the interaction process that build the experience where, in their absence, the experience would be poor. The basis of the CEGE is the game and the interaction between it and the user, which they call 'puppetry'. Video game is a guiding element for 'Game-play' and 'Environment', while Puppetry is a guiding element for 'Control', 'Ownership' and 'Facilitators'. The value of this work lies in the bottom-up approach used to uncover the core elements of their defined gaming experience, but appears to fall short when considering other key elements that could provide a positive experience.

Fernandez (2008) also contributed to the debate also introducing a model. The author defends his framework is a tool that further clarifies the relationship among game components. The presented model is based on three ideas, suggesting that the experience is built upon three moments (*before*, *during*, *after* the experience); the elements of the model act upon and influence other elements, and that fun is the result of the experience. The model consists in a group of constructs framed within 'antecedents', 'processing' and 'consequences' components. More than other referred models, this work pays special attention to the multiple player related facets that play a role in the experience with games. The *antecedents* consider many specific characteristics such as *age*, *gender*, *education*, *hardware preferences* and *purpose* which lead to a *motivation* for playing. These antecedents influence a *processing* stage that result in a general consequence – fun – based on cognitive and emotional responses. However, the processing stage refers to multiple aspects that do not clearly describe the apparently essential game characteristics and how these related to the player characteristics described in the *antecedent* section.

2.6 RELATING GAMEPLAY EXPERIENCE CONCEPTS

Many game experience traits (*e.g.* immersion and flow) are analysed in similar studies and share characteristics. However, they are also different in other aspects (Qin, Rau, & Salvendy, 2010).

Flow is a psychological state where individuals are so involved and engaged in a challenging activity (not beyond their skill capacity) and have a sense of progression towards a goal. The final outcome is both a positive and a rewarding experience (Qin et al., 2010; Seah & Cairns, 2008). Flow is an optimal and extreme experience. However, immersion is not always so *extreme*.

Csíkszentmihályi (1990) defined eight core components which can contribute to the flow state: clear goals; high degree of concentration; a loss of the feeling of self-consciousness; distorted sense of time; direct and immediate feedback; balance between ability level and challenge; sense of personal control; intrinsically rewarding (Qin et al., 2010, p. 232). On the other hand, Jennett *et al.* (2008) believe immersion has the following characteristics: lack of awareness of time; loss of awareness of the real world; involvement and a sense of being in the task environment (Qin et al., 2010, p. 232). Therefore, both immersion and flow lead individuals to become so absorbed in an activity that irrelevant thoughts are screened out and their sense of time is altered.

With video games, it is possible that they create an immersive experience while not leading to a flow state. This can happen because many games do not set out clear goals, leaving it to the player to decide what to do in the game. Also, playing a video game can lead to frustrating experiences because of the player's lack of skill to overcome a particular objective without being less immersive (Seah & Cairns, 2008).

Based on these ideas, it is felt that immersion precedes flow. GameFlow, as proposed by Sweetser & Wyeth (2005) identifies immersion as an essential part of enjoyment when playing video games as it leads to flow experiences.

Immersion is also different from the experience of presence. Presence is the feeling of being inside a virtual world as opposed to the real world. Takatalo *et al.* (2010) suggest that presence is a prerequisite of flow and Jennett *et al.* (2008) believe that it is only a small part of the gaming experience. While immersion is considered to be an experience that is felt in time, presence is a state of mind that individuals experience (Seah & Cairns, 2008).

2.7 EVALUATING & MEASURING THE GAMEPLAY EXPERIENCE

In previous sections, several video game experience concepts were explored, including the ways in which some are identified and measured. Nevertheless, these experiences can be evaluated and measured using other techniques.

Recalling the ideas of Ijsselsteijn *et al.* (2007), the authors elaborate on the difficulties of measuring gaming experiences because *being* entertained is an unconscious process. Despite these difficulties, some authors have measured experience using physiological responses (Nacke & Lindley, 2008), while others have conducted experiences using eye tracking (Jennett et al., 2008; Tijs, 2006), heuristics (Koeffel et al., 2010) and focus groups (Poels, Kort, & IJsselsteijn, 2007).

Nacke & Lindley (2008) indicate emotions are an important component of the game experience which motivates cognitive decisions during gameplay. Existing psychophysiological research suggests some emotional states could be quantitatively characterized through the measurement of physiological responses such as the galvanic skin response (GSR) and facial electromyography (EMG). Nacke & Lindley set up a study where male students played three 'Half-Life 2'[19] game mods with levels designed for *immersion*, *boredom* and *flow*. Participants' physiological responses were recorded during each session. Examples of design criteria for *boredom* were: weak opponents, linear level, repeating of textures and models. For *immersion* they defined complex and exploratory environment, several opponents and a variety of textures and models. For *flow*, they defined an increasingly difficult combat, among others. Posteriorly, components of the game experience were assessed using the *Game Experience Questionnaire* (GEQ) (IJsselsteijn, de Kort, & Poels, n.d.). Results showed that in the 'immersion' level, there was an increase in positive affect and immersion. The 'boredom' level scored the lowest in terms of challenge, immersion and flow, but the highest in terms of player competence. The 'flow' level obtained the lowest value for player competence but the highest in terms of flow, challenge and tension. Nacke & Lindley's (2008) results demonstrated the GEQ could measure game experience components, but only 'challenge' and 'tension' showed statistical significance.

Further exploring the work of Jennet *et al.* (2008) – briefly introduced in *Section* 2.2 – *Immersion* (*cf. p.* 69) – the authors set up three different experiments to measure *immersion*. In the first experiment, they analysed participants' capacity to switch from an immersive to a non-immersive task. They hypothesized that if a player becomes present in a virtual world, then their 'return' (or 'awakening') to the real world could be measured by some effect. In the second experiment, they analysed changes in participants' eye movements during immersive tasks. They hypothesize that as a player becomes more immersed in a game, their eye movements might show some sort of measurable change. In the third experiment, they focused on the effect of externally imposed pace of interaction on immersion and other affective measures. They hypothesized that by altering a task component, the immersive experience of a player will also be altered. Additional information on players' feelings of immersion was acquired with a 33 item questionnaire, developed considering previous studies related to *flow*, *cognitive absorption* and *presence*.

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[19] 'Half-Life 2' is a First-Person shooter game developed by the 'Valve Corporation', originally released in 2004. Official website: *http://orange.half-life2.com/* [Accessed: October 21, 2013]

Among other findings, Jennet *et al.'s* (2008) results allowed them to conclude several ideas in response to their three hypotheses:

i. If a player was more immersed while playing a game, the longer it took them to complete a non-game related task afterwards. Therefore, the authors suggest that "*being increasingly immersed in a game decreased one's ability to re-engage with the 'real world'*" (Jennett et al., 2008, p. 657).

ii. The second experiment analysed the relationship between immersion and changes in eye behaviour. The study results indicated that participant's eye movements increased over time when in a non-immersive state, whereas they decreased over time when in an immersive state. Based on this data, the authors suggest that "for an immersive game an individual's eye movements will decrease, as their attention becomes more focused on visual components relevant to the game" (Jennett et al., 2008, p. 657).

iii. The third experiment looked to understand how altering one component of a task could alter the immersive experience. By controlling the pace of interaction, the authors indicated that the level of affection varied. Therefore, they suggest that immersion is also related to emotional involvement, an idea previously supported by Brown & Cairns (2004).

Tim Tijs (2006) developed a study to quantify immersion in games through the analysis of eye movements, an approach similar to Jennett *et al.'s* (2008) study. In the study, 20 participants (15 men, 5 women) played an apparently immersive and a non-immersive (according to the author) racing game; 'Gran Turismo 4'[20] and 'Ford Simulator 5'[21], respectively. Racing games were selected because of their focus on tactical immersion and the possibility of achieving immersion quickly. Sessions began with 5 minutes of training, 10 minutes of playing and finished with an experience questionnaire. Player eye movements were recorded with a video-based eye tracker. Tijs' (2006) results indicated, as expected, that the self-reported immersion scores were higher for the 'immersion' racing game. In terms of eye movements, a correlation was found between fixation duration and reported immersion. Therefore, players which identified higher immersion demonstrated stronger increases in fixation duration. While the author defends that eye movements cannot completely identify levels of immersion, they can be a potential asset in the development of measures for immersion.

[20] Gran Turismo 4' is a racing-simulator game for the PlayStation 2, developed by 'Polyphony Digital', originally released in 2004. Official website: *http://www.gran-turismo.com/* [Accessed: October 21, 2013]

[21] 'Ford Simulator 5' is a car racing game developed by 'SoftAd', originally released in 1994. Additional information available at: *http://www.classic-pc-games.com/pc/simulations/ford_simulator_5.html* [Accessed: October 21, 2013]

Koeffel *et al.* (2010) conducted a study to determine if a heuristic based usability evaluation could be used to determine user experience. Recalling, the heuristic evaluation is a common method in the evaluation of user interface and other game usability issues (*cf.* Section 1.6.3 – Video Game Evaluation Studies, *p. 61*). The authors carried out this study based on Larsen's (Larsen, 2008 apud Koeffel et al., 2010) work which suggested video game reviews have an extensive subjective evaluation of a game's user experience from the reviewer's standpoint. Koeffel *et al.* (2010) evaluated several computer games using a list of 29 heuristics based on a literature review (*cf.* Koeffel *et al.* (2010, pp. 242–245) for full list of heuristics) and compared them with game reviews. Their study was conducted by a male and a female evaluator, both with experience in the area of video games. Five games were selected from different gaming genres, all with successful revenue in terms of units sold. In the evaluation, both evaluators applied two ratings: a Nielsen severity scale (Nielsen, 1995) and a point-scale ranking. The overall score of the evaluation of each game was based on the sum of the rankings and then converted to an average ranking. The score was then converted into a percentage which indicated the degree to which the game complied with the heuristics. A subjective analysis of the study led the authors to recognize the use of a quantitative score from the reviews leaves out the qualitative data present in the review. Nonetheless, the authors believe this approach led them to conclude the game experience is inferior when the game does not comply with the defined heuristics.

Poels, Kort, & Ijsselsteijn (2007) felt game experiences were studied in a fragmented manner. As a result, they conducted a focus group study in order to categorize game experiences. The study consisted in four focus groups with gamers, divided according to variables such as age, game frequency and occupational status. The discussion was centreed around three main questions: (*i*) on what occasions do you typically start gaming? (*ii*) What do you experience or feel while gaming? (*iii*) What do you experience or how do you feel after gaming? Based on the focus group methodology, the authors defined a group of dimensions and associated to each a series of in-game and post-game experiences. For example, dimensions such as 'enjoyment', 'flow' and 'control' were defined. For the 'enjoyment' dimension, in-game experiences such as 'fun', 'amusement', 'pleasure' and 'relaxation' were associated. For the same dimension, the post-game dimensions 'energised', 'satisfaction' and 'relaxation' were identified (*cf.* Table 1 in Poels *et al.* (2007, p. 88) for full list of dimensions and in-game/post-game experiences).

2.8 Final Considerations on the Chapter

This chapter has presented a detailed look into the concept of the Gameplay Experience, a concept applied to describe the resulting experience from playing video games. Within the video game context, the gameplay experience is commonly associated to a group of other concepts such as immersion, flow or presence, among others (Bernhaupt, 2010).

Specifically, immersion, flow and presence are considered and explored in this chapter. Each of these experiences is analysed according to the research of several authors. In addition to these specific concepts, additional gameplay experience models are presented. Lastly, a reflection on how the gameplay experience can be measured is considered.

While the previous chapter (*cf.* CHAPTER 1 – Video Games, *p. 15*) introduced video game and player related concepts – important in understanding what elements may play a role in the gameplay experience – this chapter is important to further understand work which has been previously developed on the gameplay experience. This theoretical framework informs on various aspects of the gameplay experience in general, and the concepts of immersion, flow and presence in particular. From the analysis of these various concepts, it is possible to understand what specific characteristics – or shared by multiple concepts – can play a role in the formation of these particular experiences.

With this framework of knowledge, it is possible to understand the various specificities of the gameplay experience. Furthermore, it is possible to understand the existing flaws and limitations within the gameplay experience debate, in order to conceptualize and develop a new gameplay experience model which focuses on the video game and player, and contemplates elements associated to each of these vectors.

CHAPTER 3
EYE TRACKING & VIDEO GAMES

While eye tracking has been applied in various research areas since the end of the 19th century, it has yet to be fully explored and appropriated in the thriving video game industry. The value of eye tracking in this study is diverse. Studies have explored the use of eye tracking as a form of providing insight regarding player visual behaviour and attention. As presented in CHAPTER 2 – *The Gameplay Experience*, player attention has been explored as a form of understanding or characterizing game related experiences. As eye tracking can inform on visual attention; this particular technique can be used as a means to explore the *attention* component of the experience. Furthermore, eye tracking can also be an important tool in video game evaluation scenarios, providing psychophysiological information which can be used in improving video games and, consequently, the experience of playing video games. In this chapter, the topic of eye tracking is presented and discussed, in addition to visual attention and behaviour. Also, eye tracking strengths and weaknesses are discussed, prior to a look of the application of eye tracking in various research areas, video games included.

3.1 EYE TRACKING & VISUAL BEHAVIOUR

Eye tracking can be considered a valuable tool in the evaluation of video games and analysis of player behaviour. In the following sections, the eye tracking technique and methods are presented, followed by some of its strengths and weaknesses. Eye tracking studies, both related to video games and other areas are also presented. However, as the essence of eye tracking resides in eye movement behaviour, an initial look into the Human Visual System is presented.

The first analysis of eye movements was possible through introspection[22], or by hand of the researcher, which observed a user's eye with a mirror, a telescope or a peep hole. These methods were naturally doubtful because it was the researcher's eyes that measured the eye movements (Richardson & Spivey, 2008). The measurement of eye movements only became truly valid when mechanical devices that could permanently record an eye's movement appeared.

Some of the first empirical studies are credited to Louis Émile Javal, a French ophthalmologist. Javal used mirrors to observe subject reading behaviour while reading. Javal was the first to suggest that eyes moved through a series of 'jerks' (Richardson & Spivey, 2008). Delabarre, in 1898 – as explained by Richardson & Spivey (2008) – analysed eye movements by attaching a molded cap to his eye, which he previously anesthetized with cocaine. Attached to the cap was a wire that was connected to a lever which drew the horizontal representation of eye movements on the surface of a kymograph cylinder. Delabarre was able to read the text through a hole that was previously drilled in the cap.

Edmund Huey (2009, p. 17), around the 19th century, presented an eye movement measurement apparatus of similar nature. Huey molded a piece of a cup to fit the eye which was also previously anesthetized with holocain or cocaine. Huey attached a flat and thin aluminium pointer to the cup which responded to the slightest of eye movements. These movements were registered by the aluminium pointer on a moving drum-cylinder. The observer's head rested in a frame, reducing involuntary head movement, and which held an attachment that prevented the eyelids from interfering with the cup to which the aluminium pointer was attached.

While Delabarre and Huey both contributed with valuable information regarding eye movements, their devices were criticized for inhibiting eye movements and straining the eye (Richardson & Spivey, 2008). In an attempt to overcome these limitations, Dodge & Cline (1901) developed a non-invasive eye movement technique based on the use of photography. This method, frequently used until the 1970s, was defined by Dodge & Cline as "*a group of what we may justly claim to be the first accurate measurements of the angle of velocity of the eye movements under normal conditions*". The use of photographical recordings continued throughout the 1920s. However, with technological advancements, it became possible that the reflection beam from the eye be divided; that the horizontal and vertical components be measured and recombined into a fixation dot, then recorded onto a film reel (Richardson & Spivey, 2008). Buswell (1935) benefited from these advances, and produced some of the first two-dimensional scan paths based on users visualizing images.

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[22] Introspection: the observation or examination of one's own mental state. Retrieved from: *http://plato.stanford.edu/entries/introspection/* [Accessed: February 21, 2011]

Despite extensive research in the first half of the 20th century, mainly related to the connection between mental imagery and eye movements; the greater portion of eye tracking research elaborated up to 1950 focused on the processes, habits, and individual and cultural references involved with reading (Richardson & Spivey, 2008). In the second half of the 20th century, new invasive techniques were introduced for eye movement recording (1960s) as well as techniques that scanned the eye with cameras (1970s).

Even with the advances in development and improvements on existing techniques, many of the methods developed up to that time were for recording eye movements in their relation to the head. This implied that for eye movement research, researchers had to guarantee that the study subject's head remained fixed. This frequently involved the use of uncomfortable or extreme methods of head restraint (Richardson & Spivey, 2008).

The 1970s witnessed a solution to these uncomfortable eye movement measurement techniques, when the simultaneous measuring of two optical characteristics of the moving eye became possible. Because these features behaved in a different manner under head movement and eye rotation, their differential helped calculate the 'point of regard' (POR) the place in the world where a subject is looking at (Duchowski, 2007; Richardson & Spivey, 2008).

While older or modern POR measurement techniques still require some head stability, eventual head movements do not automatically alter the quality of the results. Therefore, these techniques offer more accurate and reliable gaze tracking data. Merchant, Morrissette & Porterfield (1974) introduced an eye scanning method that not only detected the centre of a brightly lit pupil, but also, was able to find the smaller and brighter corneal reflection. These authors' method was able to measure the point of regard because during head movement, while the corneal reflection in relation to the centre of the pupil remains constant, it changes with eye rotation. Lambert, Monty & Hall (1974) introduced an oculometer capable of calculating where on the screen a subject was looking. Richardson & Spivey (2008, p. 1030) suggest "*the balance between obtaining a high-precision record of an observer's point-of-regard and allowing natural head and body movements is where much of the technological advancement in eye-tracking takes place in the current state of the art*".

Over time, these limitations have slowly been reduced. The introduction of head-mounted eye trackers allowed greater movements from study subjects. Additionally, table-mounted eye trackers also allowed more natural head movement (Richardson & Spivey, 2008).

3.1.1 The Human Visual System & Visual Attention

The ability to see the world that surrounds us is directly related to the work of the (human) visual system; a set of complex components that together, extract light from the world and transform it into an understandable image. Figure 10 represents some of the key components of the human visual system. Some of the main components of the system include the cornea, the iris, and the retina.

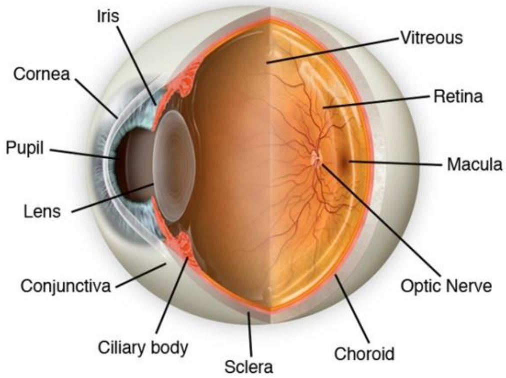

Figure 10: Anatomy of the Eye
Retrieved from: *http://www.institutdeloeil.com/eye-treatment/eye-anatomy.html*
[Accessed: January 15, 2014]

The *cornea*, the first component to be hit by light due to its outermost location, is transparent and approximately ½ a millimeter in thickness. The *cornea* and the *lens*, located just behind the *pupil*, function similarly to the lenses of a photo camera. These components work together to focus images, through the refraction of light at determined points on the retina. However, the lens plays a greater role in focusing objects at different distances (Hubel, 1995, p. 34; Ramos, 2006).

The *iris*, located behind the cornea, controls the quantity of light processed by the inner eye. When large quantities of light are present, the iris contracts, whereas it will expand in the presence of smaller quantities of light. At the centre of the iris is the *pupil*, a structure through which light passes before hitting the retina (Ramos, 2006).

The *retina* is responsible for converting light waves (or light energy) entering the eyes into nerve signals which allow us to see in various types of conditions. The *retina* is also capable of differentiating wave-lengths, which allow the visualization of colour, once the signal is sent to the visual cortex (located at the back of the brain) through the optic nerve (Hubel, 1995, p. 36). The retina consists of three separate layers of nerve-cells, held together by an additional two layers of synapses formed by the axons and dendrites of the nerve-cell layers (Hubel, 1995, p. 36). At the innermost part of the retina lie the light receptors: the *rods* and *cones*. *Rods* (approximately 100 million) are responsible for vision in reduced light; *cones* (approximately 7 million) are responsible for colour vision and detail (Bianco, 2000).

Once light enters the eye and hits the retina, a sequence of complex chemical reactions follows. These reactions result in the formation of *activated rhodopsin*, a chemical which produces several electrical impulses in the optic nerve (Bianco, 2000). Each reaction produces a series of electrical impulses in the brain which are converted to colour and light sensations. The human capacity to discriminate colour is not a process limited to the eye's components but also the result of processes in the cerebral cortex. This is to say that sight is only *complete* when the human brain receives impulses from the retina. The cerebral cortex is responsible for translating the electrochemical signals from the retina which ultimately identifies the images and their characteristics such as colour, form, shape, distance, size and orientation (Oliveira, 2000).

3.1.2 Taxonomy of Eye Movements

Just as important as understanding how eye vision works, is to comprehend what movements the human eye is capable of. Eye movements occur through the coordination of extraocular muscles which move the eyeball. Six muscles are responsible for eye movements: *lateral and medial recti*, (responsible for sideways movement); the *superior and inferior recti* (responsible for vertical movement) and the *superior and inferior obliques* (responsible for twist). The *lateral rectus* moves the eye outwards, away from the nose; the *medial rectus* moves the eye inward, towards the nose; the *superior rectus* moves the eye upward and slightly outward; the *inferior rectus* moves the eye downward and slightly inward; the *superior oblique* moves the eye inward and downward; and the *inferior oblique* moves the eye outward and upward (Williams, 2013). These muscles work in pairs through control of the brain. For eye movements to occur, while one muscle relaxes, the other must contract, with an equivalent intensity to create the desired movement. If this contract-expand operation occurred with different intensities, the eyeball would move loosely in the eye socket (Hubel, 1995, pp. 28–29).

Through the referred *contract-expand mechanism*, the eyes are capable of performing 5 different movements: (*i*) *smooth pursuits*, (*ii*) *vergence*, (*iii*) *vestibular*, (*iv*) *saccades*, and (*v*) *fixations*.

SMOOTH PURSUITS

When an object is in movement, the eyes have the capacity to remain fixed on that same object. This type of movement is known as smooth pursuits. This movement is possible due to a complex mechanism that is able to sense a determined movement and respond with a complementary course of eye movement (Guyton & Hall, 2006, p. 647).

VERGENCE MOVEMENTS

Vergence movements are considered disjunctive as they move in opposite directions. Specifically, when a person is looking from an object at a greater distance to one placed closer, the eyes will converge (*i.e.*, rotate towards the nose); however, moving from an object placed closed by to one further away, the eyes will diverge (*i.e.*, rotate towards the temples).

VESTIBULAR MOVEMENTS

The vestibular movement – or the vestibular-ocular reflex (VOR) – is a movement that focuses the retinal image while the head is in movement. This is possible through the counter-rotation of the eyes at the same velocity the head moves in the opposite direction. When the head is in movement, information related to that same movement is sent from vestibular sensors present in the inner ear to VOR circuitry found in the brainstem. Here, the correct eye velocity is calculated. Therefore, it is the VOR's function to create a direction for the eye that balances any changes in the head's position and orientation (Wong, 2008, p. 22).

SACCADES

Saccades can be defined as rapid eye movements. Saccades are both voluntary and reflexive movements, used to reposition the fovea – an area of the retina responsible for sharp vision – to a new location in the visual field. Saccades last approximately 10 *ms* to 100 *ms* (0.01 to 0.1 seconds).

FIXATIONS

The ability to fix our gaze on an object in the visual field is the responsibility of the fixation movement. Fixations are controlled by two neuronal mechanisms: (*i*) the *voluntary fixation mechanism*, allowing humans to voluntarily find the object on which they want to fix their vision; and (*ii*), the *involuntary fixation mechanism*, which holds the eye on the object once it has been found (Guyton & Hall, 2006, p. 645). Fixations are categorized into three small eye movements: *microtremors*, *microsaccades* and *microdrifts*. Humans spend approximately 90% of the time in fixations, lasting approximately 150 *ms* to 600 *ms* (0.15 to 0.6 seconds) (Hubel, 1995, pp. 46–47).

3.1.3 Visual Attention & Video Games

Attention is a core concept in cognitive psychology. Only recently has a general definition been established (Wright & Ward, 1998), whereas previously multiple definitions or metaphors were used to describe attention: a *filter*, a *skill*, a *selective attenuator*, a *spotlight beam*, among others. William James (1890, pp. 403–404), for example, described the concept as follows:

> *(…) It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others (...).*

James' (1890) view on attention generated a problem regarding the field of attention: the relationship between *attention* and *consciousness*. Johnston & Heinz (1978) indicated that attention is "*the systematic admission of perceptual data into consciousness (…) the process whereby perception is biased toward or against specific inputs*". This view, while fitting with the *bottleneck* theories of selective attention, introduces problems related to the fact attention may or not be under conscious control.

This raises another question: *when is attention in fact under conscious control*? Another problem with Johnston & Heinz's (1978) view is related to the supposition that attention is a selective process before ideas come into consciousness, an idea that is not corroborated with other research. Some approaches have shown that attention and consciousness are separate. Dixon (1981), for example, proposed a model in which the mind is an information processor with two systems, one concerning conscious/awareness and the other involving preconscious (unconscious) processing. Therefore, this view suggests that attention works separately from consciousness.

Attention studies have raised many arguments. Even though James' (1890) view on attention dates back 120 years, the true nature of attention is yet to be completely understood.

3.1.3.1 Visual & Selective Attention

At any given moment, a large quantity of information invades our senses. With the incapacity to process this vast load of information, there is a need for selection. While in theory stimulus selection can be random, people are capable of performing specific selections (Cohen, 2006). The mechanism responsible for such selections is called *selective attention*. In short, selective attention is the mental ability to select a fraction of all the stimuli present in our surroundings. The act of information selection assumes that in an individual's surroundings, information exists to be selected. Therefore, pre-attentive processes must be performed before the actual selective attention operation. The output of this process is then used in the intended selection (Cohen, 2006).

Attention studies led to further research regarding selective attention, culminating in a group of *bottleneck theories*. The most influential of these were those proposed by Broadbent in 1958, Treisman in 1960 and Deutsch & Deutsch in 1963 (Cohen, 2006; Rossini & Galera, 2006). As Cohen (2006) notes, when performing a task, information processing begins with input (usually via our senses) and ends with output (normally a behavioural action). The authors mentioned above discuss the stage in which selective attention information processing takes place. Considering that pre-attentive processing is unlimited and post-attentive processing is limited, the stage at which selective attention occurs may be found where limitations first occur, *i.e.*, the *bottleneck*. This question resulted in the *Early versus Late Selection* debate.

Broadbent proposed an *early selection* model to justify findings indicating that when stimuli differ in semantic content, subjects are unable to *shadow* them. However, if they differ in terms of physical properties, subjects can shadow one stimulus, but are unable to describe the ignored stimuli. The early selection model suggests that physical properties in a scene are processed in parallel and without limitations. In short, Broadbent's model states that incoming stimuli are filtered according to a preattentive filter based on a physical characteristic. Stimuli not filtered pass a channel to a detection device where they are then semantically analysed. Stimuli that are not selected and filtered out are not analysed and do not reach the subject's consciousness.

Treisman's model differs slightly from Broadbent's approach. Studies showed that while subjects didn't always recognize ignored content, in certain cases, information could be detected. This indicates the attention filter may attenuate certain stimuli rather than completely blocking it. Treisman's model states that incoming stimuli are analysed preattentively through an attenuation filter based on physical characteristics with resulting information becoming available to the individual's consciousness. Selected stimuli are then channelled into semantic analysis. Stimuli that are filtered out are attenuated but pass along the channel to become semantically processed and reach consciousness if certain criteria are met. Therefore, in Treisman's model, non-selected stimuli may also be processed, even if to a lesser extent.

Contrary to Broadbent and Treisman, Deutsch & Deutsch propose a *late selection model*. Deutsch & Deutsch's model indicates all stimuli reach perceptual mechanisms, independently if attention is or not paid to them. All incoming stimuli activate a semantic representation and all incoming information is recognized. Because the capacity to respond to input is limited, only a part of incoming information is recognized and responded to. The selection of which information is recognized is based on its level of importance and pertinence. In this selection, little importance is given to the input's physical properties.

Treisman's model differs from Broadbent's because Broadbent's filter is *all-or-nothing*, in which a message passes or gets dropped. Treisman indicates the selective filter allows messages to pass but in an attenuated form. Deutsch & Deutsch's model is different from Treisman's because contrary to Treisman's suggestion of a lower level filter (based on physical characteristics), Deutsch & Deutsch don't recognize this primary filter in selective attention.

Cohen (2006) also speaks of existing literature suggesting two distinct levels where attention takes place, each with distinct operating mechanisms. This idea of *Multiple Levels of Selection* indicates that there is a high level selection through processes called *executive functions* which are used for strategic choices (*e.g.* task selection). A second lower-level selection mechanism is suggested to be modality-specific. *Executive functions* work in the selection of a task and the shift to another. An example is the case of driving a car, listening to the radio and talking to a friend. The executive functions process is responsible for deciding which has a higher priority and when to shift these priorities. The *modality selection* mechanism is responsible for selections within tasks. An example is a task where a subject is required to respond to a stimulus when it appears inside a box, located to the left or right. Research suggests that if a subject is inclined in advance to select a specific box, the response is faster if in fact the target appears in the suspected box and is slower if it appears in the other box. These *cued* selections are attributed to the operation of visual attention. These cued selections may justify, for example, why more experienced game players are able to quickly anticipate player and enemy movements in first-person shooter games. If gamers are cued to a certain area, they are able to respond to incoming stimuli from that area faster than if they were cued to a different location.

Another approach to visual attention was introduced by Posner, Snyder, & Davidson (1980) with their coined *spotlight model* theory. These authors stated that individuals' visual attention moves and focuses on specific parts of their visual field, as does a spotlight over a dark surface. This model considers that the spotlight's characteristics are stable. In a similar study, Eriksen & Yeh (1985) proposed the *zoom-lens model* based on and inheriting all the spotlight model's characteristics, with the addition of a property related to size change.

Additional research led to the definition of two methods in which items and stimuli are selected from the surrounding environment: (*i*) Bottom-up; and (*ii*) Top-down. In the (*i*) *Bottom-up* method, data is collected through senses which are triggered according to changes in the environment. To exemplify, the emergence of an intense colour such as red on an existing green surface or the sudden movement of an animal. In the (*ii*) *Top-down* method, attention is directed to stimuli according to a subject's current goals and expectations based on existing information held in stored memory (Connor, Egeth, & Yantis, 2004).

Finally, in terms of visual processing, humans can process visual data as *patterns* and *motion* (Kremers, 2009, p. 192). *Pattern recognition* is used frequently when individuals select and process information from their surroundings. Humans can differentiate large quantities of input (coming in at high-speeds) because pattern recognition can divide visual input into important pieces to which we attribute meaning and behaviour. This division happens when individuals come into large quantities of visual data and condense it into visual models which are easier and faster to deal with (Kremers, 2009). For example, when something gets lost in the grass, an individual doesn't have to process every blade of grass. Instead, individuals create a pattern (the grass) and then look to find where the object *breaks out* (Kremers, 2009, p. 192). *Motion tracking* deals with the ability to pick out, track and process the movement of objects in an individual's field of view. It is a complex system considering, for example, the quantity of objects an individual must track and analyse in the act of crossing the street in a busy city.

In addition to the mechanical elements of the human visual system; emotions can also play a role in visualization behaviour. Emotions and other psychological considerations are responsible for the fear one has of the dark or the beauty one finds in a landscape. Kremers (2009) suggests there are many emotional elements, for example: (*i*) *aesthetic sensibilities*; (*ii*) *primal reactions*; and (*iii*) *taught reactions*.

i. ***Aesthetics*** is both a complex and contradictory discipline. In general, it studies an individuals' reaction to things like art. Most believe aesthetics deal with the study of what makes things beautiful or enjoyable to the senses. Aesthetics principles can offer information on how to make visual scenes pleasurable to look at.

ii. ***Primal reactions*** are emotional responses to visual scenes or stimuli which are deep within an individual's mind. For example, they are responsible for the tremor one feels when standing on the edge of a cliff (Kremers, 2009, p. 195).

iii. ***Taught reactions*** are responses based on "*long established visual conventions*" (Kremers, 2009, p. 195). Individuals are taught many visual conventions, for example, 'red is often related to danger'.

3.1.3.2 Visual Attention & Video Games

Studies have shown that video games not only lead to specific visual attention patterns while playing games, but that video games themselves are capable of altering a series of visual skills. In this section, studies that have focused on this issue will be explored.

Green & Bavelier (2003) demonstrated through a set of experiments that playing action-video games is capable of changing an individual's visual skills. In initial tests, the authors tested the hypothesis that playing video games increased the capacity of the visual attention system. The hypothesis suggests that if video game players (VGP) have a greater attention capacity, their attention resources should last longer than for non-video game players (NVGP). Using a 'Flanker Compatibility' experiment, at a high level of difficulty, the authors found that NVGP exhaust their attention resources more quickly than VGP which are able to perform the task. In an enumeration task, the authors also found that VGP were able to visualize more items than NVGP. In additional tests that measure performance over space and time, VGP continued to outperform NVGP. In order to preserve the validity of these tests, namely the fact that the VGP selected for the studies had inherently better attention skills, Green & Bavelier had a group of NVGP undergo game training, playing 'Medal of Honor' for one hour a day, during 10 consecutive days. A control group was also trained, under the same time conditions, with the game 'Tetris'. As the authors explained, 'Tetris' has a strong visuo-motor component but only requires that the participant focus on one object at a time. The action game requires that attention be distributed around the visual field. Prior to the training, subjects were tested in enumeration, useful-field-of-view and attentional-blink experiments. The same experiments were applied after the training sessions.

Results indicated that the training sessions helped participants improve their scores for games played. Furthermore, participants that played the action video game showed greater improvement for all three tasks. Based on their results, Green & Bavelier suggest that 10 days of training is sufficient to improve the capacity of visual attention, the spatial distribution and temporal resolution of attention. As they state, "*by forcing players to simultaneously juggle a number of varied tasks (detect new enemies, track existing enemies and avoid getting hurt, among others), action-video-game playing pushes the limits of three rather different aspects of visual attention*" (Green & Bavelier, 2003, p. 536). In addition to this study, Green & Bavelier have conducted further research on the effects of video games on aspects of attention (Green & Bavelier, 2006a, 2006b, 2007).

Boot *et al.* (2008) conducted a study which intended to replicate and extend on Green & Bavelier's (2003) aforementioned work. Their study consisted in examining the differences between expert video game players (VGP) and non-video game players (NVGP) in areas such as attention, memory and executive control. Eleven VPG and ten NVGP played the games 'Medal of Honor: Allied Assault' (First-person shooter), 'Tetris' (puzzle game) and 'Rise of Nations' (real-time strategy game). Several batteries of tests were conducted related to visual and attention tasks, spatial processing and spatial memory as well as executive control and reasoning. In a number of executed tasks, VGP outperformed NVGP. Specifically, VGP were able to track objects that moved at greater speeds, performed better in a visual memory test, switch between tasks more quickly as well as make decisions about rotated objects more quickly and accurately. Results also showed that, with exception to the game 'Tetris', 20h of practice was insufficient for NVGP to show improvements in their tasks. These results somewhat contradict those presented by Green & Bavelier's (2003). Boot *et al.* suggest that this finding could be related to the differences in the tasks they applied when compared to other studies.

Castel *et al.* (2005) developed a similar study regarding visual search capacities and differences between video game players (VGP) and non-video game players (NVGP). Specifically, the authors' research intended to examine similarities and differences between these two groups in two areas: (i) the ability to prevent their attention from returning to areas previously seen; (ii) the efficiency of visual search in easy and more demanding search environments. Castel *et al.* conducted two experiments. In the first, the similarities and differences between VGP and NVGP in terms of the ability to disengage attention from cued locations and later avoid these locations were examined. In the second experiment, the authors examined performance differences and similarities between VGP and NVGP in visual search tasks that involved finding a target letter among various other distractor letters. The authors' findings from the two experiments corroborate those found in similar research (Green & Bavelier, 2003). In general, their results demonstrated that both VGP and NVGP were equally competent at constraining from returning their attention to previously seen locations. However, VGP's reaction times were faster when detecting selected targets. VGP also performed better in responding quicker in easy and difficult visual task searches. Even so, the authors indicate that VGP and NVGP share similarities which suggests these two groups share similar attentional processing mechanisms in specific situations.

A final study without specific attention to video game players and non-video game players also focused on issues of attention using video games. Clark *et al.* (1987) developed a study to demonstrate the possibility of reversing the decline of senior people's (57-83 years of age) response selection to stimuli. A group of participants played video games for 7 weeks whereas a second did not. Results of the study indicated that the participants that played the video games were able to perform faster and had better reaction times in the experimental tasks.

3.1.4 Eye Tracking Techniques, Methods and Data Visualization

With eye tracking, two types of eye movement techniques can be considered: (*i*) the technique that measures the *eyes' position relative to the head*, typical in some of the older technology (Huey, 2009; Delabarre, 1898 apud Richardson & Spivey, 2008), and (*ii*) the technique that measures the *orientation of the eye in space*, known as the *point of regard* (POR) (Duchowski, 2007, p. 51). While the first was widely applied in the analysis of reading behaviour (Richardson & Spivey, 2008), the second is commonly used to identify items in a visual scene. Duchowski (2007) also presents four extensive categories of eye movement measurement methods, involving the use or measurement of: Electro-OculoGraphy (EOG); sclera contact lens/search coil; Photo-OculoGraphy (POG) or Video-OculoGraphy (VOG); and video-based combined pupil/corneal reflection.

Of the mentioned methods, the *video-based combined pupil/corneal reflection* can be considered the most widely used for eye movement analysis. Furthermore, it grants point of regard measurement. As Duchowski (2007, p. 54) suggests, *"to provide POR measurement, either the head must be fixed so that the eye's position relative to the head and point of regard coincide, or multiple ocular features must be measured in order to disambiguate head movement from eye rotation. Two of these features are the corneal reflection (usually by means of an infra-red light source) and the pupil center"*.

Video-based eye trackers function through the use of cameras and additional image processing hardware which calculate the POR in real-time. These measurements are possible through the use of a table-mounted eye tracker or worn on the head. Figure 11 and Figure 12 represent two examples of *video-based eye* trackers, a table mounted and head mounted eye tracker (in the form of glasses), respectively. Both these eye tracking solutions are products of Tobii Technology[23].

Figure 11: A table mounted eye tracker
Retrieved from: *http://www.tobii.com/en/eye-tracking-research/global/products/hardware/tobii-t60t120-eye-tracker/* [Accessed: January 15, 2014]

Figure 12: Head mounted eye tracking glasses
Retrieved and adapted from: *http://www.tobii.com/en/eye-tracking-research/global/products/hardware/tobii-glasses-eye-tracker/* [Accessed: January 15, 2014]

[23] Tobii Technology: *http://www.tobii.com* [Accessed: October 21, 2013]

Both table and head mounted eye trackers function similarly in optical terms. When light hits the eye, the eyes' corneal reflection of the light source is measured relative to the location of the pupil's center. These reflections are called *Purkinje reflections* or *Purkinje images*, previously researched by Cornsweet & Crane in 1973 (Richardson & Spivey, 2008) and Clark (1975). When light hits the eye, four Purkinje reflections are formed. Video-based eye trackers are capable of locating the first Purkinje image (Duchowski, 2007, pp. 54–56).

With the data collected from an eye tracker, several software solutions (e.g. Tobii, iMotions, EyeTracking, SMI) offer the possibility of visually representing this data. From the data collected using eye tracking (*e.g. x, y* coordinates, and time-related data), multiple data representation and visualization techniques can be applied, depending on the type of study being conducted. Figure 13 represents four of these techniques: (*a*) *Heat Map*; (*b*) *Gaze Plot*; (*c*) *Clusters*; (*d*) *Bee Swarm*.

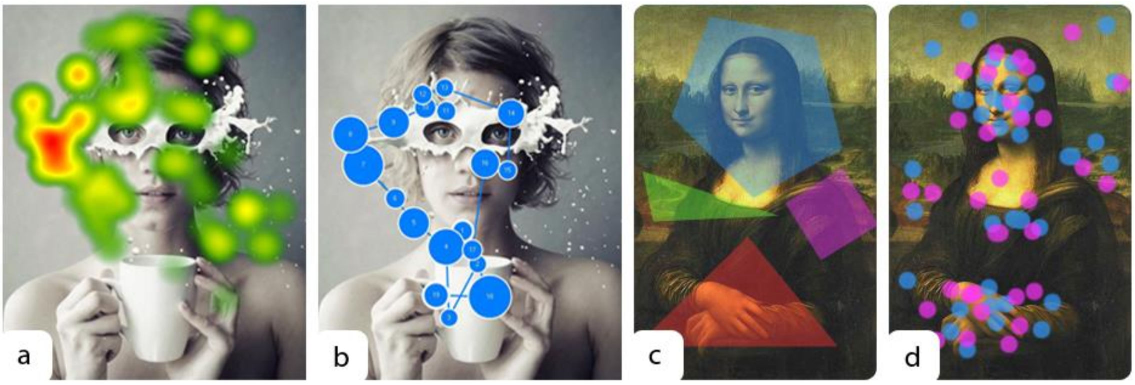

Figure 13: Representation of Eye Tracking Data Visualization Techniques

a. The ***heat map*** consists in the use of colour to represent specific element of analysis. Commonly, *hot* and *cold* spots – based on hot (red) and cold (green) colours – represent the most attractive elements of an image, the most intense areas of a map or others, depending on the analysis context. The *hotter* the colours, the higher the intensity of visualizations in the area the colours are representing.

b. A ***gaze plot*** summarizes eye behaviour, displaying *fixations* and *scan paths*. Furthermore, it indicates the sequence and order of an individual's eye movements. Gaze plots use circles and lines to represent data. Circles represent fixations. The larger the size of the circle, the longer the duration of the fixation. The lines that connect these circles (fixations) represent scan paths (saccades), rapid movements occurring between fixations. Commonly, gaze plot representations will include numbers within the circles, indicating the chronological order in which the eye movements and fixations occurred.

c. ***Clusters***, which summarize individuals' main areas of interest, are normally generated automatically, based on the intensity and concentration of visualization points spread out through an image or some other representation. When clusters are generated manually, they are normally called *Areas of Interest* (AOI).

d. The ***Bee Swarm*** is used to dynamically represent a set of points on dynamic media (video or other temporal media), corresponding to where individuals concentrated their attention. When a bee swarm is applied to multiple individuals, different colours are used to distinguish each individual's focus of attention in time.

The four mentioned techniques are commonly optimized for static media, such as images. However, when eye tracking is applied to dynamic media such as video or video games, tailored data processing and representation techniques are frequently necessary for the visualization and interpretation of eye movement data.

3.1.5 Strengths & Weaknesses

While several decades of technological advances have helped overcome existing limitations with eye tracking, it continues to lack full confidence from researchers. Researchers believe eye tracking to be a valuable tool, but defend it still has several weaknesses. Furthermore, despite long decades of possible improvements, several authors (Crowe & Narayanan, 2000; Redline & Lankford, 2001) – presented in Jacob & Karn's (2003) view on the value of eye tracking – share a similar idea: eye tracking is a *promising* technique. In the following sections, an overview of the *strengths* and *weaknesses* of eye tracking will be presented to further understand its value, but also understand its flaws in multiple research areas.

3.1.5.1 Eye Tracking *Strengths*

The multiplicity of research areas in which eye tracking has been applied suggest it is a technique of value, allowing a greater understanding of individuals' visual behaviour. Specifically, several strengths can be identified:

i. ***Register and measure eye movements***: An initial strength of eye tracking is its basic function to register and quantify an individual's eye movements. This function is important in the analysis of different types of products.

ii. ***Help identify usability problems*** (Ross, 2009): Within a usability context, eye tracking is valuable for finding and interpreting design and usability problems. While it should be used with additional methods (e.g. participant behaviour observation), knowing where participants look at while performing a certain task is helpful in understanding, for example, whether participants noticed a particular element (such as a link, buttons or something new to the interface, in the case of websites); whether there are differences in task performance between new users and experienced users; and which content and how participants read content.

iii. ***Provide compelling visualizations of usability problems*** (Karn, 2006; Ross, 2009): Eye tracking visualizations are a valuable way of visually demonstrating usability problems. The use of *gaze plots* or *heat maps* can help in describing and representing a user's visual behaviour.

iv. ***Show hard to articulate behaviour*** (Ross, 2009): Occasionally, participants will show difficulties in recalling whether they noticed a specific element or why they had a problem with a task. Because many eye movements are done unconsciously, it is often difficult do describe where we look at, for how long or in what order, which can result in filtered and incomplete explanations.

3.1.5.2 Eye tracking *Weaknesses*

As referred, many studies which could possibly benefit from eye tracking data have overlooked its applicability. This may be related to multiple weaknesses which can also be identified, namely:

i. ***Eye Tracking Can't Track Peripheral Vision*** (Ross, 2009): Peripheral vision makes up 98% of an individual's visual field. However, eye trackers record foveal fixations – which are responsible for sharp vision – and aren't capable of capturing peripheral vision, which we use to select where we look to next. Individuals are capable of seeing elements on a screen (or in a room, or outside, for example) without having to fix their eyes on them. For example, an experienced individual may be able to identify elements based on their position, their appearance or experience that a specific element on the right side of the page is related to publicity. However, despite this knowledge, the individual doesn't necessarily have to fixate on that object to understand that it's there. Therefore, because eye tracking visualizations don't show peripheral vision, they can be considered misleading.

ii. ***Fixations don't represent attention, understanding and meaning*** (Ross, 2009): A participant's fixations don't automatically translate into attention or understanding. While eye tracking shows saccades and fixations it doesn't inform on the higher-level processes of attention and comprehension. Therefore, just because an individual's eyes fixate on an element, this doesn't mean he is consciously paying attention or understanding it. Furthermore, eye tracking data merely shows where a participant fixed his eyes, but does not explain the meaning behind those fixations. In other words, it's possible to understand where an individual looks, but difficult to understand why.

iii. ***Eye tracking Is Subject to Technical Problems*** (Jacob & Karn, 2003; Ross, 2009): While eye tracking technology has evolved in the last 50 years, there still exists limitations that interfere in the relationship between the eye tracking device and the participant. While device calibration processes are becoming less problematic, other limitations related to head movement constraints still exist to some extent which condition a participant's comfort during the test.

iv. ***Eye tracking Tests Take More Time*** (Ross, 2009; Spool, n.d.): Planning, setting up and conducting a study with eye tracking can be time consuming. Furthermore, eye trackers can generate extensive data, implying extra time in the analysis phase.

v. ***Labour-intensive data extraction and data interpretation*** (Jacob & Karn, 2003): While the visual orientation of a person's gaze can be resumed to a simple '*x, y*' coordinate, the duration of each test session influences the quantity of collected data. Longer test sessions result in larger quantities of data. While some software will simplify the extraction process, others (Almeida, 2009; El-Nasr & Yan, 2006) have no choice but to rely on extra manual work, proceeding with manual frame-by-frame analysis of eye movement data. Also, while technical problems and data extraction problems may be minor difficulties in the success of eye tracking studies, another possible barrier is related to the interpretation of acquired data. Relating a participant's eye movements and fixation patterns with their cognitive activity is not an easy endeavour.

vi. ***Eye tracking Is Expensive*** (Ross, 2009; Spool, n.d.): While the cost of eye tracking hardware and software has decreased over the years, eye trackers are still expensive. A new eye tracking system can have a prince in the thousands of dollars. While more affordable solutions exist, they do not offer the same potential commercial software does.

vii. ***Eye tracking Can Be Difficult to Learn*** (Ross, 2009): The use of eye tracking by a professional requires time to be effectively used. However, more important than knowing how to use the equipment is to know how to plan and conduct studies as well as interpret results. Therefore, as occurs with most situations, learning how to use eye tracking is a skill that is developed through experience.

viii. ***Not Every Participant Can Work with an Eye Tracker*** (Spool, n.d.): While modern eye trackers are not as sensitive to this problem, older eye trackers and hardware may have problems detecting eye movements in participants with determined attributes. Participants that wear contact lenses or have longer eye lashes might be problematic subjects for tracking eye movements.

Based on the various strengths and weaknesses explored, the question that remains is: *is eye tracking worth it?* In an online contribution, Ross (October 2009) answers the question as follows:

> *Some have concluded that the benefits of eye tracking are not worth the high cost, effort, and complexity it adds to usability testing. On the other hand, some eye tracking vendors and consultants have promoted the idea that you cannot conduct usability testing effectively without eye tracking. The truth lies somewhere between these extremes. If you know how to use eye tracking effectively, it can provide additional insights to usability testing that can help you find problems and answer questions about user behavior. Eye tracking is not essential to usability testing, but if you can afford it and have the time to learn how to use it effectively, it is definitely worth it.*

Table 4: Summary of Eye Tracking Strengths and Weaknesses

	Description	Author
Strengths	Help identify usability problems	J. Ross
	Show hard to articulate behaviour	J. Ross
	Visualizing data for observers	J. Ross, M. McElhaw
	Provide compelling visualizations of usability problems	J. Ross, K. Karn
	Video-based eye tracking equipment is becoming relatively inexpensive	K. Karn
	Better visualization and analysis tools are becoming available	K. Karn
	Tool of choice for study of visual search	K. Karn
	Evaluating efficiency of systems where visual-motor reaction time is crucial.	K. Karn
	Studying learning (changing of dwell patterns with experience)	K. Karn
	Analysis of tasks where traditional usability testing methods have indicated a problem that eye tracking might clarify	K. Karn
Weaknesses	Eye Tracking Can't Track Peripheral Vision	J. Ross
	Fixations don't represent attention or understanding	J. Ross
	Fixations don't communicate meaning	J. Ross
	Interactions between facilitator and participant change	J. Ross
	Eye tracking Can Be Intrusive	J. Ross
	Eye tracking Tests Take More Time	J. Ross, J. Spool
	Eye tracking Is Expensive	J. Ross, J. Spool
	Eye tracking Can Be Difficult to Learn	J. Ross
	Eye tracking Is Subject to Technical Problems	Jim Ross, R. Jacob & K. Karn
	Eye tracking Can Become a Gimmick	J. Ross
	Not Every Participant Can Work with an Eye Tracker	J. Spool
	Labor-intensive data extractions	R. Jacob & K. Karn
	Difficulties in data interpretation	J. Spool, R. Jacob & K. Karn

3.2 EYE TRACKING RESEARCH

Regarding eye tracking, the technique and supporting technology has been applied in a large diversity of areas. In the following sections, the use of eye tracking in video game related research will be explored, followed by its applicability in additional research areas.

3.2.1 Eye Tracking and Video Game Research

The previous section demonstrated how eye tracking has been applied in a wide variety of research areas: reading, the *web* or even television, for example. However, eye tracking has also managed to enter the video game context. Several studies have centred their attention on the possibilities of eye tracking in a video game context, mainly the application of the technique and eye gaze as a method of input for controlling video games.

Erika Jönsson (2005) developed a study to evaluate the use of eye tracking in computer games. Jönsson developed different game prototypes that could be controlled with eye movement. Jönsson previously identified how eye tracking could be used in games with the help of a focus group. Participants identified speed, accuracy, calibration easiness and *invisibility* of the eye tracker as requirements. Additionally, the focus group generated ideas relative to what actions the eye tracker should perform: aim/shoot; marking/choosing; changing view/scrolling; zooming.

Based on the data collected, Jönsson defined a series of interaction sequences which could be controlled by the eyes as well as different types of comparative studies. Prototypes were developed using the SDK (software development kit) to run the game 'Half Life'. The game 'Sacrifice' was also used for testing. The interaction methods selected were: (*i*) change field of view/aim with the eyes; (*ii*) change field of view with the mouse and aim with the eyes. In the majority of FPS games, the player's weapon is always aimed at the centre of the screen. When a player moves the mouse, the field of view changes, but the weapon continues to be at the centre of the screen. The first interaction method attempted to replicate this idea in which the eyes would control the field of view. In the second interaction method, the field of view would be mouse-controlled while the weapon is controlled by eye gaze. Changes were applied to the 'Half Life' SDK to interpret these changes. Based on this work, multiple demos were developed for usability testing and feedback was collected regarding participant satisfaction as well as data regarding how participants' performance differed among interaction methods.

Isokoski & Martin (2006) described in a *work in progress* report their work regarding the use of an eye tracker as an input device in FPS games. The authors also intended to compare the efficiency of eye trackers as *game controllers* when compared to conventional devices. Rather than working with an existing game engine, Isokoski & Martin used an originally developed game.

For their experiments, unintelligent targets were created so game situations could be easily controlled. The game world was also simple and contained random hills and valleys with scattered trees. As occurred with Jönsson's study (2005), Isokoski & Martin (2006) had to define a *use* for the eye tracker input, having selected that it would be used for weapon aiming within the game. Additional mouse and keyboard controls were used to control the camera angle and move the character inside the game world. A red point on the screen indicated where the player was looking at. Shooting at the 'visually selected' region was done through the use of mouse clicks. Isokoski & Martin believed that aiming at targets with gaze rather than with the mouse would be an advantage, namely in situations where the player would reach the top of a hill and targets are revealed. However, a disadvantage with eye gaze aiming could be accuracy related. At the time of their work, limited results suggested that the use of the eye tracking did not outperform the simple keyboard and mouse combination. However, eye tracking with the keyboard and mouse did perform better against an 'Xbox 360' controller.

Smith & Graham (2006) also developed a study focused on eye tracking as an input device for video games. They studied the effects of eye-based input on the experience of playing games, having used three different games from three different game genres: 'Quake 2' (FPS); 'Neverwinter Nights' (Role-playing game); 'Lunar Command' (action/arcade). For each game, player performance with the mouse and eye tracker was collected as well as subjective data. Twelve participants played each of the three selected games. Collected results were divided into two types: performance measures and subjective measures.

Regarding performance measures, *ANOVA* analysis results indicated that for 'Quake 2' and 'Neverwinter Nights', no significant differences were found between mouse and eye input. For 'Lunar Command', mouse interaction was better than eye based input. In terms of subjective measures, results indicated that players only enjoyed playing 'Neverwinter Nights' more with the use of eye gaze. For 'Quake 2' and 'Lunar Command', using the mouse was indicated to be easier; 'Neverwinter Nights' received divided opinions. In terms of immersion, the majority of players, for all three games, suggested that they felt more immersed when using their eyes as input, possibly because of the continuous nature of eye based control.

Ekman *et al.* (2008) in a *work in progress* study introduced 'Invisible Eni', an 'eyes only' computer game which uses gaze, blinking and pupil size. Pupil size was introduced as a novel element in this type of studies. Ekman *et al.* state (2008, p. 3136), "*since pupil size is sensitive to excitement and mental effort, the control itself is always partly responding to the act of using it as a control. This can serve as a positive feedback loop: If the interaction is engaging enough, pupil sizes will increase to reflect this feeling, further influencing the action of pupil control. In our game, we use this loop to model magic powers."* The 'Invisible Eli' game's objective is to free butterflies in captivity by feeding them magic nectar while avoiding nearby *nightmare monsters*. It uses the following controls: gaze direction for character control; blinking as a mechanism for escaping from enemies; pupil size is used to model magic. At the time of their work, limited results indicated that feedback and training would be essential for the success of their pupil-based interaction option.

These are a handful of the many study examples that have applied eye tracking as a method of input in video games. In the following section, an overview of eye tracking as a method of evaluation will be discussed among other topics.

3.2.2 Eye Tracking in Other Research Areas

Despite the list of strengths and weaknesses inherent to eye tracking, the technique has been widely applied in various research fields. It has been applied in usability and HCI studies, web and television studies, as well as reading, medicine, psychology and sports, among others. In this section, a brief look into studies that have applied eye tracking will be presented.

Fitts, Jones & Milton's work (1950) is credited to be the pioneering study in the field of HCI (Jacob & Karn, 2003, p. 576). Through the use of motion picture cameras, Fitts *et al.* (1950) were able to capture the movements of pilot's eyes while they used an airplane's cockpit controls and instrumentation to land the aircraft. As Jacob & Karn (2003, p. 574) state, this *"study represents the earliest application of eye tracking to what is now known as 'usability engineering' — the systematic study of users interacting with products to improve product design."*

The 'web' is one area where eye tracking has been applied with greater incidence in recent years. Numbers suggest that there are nearly 2.4 billion internet users (as of June 30, 2012)[24] and that in the United States of America, users spend on average 13 hours a week on the internet (2009). Satisfying an internet user's needs requires that a web site be efficient and, in some cases, fun. Many studies have focused on understanding typical internet user behaviour so that websites can be optimized.

Goldberg *et al.* (2002) studied how participants visualized web portals during search tasks. Their results suggest that header bars are normally disregarded in terms of visualization before users focus on the main part of a page. Consequently, the authors suggest placing navigation bars on the left side of a page. Almeida, Mealha, Veloso & Luís (2010) studied how a group of Portuguese internet users interacted on the SAPO portal, namely inside the News area. These authors' study suggested that the use of tabs is a more efficient solution for interaction when compared to vertical navigation. These results oppose those of Goldberg *et al.* (2002) which favour a left-sided navigation. Almeida *et al.* also concluded that in terms of advertising, advertisements localized in the centre of the screen receive greater user attention. Josephson & Holmes (2002) studied the possibility that users might select a regular and preferred scan path when visualizing a Web page. Furthermore, the authors also hypothesized that variables such as memory or other features specific to a web page might influence scan paths. Having only used three websites, the authors affirmed that there results could not be generalized. Beymer, Orton & Russell (2007) also focused on web pages, analysing how images placed next to textual information influences eye movements during a reading task. The authors' results indicated that in fact images influence reading, namely in terms of reading speed and regressions and that these were dependent of the type of image used (related or non-related to the information).

[24] Number of world internet users. Retrieved from: *http://www.internetworldstats.com/stats.htm* [Accessed: January 15, 2014]

Regarding television studies, Josephson & Holmes (2006) developed a study where the influence of graphical elements such as 'headline bars' or 'bottom-of-the-screen crawlers' on viewing television was tested. Through the use of eye tracking, the authors recorded participant eye movement while viewing three news stories with three design levels: a standard screen, a screen with a crawler and a screen with both the header and crawler. Using different techniques, the authors measured the influence of screen design on different fixation variables as well as the influence of the screen design on story processing. Results indicated that television news is becoming visually more complex and that viewers can process both visual and audible content if the information is related. Furthermore, they verified that screen design impacts the recall of content. Headlines, for example, aided the recall of summarized news pieces but subjects exposed to headline summaries were less likely to remember other story points.

Brasel & Gips (2008) questioned how an individual's eye gaze disperses across the screen when watching television. Using eye tracking, the authors conducted an exploratory study where 24 minutes of television (13 minutes of show content and 11 of advertisement) were visualized by nine participants. Their results indicated that eye gaze is biased towards the centre of the screen. Additionally, eye dispersion is less present in show content than in advertisement sections and is also greater in advertisements that are repeated.

Rodrigues' (2010) study focused on understanding how viewers approve and process messages from various graphical elements presented in TV News. He developed a case study and analysed two types of television news: one with graphics and one with a clean feed (where only an anchor was present). Based on the results of 80 participants, he identified that in a clean feed scenario, the time spent visualizing the anchor is almost equivalent to the duration of the news piece. In a scenario with graphics, the elements that receive the most attention are the news anchor and the news ticker while the station logo is the least visualized element. Furthermore, his results suggested that viewers are able to acquire and memorize a greater quantity of information in a clean feed scenario because viewers are not exposed and distracted with extra visual stimuli.

In terms of reading behaviour, Buscher *et al.* (2010) developed an exploratory study to examine users preferred reading regions on a monitor. In order to answer a series of pre-determined research questions, the authors designed a study with two reading tasks that used eye tracking to collect data, as well as mouse movements and scrolling interactions. Based on the results of 20 participants in their exploratory study, the authors affirm that visual attention is not evenly distributed. Rather, participants demonstrated having personal preferred reading regions when working with extensive documents, varying both in locations on the screen as well as in size. Additionally, they explored the relation between scrolling and mouse interactions and correlate these with the positions and size of the users preferred reading regions.

Quinn & Adam (2008) conducted a study in order to understand how near 600 people in the U.S.A viewed their hometown newspaper and websites and the differences between them. Some of the main questions at the core of their study were: *'how do print and online readers navigate through the paper or Web site?'*; *'do people behave differently when reading broadsheets and tabloids?'*; *'are headlines, photos, teasers, briefs and ads viewed differently?'*; and even more important, *'how much do people read?'*. Through the analysis of their results, the authors found several important answers to their questions. (1) In both print and online formats, participants tend to read deep into stories (on average, 77% of the story for online; 62% for broadsheet and 57% for tabloid), although reading decreases as the story length increased. (2) Participants were either methodical readers or scanners. (3) Points of entry between online and print reading are distinct. Print readers preferred headlines and photos whereas online readers favoured navigation. (4) Lead stories – those with the biggest headline – attracted more attention in print when compared to other stories as did 'opinion' content, such as editorials and the work of columnists. (5) Large photos as well as documentary photos captured more attention from print readers as did colour photos. In terms of graphics, maps and explanatory graphics were viewed more than charts both in print and online.

In another study, Beymer *et al.* (2008) questioned: "*how should a designer choose typographical variables such as font size and font type?*". To answer their question, the authors conducted an eye tracking study that analysed how font size and font type affect online reading. In their study, 82 participants were presented with stories in various formats that varied in font and size. Collected data suggested that for smaller font sizes, participant fixation durations are significantly longer which results in a slightly slower reading pace. In terms of font type – serif vs. san serif – serif reading was slightly faster. Other differences were also found considering age group and the native language of the participant.

In medicine, Benjamin Law *et al.* (2004) research defended that the study of surgeon's eye movements is an innovative way in understanding skill and that comparing eye movements of novice and expert surgeons could identify differences that could be used in training. In the light of this, the authors conducted a preliminary study where the eye movements of 5 experienced and 5 novice surgeons were recorded while performing a one-handed aiming task on a computer-based laparoscopic surgery simulator. The acquired results showed performance differences between expert and novice surgeons. The results indicated that experts were quicker and committed fewer errors in the task. When analysing eye movements, the authors found that the novice surgeons required more visual feedback of the tool position than the experts. Additionally, expert surgeons tended to fix their eyes on the target while manipulating the tool whereas the novice surgeons demonstrated more varied eye movement behaviour.

In sports related studies, Wood & Wilson (2010)developed a study based on the existing idea that when footballers take penalty kicks, they generally focus on the goalkeeper and ignore the area they are targeting. The authors set up a multiple experiment study in order to analyse this problem. In experiment 1, the objective was to analyse the aiming coordination and shot accuracy of shooters when asked to hit specific areas while maintaining their eyes fixed centrally. The aim of experiment 2 was to explore the effect that the presence of a goalkeeper had on shooters' aiming coordination and accuracy. The results of experiment 1 demonstrated that for football shooters, coordinating gaze and aim is crucial for a successful shot. The first experiment also demonstrated that when a goalkeeper is not present, all shooters look at the place they are aiming. Experiment 2, which included the presence of a goalkeeper, showed that kickers use one of three kicking strategies. Contrary to what occurred when the goalkeeper was not in net, experiment two showed that players utilized keeper-dependent (KD) centrally focused shot the most. However, this strategy also affected players' shooting accuracy. In general, the authors' results showed that when looking to where you are aiming, shooting accuracy is the greatest.

Finally, Franchak *et al.* (2010) work focused on the analysis of infant's visual behaviour. Despite the existence of extensive work on infant's visual exploration of experimental stimuli, there is a lack of knowledge regarding where infant's look during typical interactions. Furthermore, while head-mounted eye trackers have shed light on adult's visual behaviour, common eye trackers are unsuitable for infants. In this study, the authors mounted the first study for analysing infants' visual behaviour during their natural interactions. Through the application of this novel method, the authors recorded the eye gaze interactions of 6 infants while they played with their caregivers in a cluttered, toy-filled room. Interactions of both infants and caregivers were spontaneously produced as infants were allowed to choose their own activities and where they looked. The authors focused essentially on where infants looked during obstacle navigation, object exploration and responses to the caregiver's vocalizations. The authors' exploratory analysis showed that infant's fixations fell into three categories: obstacles, objects and people. They also verified that infants fixed objects before they attempted to reach them and obstacles before moving around them. In what regards mother-infant interaction, the caregiver's vocalizations occasionally captured the infants' attention and caused the infant to direct his attention towards her.

3.2.3 Eye Tracking Based Evaluation Studies

Of the many possible game evaluation and analysis options, eye tracking is an alternative yet to be considered within the industry. In this section, a collection of some of the game related studies in which eye tracking was applied for evaluation purposes will be explored.

The number of game usability studies that have looked into the potential of eye tracking as a usability evaluation method is limited. Studies by El-Nasr & Yan (2006), Johansen *et al.* (Johansen, Noergaard, & Rau, 2008) and Almeida (Almeida, Mealha, & Veloso, 2010; Almeida, 2009) are a sample of studies that introduce the eye tracking technique as a form of evaluating usability problems found in video games.

El-Nasr & Yan's (2006) study begins with the opinion that game and level design could be improved if players' visual search patterns were analysed and understood. Additionally, game designers could also improve game play by altering game elements such as textures, colours and object locations if players' visual attention patterns were understood. El-Nasr & Yan state: "*many non gamers get lost in 3D game environments, or they don't pick up an important item because they don't notice it*" (2006, p. 1). Therefore, if level designers and game developers in general understood how players visually interact with a game, it would be easier to understand where in the level objects should be placed, or how the mixing and selection of colours and textures could draw player attention. El-Nasr & Yan's work also included two studies in which players' attention was analysed. Specifically, their studies aimed to determine if players' visual attention followed the bottom-up or top-down visual theories. Having used two games of distinct genres, they concluded that because action-adventure games are goal-oriented, top-down visual patters are more frequent. For the first game – an adventure game – they concluded that if game designers wish for objects to be more noticeable, these should be placed in locations or near items that are similar or related to the player' search pattern for a specific goal. For the second game – a First-person shooter game, they concluded that players focus mainly on the centre of the screen where the cross indicator is located; results that contrast with those found for the adventure game, where players had a more heterogeneous visual search pattern.

Johansen *et al.* study (2008) focused on several issues related to eye tracking in the game industry, specifically in a game development company. Working closely with a game developer, they looked to: (i) understand how they could persuade game designers to consider the relevance of usability results; (ii) understand how they could involve game designers in usability related work; (iii) identify methods that could provide new information about user behaviour and experience. Although the authors did not intend to prove that eye tracking could solve all usability related issues, they did expect to demonstrate the value of eye tracking as a means to provide information related to the importance of usability results in game development. During the elaboration of their study, which coincided with the development of a game by the IOI[25] team, the authors were able to demonstrate the value of eye tracking technology as a means to solve a scenario [game level] related problem. Finally, to conclude their work, the authors defend the value of eye tracking as a means to provide valuable information about user behaviour and experience.

[25] IOI – IO Interactive: game development company from Denmark [*http://www.ioi.dk*]

Almeida (2009) developed a study using eye tracking to evaluate how players visually interacted with game scenarios. Although one of the study contributions resulted in a preliminary suggestion of guidelines for the development of greater quality video games (namely in terms of multiplayer options); another contribution was the method developed and applied to understand what areas of video game scenario players do and do not visualize. Almeida's study consisted in video game players, namely hardcore players, playing a First-person shooter video game while their eye movements were registered with an eye tracker. After all players completed their sessions, samples that included information related to player position on the map and what the player was looking at were registered every 5 seconds. The heat map was selected as the visualization instrument to represent the collected data. Figure 14 and Figure 15 represent the two constructed heat maps using the eye tracking data and the developed method. Figure 14 represents the 'Visual Field View' heat map as it characterizes the areas that were seen by the players, whether or not they were in the players' focal point. Figure 15 represents the 'Point of Regard' (PoR) heat map. The PoR represents the exact location where a player was looking at. Therefore, this heat map characterizes, for each sample taken, the exact place in the scenario the players were looking at. In either heat map, warmer colours represent areas with greater intensity and a greater number of player visualizations whereas darker colours or no colouring represent a less number of visualizations or complete absence of visual interaction.

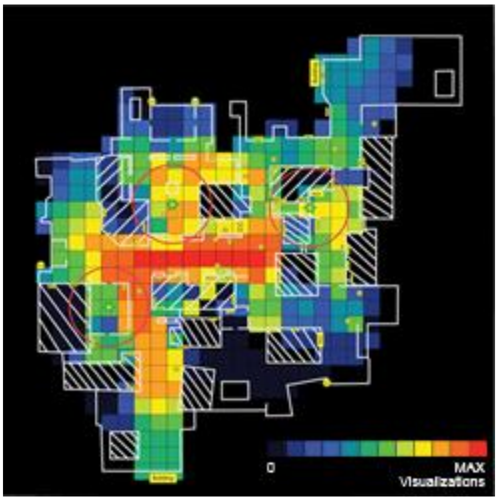

Figure 14: Representation of a 'Visual Field View' heat map

Figure 15: Representation of a Point of Regard heat map

In another study, Almeida *et al.* (2010) applied the method developed by Almeida (2009) in order to analyse the differences in hardcore and inexperienced players' interaction behaviour in the FPS game 'Call of Duty: Modern Warfare'. In the study, 12 hardcore and inexperienced players played a game mode in the selected game. The objective of the mode was to play as a team and secure the areas where the flags were located. Participants' eye movements were recorded with an eye tracker. The applied method resulted in four heat maps, two for each gaming group: 2 'visual field view' heat maps and 2 'point of regard' heat maps. Results from the heat map as well as video analysis showed that hardcore players presented a greater objective approach when playing. This idea can be corroborated by the fact that hardcore players had a greater number of visualizations in the areas where the game flags were located, directly related to the objective of the game mode played. Video analysis also confirmed this behaviour. When beginning the game or, after *respawning*, hardcore players would move towards the flags. However, inexperienced players adopted a more exploring orientated behaviour. In fact, this type of behaviour resulted in a greater number of visualizations in their 'visual field view' heat map when compared to the hardcore players' same heat map. Additional findings indicated that both groups concentrated much of their attention on the central corridor of the map. In general, the 'visual field view' heat map data indicated that areas visualized by all 12 hardcore and inexperienced participants represent 2% and 1% of the entire visible map, respectively.

3.3 Final Considerations on the Chapter

This chapter has presented an overview of several eye tracking related topics. Considering eye tracking deals with the recording of eye movement, an initial analysis of the human visual system is presented, followed by research related to visual attention and video games. Eye tracking techniques are also considered, as well as existing forms of representing collected data. The chapter also introduces several studies related to a variety of eye tracking studies, suggesting the potential of eye tracking in multiple research contexts, including eye tracking.

While the topic of eye tracking may only represent a fraction of the work present in this document, it is explored with some detail given the importance it has or can have in the video game industry. Clearly eye tracking is still looked at with some distrust, namely when considered in a video game context. However, eye tracking can provide valuable information regarding players' visual behaviour when in a gaming situation.

In this study, analysing players' visual attention patterns can be important in understanding the influence of specific game related elements (*e.g.* changes in the video game scenario) on their attention when playing. As introduced when reflecting on *immersion* (*cf.* Section 2.2, *p. 69*) and *flow* (*cf.* Section 2.3, *p. 72*), attention is one possible indicator of a player's possible level of immersion or sense of flow. Considering eye tracking can provide information on players' visual attention, this data can also contribute to understand this particular aspect of the gameplay experience.

CHAPTER 4
COMMUNICATION & VIDEO GAMES

The idea of communication is transversal to various areas, including video games. However, existing studies commonly discuss computer-media communication processes during and around the act of video game play. Communication theories can be categorized according to several aspects. For that reason, within video game studies, communication can be explored in its transversality in other aspects of video games. In this chapter, an introduction to communication is presented, followed by an extensive analysis on various theories related to and focusing on diverse areas of communication processes.

4.1 Communication in Video Games

Communication – more specifically computer-mediated communication (CMC) – has made its way into various areas such as video games. CMC refers to the interaction between two or more people using computer technology via a network communication (Thurlow, Lengel, & Tomic, 2004). Furthermore, this interaction can involve the use of social software, including instant messaging, e-mail and forums – internet-supported technologies for social interaction (Peña & Hancock, 2006).

One of the most common *communication-based* game genres is the Massively Multiplayer Online Role Playing Game (MMORPG). Many people believe that video games are solitary activities; however, this type of game in particular relies on extensive social interaction (Schiesel, 2005), which promotes extensive synchronous and asynchronous communication. The increasing popularity and expansion of these and other video games has led to the development of various forms of communication – outside of the game world – such as social communities and forums.

Communication in video games or virtual worlds is not limited, however, to what occurs between players. With video games, multiple levels of communication occur simultaneously and over a different number of modes. There is the *traditional* player-to-player communication, the actions of bots or other intelligent objects, the Graphical User Interface as well as the game world's responses to the player's interaction (Innocent & Haines, 2007).

Today's games and many virtual worlds are based on three-dimensional spaces on which elaborate graphical user interfaces are placed. In some cases, this is the same structure found in text-based game worlds, where the interaction is very similar. In others, *"the interaction is situated more within the space of the world and these make better use of direct interaction with the graphical representation of the gameplay"* (Innocent & Haines, 2007). Nonetheless, more frequently, communication channels are placed on the screen and lack a proper integration within the simulated world. Furthermore, simultaneously running a chat application while interacting with the virtual world places some limitations on communication within the virtual world (Innocent & Haines, 2007).

Multiple other approaches can be considered when aggregating communication and video games. This pairing can be considered from the perspective of the form of text-based language used when communicating with players while playing video games. For example, when playing, one may encounter terminology very specific to the gaming context. Costikyan (2002) states *"there is a rich terminology that is used almost exclusively in certain gaming contexts, e.g. among players of multiplayer FPS [First-person shooter] games. Here, killing the avatar of another player may be called 'fragging', letting one's avatar jump about the game space in order to avoid being shot may be called 'bunny hopping' (…)*. Additionally, some players adopt a specific style of terminology, substituting letters for numbers or characters. This can be of value considering that "*in fast-paced games such as multiplayer FPS, this need to use as little time for typing as possible is even more urgent. Hence, a variety of abbreviations and acronyms can be found in the communication that takes place in these games"* (Thon, 2006, p. 256).

4.2 A LOOK INTO COMMUNICATION

The concepts of information and communication are two of the oldest and primary concepts in humanity. Communication has been defined and applied in the widest variety of areas and with multiple intentions. Finding a single definition has proved to be impossible and, in many cases, may not be of importance (McQuail & Windahl, 2003).

Frank Dance – as indicated by Littlejohn & Foss (2007) – played an important role in helping to clarify the concept of communication, indicating three points of 'critical conceptual differentiation' that form the basic dimensions of communication (Littlejohn & Foss, 2007). The first dimension (*i*) is the 'level of observation' (or abstractness), where some definitions are broad and inclusive, while others are restrictive. The second dimension (*ii*) is 'intentionality', where some definitions only include purposeful message sending and receiving, while others do not have this limitation. An example of an intentional definition is "*those situations in which a source transmits a message to a receiver with a conscious intent to affect the latter's behaviors*" (Littlejohn & Foss, 2007, p. 3). Lastly, the third dimension (*iii*) is normative 'judgement', where some definitions refer to a statement of success or effectiveness, while others do not refer to these judgements. An example of a definition without judgement is "*Communication [...] is the transmission of information*" (Littlejohn & Foss, 2007, p. 3). In this scenario, information is sent, but there is no reference to its reception or if it was understood. With this in mind, as Littlejohn & Foss (2007, p. 3) refer, "*a definition should be evaluated on the basis of how it helps scholars answer the questions they are investigating. Different (...) investigations require separate, even contradictory, definitions of communication. Definitions, then, are tools that should be used flexibly.*"

Returning to communication definitions, while authors will believe their definition prevails, multiple definitions can be accepted. Referencing previously established work, McQuail & Windahl (2003) present definitions of Theodorson & Theodorson from 1969, and Osgood *et al.* from 1957: "*the transmission of information, ideas, attitudes, or emotion from one person or group to another primarily through symbols*" and "*in the broadest sense, communication exists every time a system, a source, influences another – the receiver – through manipulation of alternative symbols that can be transmitted through the channel that connects them*" [own translation].

Based on these two definitions, McQuail & Windahl (2003) infer that communication implies a sender, a message, a destination, a relation between the sender and the receiver, an effect, a context in which the communication occurs and a series of things to which the *messages* refer. Furthermore, communication can be any or a group of the following situations: an 'action over' another; an 'interaction with' another and a 'reaction to' another.

In addition to these considerations, many communication theorists have also elaborated on the importance of the 'encoding' and 'decoding' process (McQuail & Windahl, 2003). Encoding – located on the side of the sender – implies that a message is translated into a language or code that is adequate to the means of transmission and the intended receiver. Decoding – on the side of the receiver – refers to the translation of the message in order to extract is meaning. Many communication models also refer to the concept of 'retroaction', also known as 'feedback' (McQuail & Windahl, 2003). Retroaction is the process in which the communicator receives information regarding if and how the intended message receiver got the message. This information can prove to be useful in order to adapt the communication process in the future.

The post-World War II period opened doors to the possibility of a communication science being discussed for the first time. As a result, the 1950s were fertile in the introduction of communication models. During this time, the initial and basic 'sender-channel-message-destination' model was abandoned, and suffered alterations according to each authors intentions (McQuail & Windahl, 2003). New approaches recognized the importance of the concept of retroaction (feedback) and acknowledged communication as a non-linear process. Furthermore, importance was given to the way in which the receivers perceive, interpret and retain messages.

In the late 1940s, Harold Lasswell wrote what may be the most famous expression in communication research – as presented by McQuail & Windahl (2003): "*A convenient way to describe the act of communication is to answer the following questions: Who? Says What? In Which Channel? To Whom? With what effect?*" Lasswell's question on the act of communication is described as the 'Lasswell Model'. Figure 16 represents the referred model.

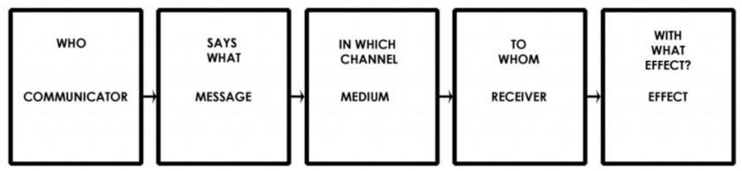

Figure 16: Lasswell Model of Communication
Retrieved from: *http://communicationtheory.org/lasswells-model/* [Accessed: October 21, 2013]

This early and simple model on communication can be used in a variety of contexts, but was explored and developed to further suit other authors' needs. Braddock, in 1958, elaborated on Lasswell's model, and introduced additional elements such as the circumstances in which the message is sent and the sender's objective when communicating (McQuail & Windahl, 2003).

While Lasswell and Braddock's model may have broken ground in communication research, Shannon & Weaver's model of communication was a primary stimulus for the future of research in this context (McQuail & Windahl, 2003). Shannon & Weaver presented the 'Shannon-Weaver model of Communication', a model designed to develop the effective communication between sender and receiver, while introducing a factor called 'noise', capable of affecting the communication process. Figure 17 represents the 'Shannon-Weaver model of communication'.

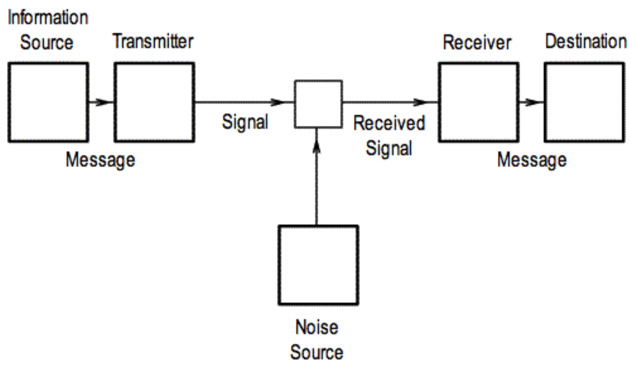

Figure 17: Shannon & Weaver's Model of Communication
Adapted from: McQuail & Windahl (2003)

Explained, the 'Information Source' (Sender) is from where the message originates; the 'Transmitter' (Encoder) converts the message into signals; the 'Receiver' (Decoder) is where the signal is received and converted into a message; the 'Destination' is the destination of the message; the message that is sent can be influenced by the 'Noise Source', exterior interferences that can alter the message that was sent and posteriorly received (McQuail & Windahl, 2003).

While Shannon & Weaver's model of communication is visibly linear, with focus on the communication channels; other forms of interpreting communication emerged with the work of Schramm and Osgood in 1954, when they presented a circular model with focus on the communication actors (McQuail & Windahl, 2003). Figure 18 represents the Osgood-Schramm Model of Communication.

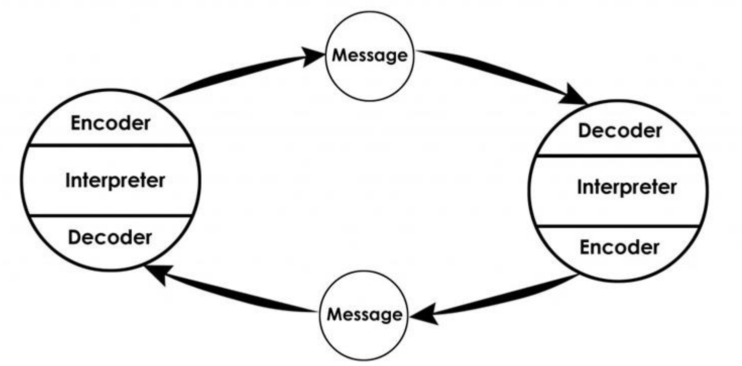

Figure 18: The Osgood-Schramm Model of Communication
Adapted from: *http://communicationtheory.org/osgood-schramm-model-of-communication/*
[Accessed: October 21, 2013]

The Osgood-Schramm model seeks to present communication as a circular process; there is no fixed source and sender or receiver and destination in the process. Rather, in this model, the same functions are executed, without references to those two 'poles'. In the circular model, these extremities are represented by three functions: encoder (who does the encoding or sends the message), interpreter (who interprets and analyses the message) and decoder (who receives the message). In this process, there is a continuous act of interpretation. While this model helped break the idea of linearity in the communication process, it also portrays the idea of equality in the communication, which is not always the case. Frequently, communication is an unbalanced process in terms of resources, capacity as well as time to carry out a communication task (McQuail & Windahl, 2003).

Another valuable model is the 'Helical Model of Communication' introduced by Dance in 1967, which seeks to solve problems related to communication process where the circular model falls short. Dance stresses the dynamic nature of communication, where its processes, relations and contexts are in continuous change. The helix represents these dynamics through time and can assume different forms for different situations and individuals (McQuail & Windahl, 2003). Figure 19 represents the Helical Model and its dynamic nature.

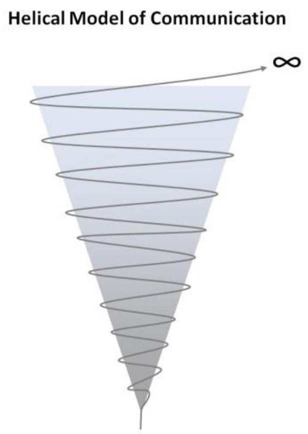

Figure 19: Helical Model of Communication
Adapted from: *http://communicationtheory.org/helical-model-of-communication/*
[Accessed: October 21, 2013]

The value of the Helical Model resides essentially in the value it gives to the dynamic nature of communication. Furthermore, it stresses that individuals, while communicating, are actively and creatively gathering information which can be used throughout the communication process (McQuail & Windahl, 2003).

These *basic* models of communication offer a glance at a handful of the multiple existing models that have surfaced throughout the years. While the large majority of existing models will have been developed and theorized while considering human communication, it is reasonable to look at these and other models and attempt to understand their applicability within a specific context such as that of the gameplay experience.

4.3 Selected Communication Theories

The theories explored in the following sections can be categorized according to several approaches. Here, theories based on the work of Littlejohn (1999) and Littlejohn & Foss (2007, 2010) are explored, including theories and models within the 'System Theory' (Littlejohn, 1999), 'Theories of Message Reception and Processing' (Littlejohn, 1999), Theories on the 'Communicator' (Littlejohn & Foss, 2007, 2010) and Theories of 'Communication and Media' (Littlejohn, 1999). In secondary categorizations, many of these theories and models can be associated to the 'Semiotic Tradition', 'Phenomenological Tradition', 'Cybernetic Tradition', 'Sociopsychological Tradition', 'Sociocultural Tradition', 'Critical Tradition' and 'Rhetorical Tradition'. However, for the purposes of our analysis, these later categorizations are secondary to the aforementioned theories.

4.3.1 System Theory

The concept of a 'system' refers to a set of interacting components that result in something greater than a sum of individual parts (Littlejohn & Foss, 2007). According to Littlejohn (1999) a system consists of four parts: (*i*) *objects*, which are the parts or elements within a system; and depending on the system, may be physical or abstract; (*ii*) *attributes*, which are the qualities or properties of the system; (*iii*) *internal relationships*; and (*iv*) *environment*.

4.3.1.1 Cybernetics

Initially considering the '**Cybernetic** Tradition', "*'Cybernetics' is the tradition of complex systems in which many interacting elements influence one another*" (Littlejohn & Foss, 2007). Within this tradition, communication is understood as a system of parts or elements that have an influence over one another, shape and control the system as a whole and – as occurs with other organisms – can achieve balance and change.

The connections established above can be considered as part of the 'basic systems theory', one variation of the global cybernetics theory. As explored, the basic systems theory considers systems as structures that can be analysed and observed from the exterior, consisting of visible parts and interactions (Littlejohn & Foss, 2007). The field of cybernetics itself, as popularized by Norbert Wiener in the 1950s (Littlejohn & Foss, 2007) focuses on *feedback* loops and control processes, rejecting the idea of linear relations within a system. According to this perspective, the model presented here can also be considered, such that *feedback* is a characteristic that bonds many of the other model characteristics.

Within cybernetics, 'feedback processes' and their presence within systems are also a central discussion (Littlejohn, 1999). We refer to feedback within a more traditional approach in order to analyse its importance within this gameplay experience model. As briefly introduced, *feedback* is the "*transmission of the receiver's reaction back to the sender*" (Fiske, 1990, p. 21).

4.3.2 Theories of Message Reception and Processing

Theories of Message Reception and Processing are related to how messages are received, and how individuals understand, organize and use the information present in messages (Littlejohn, 1999). Within the theories of message reception and processing, attention is given to those related to 'Message Interpretation' and 'Information Organization'.

4.3.2.1 Message Interpretation

Interpretation is a term used to describe how individuals understand an experience (Littlejohn, 1999). Within the theories of 'Message interpretation', the work of 'Osgood on Meaning' and the 'Relevance Theory' are considered, related to how individuals attribute meanings to concepts and understand a communicator's intentions, respectively.

OSGOOD ON MEANING

Charles Osgood's **'Theory on Meaning'** deals with the way meanings are learned and how these are related to thinking and behaviour. The theory explores an individual's associations to words – an individual's 'connotations' – what they consist in, and their origin (Littlejohn, 1999). As Littlejohn (1999) exemplifies, the word *flight* may be associated to a pleasant experience for some, and frightening to others. The theory begins with the assumption individuals respond to stimuli present in the environment, forming a stimulus (*S-R*) relationship. This association is responsible for establishing meaning which is a mental response to a stimulus. In addition to physical objects, meanings are also established for the signs of those objects, such as words and gestures. Additionally, meanings are said to be *connotative*, because they are unique to an individual's own experience. Lastly, meanings can be learned in the absence of the original stimulus, and are formed by associations to other concepts (Littlejohn, 1999).

RELEVANCE THEORY

Dan Sperber and Deirdre Wilson's **'Relevance Theory'** explores how listeners understand a speakers' intentions according to two models: the 'coding' and 'inferential' model (Littlejohn, 1999). The coding model – consistent with Osgood's theory – is commonly related to semiotics, suggesting that words and other symbols transport meaning. The inference model suggests that meaning is not simply transferred, but must be inferred using evidence in the message. While Sperber and Wilson will defend both models to be important (Littlejohn, 1999), human communication is more than simple coding. Individuals produce messages not only to represent referents but also to complete a purpose. A communicator will always have two levels of intent (Littlejohn, 1999): an 'informative intent', related to the will to have a listener become aware of something; and a 'communicative intent', related to having a person realize the purpose of a statement. In addition, *context* is valuable in order to infer a communicator's intention. Each person operates in a distinct context or cognitive environments, based on all the facts that an individual relies on. When new information is given and combines with old information, the context is affected by strengthening existing assumptions and posterior abandonment of older assumptions. As a result, relevant information has a greater impact on an individual's cognitive environment than irrelevant information. Therefore, during communication, an individual tries to modify the cognitive environment of the other person and affect their assumptions.

4.3.2.2 Information Organization

Information Organization theories deal with how individuals organize and manage information, and how it affects the cognitive system. Many of the these theories relate to the formation and change of *attitudes* – elements of the cognitive system held in memory and accessed in response to a situation (Littlejohn, 1999). Within the theories of 'Information Organization' – also categorized as theories of 'The Communicator' within the Cybernetic Tradition (Littlejohn & Foss, 2007) – the 'Information-Integration Theory' and 'Consistency Theories' are considered.

INFORMATION-INTEGRATION THEORY

The **'Information-Integration Theory'** – related to the Cybernetic Tradition – explains how information is accumulated and organized about persons, objects, situations, and ideas, to form 'attitudes' or a predisposition to act in a positive or negative way toward some object (Littlejohn & Foss, 2007). This theory is a popular model used to explain the formation of attitudes and attitude change. The model begins with the concept of cognition, described as a system of interacting *forces*. One of the forces is 'information', which has the capacity of affecting an individuals' belief system or *attitudes*. In turn, an attitude can be described as a collection of information about an object, person, situation or experience. Changes in attitudes are dependent of two variables: (*i*) 'valence', referring to whether information supports an individual's attitudes and which can be positive (when it supports) or negative (when it does not support); and (*ii*) 'weight', referring to the credibility given to the information, which can be high or low. Attitude change can occur because new information arises which can impact a belief, causing a shift in attitude; or because new information changes the valence of weight given to some piece of information. In summary, "*valence affects how information influences your belief system, and weight affects how much it does so*" (Littlejohn & Foss, 2007).

CONSISTENCY THEORY

The **'Consistency Theory'** – also related to attitude and attitude change – considers the following premise: "*people are more comfortable with consistency than inconsistency*" (Littlejohn & Foss, 2007, p. 78). Therefore, *consistency* is important in cognitive processing such that attitude change may occur when new information disrupts this balance. The 'Theory of Cognitive Dissonance' is a theory within the Consistency Theory, and considers that the communicator possesses a vast collection of 'cognitive elements' (*i.e.* attitudes, perceptions, knowledge and behaviours) which relate to each other within a system. The elements within the system will maintain one of three types of relationships with the other elements (Littlejohn & Foss, 2007): (*i*) *null* (or irrelevant), where an element doesn't affect the other; (*ii*) *consistent* (or consonant), where one element reinforces the other; and (*iii*) *inconsistent* (or dissonant), where an element would not be expected to follow from another. Two premises rule the dissonance theory. The first is that dissonance produces tension or stress, creating pressure to change. The second follows the first: when dissonance is present, an individual will attempt to reduce the tension and avoid situations in which additional dissonance may occur.

4.3.2.3 Judgment Processes

Judgement Processes theories – as the name suggests – deal with how individuals make judgments in communication regarding arguments, nonverbal behaviour, belief claims and attitudes (Littlejohn, 1999). Within the theories of 'Judgment Processes', the 'Elaboration Likelihood Theory' and 'Expectancy Violations Theory' are considered.

ELABORATION LIKELIHOOD THEORY

The **'Elaboration-Likelihood Theory'** – introduced by Richard Petty and John Cacioppo (Littlejohn & Foss, 2007), and part of the Sociopsychological Tradition – focuses on the reasons an individual will or not be persuaded by certain messages, and the way in which received information is evaluated (Littlejohn & Foss, 2007). An individual, in the presence of a message, will evaluate it in an elaborate way, using critical thinking; or in a simple, less critical manner. 'Elaboration likelihood' is the probability that an individual will evaluate information critically and can range between *little* and *great*. Available information can be processed using two routes: (*i*) a central and (*ii*) peripheral route. The first is used for critical thinking and arguments are considered, possibly leading to attitude change; the second is used for less critical thinking and, if attitude change occurs, it is only temporary. The amount of critical thinking that is applied depends on an individual's motivation and ability. An individual that is highly motivated will use the central route.

EXPECTATIONS-VIOLATIONS THEORY

The **'Expectancy-Violations Theory'** explores how people react when their expectations are violated (Littlejohn & Foss, 2007). The theory considers that individuals have expectations regarding another person's behaviour based on social norms, previous experiences with that person or the situation in which the behaviour occurs. The expectations that an individual has can involve almost all types of nonverbal behaviour. The common hypothesis is that when an individual's expectations are met, the other person's behaviours are judged as positive; if they are violated, the behaviours are judged as negative. However, this is not always the case, such that violations of expectations can also be judged positively if these draw the person's attention and something new is learned.

4.3.3 The Communicator

Theories related to 'The Communicator' deal with questions related to the identity of the communicator, how one communicator differs from another, what resources one has to communicate, how an individual's communication changes according to different situations. Also, these questions are observed both from a sender and receiver standpoint (Littlejohn & Foss, 2010). Related to the Communicator is the consistency of an individual's behaviour in across situations. This has led to work in identifying and measuring individuals' personality and behavioural traits. Moreover, communication theorists have explored specific communication traits and their emergence and development over time (Littlejohn & Foss, 2010). Related to an individual's traits, the Trait Theory is considered.

4.3.3.1 Trait Theory

Within the **'Trait Theory'**, a 'trait' is considered a distinguishing quality or characteristic; it is an individual's "*relatively consistent way of thinking, feeling, and behaving across situations*" (Littlejohn & Foss, 2007, p. 66). Human behaviour is believed to be defined by a combination of an individual's traits and situational factors. Therefore, how an individual communicates depends on his traits and the situation or environment in which he finds himself.

TRAIT-FACTOR MODELS

The **'Trait-Factor Models'** result from work attempting to group many small traits into a group of general traits – or super traits (Littlejohn & Foss, 2007). A popular trait-factor model is the 'Five-factor model', which identifies five general traits that, in combination, can determine an individual's more specific traits (Littlejohn & Foss, 2007): (i) *neuroticism*, which is the tendency to feel negative emotions; (ii) *extraversion*, which is the tendency to enjoy being in groups, be assertive, and think optimistically; (iii) *openness*, which is the tendency to be reflective, have imagination, pay attention to inner feelings, and be an independent thinker; (iv) *agreeableness*, which is the tendency to be sympathetic toward others, to be eager to help others and avoid antagonism; and (iv) *conscientiousness*, which is the tendency to be self-disciplined, resist impulses, be organized and thoroughly complete tasks.

4.3.4 Communication and Media

Existing communication media has made it possible for people spread across the world to communicate with each other. Within a society, media also gains importance through *mass communication*. *"Mass communication is the process whereby media organizations produce and transmit messages to large publics and the process by which those messages are sought, used, understood and influenced by audiences"* (Littlejohn, 1999, p. 327). An important part of mass communication is the media. Furthermore, media organizations distribute messages which influence and are a reflection of a society. Scholars consider two sides of mass communication (Littlejohn, 1999): (*i*) a *macro side*, related to the bond between media and society, and the mutual influence between them; and (*ii*) a *micro side*, related to connection between media and its audiences (groups and individuals), and the effects of the media transaction on these audiences. Within the existing theories, 'Theories of Individual Outcomes' are considered.

4.3.4.1 Theories of Individual Outcomes

The **'Uses, Gratifications and Dependency Theory'** – related to the Sociopsychological tradition – is a theory of mass communication and focuses on the consumer, rather than the message. The idea of the tradition is as follows: "*(...) the uses and gratifications approach takes the media consumer rather than the media message as its starting point, and explores his communication behaviour in terms of his direct experience with the media. It views the members of the audience as actively utilizing the media contents, rather than being passively acted upon by the media*" (Littlejohn, 1999, p. 350). In this theory, the audience is assumed to be active and goal-directed, and responsible for selecting media that suits the individual's needs, choosing ways to gratify his needs.

EXPECTANCY-VALUE THEORY

Within the 'Uses, Gratifications and Dependency' theory, reference can be made to the **'Expectancy-value Theory'** introduced by Fishbein (Littlejohn, 1999) and later explored by authors when adapting the theory to media studies. Here, the gratifications an individual seeks from media are determined by the individual's attitudes towards the media, the individual's beliefs about what a particular medium can offer him, and the evaluations on the material (Littlejohn, 1999). The *original* 'expectancy-value theory' explores two kinds of beliefs: first, the *belief in* a thing (or when an individual believes in something); second, *belief about* (where an individual recognizes a particular relationship between two things). In any media, if an individual believes that a particular media will entertain him and he is looking to be entertained, the individual will seek gratification of his entertainment needs by watching that particular media. However, the amount of gratifications that an individual seeks from a media is also influenced by the experience an individual has with that particular media and its influence on his beliefs.

DEPENDENCY THEORY

Still within the 'Uses, Gratifications and Dependency' theory, we look at the **'Dependency Theory'**. The dependency theory is based on the idea that an individual depends on media information to meet certain needs as well as to achieve certain goals. However, individuals do not depend on all media in the same way (Littlejohn, 1999). This dependency is based on two factors. First, an individual becomes more dependent of media that meet a larger number of needs than just a few needs. Second, dependency is influenced by social stability. When there is a change in social patterns, an individual's established beliefs are challenged which can force the individual to rethink and reconsider his beliefs, making new choices.

4.3.5 Theories of Experience and Interpretation

Theories of Experience and Interpretation are related to the nature of conscious experience and the role of communication within the experience. Theories within this primary theory deal with the assumption people actively interpret their experience by assigning meaning to what they see (Littlejohn, 1999). *Interpreation*, therefore, is an individual's active process of assigning meaning to any type of experience. Within this theory, while two traditions can be considered – phenomenology and hermeneutics – the second is the object of analysis. Hermeneutic is the study of understanding and interpreting action and text, where almost any interpretative related activity can be called 'hermeneutic' (Littlejohn, 1999). This can be related to understanding an individual's feelings, understanding and exploring the meaning of a group's actions, or others. Two types of hermeneutics can be considered: 'textual hermeneutics' and 'social *or* cultural hermeneutics'.

4.3.5.1 Cultural Interpretation

'Cultural Interpretation' (cultural hermeneutics) relates to understanding the actions of a group or culture. The term 'ethnography' is also applied to describe cultural interpretation. Within cultural interpretation, we look at the theory of **'Interpretative Media Studies'**. Interpretative media studies consider audiences as interpretative communities, with different meanings for what is read, viewed or heard (Littlejohn, 1999). Communities develop around a shared pattern of consumption: common understandings of the content of what is read, heard, or viewed, and shared outcomes (Littlejohn, 1999, p. 218). Furthermore, an individual may belong to a variety of interpretive communities. Thomas Lindlof – as mentioned by Littlejohn – indicates three dimensions found within an interpretive community, which he calls genres – or "*general types of media outcomes created by interaction within the interpretive community*" (Littlejohn, 1999, p. 219). The first genre that characterizes a community is 'content' which refers to the content that that is consumed by the community. The second genre is 'interpretation', related to the meanings that are shared by members of the community. The third genre is 'social action' which are a shared group of behaviours towards the media, including how the media is consumed as well as the way it affects the conduct of the community's members.

4.4 SUMMARY OF CONSIDERATIONS ON COMMUNICATION

In the previous sections, twelve communication theories were considered and detailed. The presented discussion looked into the 'Basic System Theory', which focuses on the interacting components of a *system*. Theories related to 'Message Reception and Processing' were also considered and discussed, are related to how messages are received, and how individuals understand, organize and use the information present in messages. Theories associated to the 'The Communicator' were also discussed, focusing on topics related to the identity of the communicator, how communicators differ from one another, the various resources individuals have to communicate; and how an individual's communication changes according to different situations. 'Communication and Media' theories are also considered, focusing on an individuals' interaction with media and the resulting gratifications obtained, determined by attitudes and beliefs. Lastly, 'Theories of Experience and Interpretation' are explored, related to how individuals interpret information as individuals or part of a community.

Table 5 summarizes the various communication theories considered according to their topic, main theory and secondary theory (and related tradition, where applicable). Furthermore, it presents an initial summary of the theory.

Table 5: Summary of Communication Theories

Theories according to topic[26]	Main Theory	Secondary Theories (and related Tradition[27])	Summary of respective theory
System Theory	Cybernetics	Basic System Theory (*Cybernetic*)	'System' refers to a set of interacting components that result in something greater than a sum of individual parts
		Feedback Processes (*Cybernetic*)	Feedback is the transmission of the receiver's reaction back to the original sender
Message Reception and Processing	Message Interpretation	Osgood on Meaning (*Sociopsychological*)	Explores how meanings are learned and how they relate to thinking and behaviour
		Relevance Theory	Explores how listeners understand a speaker's intentions according to the 'coding' and 'inferential' model
	Information Integration	Information Integration Theory (*Cybernetic*)	Explores how information is accumulated and organized to form 'attitudes' or a predisposition to act in a positive or negative way toward some object
		Consistency Theories	Explores the idea that people are more comfortable with consistency than inconsistency
	Judgment Processes	Elaboration-likelihood theory (*Sociopsychological*)	Focuses on the reasons an individual will or not be persuaded by certain messages and how received information is evaluated
		Expectancy-violations theory (*Sociopsychological*)	Explores how people react when their expectations are violated
The Communicator[28]	Trait theory	Trait-factor model (*Sociopsychological*)	Explores the grouping of small traits (a consistent way of thinking, feeling, and behaving across situations) into a group of general traits
Communication and Media	Theories of Individual Outcomes: Uses, Gratifications and Dependency Theory	Expectancy-Value Theory (*Sociopsychological*)	Explores how the gratifications an individual seeks from media are determined by the individual's attitudes and beliefs about a media
		Dependency Theory (*Sociopsychological*)	Focuses on the idea that an individual depends on media information to meet certain needs as well as to achieve certain goals
Theories of Experience and Interpretation	Hermeneutics: Cultural Interpretation	Interpretative Media studies (*Phenomenological*)	Considers audiences as interpretative communities, with different meanings for what is read, viewed or heard

[26] Based on the division presented in Littlejohn (1999)

[27] Based on the 'Traditions of Communication Theory' presented in Littlejohn & Foss (2007)

[28] Theory exceptionally listed according to the categorization presented in (Littlejohn & Foss, 2007)

4.5 Final Considerations on the Chapter

This chapter has presented an overview of a topic which is common to many other areas: communication. With video games, the association between the two areas is usually via work related to computer-mediated communication.

In addition to a brief overview of some of the more traditional communication theories – focussing on ideas introduced by Lasswell, Shannon & Weaver, Osgood-Schramm, and Dance (McQuail & Windahl, 2003) – this chapter also looks into various other communication theories covering topics related to the ‘System Theory’, ‘Message Reception and Processing’, ‘Experience and Interpretation’ as well as ‘Communication and Media’. Each of these topics covers a variety of other theories which reflect on the individual as a communicating agent.

With this chapter, the intent is to show that theories of communication and video games are two fields that do not necessarily have to be limited to traditional computer-mediated communication studies. The science of communication is grounded on multiple studies that can reach into other areas, such as video games. The purpose of this argument is to promote a discussion regarding two well established areas while forcing their confrontation and suggesting that both communication and video games can borrow from one another.

Given the nature of the interaction between a player and a video game, understanding how a player as an individual is shaped by the various phenomena discussed in these communication theories, can possibly provide insight on the nature of the mentioned interaction and the player’s resulting gameplay experience.

2

PART TWO

EMPIRICAL STUDY: A GAMEPLAY EXPERIENCE MODEL PROPOSAL & VALIDATION

CHAPTER 5
A GAMEPLAY EXPERIENCE MODEL PROPOSAL

Video games are developed to entertain and create satisfying experiences for players. This chapter focuses on the development of a Gameplay Experience Model proposal, centred on the dynamic interaction that exists between a player and the video game. The chapter focuses on the development of the model – based on a literature review and focus groups – and is later explored in terms of its various elements and dimensions, in addition to its applicability in game contexts. Furthermore, and considering the communication theories presented in CHAPTER 4 – *Communication & Video Games*, various components of the gameplay experience model are analysed according to these theories. The transversality of these theories assists in corroborating the presence and importance of the characteristics within the model.

5.1 REVISITING THE USER EXPERIENCE IN VIDEO GAMES

As presented in *CHAPTER 2 – The Gameplay* Experience (*cf. p. 65*), there are an endless number of studies regarding the global concept of *user experience* in video games. Under the name of 'player', 'gaming' or 'gameplay' experience, research has focused on what these experiences are, how they are formed and how they can be measured. One approach suggests that the user experience is a term that contemplates concepts such as 'immersion', 'presence', 'fun', 'involvement', 'engagement' and 'flow' (Takatalo et al., 2010). However, the problem is that many of these concepts have too broad of a definition (Takatalo *et al.*, 2010) or, in some cases, have overlapping meanings and are simply extensions of another concept. Considering the multiple studies presented, some have focused on 'immersion' (Brown & Cairns, 2004; Ermi & Mäyrä, 2005; Jennett *et al.*, 2008); some on 'flow' (Bateman & Boon, 2006; Chen, 2007; Csíkszentmihályi, 1990; Nakamura & Csíkszentmihályi, 2002; Sweetser & Wyeth, 2005) and others regarding 'presence' (Lombard & Ditton, 1997; Nunez & Blake, 2006; Slater et al., 1994; Zahorik & Jenison, 1998).

Briefly recalling some of the ideas explored in these studies; Brown & Cairn's (2004) work on immersion divides the *experience* into three levels: *engagement*, *engrossment* and *total immersion*. McMahan (2003) explores three conditions that create a sense of immersion: users' *expectations*, users' *actions* and *conventions*; Ermi & Mäyrä (2005) present a gameplay experience model focused on immersion divided into three components: *sensory*, *challenged-based* and *imaginative immersion*. Looking into flow, Csíkszentmihályi's (1990) foremost work on the concept of *flow* and *optimal experience* introduced a series of different components that contribute towards the experience. Because Csíkszentmihályi's work wasn't originally regarding games, Chen (2007) and Sweetser & Wyeth (2005) explore how flow can be adapted to the video game medium. Lastly, regarding presence, Lombard & Ditton (1997) found and explored six conceptualizations of presence, namely: presence as (*i*) *social richness*; (*ii*) *realism*; (*iii*) *transportation*; (*iv*) *immersion*; (*v*) *social actor within medium*; (*vi*) *medium as social actor*.

Within each concept's differences, several characteristics can be identified that bond *flow* and *immersion*, and work towards creating the gameplay experience. However, among these and other studies on the matter; there lacks a framework that organizes these and other characteristics found at the heart of the gameplay experience. As a result, we seek to present a model that represents the multiple characteristics related to the gameplay experience. The value of this model proposal lies in the re-examination of the aforementioned concepts (e.g. *immersion* and *flow*) which are considered two prominent states of the gameplay experience. While valuable research has been conducted individually on each, there is a need to break down these concepts and understand their individual characteristics, many of which are shared by both concepts.

5.2 A GAMEPLAY EXPERIENCE MODEL PROPOSAL

The present Gameplay Experience Model proposal extracts and presents the key characteristics which can help construct the gameplay experience. The model results from a two-step process.

First, the model is established based on a number of characteristics related to the gameplay experience and extracted from the literature review, supported on the previously referred studies. Some of these characteristics are related to *immersion*; others are related to *flow*; and some characteristics are shared by both concepts. Second, additional characteristics were collected through two focus group sessions aimed at understanding *video game* and *player* related characteristics that are believed to influence the gameplay experience. This model explores these multiple characteristics, the associations that can be established between them, and their connection to either the 'Player' or the 'Video Game', essential in our conception of the gameplay experience.

The value of this model lies in the re-examination of the mentioned concepts, which are considered two prominent states of the gameplay experience. While valuable research has been conducted individually on each, there is a need to break down these concepts and understand their individual characteristics, many of which are shared by both, supporting the need for a global analysis of these two concepts simultaneously. Furthermore, the model is also built upon characteristics identified by video game players, an important element in the model itself, and enthusiasts and connoisseurs of the video game medium.

The core of this model is sustained on the initial premise – based on the ideas of Ermi & Mäyrä (2005) – that gameplay experiences result from the interaction process between a *video game* (or a computer/digital game) and the individual that plays a game: the *player*. Figure 20 represents this understanding of the Gameplay Experience: an interaction between a video game and a player.

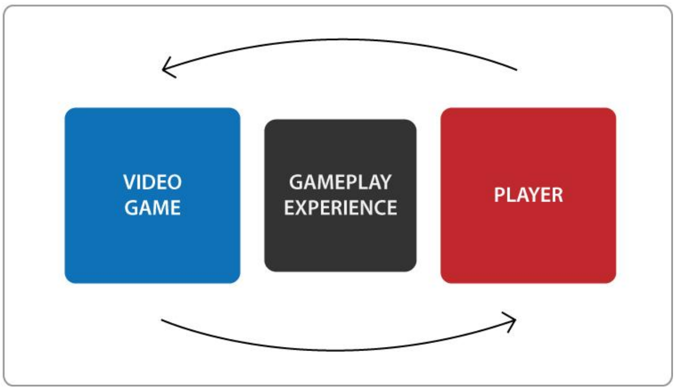

Figure 20: Representation of the Gameplay Experience as the result of an interaction between a *Video Game* and a *Player*

Based on this initial representation of the gameplay experience, the following stages in the development of the gameplay experience model proposal included characterizing each of these two vectors. As referred, a first moment consisted in collecting game and player related characteristics through a literature review process. Posteriorly, two focus groups were held in order to further gather and complement the collected characteristics.

5.2.1 The Need for a New Gameplay Experience Model

As introduced, multiple studies have looked at the gameplay experience, considering concepts such as *immersion* (*cf. p. 69*) or *flow* (*cf. p. 72*). Other studies have further looked to present models (*cf. p. 81*) that characterize and represent the gameplay experience process. However, some of these studies lack focus on specific aspects of the experience we believe cannot be overlooked.

The proposed model equally positions the player and video game in the definition of the gameplay experience. The gameplay experience itself is not limited to the resulting emotional experience, but also contemplates the interactive processes which lead up to the resulting emotional experience. Among existing work, it is felt none equally reflect the proposed interpretation on the gameplay experience. Despite each study's valuable contribution to the discussion, the focus is mainly on the video game or player elements.

The MDA Framework (Hunicke et al., 2004) divides games into three dimensions – mechanics, dynamics and aesthetics – and enlightens on the value of each of these vectors in the game experience, considering both game and player perspectives. However, the framework lacks expression of how player specific characteristics can shape and influence the frameworks elements. The CEGE Model (Gámez et al., 2010) focuses on the fundamental elements present in the interaction process with a game. The work scrutinizes the core elements present in the interaction between the user and the video game, but fails to explore how the user (player) plays a role in the interaction. While Gámez *et al.* (2010) clarify their model does not focus on player motivations or resulting psychological implications from gaming, the interaction process in gaming will likely be conditioned by several player related factors which are not portrayed or proposed in the CEGE Model. The model does reference some characteristics which could be related to players (*e.g.* memory, previous experience), but not in depth. Fernandez's (2008) framework clarifies the relationship among game components built during three moments (*before*, *during*, *after* the experience), where *fun* is the result of the experience. This work reflects to a greater extent on multiple player related facets which play a role in the experience with video games (*e.g.* age, gender, education, and hardware preferences), leading to a motivation for playing. These antecedents influence a *processing* stage which results in a general consequence – *fun* – based on cognitive and emotional responses. However, the processing stage refers to multiple aspects which do not clearly describe the apparently essential game characteristics and how these are related to multiple player characteristics.

Each of the studies previously mentioned have all contributed towards defining and clarifying on the concept of the game experience, either as a process, an outcome of interaction or both. While these studies are not referred for the purpose of debating their findings or their output on the gameplay experience; they are introduced given the uneven attention paid to the video game and player dynamism, and the possible connections resulting from their coexistence; thereby justifying the need for a fresh gameplay experience model to fill this existing gap.

5.2.2 Designating the Gameplay Experience Model

Before describing the development of the model and all its constituents, a brief reflection on the reasons behind the designation of the model as a 'Gameplay Experience' model is introduced. Several terminologies have been used to describe game-related experiences: *player experience* (Drachen, Nacke, Yannakakis, & Pedersen, 2010; Gerling, Klauser, & Niesenhaus, 2011; Kort & IJsselsteijn, 2008; Nacke & Drachen, 2011); *gaming experience* (Gámez, Cairns, & Cox, 2009; Gámez *et al.*, 2010; Gámez, 2007; Tychsen, Hitchens, Brolund, McIlwain, & Kavakli, 2008) or *gameplay experience* (Ermi & Mäyrä, 2005; Mirza-babaei, 2011; Nacke & Lindley, 2008).

While the *player experience* terminology appears to imply a greater focus on the *player* (Nacke *et al.*, 2009), it seems that *gaming* and *gameplay* are often used in an interchanged manner. However, there are differences between these two concepts that suggest this interchanged usage is not linear.

When compared to gameplay, the concept of gaming acts as a broader term. The problem with the term *gaming* is the lack of concrete definitions. The term gaming originated as a synonym for 'gambling', despite most games today not involving gambling in a traditional manner (M. Rouse, 2007). Definitions extracted from traditional dictionaries all point to the idea that gaming is «*the [act] of playing video [or computer or internet] games*» (Dictionary.com, 2012; Merriam-Webster.com, 2012; Webopedia, 2012). In these definitions, gaming is simply an act, and does not consider what elements make up the act of gaming. Therefore, the concept of *gaming* falls short for in designating the model.

Considering the term *gameplay*, Rollings & Adams' (2003, p. 200) definition is initially founded on the ideas of Sid Meier, describing gameplay as *"a series of interesting choices".* They build on Meier's definition, stating it is *"one or more causally linked series of challenges in a simulated environment"*. This definition alone differs from that of *gaming* as it establishes two initial elements: *challenges* and *environment*, *i.e.* what is done and where it is done. Another definition goes further: *"The experience of gameplay is one of interacting with a game design in the performance of cognitive tasks, with a variety of emotions arising from or associated with different elements of motivation, task performance and completion"* (Lindley, Nacke, & Sennersten, 2008, p. 1). Salen & Zimmerman (2003, pp. 309–310) indicate gameplay is *"the experience of a game set into motion through the participation of players. Game play clearly embodies the idea of play as a free movement within a more rigid structure. The particular flavor of a game's play is a direct result of the game's rules"*.

Considering the two last definitions (Lindley *et al.*, 2008; Salen & Zimmerman, 2003) – as well as several concepts embedded within them (*e.g.* interacting, tasks, emotions, motivation, participation, and players) – it is felt that *gameplay* is the most accurate to define the resulting experience from playing games. The thoughts of Ermi & Mäyrä (2005, p. 2) best represent these ideas, suggesting the gameplay experience is an *"ensemble made up of the player's sensations, thoughts, feelings, actions and meaning-making in a gameplay setting"*. As a result, the proposed model is defined as a *Gameplay Experience Model*, embracing Ermi & Mäyrä's (2005) ideas.

5.2.3 Literature Review: Methodology and Results

The first stage in the development of the proposed model consisted in extracting gameplay experience characteristics through a literature review process.

A literature review is an evaluation of existing literature related to a specific question. A literature review is important such that it informs on others' work related to a specific question, and allows a researcher to understand where work has yet to be done (Fraenkel *et al.*, 2012). The literature review applied in this part of the study consisted in the analysis of 'primary sources': publications where the results of a study are reported directly to the reader (Fraenkel *et al.*, 2012, p. 39). The literature review method applied is of *systematic literature review* nature, which consists in a *"literature survey with defined research questions, search process, data extraction and data presentation (…)"* (Kitchenham *et al.*, 2009, p. 9). Table 6 summarizes the authors analysed for this initial development stage of the model. The indicated authors focussed their work on the experience of *immersion* or *flow*.

Table 6: Authors analysed in literature review for gameplay experience characteristics

Immersion	Flow
McMahan (2003) Brown & Cairns (2004) Ermi & Mäyrä (2005)	Csíkszentmihályi (1990) Nakamura & Csíkszentmihályi (2002) Sweetser & Wyeth (2005) Bateman & Boon (2006) Chen (2007)

Regarding *immersion*, the variety of authors explored in this stage offer a valuable and a widespread analysis on the concept. Regarding *flow*, the concept itself has been well established from the beginning. As a result, studies that followed the work of Csíkszentmihályi (1990) are mainly reflections on the concept.

Table 7 presents a summary of the main ideas regarding the concept of *immersion*. The studies considered here were also the result of research developed according to several different methodologies: McMahan (2003) carried out a literature review; Brown & Cairns (2004) developed a grounded theory; and Ermi & Mäyrä (2005) used the observation method. This diversity of methods reinforces the variety of studies and data collection methods considered in the elaboration of the proposed model.

Table 7: Summary of main ideas and research regarding the concepts of *immersion*

Author	Summary of Research
McMahan (2003) Methodology: *Literature review*	Three conditions create a sense of immersion in a virtual reality or 3D computer game: 1. The user's *expectations* of the game or environment must match the environment's conventions fairly closely; 2. The user's *actions* must have a non-trivial impact on the environment; 3. The *conventions* of the world must be *consistent*, even if they don't match those of 'meatspace.'
Brown & Cairns (2004) Methodology: *Grounded Theory*	Immersion can be divided into three levels: (1) *engagement*, (2) *engrossment* and (3) total *immersion*. Each level can only achieved if the barriers of the level are removed. Removing the barriers can allow for the experience, but does not guarantee it. Barriers for *engagement*: access, investment [includes *time*, *effort* and *attention*]; Barriers for *engrossment*: **game construction** (referring to game features – *visuals*, *task*, *plot*); Barriers for *total immersion*: *empathy*, *atmosphere* (Game features).
Ermi & Mäyrä (2005) Methodology: *Observation*	Present a model of the key elements that structure the gameplay experience (GE), considering that the GE and immersion have multiple dimensions: 1st dimension – *sensory immersion*: games are 3D, *audio-visual* and stereophonic worlds that surround players; 2nd dimension – *challenged-based immersion*: immersion is at its most powerful when one is able to balance *challenges* and *abilities*; 3rd dimension – *imaginative immersion*: when a player uses their imagination and becomes absorbed with *characters*, the *story* and the *game world*.

In addition to immersion, flow characteristics were also identified from studies. These studies were essentially developed according to a literature review, mainly considering the original work of Csíkszentmihályi (1990). Table 8 summarizes the main ideas regarding the concept of *flow.*

Table 8: Summary of main ideas and research regarding the concept of *flow*

Author	Summary of Research
Csíkszentmihályi (1990) Methodology: *Interviews*	The flow experience considers eight components, not all being necessary for an individual to experience flow. 1. A *challenging* activity requiring *skill*; 2. A merging of *action* and awareness; 3. Clear *goals*; 4. Direct, immediate *feedback*; 5. *Concentration* on the task at hand; 6. A sense of *control*; 7. A *loss of self-consciousness*; 8. An altered sense of *time*.
Nakamura & Csíkszentmihályi (2002) Methodology: *Literature review*	Reflect on the concept of flow initially presented by Csíkszentmihályi and its relation with other constructs.
Sweetser & Wyeth (2005) Methodology: *Literature review*	Present a model (GameFlow) of enjoyment in games structured by flow. The GameFlow model includes the following eight elements: 1. The game; 2. *Concentration*; 3. *Challenges* and *skills*; 4. *Control*; 5. Clear *goals*; 6. *Feedback*; 7. Immersion; 8. Social interaction
Bateman & Boon (2006) Methodology: *Literature review*	Reflect on the concept of flow as introduced by Csíkszentmihályi, with greater incidence on the concepts of 'difficulty' and 'goals and feedback'.
Chen (2007) Methodology: *Literature review*	Reflect on the concept of flow as introduced by Csíkszentmihályi, considering its applicability in a video game context.

Based on the authors summarized in Table 6 (*cf. p. 139*), and the summary of research presented by these authors in Table 7 (*cf. p. 140*) and Table 8 (*cf. p. 141*), related to immersion and flow, respectively; various characteristics which contribute to the analysis of the respective gameplay experience were highlighted, analysed and extracted. Table 9 summarizes the *Immersion* and *Flow* characteristics that contribute to the Gameplay Experience, as well as the respective author(s) that mentioned the characteristics in their work. Table 9 also indicates the model element (video game or player) to which the collected characteristic can be associated to.

Table 9: Summary of collected characteristics from *immersion* and *flow*

Characteristic	Immersion [*Author*]	Flow [*Author*]	Video Game / Player
Actions	McMahan (2003)	Csíkszentmihályi	Player
Attention/Concentration/Focus	McMahan (2003) Brown & Cairns (2004)	Csíkszentmihályi (1990) Chen (2007) Sweetser & Wyeth (2005)	Player
Characteristics/Features	Brown & Cairns (2004)		Video Game
Control		Csíkszentmihályi (1990) Sweetser & Wyeth (2005)	Player
Convention/Consistency	McMahan (2003)		Video Game
Effort	Brown & Cairns (2004)		Player
Empathy/Connection	Brown & Cairns (2004)		Player
Expectations	McMahan (2003)		Player
Feedback		Csíkszentmihályi (1990) Bateman & Boon (2006) Chen (2007) Sweetser & Wyeth, 2005	Video Game
Goals		Csíkszentmihályi (1990) Bateman & Boon (2006)	Video Game
Loss of Self-Consciousness		Csíkszentmihályi (1990)	Player
Motivation		Csíkszentmihályi (1990) Csíkszen. & Nakamura (2002)	Player
Skills/Abilities	Ermi & Mäyrä (2005)	Csíkszentmihályi (1990) Bateman & Boon (2006) Sweetser & Wyeth (2005)	Player
Tasks/Challenges	Ermi & Mäyrä (2005)	Csíkszentmihályi (1990) Sweetser & Wyeth (2005)	Video Game
Time	Brown & Cairns (2004)	Csíkszentmihályi (1990)	Player

5.2.4 Focus Group: Methodology and Results

Following the initial collection of gameplay experience characteristics through a *literature review* (*cf.* Section 5.2.3, *p. 139*), a second phase in the development of the model consisted in collecting information through focus group sessions.

The objective of a focus group is to assemble a group of individuals and ask them to think about a series of questions and to have each participant hear other's opinions (Fraenkel *et al.*, 2012). The value of a focus group is to listen and gather information on a particular subject with participants that have characteristics related to the topic in discussion (Krueger & Casey, 2000). Focus groups are also advantageous when the participants are similar to one another and are cooperative (Creswell, 2011).

Two focus group sessions were held during October 2012: one at the University of Coimbra (UC) and the second at the University of Aveiro (UA), both in Portugal. The two focus groups gathered individuals with different characteristics and approaches to the topic at hand. One session included participants developing work and research related to video games. Within this first group of participants, some individuals played video games often while others did not. The second session included participants that were less involved in studying video games, but had a greater background and experience in playing video games.

The University of Coimbra focus group included a total of 10 participants, seven male and three female. The session, which lasted two hours, was recorded with audio and video devices to support a posterior analysis. The University of Aveiro focus group included a total of six participants; four male and two female. This session, lasting just over one and half hours, was also recorded with audio and video devices for posterior data analysis. All participants from both sessions signed a consent form, indicating the discussions of the session could be exclusively used for the purpose of the present work.

The focus group sessions were divided in four parts. Part one (*i*) consisted in an introduction of the session moderator and objectives of the focus group. Participants were introduced to the topic of discussion – *video games* and the *gameplay experience*. Participants were asked to reflect on game and player-related characteristics that can contribute or define the gameplay experience. This part of the focus group was driven by a series of questions, specifically:

1. *What Video Game related characteristics can contribute to the Gameplay Experience?*
2. *What Player related characteristics can contribute to the Gameplay Experience?*
3. *Considering the various Video Game and Player characteristics presented, what relationships are possible between these characteristics?*

Part two (*ii*) served to discuss the characteristics participants indicated related to video games. Part three (*iii*) served to discuss the characteristics participants indicated related to the player. Part four (*iv*) consisted in discussing possible relationships from the characteristics gathered in parts *ii* and *iii*, as well as a possible categorization of these characteristics.

5.2.4.1 Video Game

Beginning with the *Video Game* element, participants from the focus groups sessions identified several characteristics related to video games. Table 10 summarizes the video game characteristics collected from the University of Coimbra (UC) and University of Aveiro (UA) focus groups, respectively.

Table 10: Summary of *Video game* related characteristics contributing to the gameplay experience – Focus Group 1 (UC) & Focus Group 2 (UA)

VIDEO GAME				
Focus Group Session 1 – University of Coimbra				
Hardware	Software	Interface*	Balance	Compromise
Narrative	Visuals/Graphics	Possibilities	Sensorial	Control
Environment	Feedback	Context	Effort	Actions*
Virtual world	Coherence	Proper universe	Escapism	Society
Multisensory	Disruption	Excessive work	Sociability	Expectations
World	Evolution	Duration	Consistency	Suitability
Art*	Author	Time	Aesthetics	Fiction
Medium				
(*) Art, Interface, and Actions are referred by 2, 5 and 2 participants respectively.				
Focus Group Session 2 – University of Aveiro				
Appealing	Easy to use	Challenging	Graphics	Sociability
Playability	Similarities	Balance	Learning*	Predictability*
Narrative	Coherence	Expectations	Audio & Video	Freedom
Rewards	Mechanics	Objectives	Feedback	Competition
Longevity				
(*) Learning is referred by 2 participants				

VIDEO GAME: FOCUS GROUP 1 – UNIVERSITY OF COIMBRA

Several ideas can be highlighted from this group of characteristics. Five different participants referred the concept of *interface*, each with a different interpretation: interface as the 'ease of use'; as the 'technological support'; or as the means through which 'interaction' is established with the game. Regarding interface, some of the ideas[29] shared were:

> *"The experience of the game should not be the experience of dealing with the interface – and dealing with the problems of the interface, instead of playing the game."*

> *"The interface should create the feeling of presence – a feeling of 'living' the game, being within the game, being immersed."*

[29] Note to the reader: All content presented in *Section 5.2.4.1* and *Section 5.2.4.2* was translated from participants' contributions spoken originally in Portuguese

Excessive work (*i.e.* when the game requires excessive work from the player) was mentioned as something that could influence the experience. *Duration* and *time*, for example, were referred with two different meanings: duration relates to the progress of the game – if the game is constantly evolving or; if after a few minutes the game has nothing new to offer; *time* refers to the actual playing time of the game. *Context* was referred as a concept that can lie between the video game and player elements, defining scenarios that cannot be related to one element or the other. Regarding *balance*, one participant stated:

> *"[There should be] balance between the interface and the interaction that is proposed to the player – if the interface is really good but without adequate interaction, there is no balance."*

Regarding the characteristic of *actions*, one participant mentioned:

> *"The actions should carry out what is expected. The player will expect a sequence of actions after he completes a specific action, but that doesn't always happen."*

Lastly, one participant referred to 'expectations', stating:

> *"The expectations that are created are formed before playing the game."*

VIDEO GAME: FOCUS GROUP 2 – UNIVERSITY OF AVEIRO

From the second focus group session, additional characteristics were collected on the video game element. The number of characteristics collected from this group was inferior to those of the previous group. Also, the final group of characteristics was slightly more tangible when compared to the full group of characteristics of the first group, where many were abstract in meaning. Again, several characteristics can be highlighted. *Predictability* deals with the 'predictability' of a game: if a player can anticipate everything that will happen, the experience will be less interesting compared to a game that hides features the player would not have expected. *Rewards* were mentioned as a crucial game characteristic to keep players motivated, guaranteeing a better experience of playing. Related to the *easy to use* and *challenging* characteristics, one player stated:

> *"If you enter a game that you don't know how to play and you don't understand, you don't play it."*

Another participant, when commenting on the characteristic of *predictability*, said:

> *"When you already know everything that is going to happen, the experience is lost. That is why in a game where something new happens – even if small – the pleasure is maintained."*

Of the 57 characteristics mentioned in total – considering both focus groups – only four characteristics were mentioned by participants in both sessions. These characteristics are: *balance*, *coherence*, *sociability* and *expectations*. *Balance* was referred in both sessions with a slightly different idea. In the first group, it was referred as a requirement between *interface* and *interaction*, *i.e.* there should be a balance between the quality of the interface (visuals) and the interaction a game requires from players.

In the second group, balance was referred as a requirement that should be verified between the challenges put forward by the game and the help offered. *Coherence* was discussed in both groups as a requirement between several aspects of the game, so the game is understood as a whole rather than a sum of various parts. *Sociability* was also referred by both groups. The first group indicated that a game which promotes interaction among individuals (apart from the online experience) can result in a better experience. The second group referred to sociability in regards to its social potential, without limiting the idea to online or 'in person' contexts. Lastly, *expectations* were referred with similar intentions in both groups: players enter the game with certain expectations that they commonly expect to be fulfilled.

5.2.4.2 Player

The second concept participants were asked to reflect on was the related to the 'player' element of the model. Once again, participants from the focus groups sessions identified several characteristics related to players. Table 11 summarizes the player related characteristics collected from the first and second focus groups, University of Coimbra (UC) and University of Aveiro (UA), respectively.

Table 11: Summary of *Player* related characteristics contributing to the gameplay experience – Focus Group 1 (U. of Coimbra) & Focus Group 2 (U. of Aveiro)

PLAYER				
Focus Group Session 1 – University of Coimbra				
Interpretation*	Previous experience	Perception	Expectations*	Memory
Beliefs	Motivation*	Growth	Physical profile	Preferences
Co-operation	Fun	Competition	Protagonism	Learning
Expertise	Strategy	Empathy	Balance	Control
Challenge	Emotion	Recoverability	Skills	
(*) Interpretation, Motivation and Expectations are referred by 2, 4 and 2 participants, respectively.				
Focus Group Session 2 – University of Aveiro				
Emotion	Immersion	Expectations	Motivation	Experience
Preferences	Skills	Addiction	Age	Memory
Learning	Competition	Preoccupations	Strategy	Profile
Physiological characteristics	Physical characteristics			

PLAYER: FOCUS GROUP 2 – UNIVERSITY OF COIMBRA

From the University of Coimbra group, several characteristics can be considered. *Motivation* was referred by a total of four participants, related to the idea that player motivation is important in order to become more *engaged* with a game. *Interpretation* was referred by two participants. One referred to interpretation as becoming and assuming the role of the character within a universe. Another participant stated:

> *"We play for different motives, in different contexts, with different objectives and different reasons. In each of these, we interpret the artefact that we are manipulating. The player is an interpreter."*

Expectations were referred by two participants and *previous experiences/background* was mentioned by one participant. Regarding *previous experiences*, the participant stated:

> *"It essentially is related to life experience. Related to a game, what is expected from a game, what we get from playing the game is highly conditioned by what we've played before."*

PLAYER: FOCUS GROUP 2 – UNIVERSITY OF AVEIRO

From the University of Aveiro group, several characteristics are also considered. In this group, no characteristics were repeated among the participants. *Motivation* was thoroughly discussed in this session, where participants discussed the motivation for the challenges offered by a game; and the motivation to play in a social context, and to be better than other players (known or unknown):

> *"A lot of the times you'll only play a game because the people who play them are people you know. (…) the social context is important in this situation."*

Expectations and previous experience was also referred, where one participant indicated playing a specific game because he enjoyed the same titled game from the year before. *Preferences* were discussed in terms of the game genre and specific preferences within the game.

Players' specific characteristics were also discussed, namely in terms of their *physical* and *psychological* nature. One participant, speaking of player gender, stated:

> *"I know girls that are addicted to playing FPS."*

5.2.4.3 Relationships and Categorization

From the collection of characteristics related to video games (*cf.* Table 10, *p.* 144) or players (*cf.* Table 10, *p.* 144), the last task in the focus group sessions required participants to reflect on and establish possible clusters and relationships with the characteristics. Posteriorly, an attempt to categorize these relationships was made, identifying a characteristic or term which best could identify the relationship. This step of the focus group sessions served to narrow down and mark out the main characteristics for each key element. Table 12 summarizes the multiple relationships established in the focus group sessions related to the *Video Game* element; Table 13 summarizes the various identified relationships regarding the *Player* element.

Table 12: Summary of identified relationship for video game related characteristics – Focus Group 1 (U. of Coimbra) & Focus Group 2 (U. of Aveiro)

VIDEO GAME				
Focus Group Session 1 – University of Coimbra				
Relationship 1	Interface	Hardware	Software	Feedback
Relationship 2	Security	Control		
Relationship 3	Coherence	Consistency		
Relationship 4	Security	Control	Rules	---
Relationship 5	Fiction	Script	Actions	World
Relationship 6	Environment	Context	World	
Relationship 7	Sound	Fiction	Art	Interface
Relationship 8	Script	Narrative	Fiction	
Relationship 9	Sound	Art		
Focus Group Session 2 – University of Aveiro				
Relationship 10	Appealing	Playability	Mechanics	Objectives
	Rewards	Evolution	Time	Rules
Relationship 11	Challenge	Coherence	Balance	Feedback
Relationship 12	Narrative	Graphics	Appealing	Realism
Relationship 13	Social	Rewards	Competition	

Table 13: Summary of identified relationship for player related characteristics – Focus Group 1 (U. of Coimbra) & Focus Group 2 (U. of Aveiro)

PLAYER				
Focus Group Session 1 – University of Coimbra				
Relationship 1	Previous experience	Memory		
Relationship 2	Balance	Growth		
Relationship 3	Expectations	Motivation	Background	Previous experience
Relationship 4	Protagonism	Interpretation		
Relationship 5	Interpretation	Background	Personality	Emotion
Relationship 6	Skills	Background		
Relationship 7	Protagonism	Recoverability		
Relationship 8	Motivation	Competition		
Focus Group Session 2 – University of Aveiro				
Relationship 9	Emotion	Immersion	Expectations	Motivation
	Sociability	Satisfaction	Strategy	Interaction
Relationship 10	Experience	Skills		
Relationship 11	Preferences	Addiction	Profile	Competition
	Physiological characteristics	Physical characteristics	Preoccupations	

5.3 OPERATIONALIZING THE MODEL: ORGANIZATION AND CHARACTERISTICS

After collecting video game and player related characteristics from the literature review and focus groups, as well as considering the possible relationships and categorizations suggested in the focus groups; the following step consisted in organizing these items into a representative model based on the interpretation of the gameplay experience presented above (*cf.* Section 5.2, *p. 136*).

Regarding the *Video Game* element of the model, during the literature review process and focus group sessions, several characteristics emerged as possible cornerstones for the model, capable of grouping other collected concepts. Recalling, various authors (Hunicke *et al.*, 2004; Rollings & Adams, 2003; Takatalo *et al.*, 2010) have debated the different components of a video game. A game may consist in 'mechanics', 'dynamics' and 'aesthetics' (Hunicke *et al.*, 2004) – or 'interface', according to Takatalo *et al.* (2010). Rollings & Adams (2003) indicate that a game includes 'mechanics', 'storytelling' and 'interactivity'.

Regarding the *Player* element; players are the individuals that play video games and are there end target. Contrary to other types of media, the relationship between video games and players is unique, relying on an active participation from the player. Players do not passively consume video games; they actively participate in the creation of the experiences which results from playing. When playing, players bring into that moment their motivations, skills, experience and expectations; all which influence the quality of the experience (Ermi & Mäyrä, 2005).

Based on the aforementioned considerations, the model considers the gameplay experience as a continuous interaction between a *Player* and a *Video Game*. Both these elements consist of three dimensions which can influence the experience. Figure 21 is a simplified representation of the proposed Gameplay Experience Model.

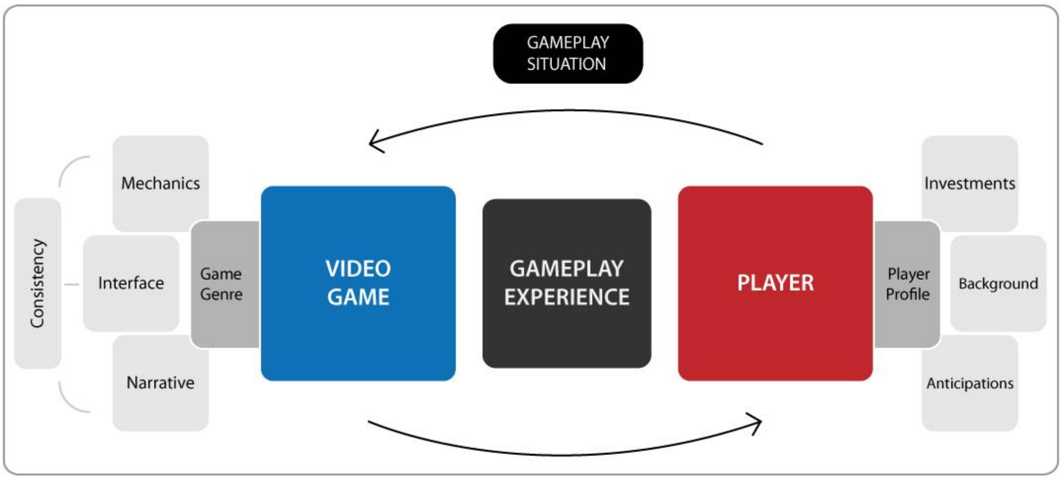

Figure 21: Simplified representation of the proposed Gameplay Experience Model

The dimensions related to the *Video Game* element are *Mechanics*, *Interface* and *Narrative*; essentially based on the concepts defined by the mentioned authors (Hunicke *et al.*, 2004; Rollings & Adams, 2003; Takatalo *et al.*, 2010). Within this element, the specificities and characteristics of these three dimensions define a specific *video game genre*. While many video game genres will share characteristics embedded within these three dimensions, specific differences in one of these dimensions can contribute to defining a specific type of genre. Regarding the *Player* element, the main dimensions are *Investments*, *Background* and *Anticipations*; based on a reinterpretation of the concepts presented by Ermi & Mäyrä (2005) when discussing player characteristics.These three dimensions form a specific player profile, normally unique to each individual. It is considered that these six dimensions form the basis of the gameplay experience model, while all other characteristics support and structure the experience.

The two-stage process described in *Section* 5.2.3 (*cf. p. 139*) and *Section 5.2.4* (*cf. p. 143*) resulted in a collection of more than 100 characteristics related to video games and players, and associated to the gameplay experience. Table 9 (cf. p. 141) summarizes the various characteristics collected from a literature review, with no particular distinction between video games and players. Table 10 (*cf. p. 142*) and Table 11 (*cf. p. 144*) summarize the characteristics collected from the focus groups, regarding video games and players, respectively.

The work described in Section 5.2.4.3 – *Relationships and Categorization* (*cf. p. 147*) was a preliminary process with the objective of condensing and grouping the collected characteristics. Posteriorly, these characteristics were associated to one of the multiple dimensions previously defined. A large majority of the identified characteristics were considered and are visibly represented in the model. Others were also considered, but serve as a support for the main identified characteristics.

Some of the characteristics discussed in the literature review and focus groups are directly related or equivalent to the six dimensions previously defined (*i.e. mechanics*, *interface*, *narrative*; *investments*, *anticipations* and *background*). For example, related to the 'video game' element of the model, *mechanics* and *narrative* were referred in the focus group sessions with a connotation similar to the equivalent dimension. In the case of the 'player' element, a similar situation occurred for the characteristics of *expectations*, similar in definition to the *anticipations* dimension.

VIDEO GAME ELEMENT ORGANIZATION

Initially considering the *Video Game* element, many of the collected characteristics were allocated to one of the three defined dimensions (*Mechanics*, *Interface* and *Narrative*). From the literature review and focus groups; 'goals', 'tasks', 'challenges' and 'objectives' were agglutinated into a single terms – *Goals* – and associated to the *Mechanics* Dimension. *Rewards* were mentioned in the focus group sessions and also included in the *Mechanics* Dimension. Lastly, *rules* were defined for the *Mechanics* dimension in representation of other mentioned characteristics.

Still related to video games, *Interface* was defined as a dimension and includes characteristics related to how the game looks, feels and how a player interacts with a game. As a result, the characteristics of *audio*, *visuals*, *feedback* and *input* were selected as representative characteristics of the *Interface* Dimension. For example, *visuals* contemplates characteristics such as 'visuals/graphics', 'environment', 'virtual world', 'world' and 'graphics'. The characteristic *feedback* was also referred in both the literature review and the focus groups, and later placed in the *Interface* Dimension. While 'feedback' can also be considered part of the mechanics – considering it is the mechanics of the game that define the type of feedback received – it was decided to associate the characteristic to *Interface*. This decision is justified by the fact that we consider feedback to be a visual or audio characteristic – something that a player sees or hears – despite being generated by the mechanics of the game.

Another of the defined dimensions for the video game element was *Narrative*, which was also referred on one occasion during the focus groups, and includes other characteristics such as 'fiction' and 'script'. Lastly, several ideas mentioned during the focus groups and registered in the literature review are 'balance', 'coherence', 'consistency' and 'convention'. This idea of balance was considered important and led to the definition of an additional characteristic – *consistency* – which connects the remaining three dimensions of the model. Table 14 summarizes the various Video Game related concepts of the model, including their respective sources and supporting ideas.

Table 14: Summary of *Video Game* related concepts, respective sources and supporting ideas

Model Concept	Source	Supporting Ideas
VIDEO GAME *Element*	Literature Review	
MECHANICS *Dimension*	Lit. Review, Focus Groups	Defined based on the Literature Review
Goals *Characteristic*	Lit. Review (F), Focus Groups	*Goals*, *Tasks*, *Challenges*, *Objectives*
Rules *Characteristic*	Literature Review	
Rewards *Characteristic*	Lit. Review, Focus Groups	
INTERFACE *Dimension*	Lit. Review, Focus Groups	Defined based on the Literature Review
Audio *Characteristic*	Lit. Review, Focus Groups	
Visuals *Characteristic*	Lit. Review, Focus Groups	*Visuals*, *Graphics*, *Environment*, *World*
Feedback *Characteristic*	Lit. Review (F), Focus Groups	
Input *Characteristic*	Lit. Review, Focus Groups	
NARRATIVE *Dimension*	Lit. Review, Focus Groups	Defined based on the Literature Review and including *Fiction*, *Script*
Consistency *Characteristics*	Lit. Review (I), Focus Groups	*Balance*, *Coherence*, *Consistency*, *Convention*

PLAYER ELEMENT ORGANIZATION

Now considering the *Player* element of the model, an initial breakdown resulted in the division of the player element into three dimensions: *Investments*, *Anticipations* and *Background*. Considering the list of characteristics collected from the literature review and focus group sessions, the mentioned dimensions were considered adequate for agglomerating these various concepts.

Related to the dimension of *Investments*, this designation is adopted based on the reflections of Brown & Cairns (2004), and adapted here considering existing definitions connected to 'investments'[30], namely related to "the act of investing effort, resources, (…)"; "a devoting, using, or giving of time, talent, emotional energy, etc., as to achieve something"; and "the act of investing with a quality, attribute, etc." Therefore, with *investments*, players give something in order to receive something. Here, what players give are *motivations*, a concept defined to agglomerate characteristics referred during the focus groups (*e.g.* co-operation, fun, competition, protagonism, learning, recoverability, strategy). These concepts were mentioned as motives an individual would play a game; therefore, a player would have a clear motivation to play in order to achieve these or other *conditions* from playing). Other characteristics also included within the dimension are *effort*, *attention* and *time*, reflecting ideas from the literature review. Also within investments is *connection*, related to player's possessing something which they can connect to in the game.

Looking at the *Background* dimension, this dimension considers the various characteristics that are related to a players' unique background. The characteristic of 'skills' was referred both in the literature review as well as in the focus groups. As a result, all eventual player skills are grouped into the main characteristic of *abilities*. Additionally, collected characteristics related to a player's *know-how* and *experiences* are included in the general characteristic of *knowledge*. Lastly, *preferences* was referred during the focus groups and therefore, considered as a main characteristic of the *background* dimension.

A final dimension of the *Player* element refers to *Anticipations*. Within this dimension, there is room for the near equivalent characteristic of expectations. Other characteristics of this dimension are *actions* and *control*, also collected during the literature review and the focus groups. In the focus group sessions, actions were referred as being part of the video game. However, in this interpretation, *actions* are related to what the player does and *anticipate* being able to do, rather than what the game allows the player to do.

Table 15 summarizes the various Player related concepts of the model, including their respective sources and supporting ideas.

30

Table 15: Summary of Player related concepts, respective sources and supporting ideas

Model Concept	Source	Supporting Ideas
PLAYER *Element*	Literature Review	Defined based on the Literature Review
INVESTMENTS *Dimension*	Literature Review, Focus Groups	Defined based on the Literature Review
Motivation *Characteristic*	Lit. Review (F), Focus Groups	*Co-operation*, *Fun*, *Competition*, *Protagonism*, *Learning*, *(…)*
Connection *Characteristic*	Lit. Review (I), Focus Groups	*Emotion*, *Empathy*
Time *Characteristic*	Lit. Review (I, F), Focus Groups	
Attention *Characteristic*	Lit. Review (I, F), Focus Groups	*Concentration*, *Focus*, *Loss of Self-consciousness*
Effort *Characteristic*	Lit. Review (I), Focus Groups	
BACKGROUND *Dimension*	Focus Groups	Defined based on the Literature Review
Ability *Characteristic*	Lit. Review (I, F), Focus Groups	*Skills*
Knowledge *Characteristic*	Focus Groups	*Know-how*, *Experiences*
Preferences *Characteristic*	Lit. Review, Focus Groups	
ANTICIPATIONS *Dimension*	Lit. Review, Focus Groups	Defined based on the Literature Review
Expectations *Characteristic*	Lit. Review (I), Focus Groups	
Actions *Characteristic*	Lit. Review (I, F), Focus Groups	
Control *Characteristic*	Lit. Review (F), Focus Groups	

5.3.1 A Twofold Gameplay Experience Model

The gameplay experience model proposed here is a framework for understanding the multiple elements and characteristics which can influence a player's gameplay experience. The experience resulting from video game play cannot be understood without considering the two key elements present during that moment: the *video game* and the *player*. The gameplay experience is defined by the interaction between these elements and their respective characteristics. During the act of play, players do not passively participate in a predefined manner of gameplay. Rather, they are a vital element in the creation of their experience. Therefore, the influence of each of the model's characteristics on the experience depends on the importance players give to a determined characteristic.

As introduced (*cf.* Section 5.3, *p. 149*), the video game element consists of three dimensions: *Mechanics*, *Interface*, and *Narrative*. The player element consists of three dimensions: *Investments*, *Background* and *Anticipations*. Each of these dimensions is supported by several characteristics. Furthermore, this model contemplates the concept of a *gameplay situation*, referring to the setting in which the game takes place, and consists of an 'ambient' and a 'platform' context.

The framework considers the gameplay experience as a *twofold* experience – it is an emotional experience embedded within an *interactive* experience. As originally referred by Dewey in 1938 (Gámez *et al.*, 2010) when discussing the concept of experience, this model borrows his thoughts and considers the gameplay experience to be both the *process* and the *outcome*. Here, the gameplay experience is both an *interactive process* and an *emotional* outcome – an emotion (or a group of emotions) that result from game playing. During game play, these experiences can influence one another and can be shaped by the multiple characteristics of the model. This process of multiple influences defines the final outcome of the gameplay experience.

The *interactive* experience is the process through which players operate and approach a game. It is how they explore the environment or game space; how they interact with other players, non-playable characters or objects; and how they make decisions. This process is framed and limited by the game itself, but influenced by the players' *background*, *investments* and *anticipations*.

However, the *interactive* experience is also influenced (positively or negatively) by the players' current *emotional* experience. During the act of game play, players are characterized by a current emotional experience that may vary throughout the game, influenced by the game's directives or the outcomes of players' actions as they progress. The *interactive* experience is continually influenced by their current *emotional* state: if players are anxious, they may be less capable of paying attention to the game, which may reflect on their ability to play correctly; if they are relaxed and stress-free, they may be in a state of *flow* where everything in the game runs perfectly.

This reciprocity can affect the gameplay result, which refers to the visible consequences of the game. In turn, these consequences can influence the emotional gameplay experience such that when positive, they can produce positive emotions within the player (*e.g.* satisfaction, enjoyment, excitement); if negative, they can produce the opposite (anger, despair, indifference). It is also possible that positive or negative consequences alter a players approach (interactive experience) by changing player motivations (*Investments*) and actions (*Anticipations*), for example.

This bi-directional relationship can explain why occasionally players can feel enjoyment and frustration throughout the duration of the game. Figure 22 represents an example of how the *Interactive* and *Emotional* experiences influence each other during the act of game play. The example represents an act of game play beginning with a players' interactive experience (InEx) and a neutral emotional experience (EmEx). Depending on the outcome of his actions (the gameplay result), his *current* emotional status may become positive or negative, which can also influence the continuous process of the interactive experience. While game play continues, this reciprocity continues until a final outcome of a positive or negative emotional experience is reached.

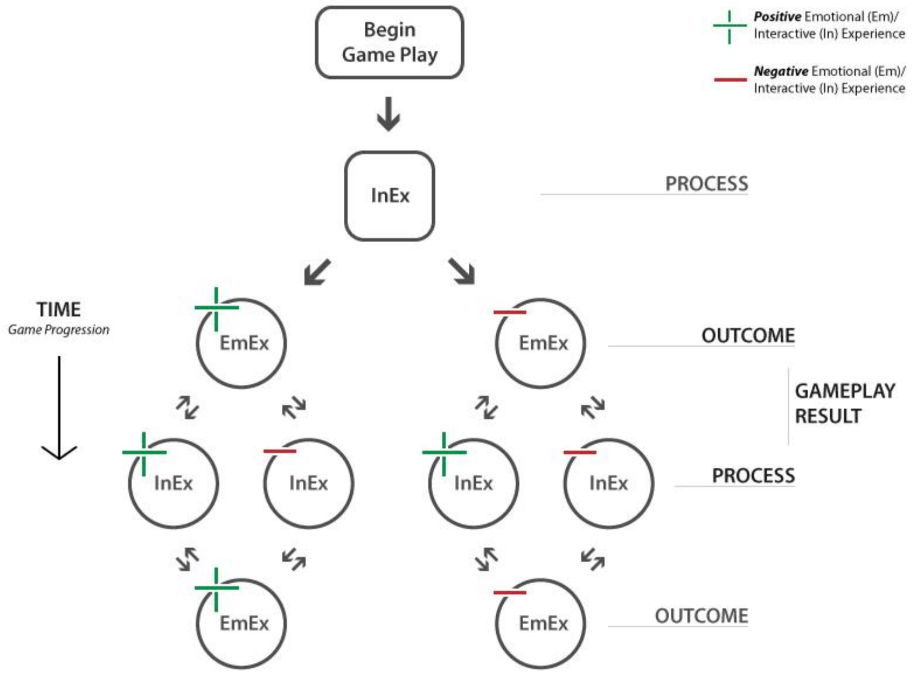

Figure 22: Representation of an example of the *Interactive* and *Emotional* experience relationship during game play

As iterated in previous sections, the elements and characteristics that make up this model were collected initially through a literature review process. An extensive analysis was carried out regarding two widely accepted gameplay experience concepts: *immersion* and *flow*. Multiple studies related to these concepts were examined in order to understand what conditions and characteristics are responsible for these experiences. Posteriorly, these characteristics were confronted and complemented with others acquired through two focus groups. Data collected from these sessions was analysed using a coding technique in order to obtain the main elements and characteristics that fit the model, and represent the key characteristics that can influence the gameplay experience.

The framework presented here emerges in response to the multiple existing theories and models on the gameplay experience, but lack equal attention to the two central vectors of the experience itself: the *player* and the *video game*. These limitations have been previously explored in Section *5.2.1* (*cf. p. 137*). The model proposed here seeks to summarize with equal balance the two referred elements of the gameplay experience, elaborating on our understanding of the key dimensions of each element and respective characteristics. Figure 23 represents a holistic view of the proposed gameplay experience model.

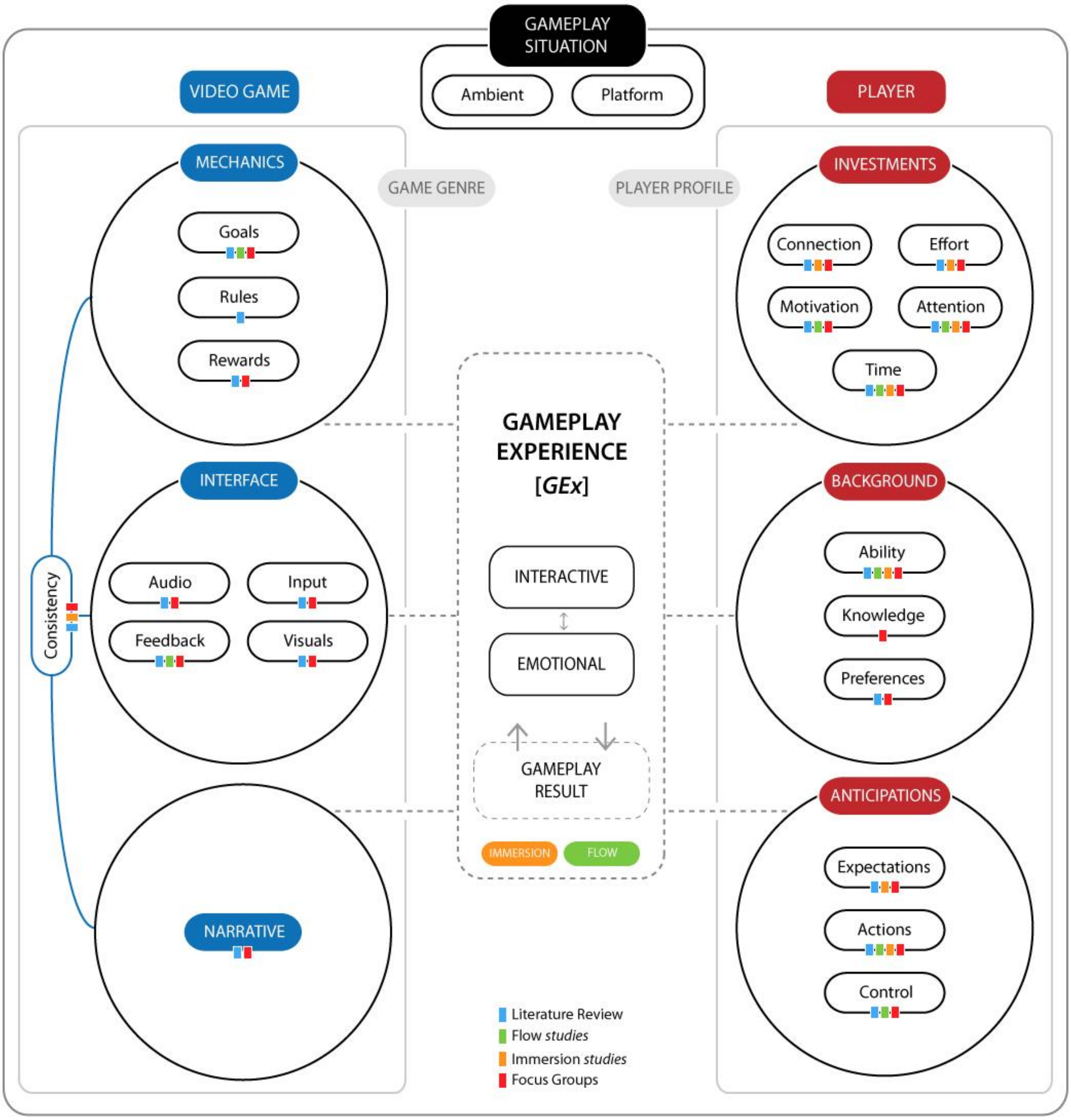

Figure 23: Representation of the proposed Gameplay Experience Model

While it should be understood as a whole, the model can be divided into four parts. Governing the gameplay experience is the *Gameplay Situation*, exterior to the player and the video game, and consisting of an Ambient and Platform setting. At the centre of the framework is the resulting gameplay experience, dependent of the *Video Game* and the *Player*, and consisting of an *Interactive* and an *Emotional* experience which can influence the *Gameplay Result*.

The left axis of the model represents the *Video Game* element which is divided into three main dimensions: *Mechanics*, *Interface* and *Narrative*. Each of these dimensions consists of one or more different characteristics. The video game dimensions are connected by a bonding characteristic of the video game element: *consistency*. Consistency is responsible for guaranteeing the coherence and balance of the multiple video game dimensions, enabling a game that can be considered an integrated and complete product, rather than a summary of multiple disconnected parts.

On the right axis is the *Player* element, represented by three dimensions: *Background*, *Investments* and *Anticipations*. Once again, each of these dimensions consists of one or more characteristics which make up the respective dimension. The way in which a player is shaped by one or more of these characteristics can define his approach to the game as well as how he plays, ultimately defining his gameplay experience.

While the proposed model does not intend to solely represent the nature of Immersion or Flow, it does gather a vast number of characteristics from the core of these concepts and supporting studies. As summarized in Table 14 (*cf. p.* 151) and (*cf. p.* 153); and visually represented in Figure 23 (*cf. p.* 156); immersion and flow are present in eight characteristics of the model, and in the same characteristics on four occasions.

Within the model, Flow is present in *goals* (Mechanics); *feedback* (Interface); *motivation*, *attention* and *time* (Investments); *ability* (Background); and *actions* and control (Anticipations). In turn, Immersion is present in the model in *consistency*; *attention*, *effort*, *time* and *connection* (Investments); *ability* (Background); and *expectations* and *actions* (Anticipations). As a result, immersion and flow experiences are also present in the centre of Gameplay Experience model (Figure 23). Therefore, while the present model is not immersion or flow oriented, it is possible to characterize and analyse the gameplay experience according to these concepts, and discuss to some extent the players' experience according to supporting immersion and flow characteristics.

For example, by looking into players' skills (*ability* characteristic) when compared to the difficulty of the challenges (*goals* characteristic) offered by a game, it is possible to infer on the extent of players' flow. The same can be said by a player's level of *attention*, or the feeling of *control* felt, for example; both possible indicators of flow. Regarding immersion, by looking into players' level of *effort* or *attention* (shared with flow), it is possible to deduce potential conclusions regarding players' level of immersion.

In order to assess the gameplay experience, several solutions can be applied. However, the particularities of each characteristic and their contribution to the experience can complicate this analysis. As previously introduced, the gameplay experience is not only the outcome of game play, but also the process. Occasionally, the process of playing a video game is absorbing to a point where a player is posteriorly unable to describe his attitudes on the experience.

Despite this possible limitation, the use of direct observation, verbal questioning, metrics and questionnaires can be used to gather information and data in order to describe the proposed gameplay experience. The analysis of the interactive and emotional experience described is essentially based on a *Gameplay Experience Questionnaire,* an integral part of this model, and described further on (*cf.* Section 6.3.2 – Gameplay Experience Questionnaire (GExQ) Description, *p.* 192). The questionnaire was developed in order to assess players' attitudes and opinions on the video game, and complemented by an analysis of extracted gameplay metrics (when available). While the interactive or emotional experience can be considered independently, a more thorough analysis of the gameplay experience is possible when both experiences are considered.

In addition to characterizing our interpretation of the key elements, supporting dimensions and characteristics responsible for the gameplay experience; the work presented here can also be applied as a tool in game development and analysis. The appropriation of this framework in game development and/or analysis can serve as orientation when considering the multiple features that must be kept in mind in either process. This gameplay experience model can be considered and applied as a development and analysis heuristic. It can be understood as a script or check-list which can be used by developers in an attempt to create better video games by orienting and directing their focus to the key characteristics that should be considered in order to create the best possible and appealing experience for the player.

5.3.2 On the 'Gameplay Situation'

The *Gameplay Situation* (GS) refers to the holistic setting in which the act of playing takes place. It references relevant details that can have an influence on the gameplay experience resulting from the act of game play, but are exterior to the player and the video game. The gameplay situation is twofold, consisting of an *ambient* and *platform* setting.

First, the *GS* consists of an *ambient* setting in which game play takes place. The *ambient* can be the weather – inside or outside – which can influence the comfort in which game playing takes place. It can be the time of day – morning, afternoon or night. It can be the place – static or in movement – the player is at, defined by choice (if the player chooses to play in a specific place) or circumstance (if the player chooses to play despite the place he is in). Depending on the player, the *ambient setting* may or may not influence the player's experience. Exemplifying, a player about to play a specific game while riding a public transport to work will possibly experience that game differently form a player playing the same game at home. This specific *ambient setting* is conditioned by the *time* the player riding the transport has to play, which is likely different from the time someone at home has to play.

Second, the *GS* refers to the platform being used to play a specific game. With the technological advancements in past decades, video games have made their way into a variety of different platforms. Video games are no longer played exclusively on arcade machines, console systems or personal computers; they are also played on handheld game consoles (developed mainly for the purpose of playing), tablets, mobile phones and game websites. Also, while many games are made for specific platforms; today, many game titles are made for one or more of the aforementioned platforms. However, while the video game is in essence the same, different platforms can result in different experiences. One of the reasons for these differences is related to the platform itself, namely its *performance* and *mechanical* possibilities. Specifically, and considering for example, a soccer game; controlling an in-game player on a computer is different from controlling the player on console; and even more different when controlling the in-game player on a mobile phone. A player that is familiarized to playing a game on a specific platform may find it difficult and frustrating to play the game on a different platform, which may lead him to stop playing the game.

The *platform setting* is in many cases conditioned by the *ambient setting*. The ambient in which a player will play a game will ultimately define and limit the platform that can be used. For example, an *ambient* characterized by playing on the bus on the way to work suggests the *platform* in this scenario will likely involve a mobile phone, a handheld game console, tablet or laptop computer. However, the likelihood of playing on a console or computer is unlikely. Succinctly, all acts of video game playing are bounded within a *gameplay situation* that considers both the *ambient* the player finds himself in, and the *platform* being used to play. The *gameplay situation* is exterior to both the game and the player, although the player is normally free to select the *platform* that will be played and, in some cases, the *ambient* in which the game is played.

5.3.3 On 'Video Game'

The 'Video Game' element of the model consists of three main dimensions: *Mechanics*, *Interface* and *Narrative*. The summary of these three dimensions define the genre of the video game. In addition to these three dimensions, *Consistency* is also considered within video games as a bonding characteristic.

5.3.3.1 Mechanics

Video game mechanics include the goals of a game, the rules by which players play and rewards given, as well as choices given to players. In the proposed model, the *Mechanics Dimension* includes video game *goals*, *rules* and *rewards*.

GOALS

> Literature Review (Flow studies), Focus Groups

> The *goals* of a game are an inclusive term which contemplate the *objectives*, *tasks* and *challenges* a player encounters when playing. A player can only fully play the game if he knows what the goals are. Therefore, game goals should be clear. Furthermore, the difficulty of the goals is relevant and may influence the experience. An excessively easy goal may leave the player uninterested and unmotivated, while excessively difficult goals may frustrate the player.
>
> Once a player understands the goals that must be completed, it is important the player be informed on his progression towards accomplishing those goals. One way to do this is through the use of *sub-goals* (*e.g.* tasks, challenges), communicated to the player in the same manner as the main goal (R. Rouse, 2001). Naturally, main goals can be sub-divided into as many smaller objectives, challenges or tasks as necessary.
>
> These sub-goals are a form of *feedback*, as they guide the player in the proper direction, but also inform him he is on the proper route towards that goal. Without these sub-goals that help the player maintain course, he may lose track and become frustrated (R. Rouse, 2001). Additionally, the execution of these sub-goals should be rewarded, just as the main goal would be, but with a reward of proportional dimension.

Figure 24 is a representation of the *Goals* characteristic and respective relationships with other elements of the model (*ability*, *rewards* and *feedback*).

Figure 24: *Goals* characteristic and respective relationships
(*Mechanics* Dimension, *Video Game*)

RULES
> Literature Review

Of all video game related characteristics, *rules* are arguably the most significant. In a formal manner, *game rules* are *"an imperative governing the interaction of game objects and the possible outcome of this interaction"* (Egenfeldt-Nielsen et al., 2008, p. 100). As previously explored (*cf.* Rules, *p. 30*), game rules have been interpreted according to several views (Caillois, 2006; Egenfeldt-Nielsen et al., 2008; Frasca, 2003; Juul, 2011; Salen & Zimmerman, 2003). While players will debate how rules limit the enjoyment of a game, some authors (Salen & Zimmerman, 2003) believe that an indispensable quality of rules is that they necessarily limit players' actions.

REWARDS
> Literature Review, Focus Groups

When a player completes game goals, specific objectives, tasks or challenges, *rewards* should be given to the player. *Rewards* can come in the form of lives, money, or objects which can be used throughout the progression of the video game, for example. Rewards can vary in multiple ways and should be adapted to specific situations. Furthermore, there should balance between what a game requires from a player and how the game rewards that effort. Also, this balance is importance given the expectations players may form on the rewards given for completing specific goals.

Figure 25 is a representation of the *Rewards* characteristic and respective relationships with other elements of the model (*goals*, *ability* and *expectations*).

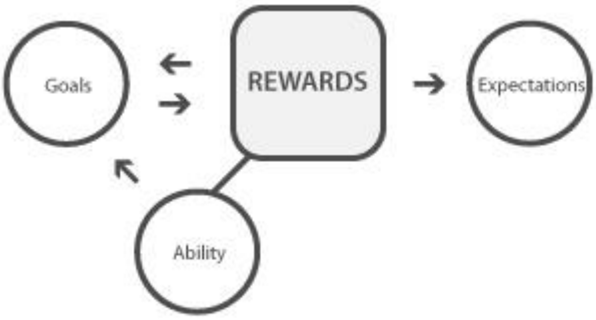

Figure 25: *Rewards* characteristic and respective relationships
(*Mechanics* Dimension, *Video Game*)

5.3.3.2 Interface

The interface of a video game is the most visible of game components. The interface is what players see and hear; it may be how they feel (the aesthetics, according to Hunicke *et al.* (2004)) and how players interact with a game (Takatalo *et al.*, 2010). In the proposed model, the *Interface Dimension* includes video game *visuals*, *audio*, *input* and *feedback*.

VISUALS
> Literature Review, Focus Groups

The *visuals* of a game are related to how the game *looks* (*cf. p. 32*). Video game visuals can be two (2D) or three-dimensional (3D); they can be more or less similar to the real-world and real-world objects or stylized according to a certain theme. Also, the gameplay experience model considers the visuals to be related to both the *space* in which all the action takes place, as well as the additional layer of information found within many games – the *Heads-up display* (HUD) – a primary source of information, conveying feedback to the player. While video game visuals have been given a growing importance throughout the years – due to diverse progressions in technology – the importance of game visuals depends on players' preferences and the game itself.

Almost all games today are bounded by a visual component, developed to a greater or less extent, more or less a copy of the *real world*, more or less capable of making the player feel he is an actual part of the game. However, a more enjoyable experience will commonly require motivating *goals*, clear *rules* and balanced *rewards*. A player may be seduced by the beauty of the game, but if it isn't *consistent*, be lost within the confusion of its mechanics.

AUDIO

> Literature Review, Focus Groups

The audio component of a video game refers to its various *sounds*, *sound effects* and *music* (*cf.* Audio *p. 35*). The audio is a video game characteristic which may be considered second to the visuals of a video game in importance. Nonetheless, it is comparable in terms of importance in creating an atmosphere and for player feedback (Rollings & Adams, 2003).

Audio has always been an important characteristic of video games. Either through specific sounds or music, the audio component contributes to the way in which players' experience a video game. While no hierarchy can be established regarding the importance of these sounds and music in a game-context, sound effects are one type of audio common to almost all games, and play a valuable role in each. A video game's sound effects can have multiple uses and will vary from genre to genre and from game to game. Specifically, one function of sound effects is to *communicate* some type of information and offer *feedback* regarding a player's actions in the game world.

INPUT

> Literature Review, Focus Groups

The *Input* of a video game (*cf.* Input, *p. 37*) relates to how players physically interact with a game through technological support: using a keyboard and/or mouse, a joystick, a gamepad, direct interaction with a device, or even through physical movements which are captured by additional devices. The input system of a game should be seamless and designed for a player to be able to control and understand the game effortlessly. An input system which is well designed can be an important factor in creating a satisfying experience, where a player feels the input process is something natural. Recalling, Rouse (2001, p. 136) states, "*nothing is more frustrating than, as a player, knowing exactly what you want your game-world character to do but being unable to actually get him to do that because the controls will not let you.*"

Successful input design can easily lead to better experiences. Many video games of a similar genre will commonly use a similar input design which a player will easily learn, and posteriorly use in future games. As a result, when playing a specific genre, players may form *expectations* in terms of the input for that game. Furthermore, some input designs are rooted within players' memory (*knowledge*) and become a personal preference when playing. Lastly, players' *abilities* can influence their experience, depending on their capacity to interact with a game.

Figure 26 is a representation of the *Input* characteristic and respective relationships with other elements of the model (*ability*, *preferences* and *expectations*).

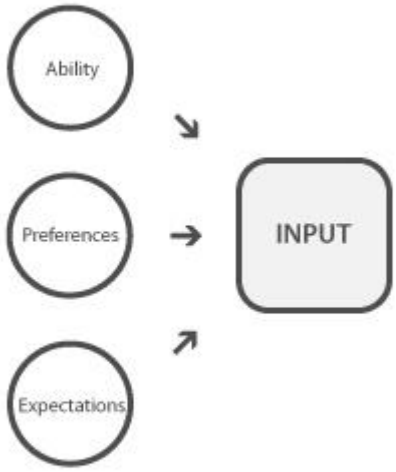

Figure 26: *Input* characteristic and respective relationships (*Interface* Dimension, *Video Game*)

FEEDBACK

> Literature Review (Flow studies), Focus Groups

Feedback can play an important role in creating and maintaining a satisfying gameplay experience (*cf.* Feedback *p. 38*). Equally important as being able to *control* and take *action* on the game world, is the response (feedback) to these actions. A well designed output system which communicates essential information to the player is important for a good experience (R. Rouse, 2001). The depth, relevance, quantity and type of feedback (*i.e.* visual, audio) may vary from game to game but is, nevertheless, important in maintaining the player conscious of his progression, his current state or other valuable information (depending on the type of game being played).

Rouse (2001, p. 141) indicates that feedback should always be present and players should not have to guess about their actions. While it is impossible for a game to inform on everything and for a player to deal with all possible game related information, a game "*must communicate what is reasonable for the player's character to know, and communicate that data effectively*" (R. Rouse, 2001, p. 141).

5.3.3.3 Narrative

In the proposed model, the *Narrative Dimension* is a self-inclusive dimension, including the single characteristic of *narrative*.

NARRATIVE
> Literature Review, Focus Groups

> The narrative of a video game – defined as a "*succession of events*" (Egenfeldt-Nielsen et al., 2008, p. 172) and consisting of various components – can be one of the most important factors of the experience of playing video games. While not all games have a specific narrative element, all video games can tell a story. The complexity and extent of the story depends on the game and its underlying genre. For example, an adventure game can be the actual story, while in other situations; the player creates his own story while playing.
>
> *Narrative* refers to the *noninteractive* part of the story told (by the author and designer) to the player. In turn, storytelling is an element of the narrative which can be divided into several categories (Egenfeldt-Nielsen et al., 2008) related to multiple aspects of the narrative, including the mechanics and game space (*cf.* Narrative, *p. 40*).

5.3.4 On 'Consistency'

In the proposed model, *consistency* is a characteristic which serves to agglutinate the three main video game dimensions of the model (mechanics, interface and narrative).

CONSISTENCY
> Literature Review (Immersion studies), Focus Groups

> *Consistency* is a characteristic transversal to the three other main dimensions of the *Video Game* element of the model, referring to the harmony and balance established between the dimensions (*Mechanics*, *Interface* and *Narrative*) and respective characteristics. The consistency of a game is what makes it a solid and enjoyable product, rather than a sum of various unrelated parts.
>
> Consistency can be applied and analysed independently for many of the characteristics of the model, or serve as a bridge between two or more characteristics. For example, the mechanics, interface and narrative of a game are three key factors in the process of game design. A game with a lack of consistency between these three distinct but complementary areas can still be played, but is likely to cause confusion, feel inadequate or incomplete; possibly creating a sense of frustration in the player.

Consistency is fundamental in specific characteristic such as *goals*, where players expect to encounter goals to complete the game and to avoid losing track of their progression. Additionally, increasingly difficult *tasks* and *challenges* create a sense of evolution, where more complex goals require more *effort*, *attention* and even *ability*. If a game fosters this type of evolution, and suddenly breaks this type of consistency, a player may easily become frustrated. The same is applicable with *rewards*. Independently of the *reward* given, if a game offers certain rewards for completing tasks, the game should do this consistently as it will be expected.

The consistency of game *feedback* – both visual and audio – is also important, as it is a primary means of information for the player regarding his progress within the game. As occurs in 'real life', feedback is important as it gives us information regarding on the outcome of our actions. Within the game, when a player is executing actions to complete a specific goal, feedback is important to keep the gamer on the right course. Specific actions within a game should trigger specific feedback and this convention should be constant. If this convention is suddenly broken during the game, a player may possibly lose the feeling of having control over the game. Independently of the game being played, consistent feedback is primary for *motivation* as well as keeping the players *attention* on the goals of the game rather than why the game did not reply to his actions.

Consistency with games can also be an important factor in the experience a player has, because of the *expectations* created based on the players' background. Considering a traditional card or board game adapted into a video game, the players' knowledge of the 'traditional' game objectives and rules will create certain expectations for the video game. If a lack of consistency in terms of these characteristics between the 'original' and 'digital' version of the game is verified, the player may not enjoy the game. However, it is plausible that differences may render a feeling of enjoyment for the player, if he is pleased by the differences between the two versions of the game.

5.3.5 On 'Player'

Video game players are an extremely diverse demographic. There are male and female players, older and younger players; and players with specific video game preferences, experience with games, expectations and motivations to play. This multiplicity of variables defines a specific player profile. In the proposed model, the Player element is grouped into three dimensions: *Background*, *Investments* and *Anticipations*.

5.3.5.1 Background

The players' background is a decisive factor in how he will experience a game. The player's background will determine what preferences he might have for games and his abilities to play games based on a history of playing a certain genre. In parallel, a player's knowledge may play a role in how he experiences the game, because of connections made or because of past experiences that are useful during the act of play. In the proposed model, the *Background Dimension* includes player *preferences*, *ability* and *knowledge*.

PREFERENCES

> Literature Review, Focus Groups

Preferences (*cf.* Section 1.5.2, *p. 47*) deal with the various aspects of video games which players enjoy the most. Preferences may be related to game *platforms*, game *genres*, game *visuals*, or others. Commonly, players' preferences are formed based on past experiences with other games, conditioned by the various video games, genres and style of gameplay enjoyed most and least. Recalling the thoughts of Zammitto (2010, p. 20), "*gaming preferences is a proposed construct for referring to the aspects of video games that players enjoy the most.*"

Players' preferences can also be manifested based on the types of game genres enjoyed the most. While some players will only enjoy a single game genre, others will enjoy and be motivated by many game genres. Furthermore, players' preferences will also manifest in the type of behaviour they may exhibit during gameplay, assuming a specific style of play (Bartle, 2006; Bateman & Boon, 2006).

ABILITY

> Literature Review (Immersion & Flow studies), Focus Groups

Abilities refer to a player's collection of learned skills: motor, cognitive or perceptual (Mackenzie, 2001). As previously explored (*cf.* Ability, *p.* 51) players may have and demonstrate *motor* skills in the effortless use of game controllers; *cognitive* skills in thinking about and resolving game situations; and *perceptual* skills when perceiving and interpreting information resulting from the game.

All video games provide goals a player must complete using their abilities. In some games, a player will start playing with the necessary sills to complete the game goals. In some cases a player will not have sufficient abilities (skills) to play and complete the challenges which can lead to a state of anxiety – according to the Flow theory (Csíkszentmihályi, 1990). To compensate and offer a learning period, some games offer tutorials in order to teach players how to do specific actions. As Sweetser & Wyeth (2005, p. 7) suggest, "*for games to be enjoyable, they must support player skill development and mastery*". As a result, games that provide more satisfying experiences may be those which provide incrementally challenging goals and require increasingly more skills from the player. This is important because it allows players to develop and master skills without becoming rapidly frustrated with the game.

KNOWLEDGE

> Focus Groups

Through the act of play, and while forming *preferences* and *abilities* for and in games; a player also creates *knowledge*. All players have knowledge about an unlimited number of things which can be applied in diverse gaming scenarios. Players' knowledge is formed from real-world scenarios, but also formed and complemented with new knowledge gained from playing other similar video games.

While a player's knowledge may not be vital in defining the quality of their experience, it can contribute towards it. Some games, especially those based on 'general knowledge', are games which require knowledge regarding multiple areas: culture, sports, history, geography or other topics. A gamer that plays these 'knowledge-based' games is more likely to enjoy the experience considering they may have existing knowledge to solve the questions or puzzles that arise in the game.

5.3.5.2 Investments

In the proposed model, the *Investments Dimension* refers to the various conditions a player must offer and dedicate while playing in order to engage in a satisfactory manner with the game. These conditions may be related to their motives of playing, the time they're willing to play, or the extent to which the player will work hard to succeed. In the proposed experience model, the *Investments Dimension* includes *motivation*, *attention effort*, *time*, and *connection*.

MOTIVATION

> Literature Review (Flow studies), Focus Groups

Motivation refers to the single or multiple incentives for players to initially play a specific game. Secondly, depending on the type of video game, players' *motivations* can influence how they play, why certain choices are made during the act of game play and in the game environment; how and why players interact with game objects and other characters (playable and non-playable); among others. Players' motivation(s) can influence their actions in the game and willingness to play. Non-motivated players will unlikely have a satisfying experience.

Of all possible motivations to play, Crawford (1984, p. 17) suggests that the *"fundamental motivation for all game-playing is to learn."* A player's motivation during the game is influence by several aspects of their background (*cf.* Section 5.3.5.1, *p. 165*). A player which prefers a specific game genre will be motivated to play games of that genre. Also, players that find a game which challenges their abilities will more likely be motivated to play.

ATTENTION

> Literature Review (Immersion & Flow Studies), Focus Groups

Attention is an inclusive term for a number of concepts (*e.g.* concentration, focus, loss of self-consciousness) presented in a diverse number of experience related studies (Brown & Cairns, 2004; Csíkszentmihályi, 1990; Sweetser & Wyeth, 2005). *Attention* is used by several authors to describe a state in which player's place all their cognitive and/or physical effort on a specific game goal, an objective or challenge.

Experience related studies Brown & Cairns (Brown & Cairns, 2004; Csíkszentmihályi, 1990; Sweetser & Wyeth, 2005) suggest that for a player to become increasingly immersed, they must gradually invest more attention while playing a video game. However, even if a player has all his attention on the game, this does not guarantee that his experience will be better. Still, a game can still be enjoyed without the player having to be completely focused and concentrated on the game, and completely abstracted from the world.

Attention can be associated to the characteristic *ability*, also present in the model (*cf.* Section 5.3.5.1 – Background*, p. 165*). In some situations, a goal which requires great skills will lead the player to focus all of his attention in the activity and become absorbed by the same activity.

EFFORT

> Literature Review (Immersion studies), Focus Groups

Effort refers to the investment and energy a player makes towards the game or learning to play. A player willing to spend great effort in the game is more likely to have a more satisfying experience. However, this is not guaranteed. A player may invest all his effort and use all his available skills; but if the challenges the game provides require more than what the player can offer, the quality of the experience may be at stake.

Studies related to the experience of immersion suggest that *effort* and *rewards* are also connected (Brown & Cairns, 2004). When a player invests great effort into the game and its goals, he *expects* to be equally rewarded for his effort. When a game rewards a player in equal manner, it creates a sense of satisfaction within the player; a feeling that the player's efforts were worthwhile.

TIME

> Literature Review (Immersion & Flow studies), Focus Groups

Similar to effort, a player must be motivated and willing to invest his *time* towards the game. In any type of context and situation, a player will begin to play a game either with a defined or undefined time limit. For example, a player riding to work on the train will know that he only has 20 minutes to play; however, a player at home may have unlimited time to dedicate to the game.

According to Brown & Cairns (2004), the possibility of a player entering an immersive state is highly dependent of the time a player invests in game, in addition to the referred characteristics of *attention* and *effort*.

From the perspective of *Flow*, when a player is able to invest an unlimited amount of time into an activity – in this case, playing a video game – a player's sense of time can become altered. There are several cases in which a player begins to play a game and, without perceiving it, long minutes or hours have passed, while thinking such was not the case. A player's losing track of time is an indication of the amount of attention a player dedicated to the game. Rarely will a player lose track of time if he has not been in a state of deep attention where the outside world was disregarded and the only focus of attention was the activity of playing the game.

CONNECTION

> Literature Review (Immersion studies), Focus Groups

A final characteristic framed within the *Investments* Dimension is *connection*. *Connection* is a term appropriated in this model to refer to the possibility of a player emotionally and mentally connecting to the game or its characters, which is likely to result in an enjoyable experience.

Because each player is unique, becoming connected with a game can be different and have diverse origins. Because emotions differ for each player, the way through which players become connected will be different. Therefore, becoming connected – or establishing a connection – doesn't imply falling in love or hating a character. Connection comes from the player identifying (*i.e.* connecting) with some aspect of the game. A connection can result, for example, from the music score that runs in the game background and reminds us of a favourite composer; from an advertisement embedded into the game scenario that makes us laugh; a drawing found in the game that we find appealing; or driving in a racing game, in a city that we desire to visit.

Not all games are capable of offering the possibility of connection. Many mobile games are normally fitted with quick goals and challenges and do not offer such a possibility. However, other game genres, mainly those with a greater complexity such as role-playing games, adventure games or action games, are more likely to create a connection. In such game genres, depending on what game characteristic triggers the connection, the time a player is willing to dedicate to the game may be important. In a case where connection occurs through identification with another character, this may not occur right away (as could occur through connection via music, for example). In a game driven by a rich narrative, only after the player learns about the characters can he eventually identify with their situation and form an emotional connection which can positively influence their experience. As a result, the chance of becoming connected will require additional time from the player.

Within immersion related studies, Brown & Cairns (2004) apply the term *empathy* which is related to connection. A player can enter a state of full immersion if he is able to feel emotionally attached with a game.

5.3.5.3 Anticipations

A player's anticipations regarding the game are formed prior to playing as well as during game play. Before beginning a game, players have certain expectations on what the game will be (related to the characteristics presented in the *Mechanics*, *Interface* and *Narrative* Dimensions) and the type of actions they'll be able to perform within the game. Furthermore, they form anticipations regarding the effect of these actions. In the proposed experience model, the *Anticipations Dimension* includes *expectations*, *actions* and *control*.

EXPECTATIONS

> Literature Review (Immersion studies), Focus Groups

Expectations refer to the collection of *things* a player anticipates and hopes to find in a video game (*cf.* Section 1.5.3 – Player Expectations, *p. 54*). However, a player's experience can be satisfying even when certain expectations are not met, if what the player finds is enjoyable. *Expectations* can be made regarding the game as a whole; specific rules or goals; the feedback or the audio and visuals of a game.

Rouse (2001) presents a list of several items regarding where players place their expectations when playing a game, including: a consistent world; direction; expect to fail; to be immersed; and to do something. Related to the gameplay experience model, a player has and forms expectations for a series of model characteristics, such as: the type of feedback given during the game, also expecting that it is consistent; has expectations for the goals of the game, based on his background; expectations in terms of the actions and control of the game.

Figure 27 represents the *Expectations* characteristic and respective relationships with other elements of the model (*feedback*, *goals*, *actions*, *control* and *consistency*).

Figure 27: *Expectations* characteristic and respective relationships
(*Anticipations* Dimension, *Player*)

ACTIONS

> Literature Review (Immersion & Flow studies), Focus Groups

As previously explored for the *expectations* characteristic, *actions* can also play an important role in the quality of a player's experience. Summarizing the ideas of McMahan (2003, p. 68), "*the user's actions must have a non-trivial impact on the environment*". In other words, when playing a video game, a player's *actions* within the game environment should have some finality and be consequential; a player's actions should have some effect on the environment as well as how the game unfolds. Furthermore, a more enjoyable experience will likely occur when a player feels he is responsible – through his actions – for what is going on in the game.

Related to the model, both the *goals* (*cf.* Goals, *p. 159*) and *rules* (*cf.* Rules, *p. 160*) of a video game will mould a player's liberty of actions. Specifically, a player can only *do* what the game allows him to do, but should ensure what that possible actions have some value to the game's progression. Still, and intimately connected actions, is the characteristic of *feedback* (*cf.* Feedback *p. 163*). As previously explored, the quality of a game's feedback may influence how a player perceives the impact of his actions. Unperceivable or inexistent feedback may lead the player to believe that his actions have no specific finality. Lastly, once a game establishes a type of feedback associated to a determined action – forming specific *expectations* within the game – this *action-feedback* association should remain *consistent* throughout the game.

CONTROL

> Literature Review (Flow studies), Focus Groups

Control is a model characteristic rooted within the *Flow* theory (Csíkszentmihályi, 1990) and applicable in a video game context. In a broad sense, *control* relates to the possibility of being in a situation where there are no preoccupations regarding the outcomes of one or more *actions* (*cf.* Actions, *p. 171*). As a result, players can face the video game without worrying about the outcome of their actions, or whether or not someone will get hurt by those actions. A video game should provide players with control over the game, rather that providing a sense of being controlled.

5.4 A Reflection on Communication Theories in the Gameplay Experience Model

Recalling the multiple communication theories previously presented (*cf.* Section 4.3 – Selected Communication Theories, *p. 122*), many of the considerations embedded within these theories are transversal to the proposed model. The reflection on how these theories are present in the model is valuable. The selected communication theories can help in understanding individual and group behaviour, and explain why individuals act and make certain decisions in a variety of contexts. The appropriation of these theories can help explain and justify the inclusion of many characteristics in the model, by reflecting on player behaviour and reasoning within a game context.

Therefore, considering the widespread applicability of communication theories, these theories in particular help describe various particularities of the model, essentially related to video game players, and how they are shaped before and during the act of game play.

5.4.1 System Theory

Within the *System Theory* (*cf.* Section 4.3.1, *p. 122*), the topic of *Cybernetics* (*cf.* Section 4.3.1.1, *p. 122*) is recalled. Based on the ideas of cybernetics, the gameplay experience model presented here can also be considered a system. Considering Alain Birou's definition – as presented by Silva (2010, p. 2) – a model is *"a physical, mathematical or logical system, which represents the essential structures of a certain reality and is capable of dynamically explaining or reproducing how those structures work."* With this model, it is possible to analyse each element and characteristic individually, but it is equally important to consider how these interact with other system elements. For example, the *goals* (*Mechanics* Dimension) of a game can be analysed and discussed independently, but eventually, further analysis requires that connections and references to other model characteristics be made. As a result, the gameplay experience model presented can be characterized by multiple relationships established between its consisting parts.

Furthermore, as the *cybernetic tradition* refers, a system can only persevere pending its openness to other resources in the form of inputs. Through the *player* – a key factor in the gameplay experience – the system is in constant growth due to players' openness to the exterior. A player is open to constant change, with a changeable *background* in terms of *preferences* and *abilities*, possibly leading to changes in *investments* and *anticipations*. In turn, a system may absorb these inputs, process them and create output. In this scenario, the input of the system can be related to the *interactive* experience while the output can be considered the *emotional* experience: the collection of feelings resulting from playing.

Additionally, systems are also characterized by self-regulation and control in order to remain stable and achieve goals. Here, *control* and *goals* should not be confused with the model's *control* and *goals* characteristics. Rather, the *video game* element of the system is essentially regulated by its *mechanics*. The *mechanics*, namely the *goals* and *rules*, serve as a form of controlling how the system maintains its stability. The lack of *goals* and *rules* will turn the game into a simple 2D or 3D environment where action can take place but without finality. The presence of *goals* and *rules* within the system defines how the game works and how the other component of the system – the player – should interact and establish relationships with the game.

While a system seeks balance, the fact that this gameplay experience model is also a dynamic system implies game goals and rules can be bent. In such a case, the goals of a game may not be completed, but the output in terms of the gameplay experience may still be positive.

Cybernetics also focuses on *feedback* loops and control processes, while rejecting linear relations within a system (Littlejohn & Foss, 2007). Within the model, *feedback* is also considered as a characteristic which bonds many of the other model characteristics. As introduced above, *feedback* is the "*transmission of the receiver's reaction back to the sender*" (Fiske, 1990, p. 21). Applied to this model, the 'sender' can be considered the *player*; the 'receiver' as the game; and feedback the transmission of the game's reaction (information about the player's actions) back to the player. During gameplay, a player *sends* his 'intentions' of interaction to the game and will commonly expect information about his interaction. The game (receiver) reacts to these interactions and provides information (feedback). As a result, this feedback allows the player to adjust his actions in the game just as a communicator would adjust his performance to the needs of a certain audience.

Furthermore, as occurs with human communication – where several channels can be used for feedback – the game can use multiple channels for feedback, namely *visual* and *audio* channels. Independently of the channel used, *feedback* is essential in order to guarantee that players are aware of their progress and the outcome of their actions, creating conditions for players to adapt – if desired – their actions and successfully complete the goals. As would occur with human communication, the lack or inexistence of feedback would leave a communicator unable to understand the effect of his message on the audience. In the game, without feedback, players would be unaware if their actions had an effect on the game; players could enter a state of continuous guessing on the outcome of their actions which could distract them from their primary intention of completing game goals. *Feedback* in a game keeps players informed rather than lost and unaware, which can eventually lead to a state of anxiety and frustration and ultimately, lead players to giving up and quitting.

5.4.2 Theories of Message Reception and Processing in the Model

Within the theories of *Message Reception and Processing*, the model considers specific theories on *Message Interpretation*, *Information Organization* and *Judgement Processes*.

5.4.2.1 Message Interpretation

Looking at the ideas of *Message Interpretation* (*cf.* Section 4.3.2.1, *p. 123*) in the proposed model, considerations explored related to the *knowledge* characteristic are recalled. A player's *knowledge* is his repertoire of information collected through the years, which may or not be related to video games. During this time, an individual will create a repertoire of information and in their day-to-day interactions, will normally respond to incoming stimuli according to their knowledge of that stimulus and the meanings they have formed. In a player's knowledge data base, commonly one will associate, for example, blood on the floor to someone being hurt; and sirens and high-pitched noises to danger.

These associations are transported into the act of game play because they are part of the player. However, these associations are only possible because the game itself communicates with the player in a way that the player can establish these meanings. In a game scenario, if the intention of the game is to create a sense of danger and that 'something bad happened' or 'is about to happen', than the game will use these connotations that are shared among many people. A player will play the game, enter that particular environment, and be able to understand the particular relationships the game intends to communicate. The game, therefore, is consistent with its 'real-life' counterpart.

The importance of *relevance* is also worth mentioning, as is the importance of context and an individual's cognitive environment. Once more, a player's knowledge and ability to interpret the information that he finds in the environment are valuable not only to be able to advance in the game, but also incorporate and live the situation, enhancing the experience of playing.

5.4.2.2 Information Organization

Within the theories of *Information Organization* (*cf.* Section 4.3.2.2, *p. 124*), the *Information-Integration Theory* emphasizes the importance of *attitudes*. While the presented gameplay experience model does not directly refer to attitudes, when a player begins playing a game, he does carry attitudes into the act of game playing. Considering attitudes are a collection of information about – in this case – an object, namely a video game, the value of this theory can be further analysed. In any situation, a gamer will begin playing a game with a formed attitude – a set of information regarding the game based on his background (the knowledge formed from previous games) or from reading, seeing or hearing information from other communication sources (websites, forums, magazines, interaction with friends and other players).

To exemplify, consider a player who is waiting to play the latest game from a particular video game franchise. The player will have a formed attitude based on his expectations for the game and his memory of past games of the franchise. However, through additional information sources, the player will possess new information about multiple game aspects: the game's mechanics, the quality of the visuals, the gameplay or others. The *valance* of these additional information sources may be positive or negative if they reinforce or weaken the player's expectations and motivations to play the game. Furthermore, the player can attribute a specific importance – *weight* – to the new information received. Continuing with the previous example, we can again consider a player that has recently bought the latest game of a game franchise. The player will likely be motivated to play and have high expectations because of the franchises' past success. However, in conversation with friends that have already played the game, the player hears that the game has a poor gameplay, and reads in a magazine the same opinion. If these friends are also avid players and have extensive knowledge about games, this information may negatively affect the player's initial attitude towards the game. Furthermore, the fact that additional information sources (*e.g.* game-related magazines) corroborate his friends' ideas gives greater weight to the information. On the other hand, if his friends have never played a game from the same series, he may assign no weight (importance) to their information and his attitudes may remain unaltered. This theory is important in showing how new information can alter a player's attitude towards a game, which can ultimately define the type of experience a player collects from the game.

Still within *Information Organization Theory*, the *Consistency Theory* is also present in the model. *Consistency* within the gameplay experience system can be seen in the comparable characteristic of 'consistency'. Within the model, consistency refers to the harmony that bonds all of the game related characteristics, enabling a balanced game rather than a summary of multiple game parts. The perception of a game's consistency is of the player's responsibility. Each player will interpret the game according to his own knowledge and expectations. If the player feels the game lacks balance or is dissonant (inconsistent) he can either quit playing, or feel the need to change the game subsystem. As a result, he may adapt the goals and rules of the game to meet his expectations and create a modified sense of balance, enabling a more satisfying experience. However, because the game subsystem is essentially stable, the player is unable to definitively avoid and eliminate the dissonance that is felt (which counters the second premise associated to this theory).

5.4.2.3 Judgment Processes

Within the *Judgment Process* theories (*cf.* Section 4.3.2.3, *p.* 125), the *Elaboration Likelihood Theory* can also be applied to several game scenarios. In many situations, a player finds himself confronted by information on which he must reflect and posteriorly use. Many games of different game genres will present information in different ways about the player's state in the game, his progress or other contextual information. Strategy games, sports simulators or role-playing games are examples of games where the way in which a player thinks about the information the game provides is decisive. In many role-playing games, for example, a player must look at the information present in the game world and interpret it. A player that is highly motivated will be more likely to pay more attention to the information and use a central route to process it.

The possible attitude change that results from this option can be related to the more adequate selections based on a correct use of the information that was given. A further interpretation of this theory in a game scenario is related to a soccer simulation game. When playing, the game is constantly changing in terms of the players' (virtual) positions on the field. The player has to take this information and interpret it to be able to complete the objective of scoring goals. A highly motivated player and with greater abilities will have the capacity to make more adequate choices to pass his opponents and score the necessary goals.

Regarding *Expectations-Violations* within the *Judgment Process Theory*, the ideas explored in the *Anticipations* dimension are considered. When a player starts playing, he has a series of anticipations for the game he is about to play, related to both the game itself (*expectations* characteristic), as well as what he may be able to do within the game (*actions* and *control* characteristics). While a player has certain expectations for a game that he looks to be fulfilled, if his expectations are not met, two things can occur: the player can become frustrated, lose motivation and quit the game; or, accept the *violation* of his expectations and be motivated by the differences (in relation to his expectations) the game offers.

Exemplifying with a hypothetic scenario, and looking at a shooter game, traditionally when an enemy is shot (one or more times), he is *eliminated* from the game. However, if a specific game decided that when shooting enemies these grew stronger rather than dying – therefore going against the players expectations because the game mechanics differ from traditional shooters – than the player could potentially not enjoy this novelty and lose motivation. However, another possibility – and considering the ideas of the theory – the player could be motivated by this new game approach and become more interested in playing the game. The player could find motivation in seeking new alternatives to eliminate the enemy, different from those found in traditional shooters. Therefore, although his expectations were not met, the differences found within the game drew the player's attention in a positive manner and gave way to a possibly satisfying experience.

5.4.3 The Communicator

Regarding theories on *The Communicator*, the model considers *Trait Theories* and more specifically, *Trait-Factor Models*.

5.4.3.1 Trait Theory

Related to the *Trait Theory* (*cf.* Section 4.3.3.1, *p. 126)*, the *Trait-Factors Models* identifies five traits which, when combined, can determine an individual's specific traits. These five general traits can also be linked to some of the player types explored in the *preferences* characteristic of the model. An individual which reflects both 'extraversion' and 'agreeableness' traits is likely to be a *Participant* (Bateman & Boon, 2006) or *Socializer* (Bartle, 2006) type player because of the importance they deposit in social relations and being on good terms with other individuals. An individual which has the traits of 'openness' and 'conscientiousness' may likely be a player that is a *Wanderer*/*Explorer* (Bartle, 2006; Bateman & Boon, 2006) as well as an *Achiever* (Bartle, 2006) because they care for using their imagination, reflecting on their choices while completing the goals of the game as well.

Therefore, the traits which influence and modify the communicative individual can also be a reflection of the video game player. Considering a trait is a consistent way of thinking and behaving, these traits reflect upon a player's preferences, which will commonly be consistent. An individual who enjoys socializing with other players will commonly prefer games with a social nature and component. An individual who enjoys thinking and reflecting will commonly prefer strategy games or games of knowledge. Therefore, an individual's traits will commonly reflect their preferences for a game and how he interacts in the game.

This line of thought can also be applied to game development, where many games are developed and include gameplay which attracts certain types of traits. A shooter game includes *goals* and *challenges* designed to attract, for example, an individual with conscientiousness traits, which reflect a self-disciplined and organized person – traits which can be important in a shooting game. Therefore, independently of the game, developers also develop games thinking about the player which demonstrate certain types of traits.

5.4.4 Communication and Media

Regarding *Communication and Media*, the proposed model references *Theories of Individual Outcomes*.

5.4.4.1 Theories of Individual Outcomes

Theories of Individual Outcomes (*cf.* Section 4.3.4.1, *p. 126*) consider the *Uses, Gratifications and Dependency Theory*, which is also present in this gameplay experience model. Video games are clearly, nowadays, an interactive and dynamic media, capable of being interacted with, and allow players to primarily assume an active role rather than passively visualizing its contents. In fact, this is what differs video games from many other media types: the possibility of controlling (even if slightly) the progression of the media. Naturally, the *goals*, *rules* and even the *game space* will limit the extent of players' interaction, but nonetheless, they are still an active participant.

The gratifications an individual – or player – seeks from a video game are tightly coupled with several of the player-related characteristics explored in the model. We have explored how attitudes are formed from – but not limited to – a player's background. Players' *background* defines their gaming *preferences*, their *motivations* to play and their *anticipations* for a certain type of game. Therefore, when playing a game, the gratifications players seek from playing is built upon their *background*, as well as their beliefs – *motivations* and *anticipations* – on what the game can offer.

Exemplifying, and as explored in the model, one particular anticipation – or gratification – can be related to *control*. Many games from different video game genres offer several possibilities of control. If a player feels that a shooting game can create a feeling of war that he desires to live, he might play a shooting game from the 'Call of Duty' or 'Battlefield' series; if a player thinks that playing a flying simulator will approximate him to the dream of flying, he'll play 'Microsoft Simulator' or a similar game; if a player thinks that a racing game will build the feeling of adrenaline felt in a Formula 1 race, he'll play a corresponding racing simulator game. The gratifications a player seeks from games will be coupled with his preferences and real-life motivations.

Of course, in line with the theory, if the experience with playing these games does not feed the gratifications that are sought according to the player's evaluations, than player gratifications can be ultimately modified because a player's attitudes and beliefs are changed. For example, a player that seeks gratification with a shooting game may find it excessively violent. Posteriorly, this evaluation will affect his attitudes and beliefs, and may lead the player to stop seeking this particular gratification. Figure 28 represents the cyclical process which is formed related to the gratifications a player seeks and the gratifications obtained.

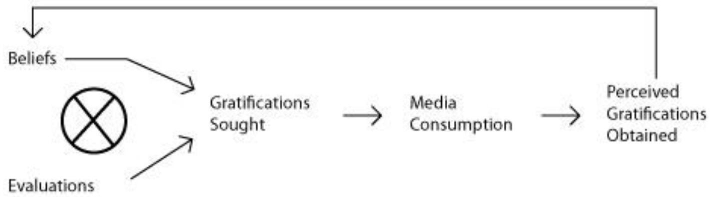

Figure 28: Representation of the 'Expectancy-Value Model of Gratifications Sought and Gratifications Obtained'[31]

Considering 'X' the media being *used* – in this case, *video games* – an individual's previous evaluations and beliefs will determine the gratifications that are sought from playing games or a specific type of game. During the act of game play (media consumption) we perceive a series of gratifications which are interpreted, analysed and evaluated; eventually altering the beliefs. Posteriorly, the gratifications we seek from a particular game can change through time. Eventually, a player may ultimately stop playing a game if he believes he gains nothing from it because of the beliefs formed about that particular game.

The *Dependency Theory*, also part of the Theories of Individual Outcomes, is also present within the model, mainly in player-related characteristics and those related to the *Background* and *Investments* Dimensions. Considering the video game media in this analysis, players do not *depend* on all video games in the same way. The same can be said for the platforms on which video games are played (consoles, computer, mobile devices or others) as well as platforms (forums, blogs, specialized websites) through which players collect information and communicate with other players about games.

Considering the first factor related to the dependency theory (*i.e.* an individual becomes more dependent of media which meet a larger number of needs than just a few needs), a player which is deeply interested in sports, may be dependent on playing all variety and available sports games so his needs for playing sports are satisfied. This *dependency* may lead a player to explore and invest in various types of platforms, such as buying and playing the games on a computer, on a console or other. If a player finds gratification from games that are focused and promote a social context – online (*e.g.* any number of games that can be played on Facebook) or standalone ('The Sims') – he may become dependent and play a large number of these games; look to make new friends which share this dependency, actively participate in discussions (online and face-to-face), and others.

Regarding the second factor of the dependency theory (*i.e.* dependency is influenced by social stability); a player's beliefs and attitudes about a game or specific type of game may be challenged. Consider a player which seeks gratifications and is dependent of shooter games. If in a real-life scenario a shooting occurs and the player discovers the individual responsible for the tragedy was influenced by a constant playing of shooter games; this social event may lead the player to consider his choices on video games, eventually leading him to stop playing this game genre.

[31] Image adapted from Littlejohn (1999)

Another possible example can be found with younger children and players. If within the family institution there is a belief that video games are harmful for players as they create social isolation, make players more violent or promote other effects – and this family attitude is constantly reinforced – a player which is dependent of games may begin to reconsider his choices and adapt himself to the reasoning found within his family institution. However, in this example, if a player is excessively dependent of video games, the 'valence' and 'weight' (*cf.* Section 4.3.2.2 – Information Organization, *p. 124*) he attributes to the information he receives will possibly be reduced, and therefore, his dependency may remain unaltered.

5.4.5 Culture and Society

Regarding *Culture and Society Theories*, attention is focused on the theories of *Cultural Interpretation*.

5.4.5.1 Cultural Interpretation

Considering *Cultural Interpretation Theories*, the focus here is on *Interpretative Media Studies*. Transporting the ideas embedded within this theory to the gameplay experience model, we focus on the ideas of communities and how they interpret games. Video game players form and are part of a community, even if unaware of it. Video game clans are an example of a small community which share an interest for a specific type of game, and discuss and strategize about the game.

These individuals belong to an interpretive community characterized by consuming a specific choice of content, interpret the content, and are affected by it in a similar way. However, a community does not have to be one which necessarily engages simultaneously in the same game. Any individual that participates in online discussions and establishes some form of discussion with other players using computer-mediated or face-to-face communication is also part of a community focused on games. Individuals which share this common interest also follow the three dimensions (content, interpretation, social action) which characterize an interpretive community as described by Lindlof.

When compared to a more specific type of community (*e.g.* a clan), the biggest differences may be related to the 'social action' characteristic. Here, a smaller community may be more deeply affected by this characteristic. This may be related to, for example, how the members of the community play the game. The behaviour of one or more individuals of a 'clan' community in team tournaments may affect the stability and conduct of the remaining community members. However, the conduct of individual members of a larger gaming community may be less affected by game-related consumption than in the referred case.

5.4.6 Summary of Reflections on Communication and the Model

The reflections regarding various communication theories – and how they are embedded within characteristics and dimensions of the proposed gameplay experience model – demonstrate a possible connection between two areas which have commonly been associated in other circumstances. The challenge of the previous sections resided in demonstrating that the considered communication theories can be used to analyse the dimensions and characteristics of the model, assisting in further justifying their presence in the model.

The presented discussion looks into *Cybernetics*, which focuses on the interacting components of a *system*. Equally, the proposed model seeks to show that both a video game and a player are individual systems and that the gameplay experience is a system itself, influenced by these two elements. The concept of *feedback* is also discussed, essential in any communication process and equally so in any act of play, so that the player is constantly aware of his state in the game.

Theories related to *Message Reception and Processing* are considered and discussed. Just as a regular individual receives and processes any piece of information, posteriorly acting upon it; during the act of play, a player receives information from the game and processes it. The way in which he does also depends on aspects such as his *knowledge* of video games, which can influence how the reception and processing are carried out.

Communication and Media theories are also addressed. Similar to the form in which an individual seeks certain gratifications from television or cinema, the same can be applied for video games. In any type of media, a player seeks certain gratifications which are determined by the individual's attitudes and beliefs. When playing a game, a player also has a series of attitudes or beliefs which shape his *anticipations*. Furthermore, the way in which individuals demonstrate a certain dependency for various types of media can also justify video game players' dependency of games. However, these dependencies differ in various situations and can be influenced by multiple aspects related to the manner in which information is collected regarding the game.

Lastly, little doubt resides in the idea that communication processes are central in any culture and society. Furthermore, every society is different in the way information is interpreted and meanings are attributed to what is read, viewed or heard. Once more, players are or can be part of a community with a common interest. These micro or macro-communities may play, discuss and strategize about a game. However, each community and player member may interpret the information which is shared in a different way. Again, this is due to the uniqueness of each player, his *background*, *anticipations* and *investments*.

Table 16 summarizes the various communication theories considered in the analysis, with indication of the theory considered, a brief summary of the theory and how the gameplay experience is related to the analysed theory.

Table 16: Summary of Communication Theories considered

Secondary Theories (and related Tradition[32])	Summary of respective theory	Summary of related gameplay experience model topics
Basic System Theory (*Cybernetic*)	'System' refers to a set of interacting components that result in something greater than a sum of individual parts	Similar to a system, the gameplay experience model is characterized by multiple relationships that are established between its consisting parts. A player is capable of being in constant change. Game mechanics are a form of controlling how the system maintains its stability. A game's goals and rules within the system define how the game works and how other component of the system – the player – should interact and establish relationships with the game.
Feedback Processes (*Cybernetic*)	Feedback is the transmission of the receiver's reaction back to the original sender	Applied to the present model, the 'sender' is the player; the 'receiver' is the game; and feedback the transmission of the game's *reaction* (information about his actions) back to the player. Feedback, through the use of multiple channels, allows the player to adjust his actions in the game.
Osgood on Meaning (*Sociopsychological*)	Explores how meanings are learned and how they relate to thinking and behaviour	A player's knowledge is his repertoire of information collected throughout the years. When playing, a gamer will respond to incoming stimuli according to their knowledge of that stimulus and the meanings they have formed.
Relevance Theory	Explores how listeners understand a speaker's intentions according to the 'coding' and 'inferential' model	A player's knowledge and ability to interpret the information that he finds in the environment are valuable not only to be able to progress in the game, but also incorporate and live the situation, enhancing the experience of playing.
Information Integration Theory (*Cybernetic*)	Explores how information is accumulated and organized to form 'attitudes' or a predisposition to act in a positive or negative way toward some object	A gamer will begin playing a game with a formed attitude – a set of information regarding the game based on his background or from reading, seeing or hearing information from other communication sources. However, through additional information sources, the player will possess new information about multiple game aspects which can reinforce or weaken the player's expectations and motivations to play the game.
Consistency Theories	Explores the idea that people are more comfortable with consistency than inconsistency	Within the model, consistency refers to the coherence that bonds all of the game related characteristics, enabling a balanced game rather than a summary of multiple game parts. The perception of a game's consistency is of the player's responsibility. Each player interprets the game according to his own knowledge and expectations. If the player feels the game lacks balance or is inconsistent he may either quit playing, or feel the need to change the game subsystem.
Elaboration-likelihood theory (*Sociopsychological*)	Focuses on the reasons an individual will or not be persuaded by certain messages and how received information is evaluated	In many situations, a player finds himself confronted by information on which he must reflect and posteriorly use. Many games of different genres will present information in different ways about the player's state in the game, his progress or other contextual information. A highly motivated player will likely pay more attention to available information.
Expectancy-violations theory (*Sociopsychological*)	Explores how people react when their expectations are violated	When a player begins playing, he has a series of expectations for the game he is about to play, related to both the game itself (Expectations), as well as what he may be able to do within the game (Actions and Control). While a player has certain expectations for a game that he looks to be fulfilled; if these are not met, two things can occur: the player can become frustrated, lose motivation and quit the game; or, accept the *violation* of his expectations and be motivated by the differences (in relation to his expectations) the game offers.

[32] Based on the 'Traditions of Communication Theory' presented in Littlejohn & Foss (2007)

Trait-factor model (*Sociopsychological*)	Explores the grouping of small traits (a consistent way of thinking, feeling, and behaving across situations) into a group of general traits	The various traits explored in the model can be linked to some of the player types explored in the *Preferences* characteristic of the Gameplay Experience Model. Because a trait is a consistent way of thinking and behaving, these traits reflect upon a player's preferences which will commonly be consistent.
Expectancy-Value Theory (*Sociopsychological*)	Explores how the gratifications an individual seeks from media are determined by the individual's attitudes and beliefs about a media	Video games are an interactive and dynamic media, capable of being interacted with. Video games allow players to assume a primarily active role rather than promote a passive visualization of contents. This idea is what differs video games from many other media types: the possibility of controlling (even if slightly) the progression of the media.
Dependency Theory (*Sociopsychological*)	Focuses on the idea that an individual depends on media information to meet certain needs as well as to achieve certain goals	Players do not *depend* on all video games in the same way. The same can be said for platforms on which games are played or through which players collect information and communicate with other players about games.
Interpretative Media studies (*Phenomenological*)	Considers audiences as interpretative communities, with different meanings for what is read, viewed or heard	Video game players form and are part of a community, even if explicitly unaware of it. Video game clans are an example of a small community that share an interest for a specific type of game, discuss and strategize about the game. Any individual that participates in online discussions and establishes some form of discussion with other players using computer-mediated or face-to-face communication is also part of a community focused on games.

5.5 Closing Thoughts on the Gameplay Experience Model

This chapter has described the development of a Gameplay Experience Model proposal; a conceptual framework which structures the multiple characteristics which can play a role in a two-fold perspective of the gameplay experience.

The model is built on the principle that the *Video Game* and the *Player* are two essential elements of the experience. It is the interplay of these elements – supported by several dimensions and characteristics – which define the outcome of the experience.

This model results from a lack of work which equally balances the two aforementioned elements. However, existing work on the gameplay experience (namely related to *immersion* and *flow*) was an initial starting point in the development of the model. From this initial literature review, multiple characteristics were collected, and later complemented with those gathered through two focus group sessions. From this two-stage process, characteristics related to players and video games were organized into a final Gameplay Experience Model proposal.

It should be stressed that the model seeks to portray the multiple characteristics that can play a role in the experience. It should not be considered that all characteristics are necessary for a player to feel the best possible experience. Each player is unique – framed according to the three player-related dimensions – and therefore, will make his own judgement regarding the importance of the respective video game related dimensions. As each individual and player is unique, so is their *interactive* and *emotional* experience.

5.6 Final Considerations on the Chapter

This chapter focused on the development of the Gameplay Experience model proposal central to this body of work. Posterior to the multiplicity of topics covered in the theoretical framework, specifically related to video games and the gameplay experience, a robust body of knowledge was available to construct the model.

Given the basis of the gameplay experience as presented in this work – a dynamic relation between a player and a video game – the proposed model is the result of a lack of studies which appear to equally balance both these elements.

The proposed model is the result of a two-stage process. Initially, gameplay experience characteristics are collected from a literature review, mainly focused on the concepts of immersion and flow. Secondly, two focus group sessions were carried out in order to collect additional characteristics related to video games and players to complement those initially gathered.

The proposed Gameplay Experience model is a twofold experience, such that it is both the process (related to the Interactive experience) and the outcome (related to the Emotional experience). It is reciprocity of these experiences, influenced by the multiple characteristics of the model that ultimately define the gameplay experience. Having presented the structure of the model, the chapter also describes the various characteristics – associated to the six dimensions of the model – which can influence the experience.

Lastly, in order to initially validate the model and several of its characteristics, the various communication theories presented in CHAPTER 4 (*cf.* Communication & Video Games, *p.* 115) are revisited and explored in terms of how they reflect on the many characteristics of the model.

CHAPTER 6
VALIDATING THE GAMEPLAY EXPERIENCE MODEL

Having presented a *Gameplay Experience Model* proposal, this chapter outlines the study developed to validate the model and constituent parts within a specific context. The chapter describes the objectives of the empirical study, developed questionnaires, study objects used, and study sample. Also, the study design is presented, as well as the statistical analysis methodology employed to validate the model.

6.1 STUDY CONTEXTUALIZATION

Having developed the proposed *Gameplay Experience Model*, the following section explores the study carried out to attempt to validate the model within a defined context, as defined within the primary *Objective vii* (*cf.* Section 3 – Study Objectives, *p. 5*) of the study. Recalling, model validation refers to determining the extent to which a model accurately represents the real world from the perspective of its intended use. As the model seeks and intends to represent the various components which can play a role in the definition of the gameplay experience, the objective of this specific validation is to demonstrate possible relationships among the multiple dimensions of the model, related to the *Video Game* and *Player* elements.

The validation of the proposed gameplay experience model is attempted considering a specific context and embedded within an empirical study. The empirical study carried out involved two independent cases and two different non-commercial video games (developed in two distinct contexts). In each of these cases, a different video game was used and played by different individuals. By using two different video games and separate participants for each case, it is possible analyse how the multiple dimension of the proposed model perform in distinct cases. Individual analysis can be carried out in each case, as well as a comparison between both cases. Posterior to the analysis on the model proposal within the defined context, further considerations on its future applicability in other game contexts can be considered.

Given two different study objects (video games), this multi-case study seek to primarily understand if *alterations* within the game have an influence on players' *Investments* and *Anticipations*, considering the sample as a whole, as well as divided into specific groups. The focus of analysis is primarily on the *Investments* and *Anticipations* dimensions given they are hypothetically the two most susceptible to vary during gameplay of the study, when players encounter and interact with different games or game maps. These two dimensions are shaped by players' understanding and satisfaction of the game and its multiple dimensions.

Steering the empirical study and attempted model validation are the previously defined hypotheses (*cf.* Study Hypotheses, *p. 10*). The empirical study carried out will validate or reject the defined hypotheses, and assist in initially validating the proposed model.

1. **The gameplay experience can be defined according to the interplay between characteristics related to video game *mechanics*, *interface*, and *narrative*; and player *motivations*, *skills*, *experience* and *expectations*.**

   In order to test *Hypothesis 1*, an analysis of possible associations between video game related model dimensions and player related model dimensions is carried out. The dimensions considered in this analysis are video game *Mechanics* and *Interface*; and player *Investments* (includes motivations), *Anticipations* (includes expectations) and *Background* (skills and experience are embedded within characteristics of the dimension). The analysis of possible associations is done using multiple *Pearson Correlation* tests.

2. **Regarding possible interplay, video game characteristics related to *mechanics* and *interface* influence the outcome of the gameplay experience.**

   In order to test *Hypothesis 2*, an analysis how player *Anticipations* and *Investments* evolve according to changes in the video game *Mechanics* (through game rules) and *Interface* (through game visuals) is carried out. This analysis is done using parametric *Paired-Samples t-tests*.

3. **Regarding possible interplay, player *gender* does not play a role in the outcome of the gameplay experience.**

   In order to test *Hypothesis 3*, an analysis of how player *Investments* and *Anticipations* evolve according to player gender is carried out. This analysis is done using parametric *Independent-Samples t-tests*.

4. **Regarding possible interplay, players' *game genre preferences* and *playing experience* influence the outcome of their gameplay experience.**

   In order to test *Hypothesis 4*, an analysis of how player *Investments* and *Anticipations* evolve according to players' *game genre preferences* and *playing experience* is carried out. This analysis is done using parametric *Independent-Samples t-tests* (for player gender) and *ANOVA – Analysis of Variance* (playing experience).

5. **Players' interaction behaviour can provide information regarding their level of understanding of the game mechanics and abilities, both part of the gameplay experience.**

   In order to test *Hypothesis 5*, an analysis of players' interaction behaviour based on collected game metrics is carried out. From the analysis of this data, it is possible to understand the extent to which players' understood the game mechanics as well as their level of playing ability, based on differences in results among player gender, playing experience groups, and game genre preferences.

6. **Eye tracking data can provide information regarding how changes in a video game modify players' visual attention patterns.**

   In order to test *Hypothesis 6*, an analysis of how a change in video game mechanics (related to the *rules* and *visuals* of a video game) modifies players' visual behaviour is carried out. This analysis is done using eye tracking data.

Given the specificities of each case used in the empirical study, not all hypotheses can be equally and fully verified in both studies. In the 'ReCycle' case (*cf. p. 189*), all hypothesis are tested; in the 'CSSmod' case (*cf. p. 190*), only Hypothesis 1, Hypothesis 4 (partially) and Hypothesis 5 are tested. This limitation results from type of statistical testing applied for each hypothesis, requiring specific variables which are not present in the 'CSSmod' case.

6.2 STUDY DESIGN

The empirical research process consisted in two independent cases, using the 'ReCycle' and 'CSS*mod*' study objects. The study was held during October 2012 and March 2013. Participants for either case all volunteered to participate without any initial limitations. This enabled a more diverse group of participants, rather than a homogeneous group of players. Individuals were invited to participate through direct contact and through the dissemination of the study using online resources. As a result, the individuals that participated in the study were based on a mix of *convenience* and *accidental*, non-probability sampling (Coutinho, 2011), which can be associated to the use of individuals that are available or when volunteers are used (Carmo & Ferreira, 1998).

In both cases of the study, participants were required to use their own computer. Data posteriorly used to validate the model was collected through three sources: (*i*) questionnaires; (*ii*) game log files (game metrics); and (*iii*) eye tracking log files.

6.2.1 'ReCycle' Case

The 'ReCycle' case consisted in a total of seven game sessions held during December 2012 and March 2013. Individuals from two Portuguese universities and a game development group from Porto voluntarily participated in the study. The sessions were held locally at the referred locations. A *within-subjects design* was applied, where the same group of individuals serves in more than one treatment (R. Hall, 1998). In the context of this study, *treatment* refers to the *game rounds* played (described below). The strengths in applying this type of design are related essentially to reduction in error variances associated with individual differences. With within-subjects designs, the conditions are always the same regarding the individual difference variables since the participants are the same in the different conditions. With an alternative between-subjects design, even if subjects were randomly assigned to groups, these groups could differ according to important individual difference factors. Nonetheless, a within-subjects design also bears a weakness, related to *carryover effects*, which suggest an individuals' participation in one treatment may affect their performance in other treatments.

Each of the seven sessions lasted approximately 1.5 hours. Participants were required to use their own computer or laptop, configured to their own needs. Once all players were prepared, they were informed on the objectives of the study and the session, as well as the video game they were going to play. Players were given the required video game files, asked to install the necessary web application, and to select a unique username which would be used throughout the entire session, in both the game and to answer the various questionnaires.

The basic setup of the sessions consisted of six rounds, with exception to two sessions (with three and four rounds, respectively). The game played consisted in three different maps of the 'ReCycle' video game. Participants played each version of the maps *M1*, *M2* and *M3* twice in the following order: $M1_1$ – $M2_2$ – $M3_3$ – $M1_4$ – $M2_5$ – $M3_6$. After each of the first three rounds ($M1_1$, $M2_2$, $M3_3$), players responded to the *Gameplay Experience Questionnaire* (administered online via the *Google Docs* platform) in order to assess their opinion on the latest map played. The remaining three rounds were played so each participant was able to play at least once on the eye tracking computer in order to collect eye movement data for all participants.

In order to play, players were required to join a specific *IP address* on which the game server was running. For each round, one player was required to play on the eye tracking computer. The researcher in charge of the study proceeded to assist in the eye tracking calibration while the remaining participants waited for the game to begin. Once the eye tracker was calibrated, the game server was initiated and players were asked to join the server and begin playing. Each round lasted approximately 5 minutes. Once players entered the game, they were free to play and interact as desired. If players were killed, they were given the option to continue playing and reenter the game, or to exit the game and wait for the round to finish.

Lastly, considering the distribution of the sample in the multiple sessions and other limitations, not all sessions and scenarios were played an equal number of times. Table 17 represents the distribution of game rounds played per Session and game map.

Table 17: Distribution of number of 'ReCycle' games per session and scenario

	Session							Total
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	
Map 1	2	2	2	1	2	2	1	12
Map 2	2	1	2	1	2	2	1	11
Map 3	2	1	2	1	2	2	2	12
Total	6	4	6	3	6	6	4	

6.2.2 'Counter-Strike: Source' *mod* Case

The 'Counter-Strike: Source' *mod* case consisted in a single session which took place in October 2012. Six individuals voluntarily participated in the session, held at the University of Aveiro.

The session lasted approximately 2 hours. Participants were required to use their own laptop, configured to their preferences. Prior to the session, participants were given all necessary game files to play the game on the 'Steam[33]' platform. Once all players were prepared, they were informed on the objectives of the study and the game session, as well as the 'Counter-Strike: Source' *mod* they were going to play. Considering the participants all previously knew each other, players were divided into two balanced groups of three individuals forming a *blue* and *red* team. The division was done in order to place an equal number of experienced and non-experienced players on each team. The *Red Team* included one experienced player and two inexperienced players; the *Blue Team* consisted of two experienced and one inexperienced player.

Six rounds of approximately 3 minutes were carried out. For each session, one participant played on the eye tracking computer running the required software. Prior to each session, the participant playing on the eye tracking computer was required to complete the eye tracking calibration procedure in order to prepare the eye tracker for that specific player. After the session was played, data was collected using the Gameplay Experience Questionnaire (administered online via the *Google Docs* platform).

[33] 'Steam' is a platform developed by 'Valve Corporation' used to distribute games online. http://store.steampowered.com/ (July 2013)

6.3 Data Collection Instruments

Two primary data collection instruments were developed in order to gather information from participants for posterior data analysis: a Pre-Questionnaire and a Gameplay Experience Questionnaire (GExQ). In addition to the two questionnaires, data was also collected from video game log files (from both video games) and eye tracking log files.

6.3.1 Pre-Questionnaire Description

Prior to the game sessions, participants were required to answer a *Pre-Questionnaire* in order to collect information on their video game playing habits in order to complete a profile characterization. Additionally, the collected information would be used to complete and possibly establish associations with data gathered from the *Gameplay Experience Questionnaire*, and the quantitative data collected from the game session log files. The Pre-Questionnaire was administered online via the *Google Docs* platform and consisted in eight questions. All questions but the first were defined as mandatory.

The first (1) question was optional and allowed participants to voluntarily indicate their name. The second (2) question asked participants to indicate a *username* of their choice, as long as it remained the same during the remaining questionnaires and game sessions they participated in. The third (3) question inquired on participants' gender. The fourth (4) question asked participants to indicate – considering all types of games – how long (on average) they played video games a week (*<1 h/week*; *1-5 h/week*; *6-10 h/week*; *>10 h/week*). This information established participants *playing experience*. While there is no apparent widely used categorization of players, the referred *time* factor was used to divide players into four different playing experience types: *inexperienced*, *casual*, *experienced* and *hardcore*, respectively. An inexperienced player can be considered one that has little or no experience with games. A casual player is one with some interest in games, but do not invest much time. This does not imply however that they only play 'casual' games[34]. Experienced players are those willing to invest more time with games and have a larger knowledge of games. Hardcore players are those that invest long periods of time into game playing. While this categorization is not fixed[35] - and this division is still debated (Alexandre, 2012) – they serve as a reference for the intended analysis.

The fifth (5) and sixth (6) question asked what *video game genres* and *platforms* participants played the most, respectively. The seventh (7) question included 3 sub-questions. Participants were asked to indicate the degree to which they 'like *Shooter* games', 'consider themselves experienced players in shooting games', and 'feel like playing [in the study]'. Participants answered using a 5 point Likert-scale (1 – *Completely Disagree*; 2 – *Disagree*; 3 – *Neither Agree/Disagree*; 5 – *Agree*; 5 – *Completely Agree*). The eighth (8) question inquired whether participants had previously participated in studies where eye tracking was used.

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[34] Casual games, traditionally described as games with simple rules and gameplay, friendly to those that are initiating video game playing (Source: http://uk.gamespot.com//news/gdc-08-are-casual-games-the-future-6186207; Accessed: July 23, 2013)

[35] Other categorizations used to describe players are mid-core gamers, pro-gamers, power-gamers, or newbies, for example.

6.3.2 Gameplay Experience Questionnaire (GExQ) Description

The *Gameplay Experience Questionnaire* (GExQ) is a by-product of the proposed model, measuring players' opinions and attitudes on the various characteristics of the model, and regarding the video game they are playing.

The GExQ is an instrument applied in the process of the intended validation, generating information which can be later used in the analysis of players' experience. Despite the existence of some experience-related questionnaires (Gámez et al., 2010; IJsselsteijn et al., n.d.; Jennett et al., 2008), these do not fully cover all of the characteristics highlighted in the proposed model. While some of the items in these questionnaires can be adopted in the GExQ, additional items are necessary to cover additional model characteristics.

The GExQ has two main questions. *Question 1* consists of 27 items which measure participants' opinion on all model characteristics. One or more items refer to and measure each model characteristic. As a result, each model dimension (Video Game *Mechanics*, *Interface*, *Narrative*, *Consistency*; Player *Investments*, *Anticipations*, *Background*) can be measured and analysed according to multiple questionnaire items. *Question 2* includes two items which measure participants' opinion regarding the influence of the eye tracker on their experience.

The Gameplay Experience Questionnaire items are assessed using a 5-point Likert scale. The 'Likert scale' is a type of *interval scale* which *"provides a continuous response options to questions with assumed equal distances between options"* (Creswell, 2011, p. 167). The Likert scale is a frequently used attitude scale in research (Fraenkel et al., 2012), and is an example of a scale with theoretically equivalent intervals among responses (Creswell, 2011). The use of a Likert scale in the GExQ coincides with the approach seen in similar studies (Gámez et al., 2010; Jennett et al., 2008).

Table 18 summarizes the distribution of questionnaire items among the video game and player model dimensions and characteristics.

Table 18: Distribution of Questionnaire Items among Model Dimensions and Charatereristics

Video Game		
Mechanics	*Goals*	QI 5 – *I knew what to do in order to win* QI 17 – *I felt challenged during the game*
	Rules	QI 6 – *I understood the rules of the game*
	Rewards	QI 7 – *The game rewarded my effort*
Interface	*Audio*	QI 8 – *The game's sounds were adequate to the type of game*
	Visuals	QI 9 – *I liked the visual aspect of the game*
	Input	QI 12 – *I liked the interaction mode*
	Feedback	QI 10 – *I saw all the information I needed on the screen*
Narrative	*Narrative*	QI 26 – *The narrative was consistent with the game*
Consistency	*Consistency*	QI 13 – *The game responded differently for the same type of action*

Player		
Investments	*Connection*	QI 1 – *I had fun playing the game* QI 2 – *I liked the game* QI 24 – *I would play the game again* QI 25 – *I liked the experience of playing the game* QI 27 – *The progress of the game generated a mixture of emotions within me*
	Motivation	QI 3 – *I was motivated to play* QI 4 – *I was bored while playing*
	Effort	QI 14 – *I had to make an effort to win*
	Attention	QI 15 – *I had to pay attention to what was going on in the game*
	Time	QI 23 – *I would have liked to play during more time*
Background	*Ability*	QI 16 – *I had difficulties playing the game*
	Knowledge	QI 18 – *I knew how to solve the game's problems*
	Preferences	QI 19 – *I normally play this type of game*
Anticipations	*Expectations*	QI 20 – *The game was what I expected*
	Actions	QI 22 – *My character reacted as I expected*
	Control	QI 11 – *My character moved according to my input* QI 21 – *What happened in the game was of my responsibility*

6.4 STUDY OBJECTS AND ANALYSIS TOOLS

The multi-case empirical study carried out involved the use of two non-commercial video games developed in an academic context: 'ReCycle' and 'Counter Strike Source: *mod*' (CSS*mod*). These two different First-person shooter video games were the study objects used in the empirical study. In addition to the two study objects, a specific analysis tool ('GAMEYE' application) was used in a posterior analysis of game metrics extracted from the CSS*mod* video game log files.

6.4.1 'ReCycle'

'ReCycle', developed by Arnaldo Moura (2011) in 'Unity 3D', is a video game platform created for multi-player first person shooter experiences. In 'ReCycle', gamers play against each other in a scenario similar to a desert and play to survive. In order to do so, players must find water sources (blue spheres), which can be harvested in order to increase their energy. The game consists of a day and night cycle, where the end of one cycle removes a determined quantity of energy from the players. Players carry a ray gun which can be used to defeat other players. Alliances can also be made with other players, where energy and loss of points is shared between the alliances. This approach in game design looked to stimulate within players the duality of defeating players and consuming energy or consistently harvesting energy in order to survive for a longer period of time. Figure 29 represents a screenshot from 'ReCycle'.

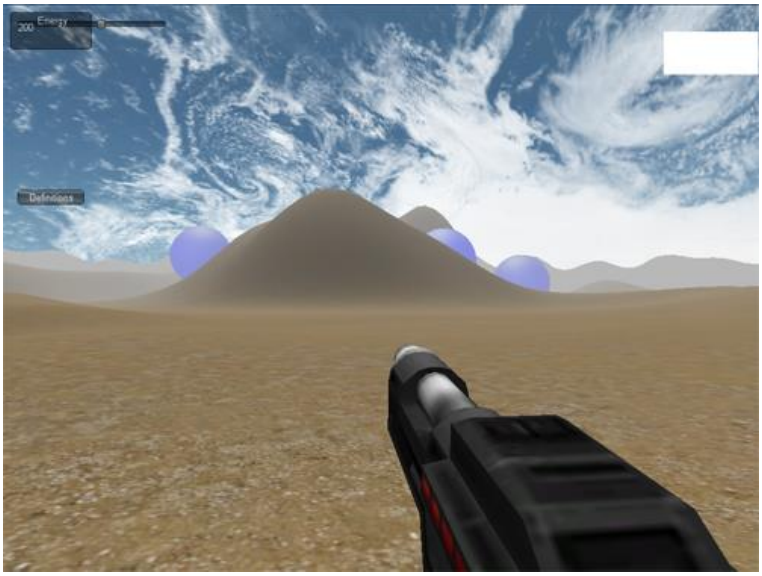

Figure 29: Screenshot from 'ReCycle'

The three 'ReCycle' maps played vary according to two visible characteristics: (*i*) daily energy loss (DEL) and (*ii*) map size (MS). Within the proposed model, daily energy loss can be associated to *game rules* (*Mechanics* Dimension) while map size is part of the *game visuals* (*Interface* Dimension). Table 19 summarizes the characteristics of the three maps M1, M2 and M3.

Table 19: Description of ReCycle Map characteristics (daily energy loss (DEL), map size (MS))

Map	Map Characteristics
Map 1 (M1)	DEL: 50 / MS: 1000 x 1000
Map 2 (M2)	DEL: 80 / MS: 1000 x 1000
Map 3 (M3)	DEL: 50 / MS: 500 x 500

'ReCycle' is also characterized by a *logging* feature which records onto two log files different information related to the player and the game. During game runtime, a first (1) log writes information with a player ID, a username (selected by the player), player's current position, rotation, alliance, energy and a time stamp for this sequence of information. This information is registered every 0.2 seconds. A second (2) log records information with players' actions, including: jumping, shooting, harvesting water (*i.e.* collecting energy), running and team alliance proposals. This log file also includes some of the information present in the first log file. Information for the second log file is registered every time the action is triggered by the player.

6.4.2 'Counter-Strike: Source *mod*' ('CSS*mod*')

A 'Counter-Strike: Source' game modification (*mod*), developed by Celso Soares (2012), was also used in the study. The game *mod* was developed using the 'Source' engine, which offered the possibility of editing an existing First-person shooter (FPS) video game which comes with the engine. Using the corresponding SDK, the developed *mod* offered an FPS game with team-style playing. Figure 30 represents a screenshot from the 'Counter-Strike: Source' *mod*.

Figure 30: Screenshot from the 'Counter Strike: Source' *mod*

The video game *mod* scenery is consists of a small platform in the middle of the water; a building sitting in the middle of a platform, surrounded by other objects including a boat and multiple trees. Considering the team-play nature of the game, the map consists of two different *spawn* points. The *mod* developed consists of a 'Team Death Match' (TDM). In a TDM, the main objective is to eliminate as many players as possible from the opposing team. When a player enters the *mod*, he is able to choose either the 'Red' or 'Blue' team, and select from one of three classes, each with its advantages and disadvantages in terms of weapons and character movements. The players play freely on their teams and within the game map. If players are *killed*, they can 'spawn' (enter the game) as many times as desired during the session's duration. The team with the most points – essentially resulting from the largest number of kills – is the winner.

In addition to its basic gaming purpose, the video game *mod* was also prepared for logging data. The *mod* generates three different log files: (*i*) *map log file*, consisting of information related to the size of the map and placement of objects; (*ii*) *player log file*, which collects data in real-time related to player name, team, coordinates, weapon, and movement actions; and (*iii*) *events log file*, which registers all the events occurring during the game related to when the player spawns, when he is shot, killed, and others. These log files can be later incorporated and read by the 'GAMEYE' application, a tool developed for player interaction analysis.

6.4.3 GAMEYE Application

The GAMEYE application – developed by Celso Soares (2012) as part of his Master's dissertation work – is a tool which fitted the needs of this study. The objective of the project was to develop an application which would allow a posterior analysis and visualization of players' *interactions* and *actions* during a game session (Soares, Veloso, Mealha, & Almeida, 2012). Part of the conceptualization process of the application resulted from results collected in an additional complementary study (Almeida, Veloso, Roque, & Mealha, 2012), regarding techniques which could be used in the analysis of player behaviour.

The GAMEYE application was developed using 'Adobe Flash' and programmed with ActionScript 3.0. Figure 31 represents a screenshot of the final application.

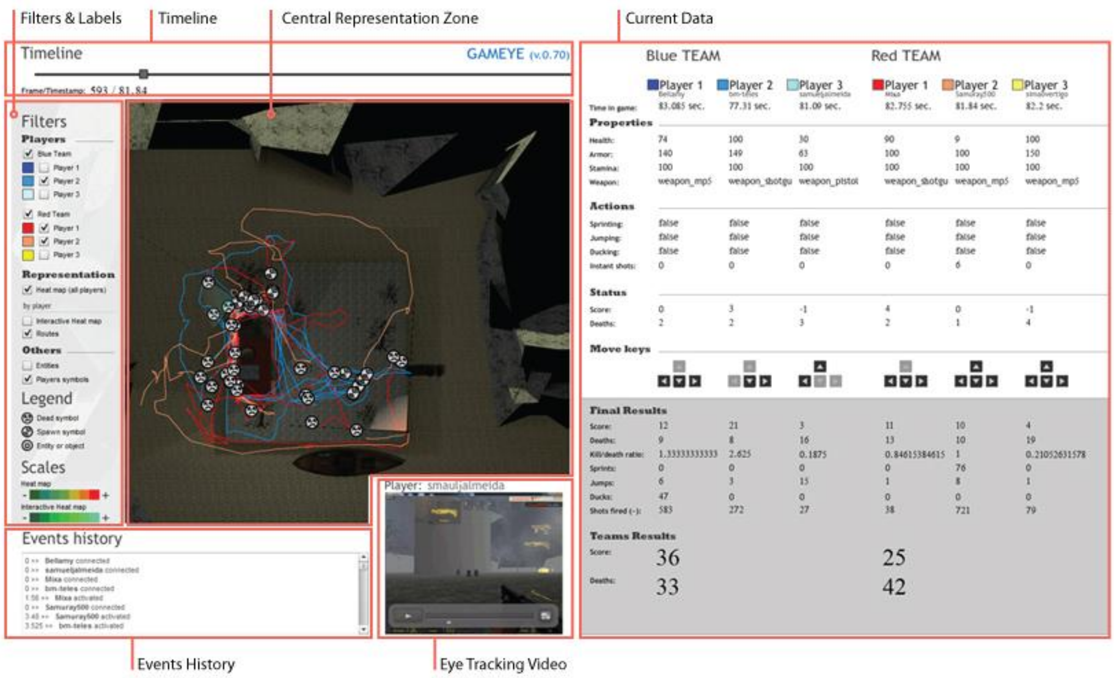

Figure 31: Detailed view of the GAMEYE application and all containing features

The application consists of six different areas with different selection possibilities and information sections: (*i*) timeline; (*ii*) filters and labels; (*iii*) central representation zone; (*iv*) event history; (*v*) current data; (*vi*) eye tracking video.

i. **Timeline**: the timeline is a horizontal navigation bar which can be manipulated in order to select a specific moment of a gaming session or dragged horizontally to visualize the entire game session. The timeline also indicates the exact frame of the game session being visualized.

ii. **Filters & Labels**: the filters and labels area allows the selection (using checkboxes) of the players and teams to appear in the *central representation zone*. Each checkbox is represented by a single colour, unique to each player. This area also allows the selection of 'player/team routes' and 'heat map simulator' visualization – visualization techniques initially planned and upheld in the results of another study (Almeida et al., 2012). It is also possible to select 'entities' and 'player symbols', related to the places where players begin the game and scenery objects.

iii. **Central representation zone**: this area contains a small representation of the map played and all player interactions. The position of a player at a specific time during the game session is represented by a small dot and a 'V' figure representing the player's view angle during the game. As referred for the *filters and labels* area, each player is represented by a unique colour. Considering each team can have up to three players, one team is represented by warm colours (*red*, *orange* and *yellow*) and a second team by cold colours (*dark blue*, *cyan blue* and *green*). Player routes are represented by a line with the corresponding player colour. When selected (filters & labels area), a heat map is activated representing map zones where players spent more time during a game session. The various selection possibilities offer up to 13 different visualizations.

iv. **Event history**: the event history area refers to part of the tool where a listing of all game events can be found: indication of when a player is killed or spawns (player is introduced back into the game); when a player shoots or is hit; among others. Overall, it is the history of a game where one can see everything that occurred during a game session.

v. **Current data**: the current data section is located on the right side of the application and is divided into six columns with diverse information. Each column represents one player and contains information on various game properties and metrics: quantity of life, quantity of stamina, weapon being used, actions (*e.g.* if the player is running or jumping), team results and the *key* that is being pressed at a given moment. This information is dynamic such that it updates according to the position of the marker on the timeline.

vi. **Eye tracking video**: the eye tracking video area is located below the *current data* area. Here, a video containing visual information extracted from an eye tracker is synchronized with the timeline and contains information regarding where the main player – Player 1 – or other, if previously defined – is looking at (the 'Point of Regard') during a specific moment. The eye tracking video is synchronized with the game session and updates according to the dragging of the timeline marker.

The GAMEYE application integrates data from two different sources: (*i*) eye movement data collected using an eye tracker; and (*ii*) three log files extracted from the video game (‘CSS*mod*’) on which the application was built. The eye tracker log file (*i*) is generated by an eye tracking system and registers information related to individuals’ eye movements and other relevant data: *timestamp*, *xyz coordinate* of the screen being visualized, *duration* of a fixation, among others. The ‘CSS*mod*’ log files are the aforementioned (*cf.* Section 6.4.2, *p. 195*) three game-related files: (*a*) map log file, (*b*) player log file, and (*c*) events log file.

a. **Map *log file***: the map log file consists of information related to the size of the game map as well as information related to the placement and name of several game map entities and objects.

b. **Player *log file***: the player log file consists of player-related information collected in real time. This log file registers players’ names, team, *xyz* coordinates; armor, weapon being used, if the player is running, jumping, shooting, crouching or other.

c. **Events *log file***: the events log file registers all events that occurred during a game session. This log file registers information related to when a player connected to the server, when he spawned onto the map, when he was hit by an enemy and the resulting damage; when a player was killed and by whom, among others.

6.5 STATISTICAL ANALYSIS METHODOLOGY

Given a large data set, data analysis is an important and necessary procedure in order to organize acquired information and simplify its interpretability (Martinez & Ferreira, 2008). When this data assumes numeric values, statistical analysis can be carried out (Pereira, 2011). The software selected for statistical analysis was ‘Statistical Package for the Social Sciences, *v. 20*[36]’ (SPSS), a primary and powerful software in the analysis and treatment of statistical data (Healey, 1996; Martinez & Ferreira, 2008; Pereira, 2011). With a prepared data set, it is possible to easily and quickly produce multiple statistics without manual computation (Healey, 1996).

Statistical analysis of the quantitative results from the empirical study (extracted from the *Pre-Questionnaire* and *Gameplay Experience Questionnaire*) was performed initially considering the ‘ReCycle’ case, and posteriorly considering the ‘CSS*mod*’ case.

Initially, and in order to characterize the two samples and describe results related to the *Investments*, *Anticipations*, *Background*, *Mechanics* and *Interface* dimensions, a univariate analysis of the data is carried out where each variable is treated independently. The purpose of this approach is to represent in understandable form information that is collected in an unorganized manner.

Descriptive statistics allow an initial understanding of the data, including their form, dispersion and structure (Coutinho, 2011). The descriptive statistics techniques applied were:

[36] **SPSS**. Available at: ***http://www-01.ibm.com/software/analytics/spss/*** (July 2013)

i. Determining measures of **central tendency** (Healey, 1996): *mean* (the average of all the scores in a distribution); *median* (the score that divides the distribution in two halves, below and above which 50 percent of the scores in a distribution fall); *mode* (the most frequent score in a distribution).

ii. Determining measures of **dispersion** (Healey, 1996): *standard deviation* (the square root of the variances, it represents the spread of a distribution); *maximum* (maximum value of a distribution); *minimum* (minimum value of a distribution).

The selection of this type of analysis relates to the fact the variables used in this study are quantitative (variables to which a measure can be attributed and present themselves with different intensities or values) of a *nominal* scale (data classified according to unordered categories; *e.g.* male or female) or *ordinal* scale (ordered categories; *e.g.* time dedicated to playing/week: *<1 hour*, *1-5 hours*, *6-10 hours*, *>10 hours*) (Coutinho, 2011). The measures of central tendency and dispersion were applied for quantitative values, resulting from data acquired through the questionnaires.

Secondly, in order to study possible relations between the dependent variables, *Pearson's correlation coefficient* values were calculated, adequate for quantitative values with a normal distribution. The dependent variables studied are related to *Investments, Anticipations, Background, Mechanics* and *Interface*. The statistical hypotheses associated to the *Pearson Correlation* are:

H_0*: The two variables are not correlated*

H_1*: The two variables are correlated*

If the observed significance level (*p* value) is inferior to $p<0.05$, H_0 is rejected. In such a case, the coefficient value (*r*) has statistical significance. The *r* value can be between *-1* and *1*, indicating the strength and direction of the correlation. The two variables are positively related if the coefficient is positive; or negatively related, if the coefficient is negative. The strength of the correlation is normally considered high when *r* is at least 0.7 or -0.7. The strength of the correlations can be classified as (Bryman & Cramer, 2005): *very low* (<= 0.19); *low* (0.2-0.39); *modest* (0.4-0.69), *high* (0.7-0.89) and *very high* (0.9-1).

Thirdly, in order to verify the statistical significance of the univariate analysis results related to the *Investments*, *Anticipations*, *Background*, *Mechanics* and *Interface* dimension variables, parametric *Paired-Samples t-tests* – also called Dependent t-tests (Statistics, 2013a) – were applied, with the objective of simultaneously comparing the means of two variables for the same group. *Parameter* – related to Parametric Tests – "*refers to a measure which describes the distribution of the population such as the mean or variance*" (Bryman & Cramer, 2005, p. 144). In theory, parametric tests require the fulfillment of several conditions, related to the *scale of measurement*, the *normal distribution* of the population and the *variances* of the variables. However, the need to meet these conditions is debated, such that it is argued these tests are sufficiently robust they can be applied even if the referred conditions are not met (Bryman & Cramer, 2005; Pereira, 2011).

Prior to the *Paired-Samples t-tests*, the normality of the data (one condition of a parametric test) is tested using the *Shapiro-Wilk* tests. The *Shapiro-Wilk test* is used in detriment of the alternative *Kolmogorov-Smirnov-Lilliefors test* because it is more appropriate for small sample sizes (<50 samples) (Razali & Wah, 2011; Statistics, 2013b). The general statistical hypotheses for the *Shapiro-Wilk test* are:

H_0*: The variable sample approximates (or follows) the Normal distribution*

H_1*: The variable sample does not approximate (or does not follow) the Normal distribution*

If the observed significance level (*p* value) is inferior to $p<0.05$, than H_0 is rejected and the normality of the data can be questioned. However, as referred, considering the robustness of this parametric *Paired-Samples t-test*, it can still be applied even if data normality is not verified. Regarding the *Paired-Samples t-test*, the general statistical hypotheses are:

H_0*: Mean in intervention 1 = Mean in intervention 2*

H_1*: Mean in intervention 1 ≠ Mean in intervention 2*

Intervention 1 and *intervention 2* refer to two different moments. In the 'ReCycle' game case, these refer to the different game maps played (M1, M2 and M3). If the observed significance levels are low ($p>0.05$), than H_0 is rejected, and there is statistical significance to affirm there is a significant difference in the means of the group before and after the defined *intervention*.

Fourth, in order to verify if there are significant differences in the means among different groups, *Independent-samples t-tests* and *ANOVA* were applied. The *Independent-samples t-test* compares the means of a variable for two independent groups, *i.e.*, groups where there is no relation between people and objects. This test can be used when the number of cases is small. Similar to the *Paired-Samples t-test*, the *Independent-samples t-test* assumes several conditions, including that variances between the two tested groups are equal. The *Levene* statistic informs on this condition, and considers the following hypotheses:

H_0*: The variance in the first group is equal to the variance of the second group*

H_1*: The variance in the first group is different from the variance in the second group*

If the observed significance level for the *Levene* test is inferior to $p<0.05$, than the null hypothesis (H_0) of equality in variances is rejected and equal variances are assumed. The statistical hypotheses associated to the *Independent samples t-test* are:

H_0*: The mean of the first group is equal to the mean of the second group*

H_1*: The mean of the first group is different from the mean of the second group*

If the observed significance level is inferior to $p<0.05$, than the null hypothesis (H_0) of equality of means is rejected. Therefore, there is statistical evidence to state that the *mean* of the first group is statistically significant from the mean of the second group.

ANOVA (Analysis of Variance) is different from *t-tests* because these can only be used to test differences between situations with a single variable, whereas *ANOVA* can be used to test for differences in multiple situations and for more than one variable or group. The statistical hypotheses associated to *ANOVA* are:

H_0*: The means of the groups are equal*

H_1*: The means of at least one group is different*

If the observed significance level is inferior to $p<0.05$, than the null hypothesis of equal means is rejected. Therefore, there is statistical significance to state there is at least one group in which the mean is different.

The study's *independent* variables are related to the participants and their *player profile*. These variables were collected from the Pre-Questionnaire (*cf.* Section 6.3.1, *p.* 191) and include: *gender*, *playing experience* (based on weekly hours of playing video games), *game genres* played, *game platforms* played, and *preference* of shooter games. The study's *dependent* variables are related to the model dimensions. These *model* variables are computed latent[37] variables, based on the questionnaire scores of the dimension's respective characteristics. For example, the *Investments* Dimension latent variable is based on the scores of the motivation (QI 3, 4), connection (QI 1, 2, 24, 25, 27), attention (QI 15), effort (QI 14) and time (QI 23) characteristics. Five latent variables were computed, for the *Investments* dimension (ID), *Anticipations* dimension (AD), *Background* dimension (BD), *Mechanics* dimension (MeD) and *Interface* (IfD) dimension. Table 20 summarizes the various *dependent* variables, including the latent dimension variables and observable model characteristics variables, as well as the defined acronym for posterior appropriation.

Table 20: Dependent variables of the model (Dimensions, characteristics and defined acronym)

Video Game *Element*		**Player** *Element*	
Dimension/Characteristic	Acronym used	Dimension/Characteristic	Acronym used
Mechanics *Dimension*	**MeD**	**Investments** *Dimension*	**ID**
Goals	GoC	Motivation	MC
Rules	RuC	Attention	AtC
Rewards	ReC	Effort	EfC
Interface *Dimension*	**IfD**	Time	TC
Input	IC	Connection	CoC
Audio	AuC	**Anticipations** *Dimension*	**AD**
Visuals	ViC	Expectations	ExC
Feedback	FeC	Actions	AcC
Narrative *Dimension*	**ND**	Control	CtC
		Background *Dimension*	**BD**
		Knowledge	KC
		Preferences	PC
		Ability	AbC

[37] **Latent variables** refer to variables not directly observable, but are inferred based on other directly measured variables (Denny Borsboom, Gideon J. Mellenbergh, 2003)

For the 'ReCycle' case, all four of the statistical analysis previously described (*Pearson's Correlations, Paired-Samples t-test*, *Independent-Samples t-test*, and *ANOVA*) are executed considering the dependent variables. For the 'CSSmod' case, analysis is limited to *ANOVA* and *Pearson's Correlations*.

In order to carry out statistical analysis of the collected questionnaires data, values were codified upon introduction into the SPSS software. Considering the *independent* variables of the study, *male* participants were codified with a '1' and *female* participants with '2'. The number of weekly hours of playing video games (*playing experience*) was classified as '1' for *<1 h/week*, '2' for *1-5 h/week*, '3' for *6-10 h/week*, and '4' for *>10 h/week*. Game genres and platforms played by participants were classified individually. If the genre/platform is played, it was classified as '1'; if they do not play the respective genre/platform, it was classified as '2'. The *dependent* variables are defined based on various items from the *Gameplay Experience Questionnaire* (*cf.* Section 6.3.2, *p. 192*). These items are measured according to a Likert Scale, and classified as '1' – *Totally Disagree*, '2' – *Disagree*, '3' – *Neither agree or disagree*, '4' – *Agree*, '5' – *Totally Agree*. This classification is inversed for Questionnaire items 4 and 6, which are negatively worded.

6.6 FINAL CONSIDERATIONS ON THE CHAPTER

This chapter reflected on the Empirical Study carried out in order to proceed with an initial validation of the proposed model.

The empirical study consisted in a multi-case study, using two video games developed in an academic context: 'ReCycle' and 'CSS*mod*'. Both these video games are characterized as being of the first-person shooter game genre, and generating log files with gameplay metrics data.

The 'ReCycle' cases consisted in a 40 individual sample, with male and female players, with different playing experiences and game genre preferences. The 'CSS*mod*' case, given its various limitations, consisted in a six individual sample, all male, but with different playing experiences.

Previously described in CHAPTER 5 (*cf.* A Gameplay Experience Model, *p.* 133), a Gameplay Experience Questionnaire is a by-product of the developed model, and is used to assess players' opinions on the video game played. In addition to this data collection instrument, a pre-questionnaire is also described, used to characterize the study samples.

Posterior to the characterization of the two study objects – the 'ReCycle' and 'CSSmod' game – as well as the GAMEYE application used to analyse game metric data from the CSS*mod* game, the statistical analysis methodology applied in the empirical study is also described. Several statistical tests are applied in order to analyse the possible relationships among model dimensions, as well as the association between the various player related independent variables and the dependent variables related to the model dimensions. Players' visual behaviour is also considered and analysed, based on data collected from an eye tracker.

CHAPTER 7
RESULTS & DISCUSSION

Considering the previous chapter, related to an initial validation of the gameplay experience model – based on two different cases – the present section elaborates on the multiple results collected from the Pre-Questionnaire and the Gameplay Experience Questionnaire. This data was extracted and analysed in order to understand players' *emotional* gameplay experience. After this initial analysis, gameplay metrics – representative of the *interactive* experience – are also considered, analysed, and confronted with the results of the questionnaires. Based on the results and discussion of the empirical study, knowledge on the validity of the proposed model is gathered and discussed.

7.1 'ReCycle' Case: Presentation of Results

Recalling, with the 'ReCycle' study object, seven game sessions were held during December 2012 and March 2013. Forty individuals from the University of Aveiro (Portugal), the University of Vila Real (Portugal) and a game development company from Porto (Portugal) took part in the study. No previous limitations were placed on the type of participant in order to collect a wider variety of individuals and player profiles.

7.1.1 Statistical Results

Considering the Statistical Analysis Methodology presented above (*cf.* Section 6.5, *p. 198*), the results applied to the multiple dependent variables are explored: *Anticipations* and *Investments* in a primary analysis; and *Background*, *Mechanics* and *Interface* in a secondary analysis.

For the 'ReCycle' case, the sample of the study is initially characterized according to simple descriptive data. Having presented the sample, possible associations among model dimensions are presented using *Pearson's Correlation coefficient*. After, and looking at the *Investments* and *Anticipations* dimensions, *Paired-Samples t-test* are used to study how these dimensions evolve based on video game related changes. Also, *Independent-Samples t-tests* and *ANOVA* are applied on player related independent variables (gender, playing experience and video game genre preference) to test their influence on *Investments* and *Anticipations*.

Note: For a complete overview of all 'ReCycle' statistical tests, please refer to Appendix 1A – ReCycle Study (cf. p. 297).

7.1.1.1 Sample Characterization

A total of 40 individuals participated in the 'ReCycle' case game sessions. Figure 32 represents the distribution of participants according to gender and their indicated playing experience.

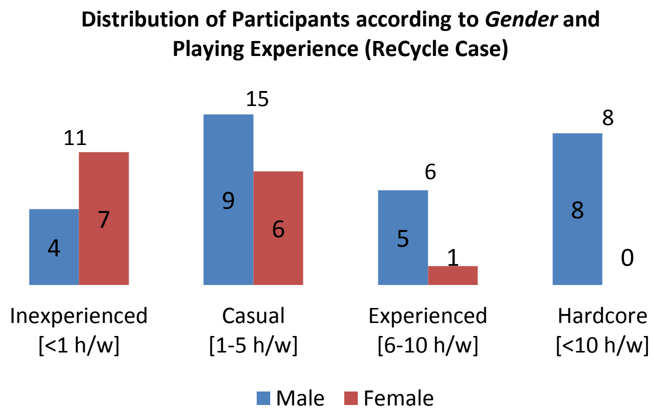

Figure 32: Distribution of participants according to gender and playing experience (*ReCycle* case)

The sample consisted in 26 (65%) male and 14 (35%) female participants. Considering the male participants, four were *inexperienced* players, nine *casual*, five *experienced*, and eight were *hardcore* players. Among the female participants, seven were *inexperienced*, six *casual*, and one was an *experienced* player. No female participants were categorized as *hardcore* players.

The sample was also characterized according to their game genre preferences. Figure 33 represents the distribution of players' game genre preferences among to player gender.

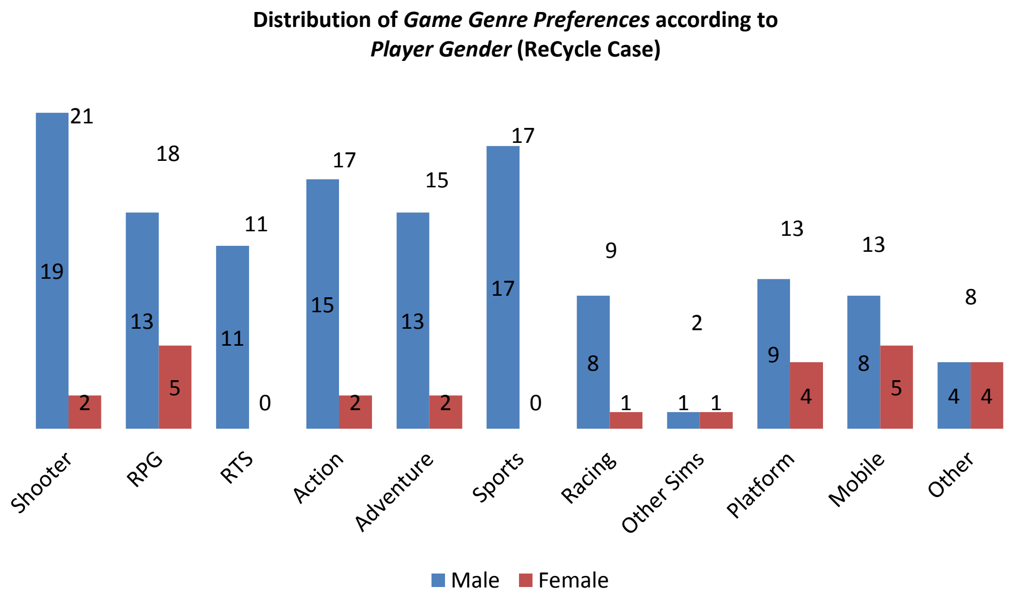

Figure 33: Distribution of game genre preferences among participants according to participant gender (*ReCycle* case)

Participants indicated preferring several different video game genres. Approximately half of the participants (21 part., 52.5%) indicated playing 'Shooter' games, with the large majority being male participants (19). 'Sports' games were the second most indicated gender by 17 participants, all male players. 'RPG' (18 part.), 'Action' (17 part.) and 'Adventure' (15 part.) are three other game genres mentioned by at least 15 participants, with the large majority being male players. None of the suggested video game genres was referred by female participants more frequently than male participants. However, the difference between the two groups is smaller regarding 'Platform' games (9 male, 4 female); 'Mobile' games (8 Male, 5 female) and 'Other Simulators' games (1 male, 1 female). The Other category received four mentions from each gender. However, in the case of the male participants, two suggestions came from the same individual.

Participants were also inquired on their video game platform preferences. Figure 34 represents the distribution of participants' answers according to their preference for video game platforms.

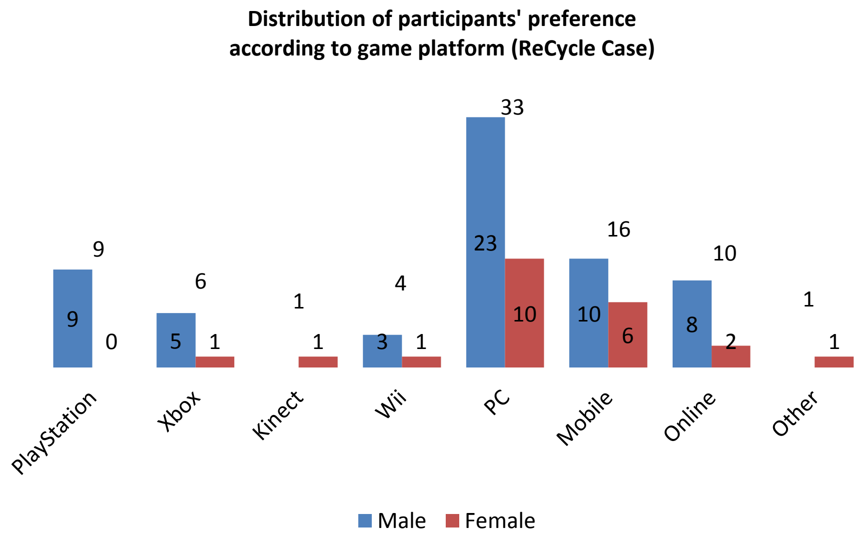

Figure 34: Distribution of participants' preferences according to game platforms (*ReCycle* case)

The 'Portable Computer' (PC) was the most preferred gaming platform, indicated by 23 (58%) male and 10 (71%) female participants. Far behind, the 'Mobile' platform was indicated by 10 (25%) male and 6 (43%) female participants; 'PlayStation' was indicated by 9 (23%) male participants; and 'Online' gaming was indicated by 8 (20%) male and 2 (14%) female participants.

7.1.1.2 Model Dimensions Correlations ('ReCycle')

Hypothesis 1 states: *the gameplay experience can be defined according to the interplay between characteristics related to video game mechanics, interface, and narrative; and player motivations, skills, experience and expectations*. Hypothesis 1 can be considered valid if there are statistically significant correlations between the multiple model dimensions in the multiple game maps played, therefore identifying interplay between the referred characteristics.

In order to test *Hypothesis 1*, and possible associations between the various dependent variables (*Mechanics*, *Interface*, *Investments*, *Anticipations*, and *Background* dimensions), *Pearson's Correlation Coefficient* is applied. Three different correlation processes are considered, one for each of the three game maps played: M1, M2 and M3. In general, for each map, the five variables can combine for a total of 10 possible correlations. Looking at the global picture of results, for each map, on average 75% of the possible correlations are confirmed. All verified correlations are positive, and the large majority are confirmed at the *0.01* level (2-tailed) of significance.

Beginning with game map M1, 8 of 10 possible correlations are confirmed with a confidence interval of at least 95% (significance level of $p<0.05$). Table 21 represents a summary of the multiple variable (model dimensions) correlations for game map M1.

Table 21: Summary of Correlations for game map M1 (*ReCycle* case)

MAP 1		Investments	Anticipations	Background	Mechanics	Interface
Investments	P.C. *(r)*		0.497	0.320	0.673	0.348
	Sig. (2-t) (*p*)		0.001	0.044	0.000	0.028
Anticipations	P.C. *(r)*			0.620	0.636	0.528
	Sig. (2-t) (*p*)			0.000	0.000	0.000
Background	P.C. *(r)*				0.676	0.196
	Sig. (2-t) (*p*)				0.000	0.226
Mechanics	P.C. *(r)*					0.209
	Sig. (2-t) (*p*)					0.196
Interface	P.C. *(r)*					
	Sig. (2-t) (*p*)					

In Table 21, it is visible that as players' *Anticipations* towards the game and player *Background* increase (possibly related to an increase in gained *knowledge* and *abilities*), so do their *Investments* (positive *P.C. (r)* value). Also, players' *Investments* increase as their awareness and judgement towards the game *Mechanics* and *Interface* increases. It is also possible to see that as players acknowledged the game's *Mechanics* and *Interface*, their *Anticipations* towards the game also increased. These various correlations are strongest for the *Mechanics* and *Investments* correlation ($r=0.665$, $p=0.000$) and the *Anticipations* and *Background* correlation ($r=0.664$, $p=0.000$), both moderately[38] positive correlations. What is possible to infer from this is that as participants' positive judgement towards the *Mechanics* of the game increased (comprehension of goals and rules, acknowledgement of rewards), so did their *Investments* towards the game map played.

In game map M2, 7 of 10 possible correlations are confirmed with a confidence interval of at least 95% (significance level of $p<0.05$). Table 22 represents a summary of the multiple variable (model dimensions) correlations for game map M2.

Table 22: Summary of Correlations for game map M2 (*ReCycle* case)

MAP 2		Investments	Anticipations	Background	Mechanics	Interface
Investments	P.C. *(r)*		0.477	0.192	0.665	0.349
	Sig. (2-t) (*p*)		0.002	0.235	0.000	0.027
Anticipations	P.C. *(r)*			0.664	0.498	0.483
	Sig. (2-t) (*p*)			0.000	0.001	0.002
Background	P.C. *(r)*				0.580	0.248
	Sig. (2-t) (*p*)				0.000	0.123
Mechanics	P.C. *(r)*					0.306
	Sig. (2-t) (*p*)					0.055
Interface	P.C. *(r)*					
	Sig. (2-t) (*p*)					

[38] According to Bryman & Cramer (2005)

Similar to game map M1, all previous correlations remain with exception to the *Background* and *Investments* correlation. In this map, the multiple correlations are strongest for *Investments* and *Mechanics* (*r=0.665, p=0.000*), and *Background* and *Anticipations* (*r=0.664, p=0.000*). Regarding *Investments* and *Mechanics*, the reasoning is similar as in map M1. For *Background* and *Anticipations*, we can infer that as players' *Background* increased (possibly supported by greater knowledge and ability to play the game), so did their *Anticipations* towards the game itself.

For game map M3, 8 of 10 possible correlations are confirmed with a confidence interval of at least 95% (significance level of $p<0.05$). Table 23 represents a summary of the multiple variable (model dimensions) correlations for game map M3.

Table 23: Summary of Correlations for game map M3 (*ReCycle* case)

MAP 3		Investments	Anticipations	Background	Mechanics	Interface
Investments	P.C. *(r)*		0.589	0.174	0.710	0.593
	Sig. (2-t) (*p*)		0.000	0.283	0.000	0.000
Anticipations	P.C. *(r)*			0.504	0.569	0.679
	Sig. (2-t) (*p*)			0.001	0.000	0.000
Background	P.C. *(r)*				0.490	0.208
	Sig. (2-t) (*p*)				0.001	0.199
Mechanics	P.C. *(r)*					0.407
	Sig. (2-t) (*p*)					0.009
Interface	P.C. *(r)*					
	Sig. (2-t) (*p*)					

These correlations are strongest for *Investments* and *Mechanics* (*r=0.710, p=0.000*) and *Interface* and *Anticipations* (*r=0.679, p=0.000*). Regarding *Mechanics* and *Investments*, the reasoning is similar to maps M1 and M2. Considering players had gained knowledge regarding the rules of the game and how to interact in order to win from the previous two rounds (also reinforcing their abilities), their attitude towards the game's *Mechanics* increased, as did their *Investments* to play, considering they were plausibly more prepared to play the map in question. Regarding *Anticipations* and *Interface*, it seems that players' *Anticipations* increased in line with their opinion regarding the *Interface* of the game. In fact, it is in this map where the most visible changes in the video game interface are found, related to the change in the size of the game map.

Overall, two of the many predominant correlations among the three maps were between (*i*) *Mechanics* and *Background*, as well as (*ii*) *Mechanics* and *Investments*. Considering the basic nature and mechanics of 'ReCycle', focused on surviving and defeating opponents, the results from these correlations follow some of the existing theory. Looking at the *Mechanics* and *Background* correlation, the nature of 'ReCycle' creates conditions for enjoyment according to multiple player backgrounds. The game supports both a 'Conqueror' (enjoys challenges and winning) or 'Manager' (enjoys learning and optimizing tactical techniques) approach (Bateman & Boon, 2006); as well as an 'Achiever' (motivation for defining goals and pursuing them) or 'Killer' (motivated to kill opponents) approach (Bartle, 2006). Because the mechanics of the game are in line with this diversity of background (game preferences), the strong correlations are justified.

With *Mechanics* and *Investments*, the game itself also reflects on the multiple characteristics of the *Investments* dimension. Despite the simplicity of the game, the changes verified along the three maps (allied to the always present competitive factor) fostered a growing motivation to play, as well as an effort and attention requirement from the player. In turn, these circumstances triggered a greater connection towards the game, sustained on the desire to continue playing and an overall enjoyment of the game.

Lastly, looking at *Investments* and *Background*, while a significant correlation was not found between these two dimensions, this can be explored from a positive standpoint. It seems that the extent to which players invest in a game is independent and not necessarily related of their profile and particular background. Specifically, it isn't completely relevant that you have the appropriate ability to play, a previous background or knowledge regarding the game to invest in the game and enjoy playing it. It is possible that any player – regardless of these background related characteristics – invest in at video game, and bring their motivations, attention, time and effort dedication into the act of play.

Based on the summary of these correlation results, and regarding *Hypothesis 1*, there are multiple statistically significant correlations between the multiple variables (model dimensions), which confirm our hypothesis. For each of the three maps considered, the minimum number of correlations verified was seven of a possible ten. This suggests that there was interplay between multiple model dimensions which are at the core of the proposed gameplay experience.

7.1.1.3 *Anticipations* Dimension (AD) Analysis

The *Anticipations* Dimension (AD) is a computed latent variable based on the scores of the *Expectations* (*QI* 20), *Actions* (*QI* 22) and *Control* (*QI* 11, 22) characteristics. Three AD variables were computed, one for each of the game maps played in the first three rounds: AD_{M1}, AD_{M2}, and AD_{M3}. These variables were computed in order to evaluate whether differences in game maps led to changes in players *Anticipations*.

HYPOTHESIS 2: VIDEO GAME MECHANICS & INTERFACE *VS.* ANTICIPATIONS

Hypothesis 2 states: *regarding possible interplay, video game characteristics related to mechanics and interface influence the outcome of the gameplay experience*. Hypothesis 2 is valid for the *Anticipations* Dimension if there are statistically significant differences in the registered means among the three game maps played.

Table 24 summarizes the univariate analysis for the three *Anticipations* dimension (AD) variables, based on questionnaire results from rounds M1, M2 and M3.

Table 24: Summary of Univariate Analysis for the *Anticipations* Dimension variables (*ReCycle* case)

	Mean	SD	Median	Mode	Minimum	Maximum
AD_{M1}	3.556	0.627	3.750	3.75	2	4.5
AD_{M2}	3.594 ↗	0.676	3.750	4	2	5
AD_{M3}	3.656 ↗	0.757	3.750	3.75	1.5	5

Based on the presented measures of ***central tendency***, the *Mean* results show a small increase in *Anticipations* from the map in the first round M1 (*M=3.556*) to the second M2 (*M=3.594*) and to the third M3 (*M=3.656*). The *Median* results are equal among all three map related variables (*Mdn*=3.750). The *Mode* results are 3.75 for M1 and M3; and 4 for M2. Considering the measures of ***dispersion***, the values of *Standard Deviation* present an increase from M1 *(SD=0.627)*, to M2 (*SD=0.627)* and to M3 *(SD=0.757).*

These values show that for each round, there is an increase in the dispersion of the values around the mean. In terms of *Minimum* and *Maximum* values, AD_{M1} and AD_{M2} both have a minimum of 2, while AD_{M2} has a maximum of 5. The *range*[39] value is highest for M3, with a value of 3.5. However, this range is influenced by a value of 1.5 in M3, appearing once in the sample.

Looking at some of the observable variables which define this latent *Anticipations* Dimension variable, one of the most fluctuating was related to the *expectations characteristic* (Ec). Table 25 summarizes the univariate analysis for the three characteristics (*expectations*, *actions*, *control*) that define the *Anticipations* Dimension variable.

Table 25: Summary of Univariate Analysis for the three *Anticipations* Dimension characteristics – *Expectations*, *Actions*, *Control* (*ReCycle* case)

		Mean	SD	Median	Mode	Minimum	Maximum
Expectations *ExC*	AD_{M1}	3.05	0.876	3	3	1	4
	AD_{M2}	3.38 ↗	0.774	3	3	2	5
	AD_{M3}	3.48 ↗	0.816	3	3	2	5
Actions *AcC*	AD_{M1}	3.70	0.883	4	4	2	5
	AD_{M2}	3.58 ↘	0.931	4	4	1	5
	AD_{M3}	3.7 ↗	1.018	4	4	1	5
Control *CtC*	AD_{M1}	3.738	0.689	4	4	2.5	5
	AD_{M2}	3.713 ↘	0.792	4	4	1.5	5
	AD_{M3}	3.725 ↗	0.784	4	4.4	1.5	5

The *Mean* values for the three *Anticipations* Dimension variables is somewhat influenced by a visible increase in the ***expectations*** characteristic variable: M1 (*M=3.05, SD=0.876*), M2 (*M=3.38, SD=0.774*), M3 (*M=3.48, SD=0.816*). It seems as players progressed from map to map, players knew more clearly what to *expect* from the game. The *Mean* values for ***actions*** in M1 (M=3.7, SD=0.883), M2 (*M=3.58, SD=0.358*) and M3 (*M=3.7, SD=1.02*) are proximate; the values for ***control*** in M1 (*M=3.738, SD=0.*689), M2 (*M=3.713, SD=0.792*) and M3 (*M=3.725, SD=0.784*) are similar for M1 and M3, with a slight decrease in game map M2.

[39] Range: A measure of dispersion in Frequency Statistics, it is the difference between the largest and smallest values of a numeric variable, the *maximum* minus the *minimum*. Source: Fraenkel *et al.* (2012)

In order to statistically test *Hypothesis 2* and verify if changes in game maps M2 (related to *rules* – *Mechanics* Dimension) and M3 (related to *visuals* – *Interface* Dimension) effectively had some influence on player *Anticipations*, a *Paired-samples t-test* was applied. Prior to these tests, the normality of the data was tested based on the *Shapiro-Wilk Statistic.* The *Shapiro-Wilk Statistic* indicated the data is normally distributed for AD_{M2} (*p=0.076*), but does not follow a normal distribution for AD_{M1} (*p=0.025*) and AD_{M3} (*p=0.039*). However, considering the robustness of this parametric test, this value is overlook and the *t-tests* results are explored.

Three *t-tests* were applied to compare the means for three variables (AD_{M1}, AD_{M2}, AD_{M3}), using two variables simultaneously. The test hypotheses for the *Anticipations* Dimension are:

Test 1, Pair 1 – $H_0: AD_{M1} = AD_{M2}$ | $H_1: AD_{M1} \neq AD_{M2}$

Test 2, Pair 2 – $H_0: AD_{M1} = AD_{M3}$ | $H_1: AD_{M1} \neq AD_{M3}$

Test 3, Pair 3 – $H_0: AD_{M2} = AD_{M3}$ | $H_1: AD_{M2} \neq AD_{M3}$

Table 26 summarizes the *Paired-Samples t-test* results for the three tests applied using the *Anticipations* dimension variables.

Table 26: *Paired-samples t-test* for *Anticipations* dimension (*ReCycle* case)

	Mean	SD	*t*	*p* – Sig. (2-tailed)
***Test 1* – Pair 1: M1 – M2**	-0.038	0.562	-0.422	0.675
***Test 2* – Pair 2: M1 – M3**	-0.1	0.843	-0.75	0.458
***Test 3* – Pair 3: M2 – M3**	-0.063	0.751	-0.527	0.601

For *Test 1 – Pair 1* (M1–M2), the varying game characteristic was related to the game *rules* (*Mechanics* dimension). While there was a positive variation in all central tendency values, there was not a significant difference in the scores for the AD_{M1} (*M=3.556, SD=0.627*) and AD_{M2} (*M=3.594, SD=0.676*) conditions; *t(39)=-0.422, p=0.675* (H_0 is *not* rejected). For *Test 2 – Pair 2* (M1–M3), the varying game characteristic was related to the video game *visuals* (*Interface* dimension). In *Test 2*, there was also an increase in the values of central tendency, but there was not a significant difference in the scores for the AD_{M1} (*M=3.556, SD=0.627*) and AD_{M3} (*M=3.656, SD=0.757*) conditions; *t(39)=-0.75, p=0.458* (H_0 is *not* rejected). For *Test 3 – Pair 3* (M2–M3), two game characteristics differed: *rules* and *visuals*. Comparing mean scores for these two maps, there was not a significant difference in the scores for the AD_{M2} (*M=3.594, SD=0.676*) and AD_{M3} (*M=3.656, SD=0.757*) conditions; *t(39)=-0.527, p=0.601* (H_0 is *not* rejected). The non-significance of these results may be related to the minor differences in the results for the characteristics that form the *Anticipations* latent variable. As explained above, while participants' attitude towards the expectations characteristic steadily increased in the three maps, this increase was counterbalanced by the proximate results in the three maps for the actions and control characteristics. Therefore, the values of the three computed *Anticipations* variables were not sufficiently distinct to result in a significant difference among them in the executed tests.

Given the three *p* values for the three tests, *Hypothesis 2* is rejected: the changes in game *rules* (M1>M2) and *visuals* (M1>M3) alone, or *rules* and *visuals* simultaneously (M2>M3) did not significantly alter players' opinions regarding *Anticipations*.

HYPOTHESIS 3: GENDER *VS.* ANTICIPATIONS

Hypothesis 3 states: *regarding possible interplay, player gender does not play a role in the outcome of the gameplay experience*. Hypothesis 3 is valid for the *Anticipations* Dimension if there are non-significant differences in the means among the three game maps played for the *player gender* variable.

Hypothesis 3 is tested using an *Independent-Samples t-test*. Prior to this test, the Levene's test is run to check for Equality of Variances among male and female participants. In all three tests for the *Anticipations* Dimension – AD_{M1} (*p=0.111*), AD_{M2} (*p=0.387*) and AD_{M3} (*p=0.691*), *p>0.05*. As a result, H_0 is not rejected and equal variances are assumed.

From here, *Independent-Samples t-tests* for equality of means are considered to verify if there is statistical evidence that there are differences in the *Anticipations* results according to player gender. The *Independent-samples t-test* tests the following hypothesis (X refers to M1, M2 and M3):

$$H_0\text{: Mean for } AD_X \text{ for Men} = \text{Mean for } AD_X \text{ for Women}$$

$$H_1\text{: Mean for } AD_X \text{ for Men} \neq \text{Mean for } AD_X \text{ for Women}$$

If *p<=0.05*, than there is a statistically significant difference between male and female participants. Table 27 summarizes the results for the *Independent-Samples t-test* for the *Anticipations* Dimension.

Table 27: *Independent-samples t-test* for the *Anticipations* Dimension according to player gender (*ReCycle* case)

Test	Male		Female		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1	3.712	0.508	3.268	0.737	2.224	**0.031**
M2	3.808	0.601	3.196	0.644	2.992	**0.005**
M3	3.894	0.752	3.214	0.533	2.970	**0.005**

For the *Anticipations* dimension, there is a slightly more visible difference in the *Mean* values among male and female participants for the three tests. For the test in M1, there was a significant difference in the scores for the male (*M=3.712, SD=0.508*) and the female (*M=3.268, SD=0.737*) conditions; *t(38)=2.224, p=0.031* (H_0 is rejected). For M2, there was a significant difference in the scores for the male (*M=3.808, SD=0.601*) and female (*M=3.196, SD=0.644*) conditions; *t(38)=2.992, p=0.005* (H_0 is rejected). For M3, there was a significant difference in the scores for the male (*M=3.894, SD=0.752*) and female (*M=3.214, SD=0.533*) conditions; *t(38)=2.970, p=0.005* (H_0 is rejected). Hence, there is statistical evidence that male and female player *Anticipations* were significantly different for each of the three maps.

These differences may find justification in the clearly different profiles between male and female participants. Recalling, of the 14 female participants, seven (50%) are inexperienced, and another six are only casual players. Furthermore, only two of these female participants indicated playing shooter games (both casual players). This contrasts with the male segment of players: 8 hardcore players and 7 experienced, which is half of the male group. Additionally, 19 (73%) indicated playing shooter games. Therefore, it is understandable that male participants have different expectations when compared to female participants. The majority of male participants, having previously played shooting games, entered the game sessions with formed expectations based on their background and knowledge of shooter games. This contrasts with the female group of players, which may have some idea of shooting games, but somewhat different from that of the male group. Furthermore, running an *Independent-samples t-test* on the *Background* Dimension variable for the first map M1 (when players have their first contact with the game), resulted in a statistically significant difference in the scores for the male (*M=3.474, SD= 0.915*) and the female (*M=2.619, SD=1.061*) conditions; $t(38)=2.667$, $p=0.011$.

Given the statistical test results, *Hypothesis 3* is rejected for the *Anticipations* Dimension: there are statistically significant differences in terms of *Anticipations* between the male and female groups in all three maps played.

HYPOTHESIS 4: GAME GENRE PREFERENCE & PLAYING EXPERIENCE *VS.* ANTICIPATIONS

Hypothesis 4 states: *regarding possible interplay, players' game genre preferences and playing experience influence the outcome of their gameplay experience.* Hypothesis 4 is valid for the *Anticipations* Dimension if there are significant differences in the means among the three game maps played for the *game genre preference* and *playing experience* variables.

Hypothesis 4 is tested using an *Independent-Samples t-test* for the *game genre preference* variable; and *ANOVA* for the *playing experience* variable.

Initially considering the *preference for shooting games* (video game genre) variable, the Levene's test for equality of variances indicates that for AD_{M1} ($p=0.060$), AD_{M2} ($p=0.323$) and AD_{M3} ($p=0.907$), $p>0.05$. As a result, H_0 is not rejected and equal variances are assumed.

From here, the *t-test* are carried out to see if there is statistical evidence that preference for *shooter* games results in significantly different *Anticipations*. The *Independent-samples t-test* tests the following hypothesis ($_X$ refers to M1, M2 and M3):

$$H_0\text{: Mean for } AD_X \text{ for Preferring Shooters} = \text{Mean for } AD_X \text{ for Not Preferring Shooters}$$

$$H_1\text{: Mean for } AD_X \text{ for Preferring Shooters} \neq \text{Mean for } AD_X \text{ for Not Preferring Shooters}$$

If $p<=0.05$, than there is a statistically significant difference between players that prefer and do not prefer shooter video games. Table 28 summarizes the results for the *Independent-Samples t-test* for the *Anticipations* Dimension in the three maps.

Table 28: *Independent-samples t-test* for the *Anticipations* dimension according to Shooter game preference (*ReCycle* case)

Test	Shooter: Yes		Shooter: No		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1	3.821	0.448	3.263	0.674	3.112	**0.004**
M2	3.845	0.584	3.316	0.676	2.658	**0.011**
M3	3.798	0.797	3.5	0.697	1.251	0.219

For the *Anticipations* dimension, there are visible differences in *Mean* values among players that do and do not prefer shooter games, namely in maps M1 and M2. For the test in M1, there was a significant difference in the scores for those that prefer *shooters – YES* (*M=3.821, SD=0.448*) and *don't* – NO (*M=3.263, SD=0.674*) conditions; *t(38)=3.112, p=0.004* (H_0 is rejected). For M2, there was also a significant difference in the scores for those that prefer *shooters – YES* (*M=3.845, SD=0.584*) and *don't* – NO (*M=3.316, SD=0.676*) conditions; *t(38)=2.658, p=0.011* (H_0 is rejected). However, for M3, there was not a significant difference in the scores for those that prefer *shooters – YES* (*M=3.798, SD=0.797*) and *don't* – NO (*M=3.5, SD=0.697*) conditions; *t(38)=1.251, p=0.219* (H_0 is *not* rejected). Hence, there is statistical evidence that the *Anticipations* of those that do and do not prefer shooter games were significantly different in the first and second map, but not in the third map.

Again, the results presented here may find reason in the differences in player profile between the groups of players that do and those that do not prefer shooter games. Players that indicated preferring shooting games entered the game with some sort of anticipations of the game based on their experience with the video game genre, which contrasts with the anticipations of those that do not prefer or even play shooter games. Also, apparently only after the first two rounds did these two groups of players show non-significant differences in terms of *Anticipations*.

To test this idea, three *Independent-Samples t-tests* were executed for the *Background* Dimension (BD) variable, one for each map: BD_{M1}, BD_{M2}, and BD_{M3}. Table 29 summarizes the results for the *Independent-Samples t-test* for the *Background* Dimension in the three maps.

Table 29: *Independent-samples t-test* for the *Background* dimension according to Shooter game preference (*ReCycle* case)

Test	Shooter: Yes		Shooter: No		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
BD_{M1}	3.730	0.688	2.561	1.031	4.255	**0.000**
BD_{M2}	3.698	0.614	2.772	0.619	4.748	**0.000**
BD_{M3}	3.825	0.544	3.088	0.701	3.737	**0.001**

For BD_{M1}, there was a significant difference in the scores for those that prefer *shooters – YES* (*M=3.730, SD=0.688*) and *don't* – NO (*M=2.561, SD=1.031*) conditions; *t(38)=4.255, p=0.000*. For BD_{M2}, there was also a significant difference in the scores for those that prefer *shooters – YES* (*M=3.698, SD=0.614*) and *don't* – NO (*M=2.772, SD=0.619*) conditions; *t(38)=4.748, p=0.000*. Lastly, for BD_{M3}, there was also a significant difference in the scores for those that prefer *shooters – YES* (*M=3.825, SD=0.544*) and *don't* – NO (*M=3.088, SD=0.701*) conditions; *t(38)=3.737, p=0.001*. These results show that the individuals that played shooting video games have a different background compared to those that do not play. This difference may have reflected on the statistically significant differences in *Anticipations* between these two groups for maps M1 and M2.

Now considering the *playing experience* variable, *ANOVA* is applied to test if there are significant differences in terms of *Anticipations* among players with different playing experiences. *ANOVA* was applied for all three maps, M1, M2 and M3, while comparing the four categories of playing experience (*inexperienced*, *casual*, *experienced* and *hardcore*). Prior to the *ANOVA* test, the Levene statistic indicates if there are variances among the tested groups. In all three tests – AD_{M1} (*p=0.061*), AD_{M2} (*p=0.106*) and AD_{M3} (*p=0.174*), *p>0.05*. As a result, H_0 is not rejected and equal variances are assumed.

From here, we look into the *ANOVA* results to test if for M1, M2 and M3, there is statistical evidence that playing experience influenced players' *Anticipations*. *ANOVA* tests the following hypotheses (M_X refers to M1, M2 and M3):

H_0: Mean for Anticipations in the 4 groups in M_X is equal

H_1: Mean for Anticipations is different in at least one of the 4 groups

If *p<=0.05*, than there is a statistically significant difference in the means of the tested groups. Table 30 summarizes the results for the *ANOVA* test for the *Anticipations* Dimension.

Table 30: *ANOVA* test for *Anticipations* dimension variable (*ReCycle* case)

Test	F	*p* – Sig. (2-tailed)
M1	2.017	0.129
M2	1.127	0.351
M3	1.573	0.213

For test M1, there was not a significant difference between the player experience groups and *Anticipations* at the $p<0.05$ level, $F(3,36)=2.017$, $p=0.129$ (H_0 is *not* rejected). For test M2, there was also a non-significant difference between the player experience groups and *Anticipations*, $F(3,36)=1.127$, $p=0.351$ (H_0 is *not* rejected). Lastly, for test M3, there was not a significant difference between the playing experience groups and *Anticipations*, $F(3,36)=1.573$, $p=0.213$ (H_0 is *not* rejected). Hence, there is statistical evidence that *Anticipations* were not significantly different among player experience groups in any of the three maps. Having run *ANOVA tests* on the *Background* Dimension (BD) variables, statistically significant differences were found for BD_{M1} and BD_{M2}, suggesting that at least one of the four defined playing experience groups scored differently. A *Turkey post-hoc test*[40] revealed a significant difference between the *inexperienced* and *hardcore* groups in maps M1 ($p=0.022$) and M2 ($p=0.018$). However, these differences did not contribute to the results obtained in the *Anticipations* Dimension.

Given the statistical test results, *Hypothesis 4* is confirmed for the *game genre preference* variable. Statistical results confirmed significant differences between those that do and do not prefer shooters for the first and second map played. However, this difference did not occur for the third map. However, regarding the *playing experience* variable, *Hypothesis 4* is rejected, considering no significant differences were found between the four different playing experience groups.

[40] The Turkey Post-Hoc test is a statistical test used with ANOVA to find means that are significantly different from each other (Source: *https://statistics.laerd.com/spss-tutorials/one-way-anova-using-spss-statistics-2.php*, Accessed: July 22, 2013)

7.1.1.4 *Investments* Dimension (ID) Analysis

The *Investments* Dimension (ID) is a computed latent variable based on the scores of the *Motivation* (*QI* 3, 4), *Connection* (*QI* 1, 2, 24, 25, 27), *Attention* (*QI* 15), *Effort* (*QI* 14) and *Time* (*QI* 23) characteristics. Similar to the *Anticipations* dimension, three ID variables were computed, one for each of the three game maps played, ID_{M1}, ID_{M2}, ID_{M3}. These three variables were computed in order to study if differences in the game maps had an influence on players' *Investments*.

HYPOTHESIS 2: VIDEO GAME MECHANICS & INTERFACE *VS.* INVESTMENTS

Hypothesis 2 states: *regarding possible interplay, video game characteristics related to mechanics and interface influence the outcome of the gameplay experience*. Hypothesis 2 is valid for the *Investments* Dimension if there are statistically significant differences in the registered means among the three game maps played.

Table 31 summarizes the univariate analysis for the three *Investments* dimension (ID) variables, based on questionnaire results from rounds M1, M2 and M3.

Table 31: Summary of Univariate Analysis for the *Investments* Dimension variables (*ReCycle* case)

	Mean	SD	Median	Mode	Minimum	Maximum
ID_{M1}	3.633	0.494	3.7	3.7	2.5	4.4
ID_{M2}	3.715 ↗	0.540	3.8	4.2	2.6	4.6
ID_{M3}	4.010 ↗	0.706	4	3.9	1.3	5

Looking at the values of ***central tendency***, the *Mean* results present an increase in *Investments* from map M1 (*M=3.633*) to M2 (*M=3.715*), and a slightly higher increase for M3 (*M=4.010*). The Median results for the three variables also increase along the three maps (Mdn_{M1}=3.7, Mdn_{M2}=3.8, Mdn_{M3}=4). This shows that along the three maps, the centre of the distribution is located at higher values. The Mode results show an increase from M1 (3.7) to M2 (4.2), but a posterior drop in M3 (3.9). Considering the measures of ***dispersion***, the values of the Standard Deviation increased along the three maps, with M1 *(SD = 0.494)*, to M2 (*SD = 0.540)* and to M3 *(SD = 0.760).* These results show that over the three rounds, there is an increase in dispersion of the values around the mean. Analysing the Minimum and Maximum values, there is a visible variation in both statistics. The Minimum value increases from ID_{M1} (2.5) to ID_{M2} (2.6), but decreases in ID_{M3} (1.3). However, the frequency of the minimum value for M3 only represents one occurrence. The Maximum values increase along the three maps, from ID_{M1} (4.4) to ID_{M2} (4.6) and to ID_{M3} (5). Here, the frequency of the maximum value for M3 only represents a single occurrence. Similar to the *Anticipations* dimension, the *range* value is highest for M3, with a value of 3.7, influenced by the occurrence of the minimum value registered.

Looking at some of the observable variables (*connection, motivation, attention, effort* and *time*) that define this latent *Investments* dimension variable, all variables except *time* show an increase in *mean* along the three game maps. Table 32 summarizes the univariate analysis for the five characteristics (*connection*, *motivation*, *attention*, *effort*, *time*) that define the *Investments* Dimension variables.

Table 32: Summary of Univariate Analysis for the five *Investments* Dimension characteristics – *Connection*, *Motivation*, *Attention*, *Effort*, *Time* (*ReCycle* case)

		Mean	SD	Median	Mode	Minimum	Maximum
Connection *CoC*	$\mathbf{ID_{M1}}$	3.48	0.793	3.48	3.7	1	4.4
	$\mathbf{ID_{M2}}$	3.665 ↗	0.62	3.665	3.8	2	4.8
	$\mathbf{ID_{M3}}$	3.99 ↗	0.746	3.99	4	1.2	5
Motivation *MC*	$\mathbf{ID_{M1}}$	3.838	0.624	4	4	2.5	5
	$\mathbf{ID_{M2}}$	3.763 ↘	0.716	4	4	2	5
	$\mathbf{ID_{M3}}$	4.05 ↗	0.783	4	4	1.5	5
Attention *AtC*	$\mathbf{ID_{M1}}$	3.75	0.809	4	4	1	5
	$\mathbf{ID_{M2}}$	3.85 ↗	0.7	4	4	2	5
	$\mathbf{ID_{M3}}$	4.025 ↗	0.8	4	4	2	5
Effort *EfC*	$\mathbf{ID_{M1}}$	3.2	0.853	3	3	1	5
	$\mathbf{ID_{M2}}$	3.25 ↗	0.927	3	4	1	5
	$\mathbf{ID_{M3}}$	3.775 ↗	0.891	4	4	1	5
Time *TC*	$\mathbf{ID_{M1}}$	4.3	0.687	4	4	3	5
	$\mathbf{ID_{M2}}$	4.2 ↘	0.823	4	4	2	5
	$\mathbf{ID_{M3}}$	4.25 ↗	0.87	4	4	1	5

The *mean* values for the ***connection*** characteristic present a significant increase from M1 (*M=3.48, SD=0.793*) to M2 (*M=3.665, SD=0.62*) and M3 (*M=3.99, SD=0.746*). The same can be said for ***attention***, with values for M1 (*M=3.75, SD=0.809*), M2 (*M=3.85, SD=0.7*) and M3 (*M=4.025, SD=0.8*). However, the ***effort*** characteristic registered one of the more significant differences between the three maps, with M1 (*M=3.2, SD=0.853*), M2 (*M=3.25, SD=0.927*) and M3 (*M=3.775, SD=0.891*). The ***motivation*** characteristic registered a variation in the mean values, with a drop from M1 (*M=3.838, SD=0.624*) to M2 (*M=3.763, SD=0.716*), but a posterior increase in M3 (*M=4.05, SD=0.783*). Lastly, the differences in the ***time*** characteristic are minor, with a slight decrease from M1 (*M=4.3, SD=0.687*) to M2 (*M=4.2, SD=0.823*), and a slight increase in M3 (*M=4.25, SD=0.87*). It appears that for the three rounds and respective game maps, players became increasingly *connected* to the game, and dedicated greater *attention* and *effort*. The value of the *Investments* dimension (ID) variable for map M3 (*M=4.010*) (*cf.* Table 31, *p. 218*) is largely influenced by the significant differences registered in the various scores when compared to the other two ID variables for M1 and M2.

In order to statistically test *Hypothesis 2* and verify if changes in game maps M2 (related to *rules – mechanics*) and M3 (related to *visuals – interface*) effectively had some influence on player *Investments*, a *Paired-samples t-test* was applied. Prior to these tests, the normality of the data was tested based on the *Shapiro-Wilk Statistic.* The statistic indicated that the data is normally distributed for ID_{M2} (*p=0.076*), but does not follow a normal distribution for ID_{M1} (*p=0.044*) and ID_{M3} (*p=0.000*). Nonetheless, as referred for the *Anticipations* dimension, the robustness of this parametric test is sufficient for us to continue to apply the *Paired-Samples t-test*.

Three *Paired-Samples t-tests* were applied to compare the means for three variables (ID_{M1}, ID_{M2}, ID_{M3}), using two variables simultaneously. The test hypotheses for the *Investments* Dimension are:

Test 1, Pair 1 – $H_0: ID_{M1} = ID_{M2}$ | $H_1: ID_{M1} \neq ID_{M2}$

Test 2, Pair 2 – $H_0: ID_{M1} = ID_{M3}$ | $H_1: ID_{M1} \neq ID_{M3}$

Test 3, Pair 3 – $H_0: ID_{M2} = ID_{M3}$ | $H_1: ID_{M2} \neq ID_{M3}$

Table 33 summarizes the results for the *Paired-samples t-test* for the three tests applied for the *Investments* dimension.

Table 33: *Paired-samples t-test* for *Investments* Dimension (*ReCycle* case)

	Mean	SD	t	*p* – Sig. (2-tailed)
***Test 1* – Pair 1: M1 – M2**	-0.083	0.071	-1.159	0.253
***Test 2* – Pair 2: M1 – M3**	-3.775	0.099	-3.798	**0.000**
***Test 3* – Pair 3: M2 – M3**	-0.295	0.102	-2.899	**0.006**

For *Test 1 – Pair 1* (M1–M2), the varying game characteristic was related to the game *rules* (*Mechanics* dimension). While there was a positive variation in all central tendency values; there was not a significant difference in the scores for the ID_{M1} (*M=3.633, SD=0.494*) and ID_{M2} (*M=3.715, SD=0.540*) conditions; *t(39)=-1.159, p=0.253* (H_0 is *not* rejected). For *Test 2 – Pair 2* (M1–M3), the varying game characteristic was related to the game *visuals* (*Interface* dimension). In *Test 2*, there was also an increase in the values of central tendency, and a significant difference in the scores for the ID_{M1} (*M=3.633, SD=0.494*) and ID_{M3} (*M=4.010, SD=0.706*) conditions; *t(39)=-3.798, p=0.000* (H_0 is rejected). For *Test 3 – Pair 3* (M2–M3), two game characteristics differed: *rules* and *visuals*. Comparing mean scores for these two maps, there was a significant difference in the scores for the ID_{M2} (*M=3.715, SD=0.540*) and ID_{M3} (*M=4.010, SD=0.706*) conditions; *t(39)=-2.899, p=0.006* (H_0 is rejected).

Given the three *p* values for the three tests, *Hypothesis 2* is rejected for one test and confirmed for two. Based on the player sample used, *rules* alone (M1>M2) did not significantly alter players' *Investments*. However, a change in game *visuals* (M1>M3) as well as *rules* and *game* visuals simultaneously (M2>M3) did significantly change player *Investments*.

The reason for this significant difference in *Investments* between maps M1 and M3 (difference in visuals) may be found in players' considerations of the *Interface* Dimension. Running *Paired-Samples t-tests* on three *Interface* Dimension (IfD) variables – IfD_{M1}, IfD_{M2} and IfD_{M3} – results show a significant difference in the scores of IfD_{M1} (*M=2.8125, SD=0.585*) and IfD_{M3} (*M=3.000, SD=0.686*) conditions; *t(39)=-2.097*, *p=0.043*. However, test results were not significant for the M1 – M2 pair (*p=0.062*) and M2 – M3 pair (*p=0.641*).

Looking for justification in the significant result between maps M2 and M3 (difference in visuals and rules), *Paired-Samples t-tests* were additionally run on three *Mechanics* Dimension (MeD) variables – MeD_{M1}, MeD_{M2}, and MeD_{M3} – to complement the *Interface* Dimension variables. With the MeD variables, statistical significance was found in all three tests: M1 – M2 pair (*p=0.042*); M1 – M3 pair (*p=0.000*); M2 – M3 pair (*p=0.001*). Therefore, in Test 3 (M2–M3) of the *Investments* Dimension variable, although there wasn't a statistically significant difference in terms of the *Interface* (*p=0.641*), there was significance in terms of Mechanics (*p=0.001*) for the same pairing of maps, which may have inclined the results of this test towards the registered statistical significance.

HYPOTHESIS 3: GENDER *VS.* INVESTMENTS

Hypothesis 3 states: *Regarding possible interplay, player gender does not play a role in the outcome of the gameplay experience*. Hypothesis 3 is valid for the *Investments* Dimension if there are non-significant differences in the means among the three game maps played for the *player gender* variable.

Hypothesis 3 is tested using an *Independent-Samples t-test*. Prior to this test, the Levene's test is run to check for Equality of Variances among male and female participants. In all three tests for the *Investments* Dimension – ID_{M1} (*p=0.066*), ID_{M2} (*p=0.258*) and ID_{M3} (*p=0.197*), *p>0.05*. As a result, H_0 is not rejected and equal variances are assumed for the three variables. Given these results, we look into the *t-tests* for equality of means for the three tests in order to see if there is statistical evidence there are differences between *male* and *female* participants regarding their *Investments*. The *Independent-samples t-test* tests the following hypothesis (*X* refers to M1, M2 and M3):

$$H_0\text{: Mean for } ID_X \text{ for Men} = \text{Mean for } ID_X \text{ for Women}$$

$$H_1\text{: Mean for } ID_X \text{ for Men} \neq \text{Mean for } ID_X \text{ for Women}$$

If *p<=0.05*, than there is a statistically significant difference between male and female participants. Table 34 summarizes the results for the *Independent-Samples t-test* for the *Investments* Dimension.

Table 34: *Independent-samples t-test* for the *Investments* dimension according to player gender (*ReCycle* case)

Test	Male		Female		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1	3.662	0.403	3.579	0.644	0.502	0.619
M2	3.681	0.580	3.779	0.471	-0.541	0.591
M3	3.981	0.820	4.064	0.441	-0.353	0.726

For the *Investments* dimension, there is a less visible difference in the *Mean* values among *male* and *female* participants for the three tests. For the test in M1, there was no significant difference in the scores for the male (*M=3.662, SD=0.403*) and female (*M=3.579, SD=0.644*) conditions; *t(38)=0.502, p=0.619* (H_0 is *not* rejected). For M2, there was also a non-significant difference in the scores for the male (*M=3.681, SD=0.580*) and female (*M=3.779, SD=0.471*) conditions; *t(38)=-0.541, p=0.591* (H_0 is *not* rejected). For M3, there was not a significant difference in the scores for the male (*M=3.981, SD=0.820*) and female (*M=4.064, SD=0.441*) conditions; *t(38)=-0.353, p=0.726* (H_0 is *not* rejected).

Given the statistical test results, *Hypothesis 3* is confirmed for the *Investments* Dimension: there are non-significant differences between the male and female groups in all three maps played. These results may be motivated by the fact that there were no statistically significant differences between male and female players regarding their opinions on the *Interface* and *Mechanics* Dimensions for all three maps. Running *Independent-Samples t-tests* on the *Mechanics* and *Interface* Dimension variables for the three maps – MeD_{M1}, MeD_{M2}, MeD_{M3} and IfD_{M1}, IfD_{M2}, IfD_{M3}, respectively – no statistically significant differences were found in the scores between the male and female player groups: MeD_{M1} (*p=0.142*), MeD_{M2} (*p=0.136*), MeD_{M3} (*p=0.129*); IfD_{M1} (*p=0.728*), IfD_{M2} (*p=0.654*), IfD_{M3} (*p=0.813*). Therefore, it is plausible to think that as both male and female players felt similarly regarding the *Mechanics* and *Interface* of the game, their *Investments* towards playing the game were also similar.

HYPOTHESIS 4: GAME GENRE PREFERENCE & PLAYING EXPERIENCE *VS.* INVESTMENTS

Hypothesis 4 states: *Regarding possible interplay, players' game genre preferences and playing experience influence the outcome of their gameplay experience.* Hypothesis 4 is valid for the *Investments* Dimension if there are significant differences in the means among the three game maps played for the *game genre preference* and *playing experience* variables.

Hypothesis 4 is tested using an *Independent-Samples t-test* for the *game genre preference* variable; and *ANOVA* for the *playing experience* variable.

Initially considering the *preference for shooting games* (game genre) variable, the Levene's test for equality of variances indicates that for ID_{M2} (*p=0.936*) and ID_{M3} (*p=0.816*), *p>0.05*. As a result, H_0 is not rejected and equal variances are assumed. However, for ID_{M1}, *p=0.038<p=0.05*. In this case, equal variances are not assumed. Nonetheless, we proceed with the test considering the robustness of the test.

From here, we look into the *t-test* to see if there is statistical evidence that preferring or not *shooter* games results in significantly different *Investments*. The *Independent-samples t-test* tests the following hypothesis (X refers to M1, M2 and M3):

H_0: Mean for ID_X for Preferring Shooters = Mean for ID_X for Not Preferring Shooters

H_1: Mean for ID_X for Preferring Shooters ≠ Mean for ID_X for Not Preferring Shooters

If *p<=0.05*, than there is a statistically significant difference between players that prefer and do not prefer shooter games. Table 35 summarizes the results for the *Independent-Samples t-test* for the *Investments* Dimension.

Table 35: *Independent-samples t-test* for the *Investments* dimension regarding Shooter preference (*ReCycle* case)

Test	Shooter: Yes		Shooter: No		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1	3.648	0.366	3.616	0.616	0.196	0.846
M2	3.695	0.544	3.737	0.551	-0.240	0.811
M3	3.962	0.779	4.063	0.631	-0.449	0.656

For the *Investments* dimension, the differences in *Mean* values among players that do and not prefer shooter games are not particularly visible. For the test in M1, there was not a significant difference in the scores for those that prefer *shooters – YES* (*M=3.648, SD=0.366*) and *don't* – NO (*M=3.616, SD=0.616*) conditions; *t(38)=0.196, p=0.846* (H_0 is *not* rejected). For M2, there was not a significant difference in the scores for those that prefer *shooters – YES* (*M=3.695, SD=0.544*) and *don't* – NO (*M=3.737, SD=0.551*) conditions; *t(38)=-0.240, p=0.811* (H_0 is *not* rejected). Lastly, for M3, there was also a non-significant difference in the scores for those that prefer *shooters – YES* (*M=3.962, SD=0.779*) and *don't* – NO (*M=4.063, SD=0.631*) conditions; *t(38)=-0.449, p=0.656* (H_0 is *not* rejected). In all three tests, *p>0.05* and therefore, there is statistical evidence that within our sample, player *Investments* do not significantly differ according to players' preference for shooter games. Again, these results may be related to the lack of significant difference in opinion on the *Mechanics* and *Interface* Dimension between these groups of players for the three maps. Running *Independent-Samples t-tests* on the *Mechanics* and *Interface* Dimension variables for the three maps – MeD_{M1}, MeD_{M2}, MeD_{M3} and IfD_{M1}, IfD_{M2}, IfD_{M3}, respectively – no statistically significant differences were found in the scores between those that do (*YES*) and don't prefer (*NO*) shooter games: Me_{M1} (*p=0.149*), MeD_{M2} (*p=0.297*), MeD_{M3} (*p=0.812*); IfD_{M1} (*p=0.300*), IfD_{M2} (*p=0.240*), IfD_{M3} (*p=0.734*). Based on these results, it is reasonable to think that as both those that *do* and *do not* prefer shooter games felt similarly regarding the *Mechanics* and *Interface* of the game, their *Investments* towards playing the game were also similar.

Now considering the *playing experience* variable, *ANOVA* is applied to test if there are significant differences in terms of *Investments* among players with different playing experiences. *ANOVA* was applied for all three maps, M1, M2 and M3, while comparing the four categories of playing experience (inexperienced, casual, experienced and hardcore). Prior to the *ANOVA* test, the Levene statistic indicates if there are variances among the tested groups. In all three tests – ID_{M1} (*p=0.061*), ID_{M2} (*p=0.106*) and ID_{M3} (*p=0.174*), *p>0.05*. As a result, H_0 is not rejected and equal variances are assumed.

From here, we look into the *ANOVA* results to test if for M1, M2 and M3, there is statistical evidence that there are significant differences among these four groups regarding player *Investments*. *ANOVA* tests the following hypotheses (M_X refers to M1, M2 and M3):

H_0: Mean for Investments in the 4 groups in M_X is equal

H_1: Mean for Investments is different in at least one of the 4 groups

If *p<=0.05*, than there is a statistically significant difference in the means of our tested groups. Table 36 summarizes the results for the *ANOVA* test for the *Investments* Dimension.

Table 36: *ANOVA* test for *Investments* dimension variable (*ReCycle* case)

Test	F	*p* – Sig. (2-tailed)
M1	1.923	0.143
M2	0.004	1
M3	1.914	0.145

For test M1, there was not a significant difference between the player experience groups and *Investments* at the *$p<0.05$* level, *$F(3,36)=1.923$, $p=0.143$* (H_0 is *not* rejected). For test M2, there was also a non-significant difference between the player experience groups and *Investments*, *$F(3,36)=0.004$, $p=1$* (H_0 is *not* rejected). Lastly, for test M3, there was not a significant difference between the player experience groups and *Investments*, *$F(3,36)=1.914$, $p=0.145$* (H_0 is *not* rejected). Hence, there is statistical evidence that *Investments* were not significantly different among playing experience groups in any of the three maps.

Having run *ANOVA tests* on the *Mechanics* (MeD) *and* Interface (IfD) Dimension variables, statistically significant differences were found for the *Mechanics* Dimension in maps M1 (Me_{M1}), suggesting that at least one of the four defined playing experience groups scored differently. A *Turkey post-hoc test* revealed a significant difference between the *inexperienced* and *casual* groups in maps M1 (*$p=0.055$*) and the *inexperienced* and *hardcore* group in the same map, M1 (*$p=0.045$*). However, these differences did not have an influence on the results of the *ANOVA* tests for the *Investments* dimension. Therefore, while there was some difference between these groups – specifically in map M1 – this did not lead to statistically significant differences between the four groups in the analysed *Investments* Dimension.

Given the statistical test results, *Hypothesis 4* is confirmed for *game genre preference* and *playing experience* variables. Statistical results confirmed non-significant differences between those that do and do not prefer shooters, as well as among the four playing experience groups.

7.1.1.5 Summary of 'ReCycle' Statistical Results

The previously presented results served to analyse the validity of the first four study hypothesis, essentially focused on the main research question.

Succinctly, regarding *Hypothesis 1*, the hypothesis is confirmed considering the multiple significant correlations verified between the model dimensions. Specifically, for each of the three maps played, the minimum number of correlations verified was seven of a possible ten.

Regarding *Hypothesis 2* – related to the influence of game characteristics – the hypothesis is rejected for the *Anticipations* Dimension in all three maps. For the *Investments* Dimension, the hypothesis is rejected for map M1, but confirmed for maps M2 and M3, suggesting the change in game visuals influenced players' investments in the game. Players' investments were also influenced by a simultaneous change in game rules and visuals.

Regarding *Hypothesis 3* – related to player gender – it is rejected for the *Anticipations* Dimension, but confirmed for the *Investments* Dimension. This suggests that while male and female players had different expectations regarding the game, related to a significant difference in background between the groups – this did not influence their investments.

Regarding *Hypothesis 4*, and looking at game genre preference, it is confirmed for the *Anticipations* Dimension in the first and second maps, but rejected in the third. This suggests that in the first two rounds, players that don't prefer shooters had significantly different thoughts on expectations compared to players that prefer shooters. However, these differences did not affect the *Investments* Dimension, where non-significant differences were registered in all three maps. Furthermore, Hypothesis 4 is rejected for the playing experience variable, where both *Anticipations* and *Investments* registered non-significant differences between the four different experience groups.

Figure 35 represents the summary of statistical results for the 'ReCycle' case. The summary includes the Pearson Correlations among the multiple dimensions for each of the three game maps played. Also represented is the summary of statistical test results for five of the model dimensions (*Mechanics*, *Interface*, *Investments*, *Anticipations*, *Background*): *Paired-Samples t-tests*, *Independent-Samples t-tests* for player gender and game genre preference, and *ANOVA* for playing experience.

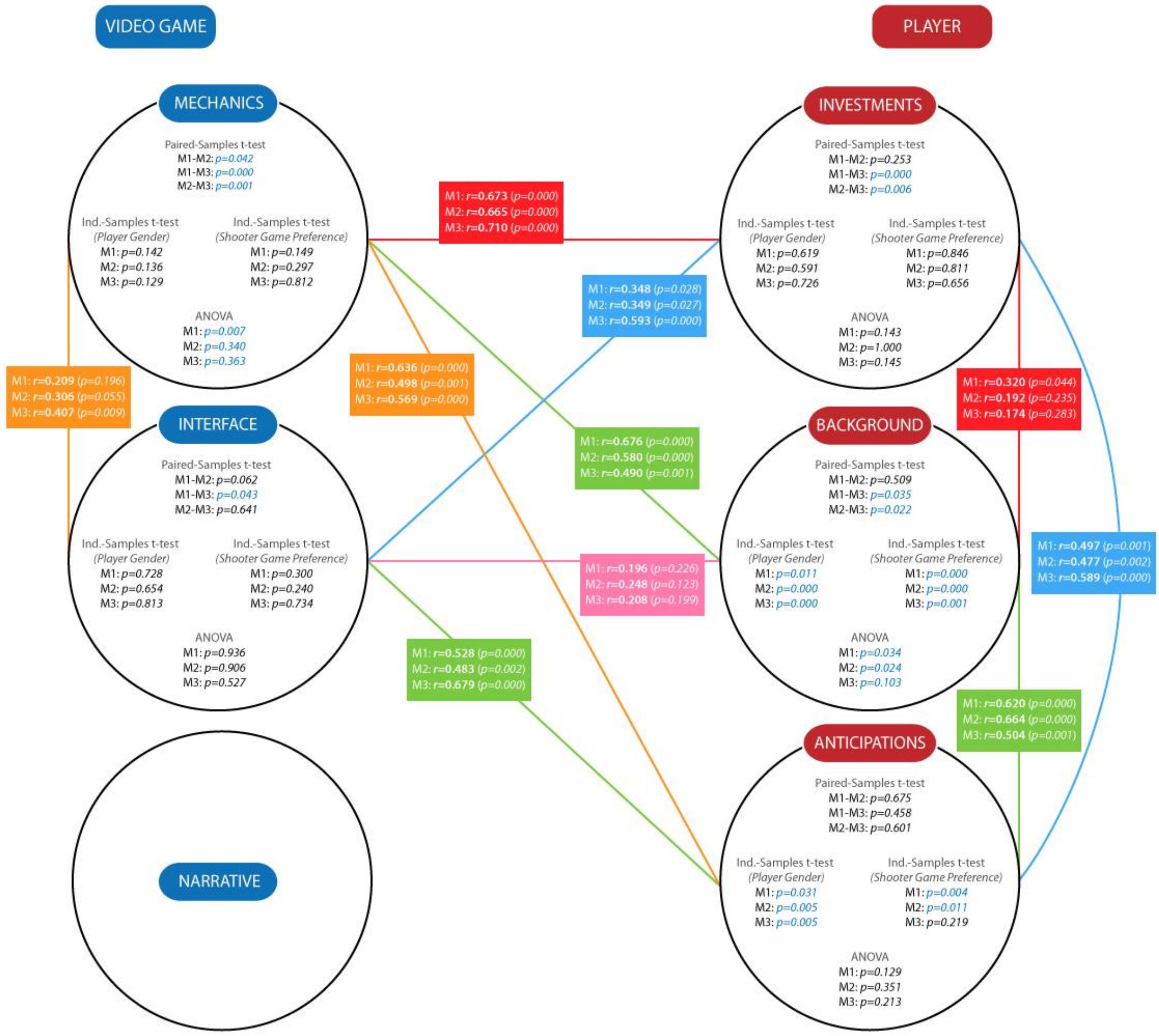

Figure 35: Visual representation of Pearson Correlations and additional statistical tests (Paired-Samples t-tests, Independent-Samples t-tests, and ANOVA) among model dimensions

7.1.2 ReCycle Gameplay Results

Hypothesis 5 states: *players' interaction behaviour can provide information regarding their level of understanding of the game mechanics and abilities, both part of the gameplay experience.* Hypothesis 5 is confirmed if the collected gameplay metrics grans some information on players' possible understanding of ReCycle's rules (related to the game mechanics) and demonstrated level of abilities, according to differences in results among player gender, playing experience groups, and game genre preferences.

As introduced above (*cf.* Section *6.4.1* – 'ReCycle'*, p. 193*), ReCycle's logging possibilities generate two log files with information related to players' positions and actions during game runtime. In this section, results from the seven game sessions are explored, based on the data extracted from the log file related to player actions. This data allows us to understand the interactive experience of the players, one part of models' interpretation of the gameplay experience.

The data collected allows us to analyse the various interactive experiences that occurred on a global level, as well as specifically on each of the three maps. For each of these situations, the analysis will consider several variables, including: player *gender*, playing *experience*, and *video game genre preference* for shooter games (information collected from the Pre-Questionnaires). Table 37 summarizes the various situations, player variables and metrics that were analysed with the 'ReCycle' metrics data.

Table 37: Summary of considered Gameplay Analysis situations, player variables and metrics for the 'ReCycle' case

Situations Analysed	Player Variables Considered	Game Metrics Analysed
Global Analysis[41] Map 1 Map 2 Map 3	• Player gender • Playing experience • Preference for shooter games	• **Number of Spawns**: number of times a player begins the game; • **Times hit by other players** (*shot hit player*): number of times a player was shot by an enemy and translates into a quantitative energy loss; • **Shots fired**: number of times a player fired a shot; • **Run**: number of times a player ran in the game; • **Killed by shooting**: number of times a player was killed by an opponent's shot; • **Added Energy**: number of times a player added energy from available sources, translated into the amount collected; • **Alliances proposed**: number of alliances a player proposed to another player; • **Alliances accepted**: number of alliances a player accepted to form with another player; • **Maximum, Minimum and Mean Energy**

[41] For a detailed analysis of Gameplay Metrics data for Map 1, Map 2 and Map 3, please refer to Appendix 2A – Map 1 (*cf. p.* 273), Appendix 2B – Map 2 (*cf. p.* 273) Appendix 2C – Map 3 (*cf. p.* 273)

Beginning with a global analysis of the accumulated metrics data, Table 38 summarizes the global analysis of the collected data for the various defined independent variables.

Table 38: Summary of 'ReCycle' accumulated gameplay data from all players and all seven game sessions

	Global	**Male**	**Female**	**Inex.**	**Casual**	**Exper.**	**Hardcore**	**Shoot *Yes***	**Shoot *No***
Spawns	**308**	217	91	64	121	34	89	168	140
Shot Hit Player	**26155**	17208	8947	4693	11769	2424	7269	13737	12418
Shoot	**3953**	3325	628	539	1580	583	1251	2621	1332
Run	**5915**	3451	2464	1391	1850	932	1742	2730	3185
Killed Got Shot	**130**	85	45	25	62	10	33	66	64
Add Energy	**12954**	9536	3418	1363	4994	2502	4095	7547	5407
Alliance Proposal	**93**	77	16	12	15	19	47	63	30
Alliance Accepted	**14**	10	4	1	6	3	4	9	5

From the larger representation presented in Table 38, Table 39 summarizes the global collected data from the various log files according to participants.

Table 39: Summary of 'ReCycle' accumulated gameplay data according to *participats*

	Sum	**Mean/Session**	**Mean/Partic.**	**Maximum**	**Minimum**
Spawns	308	44	7.7	71	22
Shot Hit Player	26155	3736.4	653.9	7477	642
Shoot	3953	564.7	98.8	1554	179
Run	5915	845.0	147.9	2152	439
Killed Got Shot	130	18.6	3.3	39	1
Add Energy	12954	1850.6	323.9	3414	839
Alliance Proposal	93	13.3	2.3	22	0
Alliance Accepted	14	2	0.4	5	0
Add Energy Team	1302	186	32.6	434	0
Max Energy	305	---	---	---	---
Min Energy	1	---	---	---	---
Mean Energy	122.9	---	---	---	---

A total of 308 'spawns' were registered from 40 participants during the seven game sessions. This results in *mean* of 44/session or 7.7/participant. The maximum value registered in a single session was 71 while the minimum was 22. The 'add energy' action was registered 12954 times, resulting in an average of 1850.6/session and 323.9/participant during the seven sessions. Regarding alliances, only 93 alliances were formed during the seven sessions, with an average of 13.3/session and 2.3/participant. Lastly, the highest value of an energy level registered for a participant was 305, with an average of 122.9 during all sessions.

PLAYER GENDER ANALYSIS

Considering the gameplay results according to player gender, male participants were responsible for 217 (70.5%) of the 308 total spawns, averaging 36.2/session (M/S) or 8.3/participant (M/P). Female participants completed 91 (29.5%) spawns, with an average of 15.2/session and 6.5/participant. Table 40 represents the summary of gameplay data according to players' gender.

Table 40: Summary of general gameplay data according to *player gender*

	MALE					FEMALE				
	Sum	**M/S**	**M/P**	**Max**	**Min**	**Sum**	**M/S**	**M/P**	**Max**	**Min**
Spawns	217	36.2	**8.3**	56	20	91	15.2	**6.5**	27	6
Shot hit player	17208	2868.0	**661.8**	5549	1670	8947	1491.2	**639.1**	3247	627
Shoot	3325	554.2	**127.9**	1424	275	628	104.7	**44.9**	179	51
Run	3451	575.2	**132.7**	1460	169	2464	410.7	**176.0**	692	28
Killed got shot	85	14.2	**3.3**	27	7	45	7.5	**3.2**	16	1
Add Energy	9536	1589.3	**366.8**	2613	615	3418	569.7	**244.1**	1189	237
Alliance Proposal	77	11.0	**3.0**	22	0	16	2.3	**1.1**	12	0
Alliance Accepted	10	1.4	**0.4**	3	0	4	0.6	**0.3**	2	0
Add Energy Team	1065	152.1	**41.0**	434	0	237	33.9	**16.9**	90	0
Max Energy	305	---	**---**	---	---	250	---	**---**	---	---
Min Energy	1	---	**---**	---	---	1	---	**---**	---	---
Mean Energy	126.3	---	**---**	---	---	113.5	---	**---**	---	---

As could be expected, male participants registered higher sum totals than female participants because of participant distribution. Additionally, mean values per participant (M/P) were also higher for male participants, with exception to the *running* metric. In many results, the differences between male and female players were accentuated, such as *shooting* (127.9/44.9) and *adding energy* (366.8/244.1). Male players also registered a higher maximum level of *energy* (305/250) and higher mean of *energy* (126.3/113.5). Considering the profile characterization of the female participants in the sample, the results registered is understandable. Of the 14 female players, 13 (93%) are *inexperienced* or *casual* players, playing up to 5 hours per week. However, these hours are usually spent on games of other genres. Only two of the female participants indicated playing shooting games, but none considered they are experienced shooting game players.

Looking into statistical data from the Gameplay Experience Questionnaire (GExQ), *Independent-Samples t-tests* for the *Mechanics* and *Interface* dimensions show there are no statistically significant differences between male and female players in any of the three game maps played. For *Mechanics*; in M1 ($p=0.142$), M2 ($p=0.136$) and M3 ($p=0.129$), $p>0.05$. Regarding *Interface*; in M1 ($p=0.728$), M2 ($p=0.654$) and M3 ($p=0.813$), $p>0.05$. This data suggests that there are no significant differences between the male and female participants regarding their interpretation of the *Mechanics* (rules, awards and goals) or the *Interface* (visuals, audio, feedback, and input) of the game. Specifically with the *Mechanics*, these similarities are somewhat translated into the gameplay results presented above.

While male players performed better according to some game metrics (number of shots fired, added energy, mean level of energy), female players also performed better in other circumstances (number of times killed). Therefore, based on the presented metrics, there is no clear 'winner' between male and female participants.

PLAYING EXPERIENCE ANALYSIS

Data registered in the log files was also analysed according to players' indicated playing experience. Table 41 represents the summary of the game data registered according to playing experience with video games. Considering participant characterization according to this factor, of the 40 individuals in the study sample, 11 participants (27.5%) indicated they were *inexperienced*; 15 (37.5%) indicated they were *casual*; 5 (12.5%) indicated they were *experienced;* and 9 (22.5%) participants stated they were *hardcore* players.

Table 41: Summary of general gameplay data according to *playing experience*

	Inexperienced *(11 part., 27.5%)*			**Casual** *(15 part., 37.5%)*			**Experienced** *(5 part., 12.5%)*			**Hardcore** *(9 part., 22.5%)*		
	Sum	**M/S**	**M/P**	**Sum**	**M/S**	**M/P**	**Sum**	**M/S**	**M/P**	**Sum**	**M/S**	**M/P**
Spawns	64	16.0	**5.8**	121	17.3	**8.1**	34	11.3	**6.8**	89	22.3	**9.9**
Shot hit Player	4693	1173.3	**426.6**	11769	1681.3	**784.6**	2424	808.0	**484.8**	7269	1817.3	**807.7**
Shoot	539	134.8	**49.0**	1580	225.7	**105.3**	583	194.3	**116.6**	1251	312.8	**139.0**
Run	1391	347.8	**126.5**	1850	264.3	**123.3**	932	310.7	**186.4**	1742	435.5	**193.6**
Killed got Shot	25	6.3	**2.3**	62	8.9	**4.1**	10	3.3	**2.0**	33	8.3	**3.7**
Add Energy	1363	340.8	**123.9**	4994	713.4	**332.9**	2502	834.0	**500.4**	4095	1023.8	**455.0**
Alliance Proposal	12	3.0	**1.1**	15	2.1	**1.0**	19	6.3	**3.8**	47	11.8	**5.2**
Alliance Accepted	1	0.3	**0.1**	6	0.9	**0.4**	3	1.0	**0.6**	4	1.0	**0.4**
Add Energy Team	70	17.5	**6.4**	503	71.9	**33.5**	135	45.0	**27.0**	594	148.5	**66.0**
Max Energy	243	---	**---**	250	---	**---**	254	---	**---**	305	---	**---**
Min Energy	1	---	**---**	1	---	**---**	1	---	**---**	1	---	**---**
Mean Energy	119.4	---	**---**	126.1	---	**---**	142.1	---	**---**	126.7	---	**---**

Considering the distribution of players among the four experience categories, the sum totals registered are understandable. The *casual* group (15 players) registered the largest number of *spawns*, *shots*, *runs*, *killed by shots* and *add energy*. Considering other values that could show some differences between the various groups, there is a substantial difference between the two least experienced groups (inexperienced and casual) and the two more experienced groups (experienced and hardcore) regarding the *shooting* and *running* data, as well as with *add energy*. Hardcore players were those that fired the most *shots* (139.0) against other opponents, followed by the experienced players (116.6). Inexperienced players *fired* at opponents on average 49 times throughout the combination of sessions. A larger difference is visible with *running*, where hardcore and experienced players ran on average 193.6 and 186.4 times, respectively; while inexperienced and casual players ran 126.5 and 123.3 times. Lastly, inexperienced players effectively showed some 'inexperience' regarding survival considering they only *collected energy* on average 123.9 times, when compared to the other groups. Casual players *collected energy* on average 332.9 times, approximately two and a half times the number registered for inexperienced players. As occurred for other data, the two most experienced groups registered significantly high values of energy collection. Experienced players *collected energy* 500.4 times, while hardcore players *harvested energy* 455 times. On a final note regarding the energy values registered, while the highest value registered for an energy level belonged to a hardcore player (305), experienced players had an average level of energy slightly higher than the remaining three groups (142.1).

Similar to that done with player gender, statistical data from the GExQ is considered to find possible reasoning in these results. The *Independent-Samples t-tests* for the *Interface* dimension shows there is a non-significant difference between the four playing experience groups in the three game maps played. For *Interface*, in M1 ($p=0.936$), M2 ($p=0.906$) and M3 ($p=0.527$), $p>0.05$. Regarding *Mechanics*, *Independent-Samples t-tests* show that for M2 (p=0.340) and M3 (p=0.363), there are no significant differences between the four tested groups.

However, for game map M1 ($p=0.007<p=0.05$), there is a statistically significant difference in at least one of the four groups. A Turkey post-hoc test revealed a significant difference between *Inexperienced* and *Casual* players ($p=0.005$), and *Inexperienced* and *Hardcore* players ($p=0.045$).

While Table 41 summarizes the total game metrics data for the playing experience groups, the specific metrics data from map M1 (*cf.* Appendix 2A – Map 1, *p.* 299) reveals some differences between *inexperienced* and *casual* players in terms of number of shots fired ($M_I=17.9$; $M_C=28.1$) and energy added ($M_I=46.4$; $M_C=94.4$). Comparing *inexperienced* and *hardcore* players, these differences are also salient, with differences in the number of *shots fired* ($M_I=17.9$; $M_H=35.1$) and *energy added* ($M_I=46.4$; $M_H=192.2$). The *running* metric also revealed some differences ($M_I=46.9$; $M_H=80.9$).

What these results suggest is that *inexperienced* players, when beginning the game in map M1, revealed possible difficulties in commencing play and a lack of assimilation of the rules and objectives of the game. Considering their lack of experience with games – *shooter* games included – these results find justification. Only with a second round of play in map M2 (and posteriorly map M3) did the inexperienced players show a better understanding of the mechanics which resulted in the non-significant differences registered for the remaining game maps played: M2 and M3.

GAME GENRE (SHOOTER) PREFERENCE ANALYSIS

Another analysis variable is based on participants' indication of *game genre preference*. Considering participant characterization, 21 participants (52.5%) – 19 male, 2 female – indicated they prefer (played) shooter games; the remaining 19 (47.5%) do not. Table 42 represents the summary of data according to the referred variable.

Table 42: Summary of general gameplay data according to player fondness for shooter games

	Shooter: YES *(21 part., 52.5%)*					**Shooter: NO** *(19 part., 47.5%)*				
	Sum	**M/S**	**M/P**	**Max**	**Min**	**Sum**	**M/S**	**M/P**	**Max**	**Min**
Spawns	168	28,0	**8,0**	47	18	140	20,0	**7,4**	38	6
Shot hit player	13737	2289,5	**654,1**	4340	1463	12418	1774,0	**653,6**	3966	253
Shoot	2621	436,8	**124,8**	1275	145	1332	190,3	**70,1**	279	102
Run	2730	455,0	**130,0**	1085	88	3185	455,0	**167,6**	1067	71
Killed got shot	66	11,0	**3,1**	20	6	64	9,1	**3,4**	19	1
Add Energy	7547	1257,8	**359,4**	2230	530	5407	772,4	**284,6**	1889	381
Alliance Proposal	63	10,5	**3,0**	22	0	30	4,3	**1,6**	14	0
Alliance Accepted	9	1,5	**0,4**	3	0	5	0,7	**0,3**	2	0
Add Energy Team	873	145,5	**41,6**	300	0	429	61,3	**22,6**	192	0
Max Energy	254	---	**---**	---	---	305	---	**---**	---	---
Min Energy	1	---	**---**	---	---	1	---	**---**	---	---
Mean Energy	127,2	---	**---**	---	---	118,3	---	**---**	---	---

Prior to the analysis of the results presented in Table 42, a stereotype might suggest that players who play and prefer shooter games will perform better than those who do not. However, the registered values suggest these differences are not that substantial. Looking at the mean values registered between these two groups, only some of the data is slightly higher for those who play shooter games. Players that play shooting games *fired shots* nearly twice as much as those who do not (124.8/70.1); and spent more time *adding energy* (359.4/284.6). However, players that do not play shooting games spent more time *running* (167.6/130), indicating a difference in strategy between these two groups. Participants that play shooting games spent more time focussed on keeping energy levels high, while those that do not play, wasted energy more frequently by running without equally reinforcing energy levels. Nonetheless, interestingly, a player which indicated not playing shooting games registered the highest value of energy recorded.

Looking into some of the statistical results obtained, *Independent-Samples t-tests* resulted in non-significant differences in terms of the *Mechanics* and *Interface* Dimension between these groups of players for the three maps. Regarding the *Mechanics* Dimension, in M1 ($p=0.149$), M2 ($p=0.297$), and M3 ($p=0.812$), $p>0.05$. For the *Interface* Dimension, M1 ($p=0.300$), M2 ($p=0.240$), M3 ($p=0.734$), $p>0.05$. These results show that players that do not play and prefer shooter games had a similar perception on the *Mechanics* and *Interface* of the game. While this apparent similarity between groups may reflect in some metrics; in others (*shooting* and *add energy*), players preferring shooter games were visibly more capable than the other group.

Worth analysing is also the possible influence of having played on the computer with the eye tracker. Given some restraints associated to using an eye tracker, playing on the eye tracking computer may have influenced players' performance within the game. Recalling, in the Gameplay Experience Questionnaire, participants were asked to indicate their opinion on the *comfort* in playing the video game on the eye tracking computer, as well as the extent to which playing on the eye tracker *influenced* how they played.

Regarding the *comfort* in using the eye tracker, and considering player gender, *Independent-Samples t-tests* indicated no significant difference in the scores for the male ($M=4.550, SD=0.605$) and female ($M=4.546, SD=0.522$) conditions; $t(29)=0.021, p=0.983$. In terms of game genre preference, *Independent-Samples t-tests* indicated no significant differences between those that prefer – *YES* ($M=4.625, SD=0.5$) and don't prefer – NO ($M=4.467, SD=0.64$) conditions; $t(29)=0.770, p=0.447$. Lastly, for playing experience, *ANOVA* testing indicated no significant difference between the playing experience groups at the $p<0.05$ level, $F(3,27)=1.052, p=0.386$.

Regarding the *influence* of using the eye tracker, considering player gender, *Independent-Samples t-tests* indicated no significant difference in the scores for the male ($M=3.750, SD=1.118$) and female ($M=3.818, SD=1.079$) conditions; $t(29)=-0.164, p=0.871$. In terms of game genre preference, *Independent-Samples t-tests* also showed no significant differences between those that prefer – *YES* ($M=3.813, SD=0.981$) and don't prefer – NO ($M=3.733, SD=1.223$) conditions; $t(29)=0.199, p=0.843$. Lastly, with playing experience, *ANOVA* testing indicated no significant difference between the playing experience groups at the $p<0.05$ level, $F(3,27)=0.619, p=0.609$.

These results reveal that for all the player related variables (gender, video game genre preference and playing experience, all players were comfortable in playing with the eye tracking computer, and felt that it did not influence how they played. Therefore, these interactive behaviour results are independent of the platform (eye tracking computer) on which they played.

Recalling *Hypothesis 5*, the aim is to understand if players' interaction behaviour (based on the presented analysis of gameplay data) can provide information regarding players' understanding of the game mechanics and abilities. Based on the presented analysis – and considering the player gender, playing experience and video game genre preferences variables – it seems the hypothesis is partially confirmed.

Looking at the interactive experience results based on gameplay metrics, for the multiple variables analysed (*i.e.* player gender, playing experience and game genre preference), it is not possible to scrutinize the extent to which each of the opposing members in the tested groups (*inexperienced*, *casual*, *experienced* or *hardcore*) understood *ReCycle's'* mechanics. While there are some differences in terms of values considering the multiple game metrics variables, none of these are sufficiently divergent to suggest a total lack of understanding of the mechanics. Only one case approximates to this possibility, when comparing *inexperienced* players number of *energy additions* to the remaining three experience groups (*cf.* Table 41, *p. 229*). Also, the non-significant differences found between the various groups in the tested variables for the *Mechanics* Dimension also corroborates that the different groups equally understood *ReCycle's'* mechanics.

While it is not possible to clearly identify players' understanding of game mechanics based on the interactive experience, the gameplay metrics do provide data regarding players' demonstrated abilities. Between playing experience groups, those with the most experience (experienced and hardcore players) fired more shots, added more energy and ran more. Male players outperformed female players in terms of shooting at opponents, adding energy and the maximum level of energy; but female players tended to run more in the game. Lastly, between video game genre preference groups, *shooter* fans shot more often and added more energy; those that don't prefer shooters tended to run more. It seems that in terms of *strategy* related choices (adding energy, shooting at opponents) male players, experienced players and those that prefer shooter games have better skills than their opposites. However, this did not reflect, for example, on the number of times players got shot or even the mean energy levels among the different groups for the analysed. Therefore, players' skills are discernible according to some metrics, but these don't necessarily impact the overall performance of the groups.

Given these results in terms of interactive behaviour in the game, and considering the lack of significant difference in terms of *Investments* between player gender, playing experience and video game genre preference groups; it seems plausible to attribute this fact to the *gameplay situation* in which the case took place. Specifically, all game rounds were played using players that knew each other, creating a friendly setting for all players. Therefore, even if players continuously lost and were defeated, the social interaction during the rounds appears to have played a decisive role in players' investments to continue playing and to try and play a bit better in order to defeat not only their opponents, but their friends as well.

7.1.3 Visual Attention Results

Hypothesis 6 states: *eye tracking data can provide information regarding how changes in a video game modify players' visual attention patterns.* Hypothesis 6 is confirmed if the analysis of player's visual behaviour – based on eye tracking data – confirms that changes in the game's mechanics (related to the jump from game map M1 to map M2) and game visuals resulted in an alteration in participants' visual behaviour.

Specifically, in order to study the differences in attention for the three maps, three analysis areas – areas of interest (AOI) – were defined: the *Central/Weapon* area; the *Energy* area; and the *Alliance* area. Figure 36 represents a screenshot from 'ReCycle' with respective AOI.

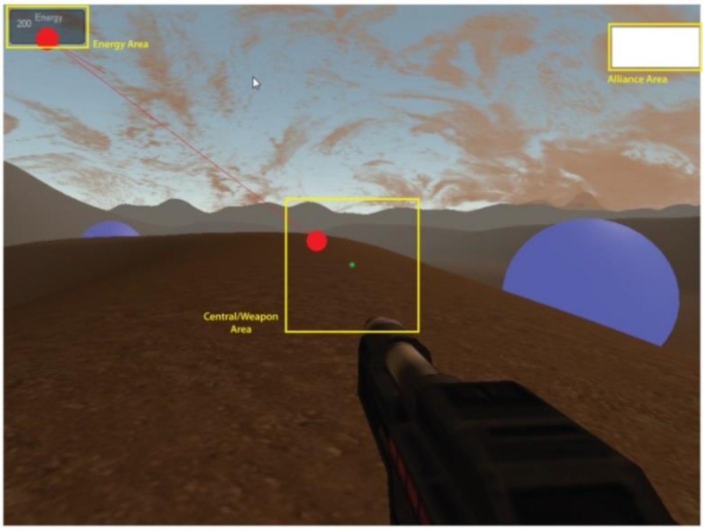

Figure 36: Definition of three areas of analysis (AOI) in the 'ReCycle' game

Two different visual behaviour metrics can be considered. The first (*i*) considers the total number of fixations that a specific area registered. The second (*ii*) considers the total time that a specific area was visualized. These two values do not necessarily have to match. It is possible for an area of analysis to be visualized multiple times but only for a minimum amount of time. However, an area can also be visualized for a long period of time, but only have been seen sporadically. Using the Tobii Studio software, eye tracking data was extracted and analysed for the three specified areas of the game interface

To test *Hypothesis 6* according to *game rules*, an analysis of the values of fixation and time count was carried out. Given the change in quantity of energy removal (game rule) from map M1 to M2, it is expected that players spend more time looking at their remaining energy (Energy Area) and possibly more frequently. Figure 37 represents the distribution of players' fixation time count (%) for the three game maps.

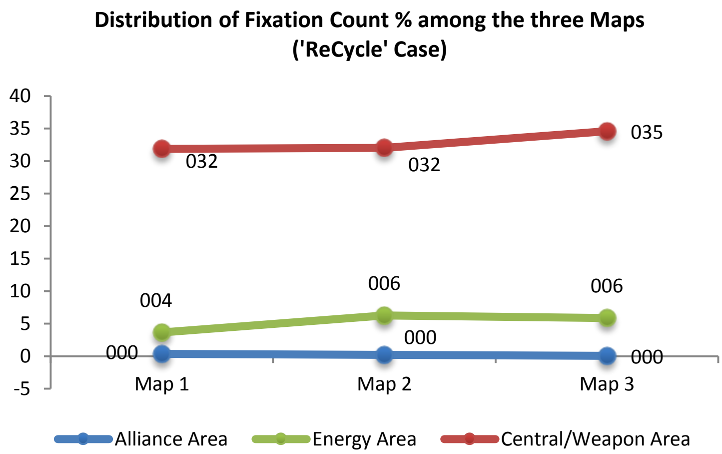

Figure 37: Distribution of players' fixation count % among the three AOI for the three maps ('ReCycle' case)

Collected data and the values present in Figure 37 show that for the *Energy* AOI, the mean fixation count (%) (based on the total number of fixations) increased from the first map M1 (*M*=3.68) to the second map (*M*=6.27). Considering that the quantity of energy players would lose returned to 'normal' in map M3, the verified decrease (*M=5.90*) is also understandable.

Visual attention was analysed considering the time spent on each of the defined areas. Figure 38 represents the distribution of players' fixation time count (%) for the three game maps.

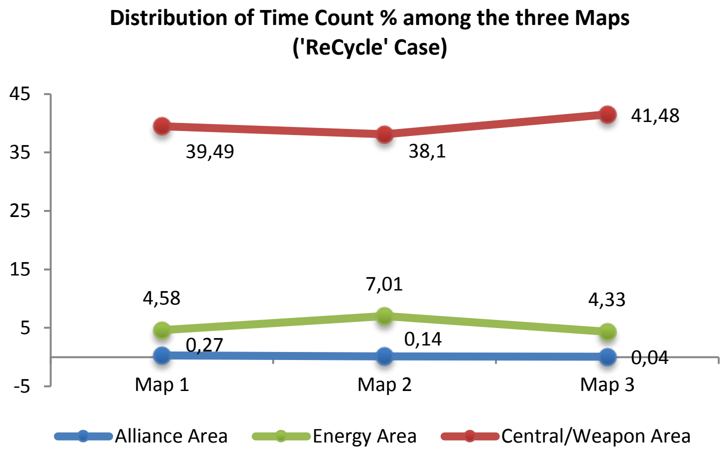

Figure 38: Distribution of players' time % count among the three AOI for the three maps ('ReCycle' case)

Regarding the mean time count (%) (based on the total time playing), values also increased from the first map M1 (*M*=4.58) to the second map (*M*=7.01), confirming players not only looked more frequently to the Energy AOI, but also looked for a longer period of time. Given the increase in daily energy loss from M1 to M2, there was a greater need to be aware of their remaining energy level which translated into the verified increase in both fixation count % and time count %.

To test the second part of *Hypothesis 6* (regarding *game visuals*), an additional analysis of the fixation values and time count was carried out. Given the reduction in map size (game visuals) from game map M2 to M3, which could foster a greater number of interactions between players, it is expected players spend more time looking at the centre of the screen where their weapon is located.

Collected data (*cf.* Figure 37 & Figure 38) shows an increase in fixation count from map M2 (*M=32.04*) to M3 (*M=34.60*) as well as in increase in time count from M2 (*M=38.1*) to M3 (*M=41.48*). This result falls in line with those verified by (El-Nasr & Yan, 2006), where in first-person shooter games, players paid attention to the centre of the screen where the aim of their gun was located. With ReCycle, map M3 also promoted more interaction and therefore, players focused more on the centre of the screen to be able to quickly and effectively fire upon their opponents.

Also worth considering is if using an eye tracker may have influenced players' visual behaviour during game play. Similar to the analysis done for the Gameplay Results, players' comfort in using the eye tracker as well as the influence it had on how they played is tested. To test possible differences in players' visual behaviour among the three game maps played, ANOVA[42] is used. In terms of players' comfort with the eye tracker, ANOVA indicated no significant difference between the three maps at the p<0.05 level, $F(2,28)=0.497$, $p=0.613$. In terms of the *influence* item, *ANOVA* testing indicated no significant difference between the playing experience groups at the $p<0.05$ level, $F(2,3)=1.236$, $p=0.306$. These results suggest that for the three game maps played, players' visual behaviour was not conditioned by their comfort in using the eye tracker, nor did they feel it influenced how they played.

Considering Hypothesis 6, it is confirmed that changes in game rules and visuals influenced players' visual attention patterns: from map M1 to M2 (change in game rules), players visualized more frequently and during a greater period of time the 'Energy Area'; from map M2 to M3 (change in visuals), players also visualized more frequently and for a greater period of time the 'Central/Weapon' Area.

PLAYING EXPERIENCE VS. VISUAL BEHAVIOUR

In addition to the previous analysis, we can look into possible differences among participants with different playing experiences. Given the irregular distribution of players with different playing experiences among the various maps, analysis is limited to the game results in general. Figure 39 represents the distribution of fixation count % according to participants playing experience.

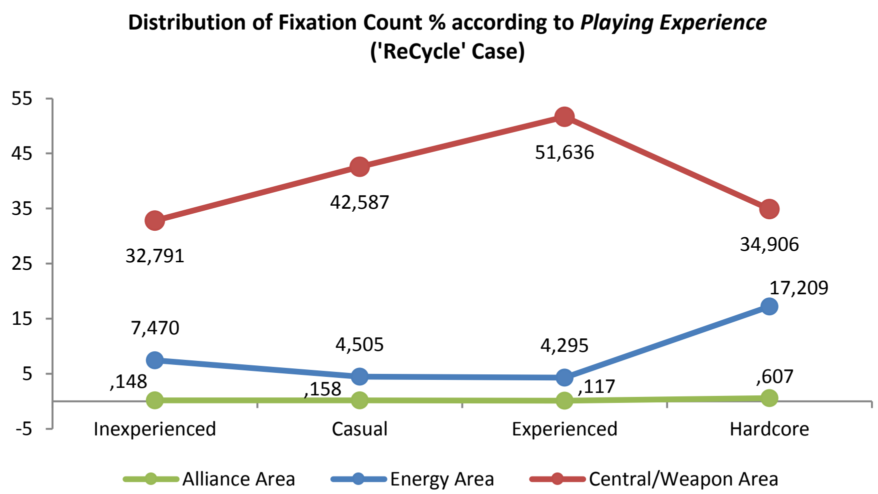

Figure 39: Distribution of players' fixation count % according to playing experience ('ReCycle' case)

[42] *Note:* For a complete overview of all 'ReCycle' statistical tests, please refer to *Appendix 1D – ReCycle & Eye Tracking* (*cf. p.* 283)

While differences in terms of the influence of game rules and visuals cannot be analysed, the overall picture shows hardcore players looked at the *Energy* (*M=17.21*) and *Alliance* area (*M=0.61*) the most compared to the remaining three groups. Nonetheless, this is not evident for the *Central/Weapon* area of the interface, where the experienced players registered the highest values (*M=41.64*). Figure 40 represents the distribution of players' time count % for the various defined areas according to playing experience.

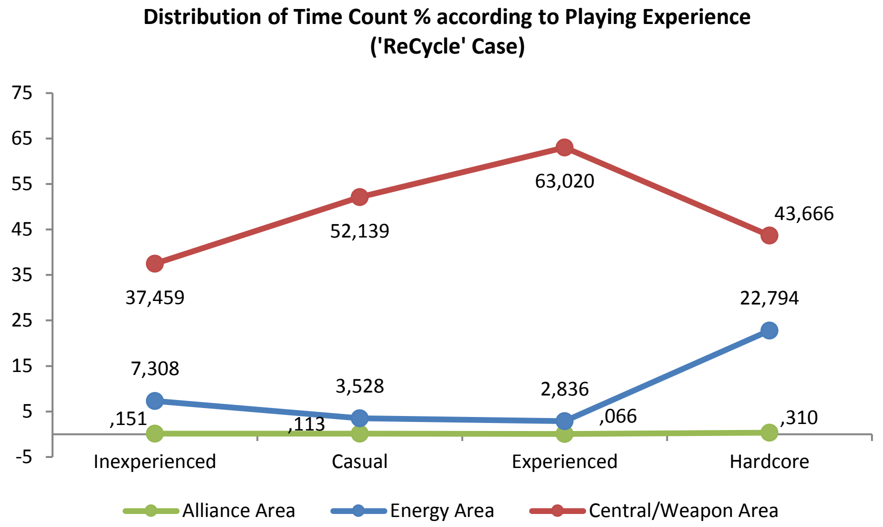

Figure 40: Distribution of players' time count % according to playing experience ('ReCycle' case)

In line with the results of the fixation count, hardcore players once again visualized during more time the Alliance (*M=0.31*) and Energy area (*M=22.79*). Also, it is the experienced players that register the highest value for the Central/Weapon area (M=63.02). These results alone cannot explain great deal about the differences in terms of visual attention between playing experience groups. However, it seems that those with more experience (Experienced and Hardcore) are those that direct their visual attention to the multiple interface areas that contain important game-related information. This somewhat confirms data from existing studies (Green & Bavelier, 2003) where it is suggested that video game players (in this case, more experienced players) have a better attention capacity compared to non-video game players (less experienced players).

7.2 'COUNTER STRIKE SOURCE: *MOD*' CASE: PRESENTATION OF RESULTS

A single game session with the *'CSSmod'* was held in October 2012. Six individuals took part in the session. No previous limitations were placed on the individual that could participate. All participants were known colleagues.

7.2.1 Statistical Results

Given the design of this case and the limitations associated to its execution, statistical analysis specific to the 'Counter Strike Source *mod*' is limited to a detailed univariate analysis of each variable independently. Hypothesis testing is also limited to *Hypothesis 1*, *Hypothesis 4* (playing experience variable), and *Hypothesis 5*.

Note: For a complete overview of all 'CSSmod' statistical tests, please refer to Appendix 1B – CSSmod Study (cf. p. 297).

7.2.1.1 Sample Characterization

A total of six participants took part in the *'CSSmod'* case game session. Figure 41 represents the distribution of participants according to gender and their playing experience.

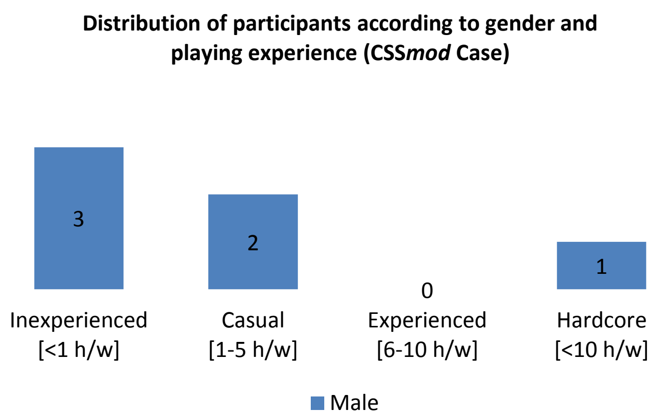

Figure 41: Distribution of participants according to gender and playing experience (*'CSSmod'* case)

The sample consisted in six male players. No female players participated in this case. Of these players, three are inexperienced, 2 are casual and one is a hardcore player.

The sample was also characterized according to game genre preferences. Figure 42 represents the distribution of players' game genre preferences.

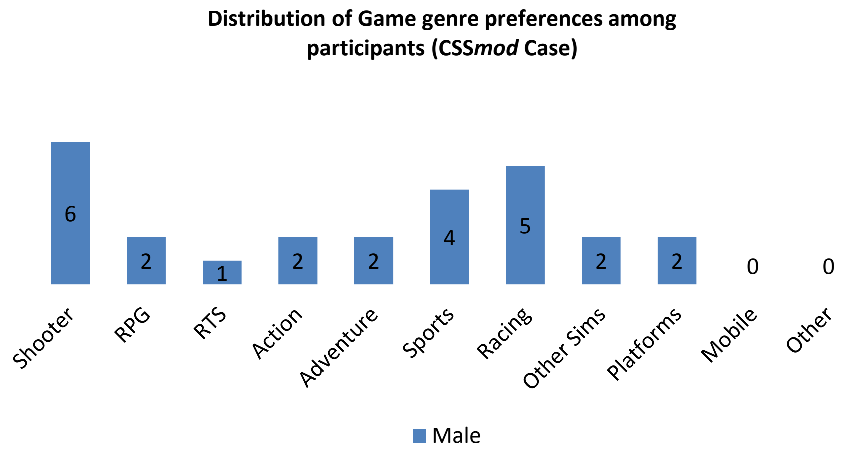

Figure 42: Distribution of game genre preferences among participants (*'CSSmod'* case)

Of the suggested game genres, shooter games were the most selected – all participants indicated preference shooter games. Five participants (83%) indicated preference racing games and four participants (67%) indicated their preference for sports games. All other game genres – except mobile games – were indicated by at least one participant.

Participants were also inquired on their game platform preferences. Figure 43 represents the distribution of participants' answers according to their preference for game platforms.

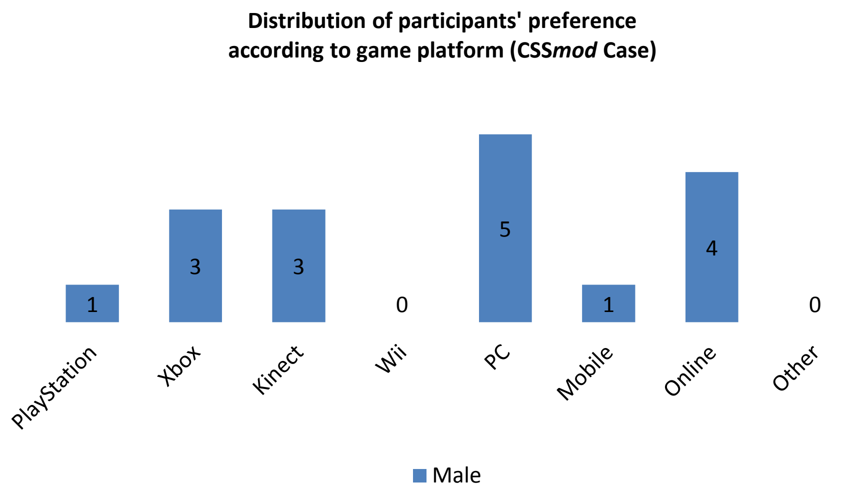

Figure 43: Distribution of game genre preferences among participants (*'CSSmod'* case)

The portable computer (PC) was the most selected gaming platform, indicated by five (83%) participants, followed by online gaming, referred by four (67%) participants. With exception to the 'Nintendo Wii', all other game platforms were mentioned by participants.

7.2.1.2 Model Dimensions Correlations ('CSS*mod*')

Hypothesis 1 states: *the gameplay experience can be defined according to the interplay between characteristics related to video game mechanics, interface, and narrative; and player motivations, skills, experience and expectations*. Hypothesis 1 can be considered valid if there are statistically significant correlations between the multiple model dimensions in the 'CSS*mod*' map played.

In order to test *Hypothesis 1*, and possible associations between the various dependent variables (*Mechanics*, *Interface*, *Investments*, *Anticipations*, and *Background* dimensions), *Pearson's Correlation Coefficient* is applied.

Looking at the possible correlations, only one in ten possible correlations are confirmed with a confidence interval of at least 95% (significance level of $p<0.05$). Table 43 represents a summary of the multiple variable (model dimensions) correlations for the 'CSS*mod*' game map.

Table 43: Summary of Correlations for 'CSSmod' variables

		Investments	Anticipations	Background	Mechanics	Interface
Investments	P.C.		-0.379	-0.750	-0.260	-0.300
	Sig. (2-t)		0.458	0.086	0.619	0.564
Anticipations	P.C.			0.791	0.822	-0.158
	Sig. (2-t)			0.061	0.045	0.765
Background	P.C.				0.433	0.250
	Sig. (2-t)				0.391	0.633
Mechanics	P.C.					-0.433
	Sig. (2-t)					0.391
Interface	P.C.					
	Sig. (2-t)					

Given the multiple possible correlations, only the *Mechanics* and *Anticipations* correlation was found to be statistically significant. Given this data, it seems that as players' awareness and agreement towards the game *Mechanics* increases, so do their *Anticipations* regarding the game. Furthermore, the coefficient value ($r=0.822$) is high, indicating this is a strong correlation.

Considering *Hypothesis 1* for this game, there is only one significant correlation between the multiple variables (dimensions). As this single correlation is not sufficiently representative of the possible correlations, the hypothesis is rejected.

7.2.1.3 Anticipations Dimension (AD) Analysis

Recalling, the *Anticipations* Dimension (AD) is a computed latent variable based on the scores of the Expectations (*QI* 20), Actions (*QI* 22) and Control (*QI* 11, 22) characteristics. Table 44 summarizes the univariate analysis for the *Expectation* Dimension variable and supporting characteristics.

Table 44: Summary of Univariate Analysis for the *Anticipations* Dimension variables (*'CSSmod'* case)

	Mean	SD	Median	Mode	Minimum	Maximum
Anticipations *Dimension*	3.833	0.204	3.875	4	3.5	4
Expectations *ExC*	3.5	0.548	3.5	3	3	4
Action *AcC*	4	0	4	4	4	4
Control *CtC*	3.91	0.204	4	4	3.5	4

Initially considering the *Anticipations* Dimension variable and measures of central tendency, the mean (*M=3.833*), median (*Mdn=3.875*) and mode (4) values are proximate. The value of the standard deviation (*SD=0.204*) is relatively small, indicating small dispersion around the mean. The minimum and maximum values are also proximate, 3.5 and 4, respectively. Considering the possible range of values in which this variable could be included, both central tendency and measures of dispersion results suggest that players' *Anticipations* were high regarding the game played.

Further looking into some of the observable variables (expectations, actions, and control) that define the *Anticipations* dimension, the obtained results follow along the line observed for the main variable. The expectations characteristic registered the lowest of the central tendency values, with a mean and median of 3.5 and a mode of 3. The value of standard deviation reports a larger dispersion around the mean, while the minimum and maximum values are 3 and 4, respectively. By contrast, the action characteristic registered the highest of central tendency values, with all values at 4. The minimum and maximum values for this characteristic are also 4. This indicates that all six participants answered '4' the action-related item of the questionnaire (*i.e.* frequency of 6 – 100% - for the value 4). Lastly, the control characteristic registered similar values compared to 'actions'. The mean value is 3.91, and the median and mode 4, respectively. The minimum and maximum values are 3.5 and 4, respectively. These values result from a frequency distribution of one for '1' (16.7%) and five for '4' (83.3%).

HYPOTHESIS 4: PLAYING EXPERIENCE *VS.* ANTICIPATIONS

Hypothesis 4 states: *regarding possible interplay, players' game genre preferences and playing experience influence the outcome of their gameplay experience.* Hypothesis 4 is valid for the *Anticipations* Dimension if there are significant differences in the mean results of the 'CSS*mod*' game map played for the *playing experience* variable. The *game genre preference* is not considered in this analysis because all six players of the sample indicated their preference for shooter games.

Hypothesis 4 is tested using *ANOVA* for the *playing experience* variable. Prior to the *ANOVA* test, the Levene statistic indicates if there are variances among the tested groups. For the *Anticipations* variable, $p=0.724$, and H_0 is not rejected and equal variances are assumed. From here, we test to see if there is statistically significant difference in the means of the three tested groups. *ANOVA* tests the following hypotheses:

H_0: Mean for Anticipations in the 3 groups is equal

H_1: The Mean for Anticipations is different in at least one of the 3 groups

If $p<=0.05$, than there is a statistically significant difference in the means of our tested groups. Table 45 summarizes the results for the *ANOVA* test for the *Anticipations* Dimension.

Table 45: *ANOVA* test for *Anticipations* dimension variable (*'CSSmod'* case)

F	Sig. (2-tailed)
0.500	0.650

The test values resulted in $F=0.5$, $p=0.$0.650. In this test, $p>0.05$ and therefore, H_0 is not rejected. Hence, there is statistical evidence that there are no significant differences between playing times in terms of players' *Anticipations*.

Given the statistical test results, *Hypothesis 4* is rejected for the *Anticipations* Dimension while considering the playing experience variable, where no significant differences were found between the three different playing experience groups.

7.2.1.4 Investments (ID) Analysis

Recalling, the *Investments* Dimension (ID) is a latent variable based on the scores of the Motivation (*QI* 3, 4), Connection (*QI* 1, 2, 24, 25, 27), Attention (*QI* 15), Effort (*QI* 14) and Time (*QI* 23) characteristics. Table 46 summarizes the univariate analysis for the *Investments* Dimension variable and supporting characteristics.

Table 46: Summary of Univariate Analysis for the *Investments* Dimension variables (*'CSSmod'* case)

	Mean	SD	Median	Mode	Minimum	Maximum
Investments *Dimension*	3.983	0.172	3.95	3.9	3.8	4.3
Motivation *MC*	4	0	4	4	4	4
Connection *CoC*	4.067	0.274	4	4	3.8	4.6
Effort *EfC*	4	0	4	4	4	4
Attention *AtC*	4	0	4	4	4	4
Time *TC*	3.5	0.837	4	4	2	4

Looking into the *Investments* Dimension variable and central tendency values, the mean (*M=3.983*), median (*Mdn=3.95*) and mode (3.9) values are proximate. Similar to the *Anticipations* Dimension variable, the Standard deviation (*SD=0.172*) is small, indicating a reduced dispersion around the mean. The minimum and maximum values are also proximate, at 3.8 and 4.3, respectively. Based on these values, and considering the possible range of values in which this variable could be included, it seems that players' *Investments* regarding the game were high.

Considering the five characteristics and observable variables (*motivation*, *connection*, *effort*, *attention* and *time*) that structure this latent variable, obtained results are consistent with the main variable. The *Motivation*, *Effort* and *Attention* characteristics registered values of '4' for all central tendency and dispersion values. These values are due to all six participants answering with '4' (frequency of 6, 100%) to the respective characteristics in the questionnaire. Regarding the *connection* characteristic, the mean value (*M=4.067*) is slightly higher than the former three characteristics, but the median and mode values remain at 4. The value of standard deviation (*SD=0.274*) suggests a small dispersion around the mean, while the minimum (3.8) and maximum (4.6) values are *positive* considering the possible range. Finally, the *time* characteristic registered the lowest of the mean values (*M=3.5*), while still remaining positive. Like all previous characteristics, the median and mode values remained at 4. The standard deviation (*SD=0.837)* is somewhat high, showing some dispersion around the mean. Lastly, the minimum value of 2 comes from a single participant (Frequency = 1, 16.7%), while the maximum value of 4 comes from four participants (Frequency = 4, 66.7%).

HYPOTHESIS 4: GAME GENRE PREFERENCE & PLAYING EXPERIENCE *VS.* INVESTMENTS

Hypothesis 4 states: *regarding possible interplay, players' game genre preferences and playing experience influence the outcome of their gameplay experience.* Hypothesis 4 is valid for the *Investments* Dimension if there are significant differences in the mean results of the 'CSS*mod*' game map played for the *playing experience* variable. Recalling, the *game genre preference* is not considered in this analysis because all six players of the sample indicated preferring shooter games.

Prior to the *ANOVA* test, the Levene statistic indicates if there are variances among the tested groups. For the *Investments* Dimension variable, *p=0.190*, and H_0 is not rejected and equal variances are assumed. From here, we test to see if there is statistically significant difference in the means of the three tested groups. *ANOVA* tests the following hypotheses:

H_0: Mean for Anticipations in the 3 groups is equal

H_1: The Mean for Anticipations is different in at least one of the 3 groups

If *p<=0.05*, than there is a statistically significant difference in the means of our tested groups. Table 47 summarizes the results for the *ANOVA* test for the *Investments* Dimension.

Table 47: *ANOVA* test for *Investments* dimension variable (*'CSSmod'* case)

F	Sig. (2-tailed)
0.927	0.486

The test values resulted in *F=0.927, p=0.*486. In this test, *p>0.05* and therefore, H_0 is not rejected. Hence, there is statistical evidence that there are no significant differences between playing experience in terms of players' *Investments*.

Given the statistical test results, *Hypothesis 4* is rejected for the *Investments* Dimension while considering the playing experience variable, where no significant differences were found between the three different playing experience groups.

7.2.2 'CSS*mod*' Gameplay Results

Hypothesis 5 states: *players' interaction behaviour can provide information regarding their level of understanding of the game mechanics and abilities, both part of the gameplay experience.* Hypothesis 5 is confirmed in the 'CSS*mod*' case if the collected gameplay metrics allows some assumption on players' understanding of the video game's rules (related to the game mechanics) and demonstrated level of abilities, according to differences playing experience. In this analysis, player gender and video game genre preference are not considered given that the sample used includes all male players and all shooter fans.

As presented in Section 6.4.2 (*cf. p. 195*), the 'CSS*mod*' video game generates two log files with information related to players' *positions*, *actions* and *events* during the game. In this section, results from the six game sessions based on the data collected from the log files are presented. Similar to the process with 'ReCycle', this data can shed light on the interactive experience of the players.

The data collected allows an analysis of the multiple interactive experiences that occurred on a global level and specifically in each of the six rounds played. For each of these situations, we look into the multiple gameplay metrics globally and understand their variation along the six rounds. Furthermore, for purposes of demonstration, we will further look into the potential of the GAMEYE application (*cf.* Section 6.4.3, *p. 196*) as an analysis tool of the interactive experience, analysing player behaviour patterns within the game. Considering players were previously divided into two groups of three players, the analysis will essentially focus on the results as individuals and grouped into *balanced* teams.

Considering the various game metrics which can be extracted from the 'CSS*mod*' game and analysed within the GAMEYE application, several analyses can be presented. Table 48 summarizes the various situations, player variables and metrics that were analysed with the 'CSS*mod*' metrics data.

Table 48: Summary of considered Gameplay Analysis situations, player variables and metrics for the 'CSS*mod*' case

Situations Analysed	Player Variables Considered	Game Metrics Analysed
Global Analysis **Round 1** Round 2 Round 3 **Round 4** Round 5 **Round 6**	• Playing experience	• **Score**: the player's score in the game; • **Deaths**: number of times a player was killed by an enemy; • **Score/Death Ratio**: ration between player's score and number of deaths; • **Sprints**: number of times a player ran in the game; • **Jumps**: number of times a player jumps in the game; • **Ducks**: number of times a player ducks in the game; • **Shots Fired**: number of times a player shoots at another player.

Recalling the study setup, the sample was previously divided into two groups of three individuals, forming a *blue* and *red* team. The *Red Team* included one experienced player and two inexperienced players; the *Blue Team* consisted of two experienced and one inexperienced player. Considering this introduction, an initial analysis can be made regarding players individually, and divided into the Blue and Red teams. Table 49 represents a summary of the global results for the 'CSSmod' case.

Table 49: Summary of Individual and Team global results for 'CSSmod'

		BLUE Team			RED Team		
	Metric	**P1** *Casual*	**P2** *Casual*	**P3** *Inex.*	**P4** *Hard.*	**P5** *Inex.*	**P6** *Inex.*
Individual *Scores*	Score (S)	73	41	20	47	28	18
	Deaths (D)	38	33	57	42	52	72
	S/D Ratio	1.92	1.24	0.35	1.12	0.54	0.25
	Sprints (Sp)	0	0	0	1733	0	1
	Jumps (J)	13	14	37	13	3	20
	Ducks (Du)	1	140	0	40	0	7
	Shots Fired (SF)	794	1958	93	3870	143	341
Team *Scores*	Score (S)	134			93		
	Deaths (D)	128			166		
	S/D Ratio	1.17			0.64		
	Sprints (Sp)	0			174		
	Jumps (J)	64			36		
	Ducks (Du)	141			47		
	Shots Fired (SF)	2845			4354		

Regarding 'team' performance, the Blue Team (BT) presented the best performance after all six rounds. With two casual and one inexperienced player, the BT managed a *Score/Death ratio* (SDr) of 1.17, mainly supported by the 1.92 SDr of player P1 (highest value among players) compared to the 0.35 SDr of the inexperienced team mate (P3). On the Red Team (RT), the hardcore player P4 managed a 1.25 SDr, but the remaining team mates registered 0.54 (P5) and 0.25 (P6) (lowest value among players), respectively. However, despite 'winning' in terms of SDr, the BT fell to the RT in the remaining gameplay metrics. Player P4 was the most active of the six players, completing the most sprints, jumps, ducks and shots fired in the game. In fact, P4 alone fired more shots than the BT combined (3870 compared to 2845). In contrast, player P3 was the least active of the players, not having registered a single run or duck, 37 jumps and 93 shots fired. In general, while the BT posted the best SDr overall, the RT was clearly more interactive (although clearly influenced by P4's scores).

PLAYING EXPERIENCE ANALYSIS

Looking at the players in terms of their playing experience, player P4 – the only hardcore player – came second to P1 (casual) in terms of SDr. However, as mentioned, P4 made apparent use of his experience and registered high values in remaining game metrics. The three inexperienced players (P3, P5 and P6) registered the lowest of the SDr values, all below 1. These values were clearly influenced by the number of registered deaths: 57 (P3), 52 (P5) and 72 (P6). The inexperienced players also registered the three lowest values in terms of 'shots fired', indicating little interaction with other players.

While these gameplay metrics provide insight on some of the players' interactive experience in the game, the complementary use of the GAMEYE application (*cf.* Section 6.4.3, *p. 196*) further clarifies on players' strategies within the game. Furthermore, it allows a closer look at specific areas in which the various interactions occurred in the game map.

For the purposes of demonstration of the GAMEYE application, we look at the examples of Round 1 (R1), Round 4 (R4) and Round 6 (R6). Round 1 is considered because it was the first round played and where all players encountered the game and all its mechanics for the first time. Round 4 is analysed considering it was the round with the largest difference in terms of SDr between the BT and RT (1.33). Round 6 is considered because it was the last round of the game.

Figure 44 represents the distribution of players (according to their playing experience) among the Blue and Red Teams for the three analysed rounds (I – *Inexperienced*, C – *Casual*, H – *Hardcore*).

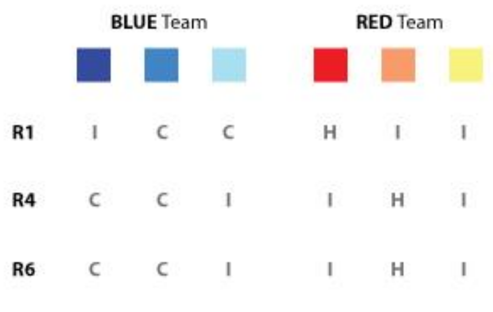

Figure 44: Distribution of players among the Blue and Red Team for the three analysed game rounds

Although players selected joining the *Blue* or *Red* Team based on a previous distribution, their allocation to one of the three *player* 'slots' was random. As a result, players from either the BT or RT are not always represented using the same colour.

Commencing with *Round 1*, we look into player behaviour in the first round and when players interacted with the game for the first time. Figure 45 represents three visualizations related to Round 1: (1A) All Routes; (1B) Heat Map and (1C) Summary of routes with player symbols over heat map.

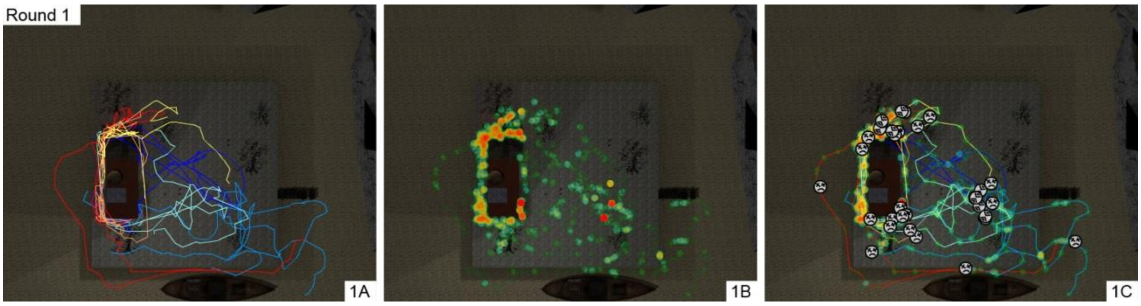

Figure 45: Representation of Round 1 visualizations – (1A) All Routes; (1B) Heat Map and (1C) Summary of routes with player symbols over heat map

In R1, the Blue Team finished with an SDr of 0.31 compared to the Red Team's 1.48 SDr. However, this value is highly influenced by the team's hardcore player (SDr = 4). The hardcore player (using the red colour) was the most active of the six players. As seen in *1A* (Figure 45), the player used a strategy that included leaving the centre of the map to look for enemies, rather than circulating the central building. Therefore, the player could easily encounter enemies and maintain discretion. In 1A, it is also possible to see that the remaining two inexperienced players of the RT rarely abandoned the left side of the building and consequentially, were fired upon more frequently. The BT members were more active in terms of diversity of movements as seen in *1A* (Figure 45). In 1B, the heat map clearly indicates that the most active area of the game map was around the building, namely at the top and left side. Additionally, three *points* are visible in the heat map which represents some areas of further interaction. Looking at 1C (Figure 45), the activity here results from four spawns (all from the Blue Team) and two deaths (1 BT, 1 RT). Figure *1C* also confirms that the intensive activity around the building visible in 1B results from multiple players' spawns and deaths.

In Round 4, we look at the moment which registered the largest difference in terms of SDr between the Blue and Red Team. Figure 46 represents three visualizations related to Round 4: (4A) All Routes; (4B) Heat Map and (4C) Summary of routes with player symbols over heat map.

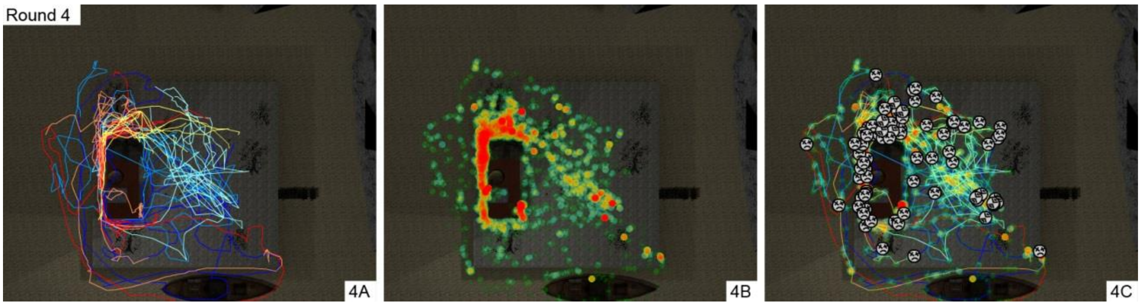

Figure 46: Representation of Round 4 visualizations – (4A) All Routes; (4B) Heat Map and (4C) Summary of routes with player symbols over heat map

Figure 46(4A, 4B and 4C) clearly shows a significant increase in activity from R1 to R4. This is a reflection of a longer period of play (approximately 3 minutes in R1, approximately 6 minutes in R4). In this round, the hardcore player (using the pink colour) continued to be an active and strategic player, but was less successful in terms of SDr (0.62) performance. Additionally, one of the inexperienced players (using red) also took more advantage of the game map, having shown some strategic initiative. However, this did not reflect in a positive SDr (0.53). The remaining inexperienced player from the RT continued to feel trouble leaving the side of the building, as represented in *4A*. Regarding the Blue Team, all three players outperformed the RT players. Not only did they occupy to a greater extent the central area of the map, they frequently took the initiative of moving to the side of the building where the RT commonly spawned. This resulted in a great concentration of activity at the top and left side of the building (Figure 46, *4B* & *4C*).

In round 6, we look at the last of the rounds played in order to see if there was any significant evolution in terms of interactive behaviour among players. Figure 47 represents three visualizations related to Round 6: (6A) All Routes; (6B) Heat Map and (6C) Summary of routes with player symbols over heat map.

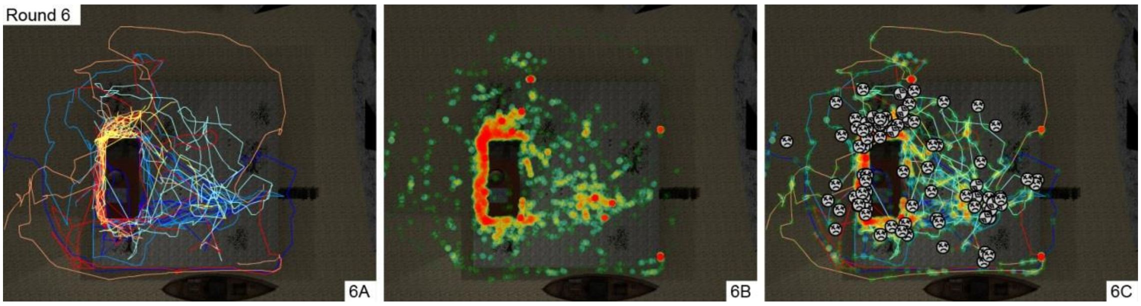

Figure 47: Representation of Round 6 visualizations – (6A) All Routes; (6B) Heat Map and (6C) Summary of routes with player symbols over heat map

Similar to Round 4, Round 6 also lasted approximately six minutes, which reflects on the multiple visible interactions that occurred. Consistent with the previous two rounds, the inexperienced player (using yellow) of the Red Team was not able to successfully leave the base area of the RT. This translated into a poor SDr (0.21), revealing that the player was killed multiple times and scored few points. In contrast, the remaining two RT players moved around the map in an attempt to surprise their opponents. In this case, the hardcore player (pink) and the other inexperienced player (red) scored a SDr of 1 and 0.85, respectively. The Blue Team was once again a clear winner, having managed to perform better than the RT and also attack them near the building where the RT spawns. In *6B* (Figure 47), the heat map shows once again that the side and top of the building was the centre of the game's action and where most of the interactions occurred (*1C*)

The results of these interactions would suggest the inexperienced players (two from the RT, one from the BT) having performed worse than the remaining two casual and one hardcore player, would have a low *Investments* value. However, as seen in Table 47 (*cf. p.* 243), no significant differences were registered in *Investments* between players of different player experiences. Furthermore, looking specifically at the questionnaire item values related to *Investments* dimension for the two most 'underperforming' (both inexperienced) players, their *Investments* score was 4 and 3.9, respectively. Considering the mean *Investments* dimension score for the session was 3.983 (*cf.* Table 46), it seems even though these players did not win, they still enjoyed playing the game.

This *enjoyment* of playing also reflects in their willing to continue to play. Both these players indicated for the *time* item of the questionnaire they would have liked to play longer. This contrasts with the answers of the two casual players, which disagreed or had a neutral opinion on continuing to play. This data helps us reflect on the level of *flow* each of these players felt at the end of the six rounds. The two casual players (both from the BT) had a final SDr of 1.92 and 1.24, respectively, even higher than the hardcore player's result (1.12). This appears to indicate these two players had reduced difficulties to win and complete their goals. Their lack of will to continue playing appears then to reflect a state of boredom, possibly resulting from the lack of balance between the difficulty of the game (the two inexperienced and hardcore player did not offer sufficient challenge) and their apparent playing skills.

By contrast, the inexperienced players, even with the visible challenge and apparent lack of skills to play, did not become anxious during the duration of the game. Rather, they invited the challenge and wanted to continue playing. Also, the underperformance does not appear to be related to their awareness of the Mechanics of the game. The two players registered a 4.25 and a 3.75 score for the Mechanics dimension, in comparison to the mean Mechanics dimension score ($M=4$, $SD=0.224$) for the session. Apparently, the players agreed they knew the goals and rules of the game, and felt sufficiently rewarded.

In a general manner, it appears that the two casual players had a positive interactive experience because they answered favourably for the mechanics and interface of the game and had the background to play. These ingredients led them to perform best in the summary of the six rounds. These results appear to have positively reflected on their emotional experience, considering the *Motivation* dimension results. As a result, it seems that players were able to, at times, feel a sense of flow, considering their acknowledgment towards the clear goals of the game, existing feedback, and sense of control. Nonetheless, it seems that despite this positive outcome, the game offered insufficient challenge to match their skills, thus delaying the opportunity to enter a state of 'optimal experience'. In terms of the inexperienced players, it also appears that the ingredients were adequate for the players to enter a state of flow. Despite these players not having demonstrated sufficient abilities to confront the challenges placed by their opponents, this did not stop them from enjoying the game and wanting to continue to play (according to the results from the *Investments* Dimension analysis).

Similar to the analysis done with the 'ReCycle' case, it is also important to analyse the possible influence of having played on the computer with the eye tracker[43]. Recalling, participants were asked to indicate their opinion on the *comfort* in playing the video game on the eye tracking computer, as well as the extent to which playing on the eye tracker *influenced* how they played. In this case, analysis is also limited to the playing experience variable.

Regarding the *comfort* item, *ANOVA* testing indicated no significant difference between the playing experience groups at the $p<0.05$ level, $F(2,3)=1,\ p=0.465$. Regarding the *influence* item, *ANOVA* testing indicated no significant difference between the playing experience groups at the $p<0.05$ level, $F(2,3)=0.214,\ p=0.818$. These results suggest that for all the playing experience variables, all players were comfortable in playing with the eye tracking computer, and felt that it did not influence how they played. Therefore, these interactive behaviour results are independent of the platform (eye tracking computer) on which they played.

Recalling *Hypothesis 5*, the goal is to understand if players' interaction behaviour (based on the analysis of gameplay data) can provide information regarding players' understanding of the game mechanics and abilities. Based on the presented analysis – and solely considering the playing experience variable – it seems once again that the hypothesis is partially confirmed.

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[43] *Note:* For a complete overview of all 'CSSmod' statistical tests, please refer to *Appendix 1E – CSSmod & Eye Tracking* (*cf. p.* 283)

Similar to that verified for the ‘ReCycle’ case, it is not clearly possible to analyse extent to which each of the opposing members in the tested groups understood *‘CSSmod’s’* mechanics based only on gameplay results. Based on the results presented in Table 49 (*cf. p.* 245), while there are some visible differences in terms of results among the three experience groups, none are sufficiently different to suggest a total lack of understanding of the mechanics. Inexperienced players were visibly killed more frequently than the other players, but did also register some points (score), suggesting they knew to some extent what they had to do. Also, the mean scores for the *Mechanics* Dimension also suggest a proximate understanding of the video game’s mechanics. On the other hand, while it isn’t fit to conclude on players’ understanding of the game’s mechanics, it is possible to speculate on their skills. In this scenario, inexperienced players’ definitively showed fewer skills when compared to the more experienced players (two casual, one hardcore player). This is visible both in terms of metrics (e.g. *Score/Death ratio* and *shots fired*) as well as visual analysis of interactive behaviour using the GAMEYE application. In the three rounds analysed, inexperienced players demonstrated a lack of ability to interact in the game world outside of the zone in which they entered the map. In contrast, the hardcore and casual players demonstrated the ability to move around the map in order to engage with other players.

7.2.3 Visual Attention Results

Hypothesis 6 states: *eye tracking data can provide information regarding how changes in a video game modify players' visual attention patterns.* Hypothesis 6 is confirmed if the analysis of player’s visual behaviour – based on eye tracking data – confirms that changes in the game’s mechanics (related to the jump from game map M1 to map M2) and game visuals resulted in an alteration in participants’ visual behaviour.

Considering player (visual) attention (characteristic of the *Investments* dimension), we look into visual data from the ‘CSSmod’ game sessions. Given the limitations of this particular case, analysis is limited to differences in visual attention according to players’ playing experience. In order to examine possible differences among players’ playing differences, four analysis areas – areas of interest (AOI) – were defined: the *Central/Weapon* area; the *Energy/Armor* area; the *Game Events* area; and *Ammunition* area. Figure 48 represents a screenshot from *‘CSSmod’* with respective AOI.

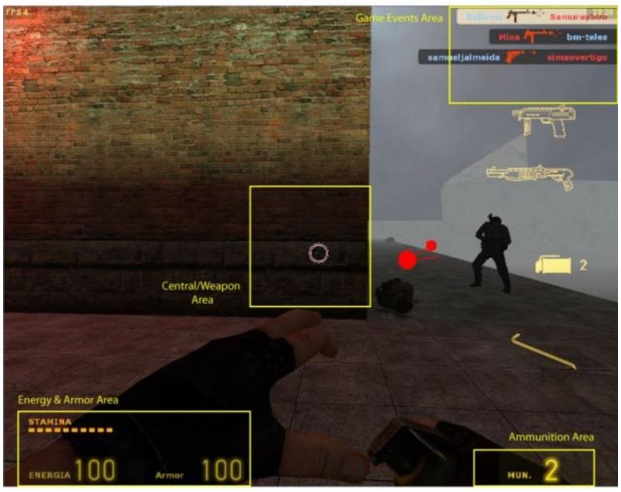

Figure 48: Definition of four areas of analysis (AOI) in the *‘CSSmod’* game

Similar to that done with the 'ReCycle' case, two different visual behaviour metrics are considered: (*i*) total number of fixations that a specific area registered; (*ii*) total time that a specific area was visualized. Visual behaviour data was extracted using the Tobii Studio software and analysed for the four specified areas of the game interface.

PLAYING EXPERIENCE VS. VISUAL BEHAVIOUR

Considering the *'CSSmod'* session was limited to six participants, results are conditioned according to this figure. Figure 49 represents the distribution of fixation count % according to participants playing experience.

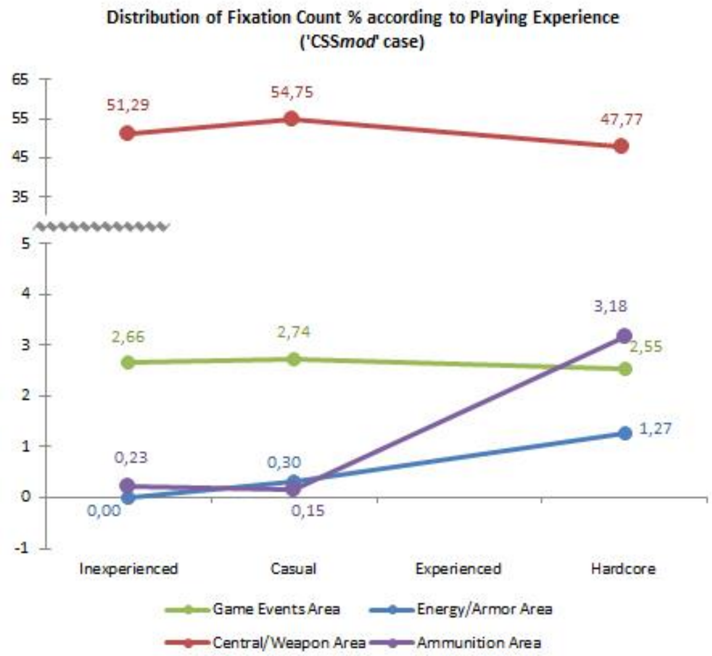

Figure 49: Distribution of players' fixation count % according to playing experience (*'CSSmod'* case)

Looking at the results presented in Figure 49, numbers indicate the *casual* group of players looked at the *Central/Weapon* (*M=54.75*) and *Game Events* area (*M=2.74*) the most compared to the remaining two groups. In the *Energy/Armor* (*M=1.27*) and *Ammunition* areas (*M=3.18*), the single hardcore player was responsible for the maximum registered value. These values are logical considering that both these areas contain information of interest for a player who approaches an FPS with a strategic vision. A player with extensive experience in shooting games (*e.g.* a hardcore *player*) will likely be concerned in constantly knowing his remaining energy and ammunition to make strategic choices regarding when and how to attack, as well as if he should or not recharge his weapon.

Considering data related to the 'Time Count', values follow along the lines of those registered for the 'Fixation Count' data. Figure 50 represents the distribution of players' time count % according to playing experience.

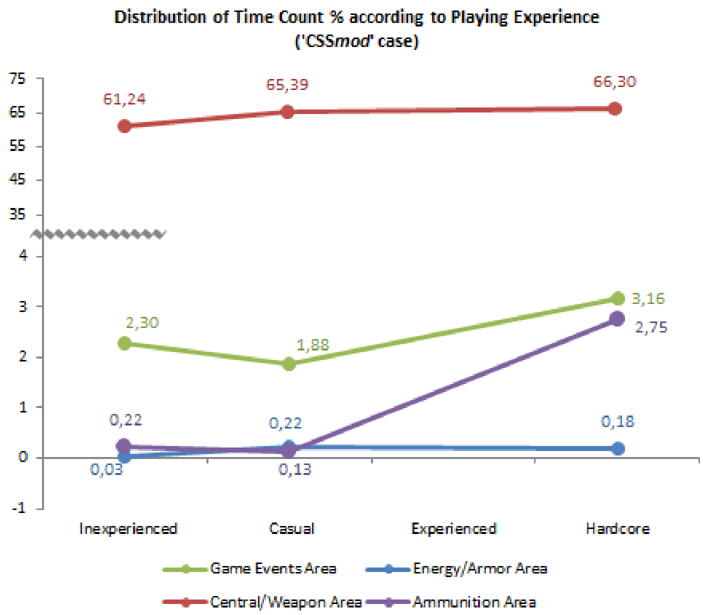

Figure 50: Distribution of players' time count % according to playing experience

Once again, the *hardcore* player registered the highest mean value for *Ammunition* areas (*M=3.18*). However, *casual* players spent more time looking at the *Energy/Armor* areas when compared to the *hardcore* player (M_C=0.22; M_H=0.18). This shows that the hardcore player looked more frequently and for a longer period of time at the *Ammunition* areas. While *hardcore* players registered higher values than *inexperienced* players in all areas, inexperienced players spent more time than casual players visualizing the *Game Events* and *Ammunition* Area.

7.3 CONFRONTING 'RECYCLE' *VS.* 'CSS*MOD*'

Despite the different study designs associated to each presented case – 'ReCycle' and 'CSSmod' – we look to see if there are significant differences in terms of the multiple model dimension variables – *Investments*, *Anticipations*, *Background*, *Mechanics* and *Interface* – between the two groups which played the referred games.

Considering two different groups played the games, an *Independent-Sample t-test* was applied to test and analyse the possible differences in *means* between the aforementioned variables. Given the particularities of the two studies, a specific grouping variable was computed for each dimension and for each of the three maps. These grouping variables use two different values to separate the cases into two groups.

Recalling, prior to the *Independent-Samples t-test*, the Levene statistic reports on the equality of variances among the groups, where *p>0.05* assumes equal variances among the tested groups. The *Independent-samples t-test* tests the following hypothesis (*x* refers to the various tested dimensions):

H_0: *Mean for* D_X *for ReCycle* = *Mean for* D_X *for 'CSSmod'*

H_1: *Mean for* D_X *for ReCycle* $\neq$ *Mean for* D_X *for 'CSSmod'*

If $p<=0.05$, H_0 is rejected and we can state than there is a statistically significant difference between the two groups.

Note: For a complete overview of all 'ReCycle' vs. 'CSSmod' statistical tests, please refer to Appendix 1C – ReCycle vs. CSSmod (cf. p. 297).

INVESTMENTS

Beginning with the *Investments* dimension, the Levene statistic indicated equality of variances for all three tests, where M1*vs*CSS (*p=0.390*), M2*vs*CSS (*p=0.580*), M3*vs*CSS (*p=0.203*), *p>0.05*. Table 50 summarizes the Independent Samples t-test results on the *Investments* dimension between the ReCycle and 'CSSmod' cases.

Table 50: Independent Samples t-test for *Investments* Dimension between ReCycle and 'CSSmod'

Test	ReCycle		CSSmod		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1 *vs.* CSS	3.606	0.514	3.783	0.387	-0.808	0.424
M2 *vs.* CSS	3.721	0.534	3.683	0.627	0.154	0.879
M3 *vs.* CSS	4	0.757	4.067	0.314	-0.211	0.834

For the three *Investments* dimension tests, M1*vs*CSS (t=-808, *p=0.424*), M2*vs*CSS (t=0.154, *p=0.879*), and M3*vs*CSS (t=-0.211, *p=0.834*). In all three, *p>0.05* and therefore, we do not reject H_0, and can affirm there are no statistically significant differences between the means of the 'CSSmod' game with either of the three 'ReCycle' game maps.

ANTICIPATIONS

Considering the *Anticipations* dimension, the Levene statistic indicated equality of variances for all three tests, where M1*vs*CSS (*p=0.609*), M2*vs*CSS (*p=0.374*), M3*vs*CSS (*p=0.288*), *p>0.05*. Table 51 summarizes the Independent Samples t-test results on the *Anticipations* dimension between the ReCycle and 'CSSmod' cases.

Table 51: Independent Samples t-test for *Anticipations* Dimension between ReCycle and 'CSSmod'

Test	ReCycle		CSSmod		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1 *vs.* CSS	3.5	0.631	3.875	0.542	-1.367	0.180
M2 *vs.* CSS	3.562	0.643	3.75	0.894	-0.609	0.546
M3 *vs.* CSS	3.699	0.712	3.417	1.021	0.838	0.407

For the three *Anticipations* dimension tests, M1*vs*CSS (*t=-1.367, p=0.180*), M2*vs*CSS (*t=-0.609, p=0.546*), and M3*vs*CSS (*t=0.838, p=0.407*). In all three, $p>0.05$ and therefore, we do not reject H_0, and can affirm that there are no statistically significant differences between the means of the 'CSSmod' game with either of the three ReCycle game maps.

BACKGROUND

Looking into the *Background* dimension, the Levene statistic indicated equality of variances for all three tests, where M1*vs*CSS (*p=0.140*), M2*vs*CSS (*p=0.272*), M3*vs*CSS (*p=0.811*), *p>0.05*. Table 52 summarizes the *Independent Samples t-test* results on the *Background* dimension between the 'ReCycle' and 'CSSmod' cases.

Table 52: Independent Samples t-test for *Background* Dimension between ReCycle and 'CSSmod'

Test	ReCycle		CSSmod		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1 *vs.* CSS	3.039	1.047	3.944	0.612	-2.043	**0.048**
M2 *vs.* CSS	3.216	0.799	3.5	0.548	-0.833	0.410
M3 *vs.* CSS	3.412	0.711	3.833	0.723	-1.366	0.189

For the three *Background* dimension tests, M1*vs*CSS (*t=-2.043, p=0.048*), M2*vs*CSS (*t=-0.833, p=0.410*), and M3*vs*CSS (*t=-1.366, p=0.189*). Here, for M1vsC22 and M2vsCSS, *p>0.05* and therefore, H_0 is not rejected. However, for M1vsCSS, *p=0.048<0.05* and therefore, there is a statistically significant difference between the means of the 'CSSmod' game and the first 'ReCycle' game map played. Given the multiple characteristics (*ability*, *knowledge*, *preferences*) that define the *Background* dimension, this result may be related to the fact all of the players (6 of 6, 100%) in the 'CSSmod' case have a preference for shooter games, while only half of the players (21 of 40, 52.5%) in the 'ReCycle' case indicated a similar preference. This not only reflects on their gaming preferences, but also influences their ability and knowledge to play, affecting in turn their initial opinion of the first 'ReCycle' map played.

MECHANICS

Considering the *Mechanics* dimension, the Levene statistic indicated equality of variances for all three tests, where M1*vs*CSS (*p=0.286*), M2*vs*CSS (*p=0.868*), M3*vs*CSS (*p=0.095*), *p>0.05*. Table 53 summarizes the Independent Samples t-test results on the Mechanics dimension between the ReCycle and 'CSSmod' cases.

Table 53: Independent Samples t-test for *Mechanics* Dimension between ReCycle and 'CSSmod'

Test	ReCycle		CSSmod		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1 *vs.* CSS	3.404	0.798	3.833	0.563	-1.256	0.217
M2 *vs.* CSS	3.669	0.72	3.833	0.701	-0.517	0.608
M3 *vs.* CSS	3.956	0.632	4.417	0.376	-1.721	0.093

For the three *Mechanics* dimension tests, M1*vs*CSS (*t=-1.256, p=0.217*), M2*vs*CSS (*t=-0.517, p=0.608*), and M3*vs*CSS (*t=-1.721, p=0.093*). In all three tests, *p>0.05* and therefore, H_0 is not rejected. Therefore, it can be affirmed that there are no statistically significant differences between the means of the 'CSSmod' game with any of the three ReCycle game maps. Despite differences in terms of *Background* (namely related to *preferences* for video games), the *Mechanics* in both games are somewhat similar and follow those of typical shooter games. Furthermore, players from both cases were previously informed on the basic rules and goals of the game. Therefore, the fact there is no significant difference between the two games is understandable.

INTERFACE

Lastly, for the *Interface* dimension, the Levene statistic indicated equality of variances for all three tests, where M1*vs*CSS (*p=0.349*), M2*vs*CSS (*p=0.831*), M3*vs*CSS (*p=0.206*), *p>0.05*. Table 54 summarizes the Independent Samples t-test results on the Interface dimension between the ReCycle and 'CSSmod' cases.

Table 54: Independent Samples t-test for *Interface* Dimension between ReCycle and 'CSSmod'

Test	ReCycle		CSSmod		t	p - Sig. (2-tailed)
	Mean	*SD*	Mean	*SD*		
M1 *vs.* CSS	2.486	0.551	2.526	0.787	0.849	0.401
M2 *vs.* CSS	3.007	0.626	2.667	0.736	1.199	0.238
M3 *vs.* CSS	3.081	0.615	2.542	0.941	1.826	0.076

For the three *Interface* dimension tests, M1*vs*CSS (*t=0.849, p=0.401*), M2*vs*CSS (*t=1.199, p=0.238*), and M3*vs*CSS (*t=1.826, p=0.076*). In all three, *p>0.05* and therefore, we do not reject H_0, and can affirm that there are no statistically significant differences between the means of the 'CSSmod' game with either of the three ReCycle game maps. Contrary to the *Mechanics* dimension, some disparity in mean values for the *Interface* dimension was expected. Given the differences essentially related to *visuals* and *audio* between the two games, a significant difference in perception towards the *Interface* of both games was expected. Justification for this may reside in the fact that the absence of a complex visual game and lack of audio in ReCycle was not of importance considering that only half of the players have some preference for shooter games where complex visuals could really make a difference. In fact, mean scores between both games show the *Interface* dimension was scored higher on two of the three tests, and was just slightly inferior in the other.

7.4 General Discussion of Results

The presented results and analysis centred on the 'Player' element of the model – namely the *Anticipations* and *Investments* dimensions – help us understand the *Emotional* component of the Gameplay Experience proposed in the model. This data is then analysed in parallel with additional gameplay results – based on game metrics – which provide insight on the *Interactive* component of the Gameplay Experience.

Several statistical tests were applied using SPSS to analyse how player *Anticipations* and *Investments* varied in each of the cases studied: 'ReCycle' and 'CSS*mod*'. The 'ReCycle' case supported a greater number of statistical tests given that three different maps were played; the number of players was bigger and more diverse. The 'CSS*mod*' case was limited to a reduced number of tests, focussed on the results of a single round of questioning.

Summarizing the results presented above, we initially look at the 'ReCycle' case. Beginning with the *Investments* dimension of the model, *Paired-Samples t-tests* indicated that a change in game rules (verified from map M1 to M2) did not result in a significant difference of means for the two maps. However, a change in game visuals (M1>M3) – related to a change in map size and possibly fostering greater interaction between players – did result in significantly different mean score results for these two maps (*p=0.000*). The same can be said when game rules and visuals changed in simultaneously (M2>M3) (*p=0.006*). Nonetheless, while these significant differences were verified for the sample as a whole, when applying statistical tests to look for differences among groups (player gender, shooter game preference and player experience), no significant differences were found. *Independent–Samples t-tests* showed no significant differences among male and female participants, or between those that do and not prefer shooter games. Also, the *ANOVA* test indicated no significant difference between players with different playing experience. What this data appears to suggest is the player sample used was in fact motivated by changes in game visuals, as well as a simultaneous change in visuals and rules. However, it can't be proven that player gender, game preferences and playing experience led them to experience the game differently from other compared groups in terms of *Investments*. Specifically, whether the players are male or female; prefer or not shooter games; o plays a single hour of games or 20 hours a week; their look towards *Investments* is similar to a player that might be the opposite in terms of profile.

Still in the 'ReCycle' case, but now looking at *Anticipations*, some of the results are quite different from those regarding *Investments*. *Paired-samples t-tests* indicated that independently of the changes in the game maps, the mean values for the tested maps were not significantly different. This result is understandable considering that players knew beforehand what changes were introduced (expectations characteristic). However, when looking at the *Independent-Samples t-test* results, there were significant differences between the male and female groups in all three maps. In fact, the difference between male and female mean scores was on average (for the three maps) *0.58*, a surprisingly large difference. Almost likewise, for maps M1 and M2, there were significant differences between the players that prefer shooter games and those that do not. For map M3, this significant difference was not registered, suggesting that those that do not prefer shooters had to some extent assimilated the game. Lastly, among the different player experience groups, the *ANOVA* test revealed no statistically significant differences for any of the three maps.

Looking at some of the profile differences between players; and beginning with male and female participants, while these two groups were different in terms of *Anticipations* along the three maps, this did not occur for *Investments*. In fact, the evident difference in terms of expectations finds some parallel in the gameplay results collected from the game metrics. With exception to 'shot hit player' metric (where the average per participant wasn't excessively different), male players performed better than female players in strategy-related metrics (shooting more frequently and adding more energy to survive). However, male and female players performed similarly when looking at the number of times either of these groups was killed in the game. Therefore, it appears that low female expectations may have complicated their adaptation to the game's strategy, but did not influence their overall motivation towards the game. In terms of preference for shooter games, there is a significant difference in terms of expectations in the first and second maps. This may have played a role in some of the game metric differences registered between these two groups, namely in terms of the strategic decisions (shooting and adding energy). However, in other metrics, the two groups posted proximate results. Therefore, and similar to the male and female analysis, while differences in expectations may have limited players that don't prefer shooter games' adaptation to the game, this did not influence their motivation towards the game.

Now considering the 'CSS*mod*' case, statistical tests were limited to a univariate analysis of the multiple model variables. In terms of the *Anticipations* Dimension, the *mean* was M=3.833, a somewhat positive value, with a median *Mdn=3.875* and a mode of *4*. In terms of *Investments*, results can also be considered positive, with a mean value of *M=3.983*, a median of Mdn=3.95 and mode of *3.9*. This suggests that sample in this study had positive *Anticipations* and *Investments* regarding the game. Looking into the player profiles – consisting of one hardcore, two casual and three inexperienced players – *ANOVA* tests indicated that there were no significant differences between the members of these groups, suggesting the three groups were equal in terms of these variables. Nonetheless, an analysis of the gameplay metrics collected suggests otherwise. The three inexperienced players clearly underperformed when compared to the hardcore and casual players (*cf.* Table 49, *p. 245*). Inexperienced players demonstrated – based on the metrics – a lack of ability to play the game, but still reported to be equally motivated. This suggests that despite their underperformance, they still enjoyed playing the game.

As referred when reflecting on the proposed Gameplay Experience Model, while the model isn't specific to immersion or flow, it does include multiple characteristics specific to these concepts. As a result, it is possible to look at each of these characteristics in a specific situation to further understand the extent to which a player was in a state of immersion or flow. Looking at the presented results, while bearing in mind the presented literature review on the Gameplay Experience (*cf.* CHAPTER 2 – The Gameplay Experience, *p. 65*) – essential in the development of the model proposal – we can find several connecting points that further help in the interpretation of these results and shed light on participants' overall gameplay experience.

RECYCLE *VS.* IMMERSION

Beginning with immersion, and considering the work of Brown & Cairns (2004), these authors indicate that there are three levels of immersion: *(i) engagement*, *(ii) engrossment* and *(iii) total immersion*. The authors also identify multiple barriers that a player must overcome to be able to enter the following level of immersion. By looking at the collected results, it appears the participants of the 'ReCycle' session may have passed through at least one of these immersive states. To possibly move from *engagement* to *engrossment*, players must invest *time*, *effort* and *attention* – characteristics present in the *Investments* dimension of the proposed model. Running *Paired-Samples t-tests* on these three characteristics (based on the results from the three maps), statistical significance was found in the *effort* characteristic (EfC). Specifically, there was a significant difference in the scores for the EfC_{M1} (*M=3.100, SD=0.853*) and EfC_{M3} (*M=3.775, SD=0.891*) conditions; *t(39)=-3.797, p=0.000*; and in the scores for the Ef_{M2} (*M=3.250, SD=0.927*) and Ef_{M3} (*M=3.775, SD=0.891*) conditions; *t(39)=-2.772, p=0.009.* This suggests that players in fact felt they had to put more effort into playing the game in maps M2 and M3, when changes in game visuals (M1>M3) and visuals and rules simultaneously (M2>M3) were altered. In the EfC_{M1} and EfC_{M2} conditions, no statistically significant difference was found. Regarding the *time* and *attention* characteristics, similar *Paired-Sample t-tests* were run, and resulted in non-significant differences in the multiple tests. As a result, it appears that players became somewhat immersed – based on the findings of Brown & Cairns (2004) – because of the continuous *effort* involved in playing, but did not feel so based on the *time* and *attention* required to play. Nonetheless, an *Independent-Samples t-test* did show a significant difference regarding the *time* characteristic in map M1 (*p=0.046*) between those that prefer and do not prefer shooter games.

Further looking into Brown & Cairns' (2004) thoughts on immersion; if we accept that players became *engaged* in the game based on the *effort* they had to invest, we can explore the barriers of the *engrossment* level of immersion: *game features*, namely *visuals*, *tasks*, and *plot*. Having run *Paired-Samples t-tests* on the *goals*[44] (GoC) and *visuals* (ViC) characteristics of the model for the three maps, statistical significance was found for the three *goal*-related tests, but not for the *visuals*. Specifically, there was a significant difference in the scores for the Go_{M1} (*M=3.400, SD=0.942*) and GoC_{M2} (*M=3.800, SD=0.766*) conditions; *t(39)=-2.929, p=0.006*; in the scores for the GoC_{M1} (*M=3.400, SD=0.942*) and GoC_{M3} (*M=4.063, SD=0.681*) conditions; *t(39)=-4.685, p=0.000*; and for the GoC_{M2} (*M=3.800, SD=0.766*) and GoC_{M3} (*M=4.063, SD=0.681*) conditions; *t(39)=-2.379, p=0.022*. Therefore, it seems that players may have become *engrossed* with the game through the *goals* (tasks) characteristic of the game's features.

[44] In the proposed model, the *Goals* characteristic (*cf.* Section 5.3.3.1 – Mechanics, *p. 132*) contemplates – among others – the idea of game *tasks*.

Lastly, if we can once again accept that some players may have become *engrossed*, we look at last of the barriers for *total immersion*: *empathy*, and *atmosphere*. In the presented model, the concept of *empathy* comes close to the model characteristic of *connection* (CoC). As a result, and analysing if players became somewhat connected to the game, *Paired-Samples t-tests* were run for the various game maps played. Results showed that there was a significant difference in the scores for the CoC_{M1} (*M=3.480, SD=0.793*) and CoC_{M3} (M=*3.990, SD=0.746*) conditions; *t(39)=-4.147, p=0.000*; and in the scores for the CoC_{M2} (*M=3.665, SD=0.62*) and CoC_{M3} (M=*3.990, SD=0.746*) conditions; *t(39)=-3.097, p=0.004.* As a result, it seems that players felt more connected to the games in maps M2 and M3, where changes in game visuals (M1>M3) and visuals and rules (M2>M3) occurred simultaneously. In the CoC_{M1} and CoC_{M2} conditions, no significant difference was registered. Hence, and depending on the flexibility of Brown & Cairns' (2004) theory on immersion, results from the tests suggest – while unable to indicate how these specifically vary among the players – that players overcame one or more barriers of each level of immersion to possibly enter the respective state. Recalling, lowering the barriers does not guarantee the experience, but does create conditions for it to occur.

In McMahan's (2003) interpretation of *immersion*, three conditions are placed for a player to feel a sense of immersion, related to *expectations*, *actions* and *consistency*. The expectations and actions are both present in the model's *Anticipations* Dimension. As previously presented (*cf.* Section 7.1.1.2 – Table 26 *p. 212*), players' *expectations* did not significantly vary throughout the three game maps, despite the values of central tendency indicating an increase in each map. However, this does not directly suggest that players' expectations were not met. In fact, the analysis of values of central tendency (*cf.* Section 7.1.1.2, Table 25, *p. 211*) of the *Anticipations* Dimension characteristics shows variations among players: some players' expectations were completely met in some maps, while other players' expectations were not.

Furthermore, expectations varied according to player gender in all three maps (*cf.* Table 27, *p. 213*) and according to players' preferences for shooting games (*cf.* Table 28, *p. 215*). In terms of *actions*, multiple answers were received for this aspect (*cf.* Table 25, *p. 211*), suggesting that some players felt their actions were consequential, while others felt the opposite. Lastly, with *consistency*, similar results were collected: some players felt a consistency within the game, others did not. Therefore, based on the ideas of McMahan (2003), we can only hypothesize that some players became immersed, while others did not; for reasons related to their *expectations* not being met, their *actions* being inconsequential, or feeling a lack of *consistency* within the game.

In Ermi & Mäyrä's (2005) interpretation of a multi-dimensional immersion, reference is made to game features such as their *3D nature* and *audio-visual* component (sensorial immersion); the balance of *challenge* and *abilities* (challenge-based immersion); and absorption with *characters* and *story* (imaginative immersion). As presented above, when discussing the *visuals* characteristic results according to Brown & Cairn's (2004) work, no significant differences were found among the three maps. Nonetheless, an analysis of values of central tendency indicate players' increasingly enjoyed the game visuals (M1: *M=2.80*; M2: *M=3.03*; M3: *M=3.05*). Also, the *mode* of the distribution increased from map M1 (Mode=*3*) to map M2 (Mode=*4*) and remained *4* for map M3. This shows that the most common opinion towards the game visuals was that players enjoyed them; suggesting players may have entered a state of *sensorial immersion*.

In terms of the balance between challenge (related to the goals (GoC) of the game) and abilities, values of central tendency suggest a balance between players' answers regarding these characteristics. For the *challenges* (goals (GoC)) characteristic, players answered they felt increasingly challenged throughout the game rounds (M1: *M=2.83*; M2: *M=3.48*; M3: *M=3.75)*. Furthermore, a *Paired-Samples t-test* shows that in two tests – between maps M1 and M2, and between maps M1 and M3 – there is a statistically significant difference.

Specifically, there was a significant difference in the scores for the GoC_{M1} (*M=2.83, SD=1.130*) and GoC_{M2} (M=*3.48, SD=1.132*) conditions; *t(39)=-3.397, p=0.002*; and in the scores for the GoC_{M1} (*M=2.83, SD=1.130*) and GoC_{M3} (M=*3.75, SD=0.981*) conditions; *t(39)=-4.611, p=0.000*. In terms of *abilities*, values of central tendency revealed a slightly stable *mean* value among the three maps (M1: *M=3.30*; M2: *M=3.33*; M3: *M=3.65*). Also, the mode value of the distribution remained 4 for all three maps. These values[45] suggest players felt they had sufficient abilities to play the game. However, these values also report on the sample distribution as a whole. Considering the sample according to playing experience, there is visible approximation between the challenges offered by the game and players' abilities as they played each of the three maps. Table 55 summarizes the mean results of the abilities and challenges characteristics according to playing experience. The cells shaded in grey refer to the results with a value of '3' or higher, indicating a positive result.

Table 55: Summary of Abilities/Challenges (goals) results according to Playing Experience

	Map 1		**Map 2**		**Map 3**	
	A	**C**	**A**	**C**	**A**	**C**
Inexperienced	2.91	2.18	3.18	3.09	3.45	3.73
Casual	3.40	3.33	3.07	3.60	3.67	3.73
Experienced	3.33	2.83	3.67	3.83	4.17	4.17
Hardcore	3.63	2.75	3.75	3.5	3.5	3.5

Looking at the results for each map, it is visible that in map M1, the difference between players' abilities (A) and the challenges (C) is more than *0.25* in three groups. However, in maps M2 and M3, having already played the game an initial round, the difference between abilities and challenges is less or equal to *0.25* in three cases (Inexperienced, Experienced and Hardcore players). Furthermore, in map M3, the balance is even greater, with exception to the inexperienced group of players (although the difference between values is only *0.28*). Therefore, these results suggest that there was an apparent balance between some playing experience groups for the second and third maps that may have led players to enter a state of *challenge-based immersion*.

[45] Considering the negative wording of the respective questionnaire item (*cf.* Table 18, *p. 225*), resulting values are reversed.

RECYCLE *VS.* FLOW

Considering the work on *Flow*, Csíkszentmihályi (1990) explains that an individual can enter a state of flow if one or more requirements are met: (*i*) a challenging activity requiring skill; (*ii*) a merging of action and awareness; (*iii*) clear goals; (*iv*) direct, immediate feedback; (*v*) concentration on the task at hand; (*vi*) a sense of control; (*vii*) a loss of self-consciousness; (*viii*) an altered sense of time. Aspects *i*, *ii*, *iii*, *v* and *vii* (analysed as attention[46]) and *viii* were previously discussed when confronting theories of immersion with collected results. Since other work on flow – also discussed in the Gameplay Experience section – builds upon the initial ideas of Csíkszentmihályi (1990), we will look into the remaining aspects, namely (*iv*) *feedback* and (*vi*) *control*.

Exploring the *feedback* (FeC) characteristic of the *Interface* Dimension, values of central tendency show that game feedback wasn't as present as desirable. For the three game maps, results varied greatly such that some players answered completely favourably towards feedback, while others completely unfavourably. The mean values registered were three (*M=3.00*) or less (M1: *M=2.75*; M2: *M=3.00*; M3: *M=3.00*). In addition, the mode value was *2* for all three maps. Considering these results while looking specifically at profile related variables (gender, game preference or playing experience), little difference is noted in the results. Results are above the mean value (*M=3.00*) for male participants in maps M2 (*M=3.23*) and M3 (*M=3.19*); for those that prefer shooter games in maps M2 (*M=3.29*) and M3 (*M=3.14*); and for casual (*M=3.27*) and hardcore players (*M=3.00*) in map M2, and casual (*M=3.47*) and experienced players (*M=3.00*) in map M3. This shows that when players were asked on the game's feedback, the opinions were below positive, with the exceptions previously mentioned. Furthermore, it suggests that players would possibly be unable to enter a state of flow based on the lack of feedback from the game, leading players to question if their actions during the game had any effect on the game itself.

Regarding the *control* (CtC) characteristic of the *Anticipations* Dimension, values of central tendency were moderately positive, suggesting that payers did feel some sense of control in the game. In fact, for all three maps, the mean values were very similar: CtC_{M1}: *M=3.738*; CtC_{M2}: *M=3.713*; CtC_{M3}: *M=3.725*. However, the minimum value for control decreased from M1 (*Min=2.5*) to M2 and M3 (both with a *Min=1.5*), suggesting a decrease in players' sense of control, possibly influenced by the changes in the rules of the game. Further looking into how this characteristic varied according to gender and preference for shooter games, there was a significant difference in the scores for the male (*M=3.981, SD=0.591*) and female (*M=3.214, SD=0.893*) conditions; *t(19.309)=2.890, p=0.009* in map M2; and the male (*M=3.942, SD=0.804*) and female (*M=3.321, SD=0.575*) conditions; *t(38)=2.552, p=0.015* in map M3.

[46] In the proposed model, the *Attention* characteristic (*cf.* Section **Erro! A origem da referência não foi encontrada.** – **Erro! A origem da referência não foi encontrada.**, *p. 160*) considers that a *loss of self-consciousness* derives from players investing extreme attention into an activity.

Regarding those that do and do not prefer shooter games, there was a significant difference in the scores for those that prefer *shooters – YES* (*M=3.976, SD=0.558*) and don't – NO (*M=3.474, SD=0.735*) conditions; *t(38)=2.448, p=0.019* in map M1; and those that prefer *shooters – YES* (*M=4.000, SD=0.592*) and don't – NO (*M=3.395, SD=0.875*) conditions; *t(38)=2.584, p=0.014* in map M2. No significant difference was found in map M3, suggesting an approximation in feeling of control between those that do and do not prefer shooters. In terms of playing experience, no significant different were found among the four defined experience groups. These results suggest that players did feel some control over the game, namely male players in maps M2 and M3; and those that prefer shooter games in maps M1 and M2. In these particular cases, it is possible that players may have been in some state of flow given this feeling of *control*.

Given this discussion, it appears that the 'ReCycle' game may have led players to experience one or more of experiences – immersion and flow – that supported the development of the model. While it is challenging to generalize to the sample in general – given the diversity of preferences – in some particular cases, it seems that conditions were created for players to become immersed (depending on the perspective analysed) or in a state of flow. Once more, in the case of flow, there is no direct reference to the degree to which an individual must experience one or more of the eight 'flow factors'. Simply, if one or more of the conditions are met, a player can be considered in a situation where a flow experience may occur. Therefore, given that such conditions were met in specific situations, those players may in fact have been in a state of flow, while others may have been in a state of *engagement*, *engrossment* or *total immersion*.

'CSSMOD' *VS.* IMMERSION

Mounting a similar exercise based on the *'CSSmod'* results, and despite the limited statistical analysis previously explored (*cf.* Section 7.2.1, *p. 238*), we can still attempt to question these results according to the explored work on immersion. Beginning with Brown & Cairns' (2004) work, values of central tendency regarding the *time* resulted in a mean value of *M=3.5*, while both Median and Mode were *4*, above average. A similar result was found for *effort*, where the *mean* value was *M=4*. Also, the Median and Mode values were *4*, in line with the *mean* value. In terms of *attention*, the mean value was *M=4*. Also, the Mean and Median values were *4*, equal to the registered *mean*. Therefore, it seems the majority of players were willing to invest their *time*, *effort* and *attention* to play the game, suggesting that these players were in condition to enter an initial state of immersion.

If we can accept that players may have become *immersed* according to the *time*, *effort* and *attention* they indicated were willing to invest, then we can look into the level of *engrossment*, where *visuals* and *tasks* are barriers. Considering values of central tendency on *visuals*, the mean value registered was *M=3.83*, while both Median and Mode were *4*, above average. Regarding *goals*, the *mean* value was M=4.083, with a Median and Mode value of *4*. These results suggest that players did prefer the game visuals and, moreover, enjoyed the goals of the game. Hence, based on these results, it is possible that players may have overcome these barriers to enter a state of *engrossment*.

Having possibly become *engrossed* with the game, the last barrier to *total immersion* is related– but not limited – to *empathy*, although the model considers the *connection*[47]. Looking at the values of central tendency, the mean value registered was *M=4.067*, with a Median and Mode of *4*. Therefore, this result – in addition to the previous regarding *time*, *effort*, *attention*, *visuals* and *tasks* – suggest that this small sample of players may have experience one or more levels of immersion.

Looking at the *'CSSmod'* results and immersion from the perspective of McMahan (2003), we consider the model characteristics of *expectations*, *actions* and *consistency*. Regarding *expectations*, the mean value registered was *M=3.5*, with a Median of *3.5* and Mode of *4*. In terms of *actions*, the mean value was *M=4*, with a Median and Mode of *4*. This suggests that players' *expectations* were met and their *actions* had an impact in the game. Nonetheless, in terms of *consistency*, the mean value was *M=2.33*, with a Median and Mode of *2*. Here, it appears players felt a lack of consistency within the game. Therefore, on one hand players may have felt immersed because their *expectations* were met and their *actions* were consequential, but the lack of *consistency* may have hindered such an experience.

Lastly, looking into *'CSSmod'* results according to immersion from Ermi & Mäyrä's (2005) perspective, we focus on *visuals* (for sensory immersion); and *abilities* and *challenges* (for challenge-based immersion). In terms of visuals, as mentioned above, players showed some appreciation for the *game visuals* (*M=3.83*) as well as the *sounds* of the game (*M=4.00*). Based on the *visuals* and *sounds* characteristics, players may have felt some sort of *sensory immersion*. Considering *ability* and *challenges*, players' response was balanced towards their ability to play the game (*M=3.5*). In terms of *challenges*, players felt that they were challenged (*M=4.33*), with a Median and Mode of *4*. Therefore, it seems that in fact the game was challenging, and that players may not have felt it was excessively easy because of their mixed levels of ability. Hence, it is possible that some players may have felt some sort of *challenge-based immersion*.

'CSS*MOD*' *VS.* FLOW

Now considering the work on *flow*, and having previously looked into some of the elements while analysing immersion (*i.e.* challenges/skills, actions, goals, attention, time), we explore the results of *feedback* and *control*, to further analyse the extent to which participants of the *'CSSmod'* may have entered a state of flow. Looking at *feedback*, players reported the existence of visible feedback (*M=4.00*); with a Median and Mode value of *4*. As a result, the majority of players agreed that the game responded to their actions with the desired *feedback*. In terms of *control*, the mean value registered was *M=3.917*; with a slightly above average Median and Mode of *4*. Again, the majority of players agreed that they were in *control* of the game. Recalling the mean values for the previously explored elements of flow, they all registered above average results: *actions*, *M=4*; *goals*: *M=4.083*; *attention*, *M=4*; and *time*, *M=3.5*. Also, there was slight balance between challenges and players' identified abilities. Therefore, based on these results, we can hypothesize that the game created conditions for some players to enter a state of flow, given that the game was *challenging*, had *clear goals*, provided *feedback* and *control*; and was accessible according to players' *skills*.

[47] In the proposed model, the *Connection* characteristic (*cf.* Section **Erro! A origem da referência não foi encontrada.** – **Erro! A origem da referência não foi encontrada.**, *p. 160*) contemplates *empathy*, related to the emotional attachment with a game – as explored by Brown & Cairns (2004).

Having looked at both the 'ReCycle' and *'CSSmod'* cases, the diversity of results presented suggest one or more players from each of the cases may have experienced either one of the states analysed. Because each authors' (Brown & Cairns, 2004; Ermi & Mäyrä, 2005; McMahan, 2003) interpretation of immersion is unique and open to interpretation, it is only possible to hypothesize the extent to which each player entered a specific level (considering Brown & Cairns (2004)) or type (according to Ermi & Mäyrä (2005)) of immersion. Collected results in both cases point to the possibility of participants having become immersed or in a state of flow, but further studies are necessary to confirm these results. Also, in the case of the *'CSSmod'*, given the limited number of participants and the nature of the study, insufficient statistical tests were carried out.

RECYCLE & 'CSSMOD' *VS.* VISUAL ATTENTION

Considering results regarding visual attention, and initially looking at the 'ReCycle' case, results confirmed one of the defined hypothesis (Hyp. 6), stating *changes in game rules and visuals influence players' visual attention patterns*. In the case of 'ReCycle', these changes occurred according to the game map played.

In terms of fixation count, there was an increase in the number of fixations in the *Central/Weapon* and *Energy* areas from map M1 to M2, partially confirming the hypothesis (regarding game rules). However, in terms of time count, while the percentage of time increased for the *Energy* area, it decreased for the *Central/Weapon* area from M1 to M2.

In terms of fixation count, results indicated an increase from the map M1 to M2 in the Central/Weapon area and the Energy Area. However, this did not occur for the Alliance Area. In the change to map M3, the Central/Weapon area remained the most visualized, while the Energy Area decreased slightly. In regards to the time count data, values were somewhat different. From map M1 to M2, the fixation count percentage decreased for the Central/Weapon area, while it increased for the Energy Area.

Independently of the results acquired in either case, there is one figure that stands out and is common to both cases. Looking at both 'ReCycle' and *'CSSmod'* case results, the central area of the screen was always the most visualized. With 'ReCycle', a squared area of approximately 20% of the horizontal size of the HUD was defined. On average, the 32.84% of all fixations were registered in this area, rising to 39.69% in terms of time count percentage. Also, considering the playing experience factor (Figure 39 and Figure 40), the minimum value registered for the fixation count is 32.79% (inexperienced players), with an average of 40.48% among all four groups. With the time count values, these numbers increase to a minimum of 37.46% (inexperienced players) and an average of 49.07% among all four groups. These results indicate that no less than one-third (approximately) of all visualizations was registered in the centre of the screen.

Looking at the *'CSSmod'* results, the same approach was adopted as with 'ReCycle'. Here, a squared area of approximately 20% of the horizontal size of the HUD was also defined. According to the playing experience factor (Figure 49 and Figure 50), the minimum value registered for the fixation count was 47.77% (hardcore player), with an average of 51.27% for all groups. In terms of time count percentage, the minimum was also 47.77%, with an average of 53.17% in regards to time count percentage. Therefore, with *'CSSmod'*, almost half of all visualizations were registered in the centre of the HUD. These results partially corroborate those explored by El-Nasr & Yan (2006, p. 6), which indicated that "*eye-tracking data shows that in the first-person shooter game, players paid attention only to the centre of the screen, where the cross of their gun was located*". The fact that players must use the cross of the gun to aim at and kill enemies – the main objective of a FPS game – justifies the large quantity of visualizations registered in the centre of the screen. In line with El-Nasr & Yan's (2006, p. 6) results, other defined areas of interest– related to levels of energy and ammunition – received moderate attention. The *Energy/Area* in the 'ReCycle' case received a slightly significant percentage of, but possibly influenced by the changes in game rules that somewhat steered players' attention to that area. Evidently, and in both cases, players visualized more often and during a longer period of time areas of strategic importance in a shooter game: the central area, because it is used to aim at enemies; and for more experienced players, the ammunition and energy areas in order to better manage their resources.

7.5 FINAL CONSIDERATIONS ON THE CHAPTER

Posterior to the development of the Gameplay Experience Model, an initial validation is essential in order to assess its viability and thoroughness. The previous chapter (*cf.* CHAPTER 6 – Validating the Gameplay Experience Model, *p.* 185) described the empirical study carried out, based on a multi-case study using two different study objects. This chapter focuses on the results of the empirical study.

Two case studies were considered: one with the 'ReCycle' video game and the other with the 'CSS*mod*' video game. For each case, and based on the results collected from the Pre-Questionnaire and the Gameplay Experience Questionnaire, an analysis of players' attitudes on the games played was possible. Additionally, interactive data based on game metrics was considered. The simultaneous analysis of questionnaire results and metrics data offered insight into players' playing experience. Furthermore, given the manner in which the model was built – with significant contributions from immersion and flow studies – these specific aspects of the gameplay experience were also considered and analysed based on the collected results.

Despite limitations in each of the cases, results demonstrate several associations between various model dimensions, suggesting they are in fact an integral part of the experience. As a result, and while further validation is necessary, these case studies allowed for an interesting initial validation of the model, confirming the multiple model dimensions and characteristics.

CONCLUSIONS

Considering the work developed in previous chapters, the *Conclusions* section revisits and looks to provide an answer for the proposed research question; analyses the extent to which the defined study objectives were achieved; and if the defined hypothesis were confirmed or rejected. Also, reflections on the contributions of the study are presented as well as the limitations of the study. Lastly, future work is presented and the document is finalized by some final comments.

1. REVISITING THE RESEARCH QUESTION AND HYPOTHESES

The global study presented in the previous parts of this document was framed within a research question (*cf.* Research Question *p. 4*) and a consequent series of study objectives (*cf.* Study Objectives, *p. 5*). Furthermore, several hypotheses (*cf.* Study Methodology, Analysis Model & Hypotheses, *p. 7*) were defined on the possible outcomes of the study.

REVISITING STUDY OBJECTIVES

Looking initially at the proposed objectives, considering the work presented throughout this document, it is felt the objectives were achieved to a greater or less extent.

Considering *Objective 1* and *Objective 2*, Chapter 1 (*cf.* Video Games, *p. 15*) consists in a thorough analysis of the *video game* concept as well as how games are evaluated. The chapter begins with a brief overview of the history of video games, focussing essentially on the debate over who developed the first 'video game'. From there, the discussion centres on the topics of *play* and *games*, moving posteriorly to a multiple definitions of games according to several authors. With a larger understanding of (video) games, a look into game and level design is presented. Game design deals with conceptualizing and developing the game, while level design is related to the development of the space in which all of the gameplay takes place. This section is of large significance because it is the wide variety of possible game levels in which experiences are formed, through a player's interaction with other players, non-playable characters or objects. Additional sections of this chapter focus on video game evaluation, namely the evolution of game evaluation throughout the years, game testing embedded within the development cycle, different evaluation methods, with special incidence on eye tracking based approaches.

Objective 3 set out to understand the widely debated concept of the *gameplay experience*. As presented in CHAPTER 2 (*cf.* The Gameplay Experience, *p. 65*) the gameplay experience is in fact a complex concept, defined and analysed in multiple ways. To further understand the concept, an initial analysis of the evolution of the term is presented, considering the appropriation of the concept *user experience* in a game context. Additionally, related to the gameplay experience, several concepts such as *immersion*, *flow* and *presence* have been explored. Each of these concepts is discussed considering existing work, and posteriorly the target of a collective analysis on how they all relate. Lastly, the chapter looks to explore how the gameplay experience is evaluated and measured; essentially focusing on previously developed academic studies.

Objective 4 represented one of the most ambitious of the defined objectives, and consisted in the development of a gameplay experience model which embodies the multiple characteristics of the experience. Having found a gap in existing literature, related to the lack of work which equally balance the *player* and *video game* elements in the gameplay experience, a model proposal was developed – and presented in CHAPTER 5 (*cf.* A Gameplay Experience Model, *p. 133*) – based on a literature review analysis and focus group sessions. From these two sources, multiple characteristics related to video games and the player was identified. The proposed model – which considers the gameplay experience as both the interactive an emotional experience – has in the *video game* and *player* its two main elements. Additional characteristics are allocated to multiple model dimensions: *mechanics*, *interface* and *narrative* for the video game; *investments*, *anticipations* and *background* for the player. It is felt this model is a valid contribution to the gameplay experience debate, as it not only presents an additional – somewhat different – look at the gameplay experience, but also synthesizes much of the existing work on the concept.

Objective 5 and *Objective 6* have in common the human visual system. Objective 6 pursued a deeper understanding of the human visual system and how eye movement can provide data on player behaviour. Section 3.1.1 (*cf. p.* 91) provides insight on the multiple components and functions of the human eye, while additionally discussing the multiple eye movements. From there, and considering that eye movement behaviour is unique when in a game context; the concept of *visual* and *selective* attention was presented, followed by a look at visual attention related studies in video games. The chapter also pays special attention to the topic of eye tracking, a technique which dates back many years and is now used in a variety of studies. As a result, a look into the history of eye tracking and its multiple techniques and methods are presented. This is followed by a thorough analysis of its strengths and weaknesses, in an attempt to further understand its multiple values, but also the reasons why it has yet to be completely adopted in behaviour studies.

Objective 7 consisted in validating the model proposed as part of Objective 4. The validation of the model was carried out adopting a multi-case study, using two first person shooter video games (developed for academic purposes). Each case was executed according to a particular experimental design, but both consisted in participants playing the respective game and answering a Pre-Questionnaire and a Gameplay Experience Questionnaire. Results from these questionnaires provided data regarding players' *emotional* experience, while the interactive experience was analysed according to game metrics extracted from the game. In either case, statistical studies were carried out to further understand the *emotional* experience and how it related with the *interactive* experience.

Objective 8 consisted in analysing how the proposed model and existing communication theories could be simultaneously analysed. Posterior to an introduction on communication and various communication theories (*cf.* Section 4.1 – Communication in Video Games, p. 117), a reflection on how multiple aspects and characteristics of the proposed gameplay experience model can be considered in the light of these theories is presented (*cf.* Section 5.4 – A Reflection on Communication Theories in the Gameplay Experience Model, *p.* 172). Twelve different theories are considered in total – based on a previous assembly of theories (Littlejohn & Foss, 2007; Littlejohn, 1999) – and related to, for example, the 'System Theory', 'Message Reception and Processing', 'Culture and Society', among others. While the work presented in the chapter is mainly a work of reflection, it is felt that the objective was to some extent carried out, and serves as a reference for a similar analysis in the future work.

In a general manner, it is felt the proposed objectives were answered within expectation. Although some situations (cf. Section 3 – Study Limitations, *p. 277*) limited the extent to which each objective was fulfilled, the general appreciation is positive.

ANSWER TO THE PROPOSED RESEARCH QUESTION

Recalling, the defined research question asked: *considering a video game and player based model, what possible interplay between respective dimensions and characteristics can contribute to the definition of the gameplay experience?*

Based on the work presented, the answer to the proposed question can be found in the work developed in CHAPTER 5 – *A Gameplay Experience Model* (*cf. p. 133*), and executed in the Empirical Study prepared in CHAPTER 6 (*cf. p.* 185), and analysed in CHAPTER 7 (*cf. p.* 202).

CHAPTER 5 focuses specifically on the development process of a gameplay experience model proposal which considers both a video game and player element. Each of these elements consists of three dimensions. The video game element includes *Mechanics*, *Interface* and *Narrative*. The player element includes *Investments*, *Anticipations* and *Background*. Also, in addition to the three video game dimensions, the model considers an additional supporting characteristic – consistency – which serves as a means of connecting the other three dimensions. Each of these dimensions includes one or more different characteristics. It is the possible interplay between these characteristics, the dimensions and globally, the connection between the player and video game, which define the gameplay experience. However, the model also considers factors exterior to the player and the video game, namely the idea of a *gameplay situation*. This gameplay situation remits to an ambient and platform setting in which the act of game play takes place. Furthermore, the gameplay experience defined within the model is a twofold experience: it is an interactive experience – related to the process of playing – and an emotional experience, related to the outcome of playing a video game.

Considering the work presented in CHAPTER 7 (*cf. p.* 202), related to the results of the model validation, it seems the proposed model represents to some extent the existing interplay between the player and the video game. In one of the cases studied (*cf.* Section 7.1 – 'ReCycle' Case: Presentation of Results, *p. 205*) and looking specifically at some of the correlation results, multiple correlations were verified between the model's dimensions, revealing in fact an association between the player and video game characteristics of the model. Player variables and characteristics related to *gender*, *playing experience* and *game genre preferences* can also influence players' attitudes regarding their emotional and interactive experience. Looking at the second case studied, these correlations did not occur with the same frequency (*cf.* Section 7.2 – 'Counter Strike Source: *mod*' Case: Presentation of Results, *p.* 238). However, this case was executed under distinct conditions which may have influenced these results.

Globally, it is felt the proposed model does represent the multiple characteristics intrinsic to the gameplay experience. Given the development process carried out – based on a literature review and focus groups – it is believed that model represents the necessary characteristics that can play a role in the construction of the gameplay experience, an experience resulting from the interplay between a player and a video game. However, it is also recognized that additional studies with different games, players and different contexts may shed additional and valuable information on the construction of the gameplay experience.

REFLECTIONS ON THE STUDY HYPOTHESES

Now reflecting on the defined study hypotheses, six were presented in total.

Hypothesis 1 stated: *the gameplay experience can be defined according to the interplay between characteristics related to video game mechanics, interface, and narrative; and player motivations, skills, experience and expectations*. This hypothesis looked to answer the primary research question, and was based on ideas from existing work, which considered a game to consist of *mechanics*, *interface* and *narrative* (Rollings & Adams, 2003); while *motivations*, *skills*, *experience* and *expectations* are important player related factors (Ermi & Mäyrä, 2005) during the act of game play.

From the model development process explored in CHAPTER 5 – *A Gameplay Experience Model* (*cf. p. 133*), mechanics, interface and narrative were found to be the best dimensions to characterize the video game element of the model. A fourth dimension – consistency – is also considered as a bonding characteristic. Each of these three dimensions considers one or more characteristics which describe the respective dimension. Regarding the *Player* element, only *motivations* and *expectations* (embedded within the *Anticipations* Dimension) were considered in the final model. The remaining two concepts referred in the hypothesis – *skills* and *experience* – were contemplated in the form of other characteristics and grouped under a third dimension called *background*. The concept of skills was associated to *ability*; and the concept of experience was associated to *knowledge*.

Regarding the (multi-case) empirical study conducted, and initially considering the 'ReCycle' case, results showed significant correlations among many of these dimensions for the three maps played. Furthermore, the only correlation with non-significant results in all three game maps was between the *Background* and *Interface* dimension. Excluding this result, other correlations between model dimensions were statistically significant in at least one game map. With the 'CSSmod' case, only one correlation (between *Mechanics* and *Anticipations*) was significant.

As a result, *Hypothesis 1* is partially confirmed. In terms of model construction, while the hypothesis is truthful regarding the video game element dimensions, it does not fully describe the player element. Furthermore, each of the referred ideas presented in the hypothesis should only be considered as model dimensions. From there, each dimension is made up of additional characteristics which must be considered to fully understand the extent of the gameplay experience. Lastly, considering the defined model, there are significant correlations between the multiple dimensions in one of the cases studied ('ReCycle'), but not in the other.

While the statistical results from the 'ReCycle' case contribute towards validating the model, they cannot solely be responsible for defining and validating its integrity. Furthermore, even though the results from the 'CSS*mod*' case appear to show a lack of association between the multiple model dimensions, these too cannot be solely considered in rejecting the model. Additional studies using the same video games in different conditions (with added participants and different profiles), as well as others from different genres are necessary to further test the possible interplay present in the model and infer on its representativeness of the gameplay experience.

Hypothesis 2 stated: *regarding possible interplay, video game characteristics related to mechanics and interface influence the outcome of the gameplay experience*. This hypothesis is also related to the primary research question, focussing on possible outcomes of the interplay between the player and video game elements. Considering the empirical study, in the 'ReCycle' case, three different game maps were played: a base map; a second map, where the quantity of daily energy removed was higher (changes in game rules); and a third map, where the size of the game map was reduced (change in game visuals). It was hypothesized these different changes in the rules and visuals would influence players' attitudes regarding the game and these maps in particular.

Results from statistical tests showed no significant differences in players' *Anticipations* for the three maps. However, statistically significant differences were found in terms of *Investments* with changes related to game visuals (from map M1 to M2), and when rules and visuals were simultaneously altered (from map M2 to M3). Based on further statistical studies, the significant differences in the *Investments* dimension may be related to statistically significant differences in the *Interface* Dimension for the same variation (map M1 to M3), and *Mechanics* Dimension (map M2 to M3). The *Investments* and *Anticipations* were primarily considered in the analysis considering they are most likely to be influenced by video game related changes. Therefore, the hypothesis is valid for the *Investments* dimension in two circumstances, but rejected for the *Anticipations* dimension in all tested scenarios.

***Hypothesis* 3** stated: *regarding possible interplay, player gender does not play a role in the outcome of the gameplay experience*. This hypothesis is also related to the primary research question, and was formulated based on the idea that gender is becoming less important in how individuals experience games. While studies (Erfani et al., 2010; Hartmann & Klimmt, 2006; Lucas & Sherry, 2004; Phan et al., 2012) suggest there are differences among male and female players, it was believed that given the right gameplay situation, these differences would be absent.

Considering the 'ReCycle' case, results from the validation showed non-significant differences between male and female participants in terms of the *Investments* dimension. However, looking at *Anticipations*, significant differences were found in all three game maps played based on statistical results. These differences in terms of *Anticipations* may find reasoning in further differences in terms of the *Background* dimension. As the large majority of the female players had no experience with the game genre played, their attitudes for the *Anticipations* of the game is understandable. This *Anticipations* related aspect goes in favour of the referred studies. Nonetheless, male and female players were similar in terms of their thoughts on the *Mechanics* of the game. When looking at the interactive experience – based on gameplay results from game metrics – while female players did underperform when compared to male players (demonstrating some lack of ability based on reduced experience with the game genre), this did not reflect on their *Investments*, despite having differed in terms of *Anticipations*. Therefore, the hypothesis is valid for the Motivational part of the experience, but rejected in terms of the anticipations. While female players were not prepared (abilities or knowledge) to play the type of game used in the study, the *gameplay situation* (related to playing among friends) created conditions favourable to the *Motivational* Dimension of the gameplay experience.

Hypothesis 4 stated: *regarding possible interplay, players' game genre preferences and playing experience influence the outcome of their gameplay experience.* This hypothesis also looked to answer the main study research question, while focussing on the player. Initially considering *video game genre preferences*, with the 'ReCycle' case, statistical tests revealed significant differences in terms of *Anticipations* in the first and second maps played. This difference may be related to further significant differences in terms of the *Background* dimension for all three maps, suggesting those that prefer shooter games were in fact different from those that don't in terms of their background, which may have necessarily influenced what they expected from the game. However, in terms of *Investments*, no significant differences were verified. Similarly, no significant differences were registered for the *Mechanics* or the *Interface* dimensions.

Looking into *playing experience*, with the 'ReCycle' case, statistical results showed no significant difference in terms of *Investments* and *Anticipations* among the four defined playing experience groups. Also, in terms of the *Background* and *Mechanics* dimensions of the model, there was only a significant difference when comparing the inexperienced players to the remaining three experience groups. In the 'CSS*mod*' case, while only three playing experience groups were considered, no significant differences were found in terms of *Investments* or *Anticipations*; similar to what occurred with 'ReCycle'. This shows that for the two most *changeable* dimensions (*Investments* and *Anticipations*), there are no significant differences among players according to playing experience. This suggests that independently of an individual's playing experience, players' gameplay experience – at least with these video games in particular – will be similar. When considering the *interactive* experience, in either case ('ReCycle' or 'CSS*mod*'), visible differences in how players interacted with the game were visible according to playing experience. Less experienced players visibly underperformed in terms of game strategy metrics when compared to the more experienced players. Therefore, while the interactive experience was influenced by playing experience and video game genre preferences, these did not result in significant differences in terms of the emotional experience.

Regarding the hypothesis, it is both confirmed and rejected. Based on the results obtained in the tested cases, independently of a players' preference for shooter games or playing experience, players' *Investments* do not differ. This does not occur with *Anticipations*, where significant differences are visible between players that do and do not prefer shooters in two scenarios, but not significant according to playing experience. Similar to what occurred with *Hypothesis 3*, it seems the *gameplay situation* of the case – playing the game with friends in a relaxed ambient setting – transcended whatever ability or knowledge limitation players had. Even though inexperienced and non-shooter fans played poorly, the situation in which they played was motivating and kept them interested in the game.

Hypothesis 5 stated: *players' interaction behaviour can provide information regarding their level of understanding of the game mechanics and abilities, both part of the gameplay experience*. The model presented in this work states the gameplay experience contemplates a player's interactive experience, related to how a player interacts in the game – the process of playing. This *interactive* data can be collected through – among other solutions – game metrics. Players' interaction results were considered and analysed in both cases used in the empirical study. From the results collected in either case, it is not completely clear that game metrics can clarify on players understanding of the game mechanics.

With the 'ReCycle' case, for example, and considering the multiple variables analysed, only in one game metric between inexperienced players and the remaining groups, could it be suggested that they showed a noteworthy difference regarding their understanding of the rules (mechanics). However, statistical analysis showed no significant differences in players' interpretations of the *Mechanics* Dimension for all player related variables tested. Nonetheless, when considering players' *abilities*, player performance – namely regarding metrics related to strategic selections within the game – seems to be connected to player skill (playing experience) levels. In almost all *strategic* options; more experienced and male players, as well as shooter fans, demonstrated a greater knowledge of how to play the game and to manage their resources, as well as the game's resources. Also, an additional analysis showed that playing on an eye tracking computer did not have an influence on how these different player groups performed within the game.

With the 'CSS*mod*' case, a very similar situation occurred. Although metrics related to players' interaction behaviour showed some large differences between inexperienced players and the remaining groups, it is not sustainable to affirm that inexperienced players did not understand the rules of the video game (mechanics). Moreover, statistical results showed an approximation between all playing experience groups in terms of the *Mechanics* Dimension. However, while it shouldn't be affirmed that inexperienced players did not understand the rules, it was evident that they did lack abilities to play the game at the same level as the more experienced players. This is visible not only based on differences in game metric values, but also in the visual analysis (using the GAMEYE application) of players' interactive behaviour in the game. This visual analysis identified inexperienced players' incapacity to move around the map, having constantly remained in the same areas. On the other hand, experienced players tended to explore much more of the map in order to strategically confront their opponents. Similar to what occurred with 'ReCycle', playing on an eye tracking computer did not have an influence on how players with different playing experiences performed within the game. Therefore, while it is risky to conclude on a players' understanding of mechanics based on their interaction behaviour, it is more plausible to infer on their abilities based on numeric or visual data on their interaction within a video game.

Hypothesis 6 stated: *eye tracking data can provide information regarding how changes in a game modify players' visual attention patterns*. Results from the visual analysis part of the study showed some differences in player behaviour when specific characteristics of the game were modified. Specifically, and reporting on the 'ReCycle' case, when the quantity of energy removed from the players was increased from the first map (M1) to the second (M2), players demonstrated a tendency to visualize their energy levels (located in the top left corner of the HUD) more frequently and for a longer period of time. In a second situation, when the size of the map was reduced in half – possibly fostering a greater number of player interactions and requiring attention to their gun in order to confront opponents – players also looked more frequently and for more time at the centre of the screen. Furthermore, alterations in players' visual behaviour in the three maps – related to video game changes – were not influenced by players using an eye tracking computer to play. As a result, this hypothesis is confirmed: using eye tracking, it is possible to analyse eye movement data and understand how different changes in video game characteristics can affect players' visual attention behaviour.

2. STUDY CONTRIBUTIONS

One of the main objectives of the study consisted in the development of a gameplay experience model. An extensive analysis was carried out on multiple *experience* related research, focusing on multiple concepts including *player experience*, *gaming experience*, *immersion*, *flow*, *presence*, among others. While many of concepts focus on similar topics, others branch out into very specific questions. However, common in many of these studies is the importance of the *player* and the *video game*. While an independent analysis of each of these concepts is possible, when looking at the gameplay experience, it is felt that these two elements must be analysed in terms of their interaction. As a result, the resulting model proposal seeks to equally balance these two elements, giving equivalent attention to both. The development process behind the model also contributed to summarizing some of the existing work on the gameplay experience, highlighting the multiple characteristics related to video game and player elements. As many studies reflect on similar game or player related characteristics, the model to some extent agglutinates these multiple reflections.

The proposed model also reflects on ideas felt to not yet have been considered or sufficiently explored within *experience* related studies. Specifically, the idea of a *gameplay situation* which precedes the gameplay experience is introduced. The gameplay situation considers both an ambient and platform setting, which can define how the player-video game interplay develops. Also, the model elaborates on the idea that the gameplay experience is not only an emotional experience, but also an interactive experience. While the emotional experience may be the final outcome of game playing, how a player interacts during the game influences his momentary emotions, which in turn can also affect how he continues to interact with the game. This reciprocity culminates in a final emotional experience.

In addition to the model, the study contributes with a *gameplay experience questionnaire* (GExQ) which can be used to assess the emotional experience, according to the multiple model characteristics. The essential part of the GExQ is the 27 items which assess players' attitudes towards the model characteristics. Based on these results, a better understanding of the players' emotional experience is possible. From here, single characteristics can be analysed, namely if players felt connected to the game, if they enjoyed the game visuals or understood the goals of the game. However, an agglomeration of characteristics (in the form of model dimensions) can also be analysed, providing data on players' motivations towards the game, attitudes towards the mechanics and interface, for example. Nonetheless, while the questionnaire fitted the needs of the model and developed studies, it is recognized that the GExQ has some limitations (*cf.* Study Limitations, *p. 277*) and additional work (*cf.* Future Work, *p.* 279) can be done to improve its applicability in future work.

Lastly, and related with the gameplay experience questionnaire, another contribution of the study relates to the ways in which the *emotional* and *interactive* experience are measured. The emotional experience, as referred, is measured using the GExQ. However, the interactive experience was analysed using gameplay data based on collected metrics. Combining interactive data analysis with the questionnaire analysis proved to be of value in further understanding the gameplay experience as proposed in this study. Also, in one of the cases considered ('CSS*mod*'), the interactive analysis was supported on a visual examination of player behaviour within the game map, using the GAMEYE application developed by Soares (2012). This application – conceptualized and developed based on parallel research to this study (Almeida et al., 2012; Soares, Veloso, Mealha, & Almeida, 2011) – allows a detailed look at how players' interact within the game map, using visual representations such as heat maps and movement plotting.

3. STUDY LIMITATIONS

Within this study, several limitations can be identified which hindered a more extensive and thorough analysis of certain aspects of the study.

Considering the *Gameplay Experience Model* and respective development process, while several studies on the gameplay experience (namely *immersion* and *flow*) were considered, it is plausible other existing and more recent studies could have further contributed to the model. The vast number of studies presented proves the richness of studying the gameplay experience. Furthermore, these studies only represent a small portion of existing work. It is admitted additional work not considered in the literature review could have further contributed to the development of the model. However, it is felt the focus groups provided valuable complementary data which successfully contributed to the development of the model. Nonetheless, while the work of two focus groups resulted in more than 100 game and player related characteristics, the use of additional focus group sessions was considered, but was not carried out given time constraints.

The *Gameplay Experience Questionnaire* (GExQ) used in the study is not fully validated. The GExQ in its current state fulfills to a significant extent the needs of the model, but may not be totally representative of the gameplay experience. The GExQ consists in 27 questionnaire items that cover all of the model characteristics. However, additional items that further reflect the model characteristics could solidify the questionnaire, namely through control questions. Nonetheless, a more logical choice would be to prepare the questionnaire to be sufficiently adaptable to multiple study scenarios. In this study, where the same questionnaire is administered three times to the same group of individuals (in the case of the 'ReCycle' case), an excessively long questionnaire could compromise the honesty of participants' answers, leading them to lose interest in the questionnaire and answer in a random manner, rather than in a more honest way.

Regarding the empirical and the multi-case study, ideally both the 'ReCycle' and the *'CSSmod'* case should have been played by a similar group in order to obtain more reliable and comparable data regarding the experience of playing games. However, this was not possible given the lack of interest manifested from part of the community to participate in the study. Given the duration of the study (approximately 2 hours), the community showed limited interest in participating. Furthermore, the *'CSSmod'* case represented an additional level of complexity in terms of setup. In order to play the game, participants were required to install the Steam platform and go through a series of other technical steps. Also, playing within a limited wireless network also conditioned the both the 'ReCycle' and 'CSS*mod*' cases. With 'ReCycle', the network restrictions limited player's initial connection to the game. Every time players were *killed* in the game, they had to complete a series of steps which took away from there playing time. For some players, this was frustrating and led them to only play a single round. The only session in which this did not occur was at the game development company, where a non-limited internet connection was available. With 'CSSmod', the same network limitations were verified. The possible *walk around* resulted in being able to carry out a single session, but repeating the process made the exercise very complicated and nearly unrepeatable in similar conditions.

Still within the *'CSSmod'* case, the game should have been played by a bigger and more heterogeneous group. However, as mentioned, the multiple setup conditions limited the number of players able to participate. This limitation reflected on the limited statistical analysis carried out for this case. It was not possible to compare the evolution of players' gameplay experience along multiple rounds and scenarios; rather, analysis was limited to a single questionnaire, administered at the end of the session. Nonetheless, some analysis was still possible, namely in terms of comparison of results with the 'ReCycle' case.

4. FUTURE WORK

Despite providing a contribution to the area of video games and communication, the presented work not only answers some questions, but equally important, plants the seed for other questions and additional work.

Firstly, considering the multiple limitations presented (*cf.* Section 3 – Study Limitations *p. 277*), future work consists in further validating the proposed Gameplay Experience Model. The two presented cases can be further explored for a more extensive understanding of the gameplay experience. This would necessarily involve the recruitment of a larger, more heterogeneous (but balanced) group in terms of gender and playing experience. While this wasn't the biggest limitation in the 'ReCycle' case, it was a severe limitation in the 'CSS*mod*' case. Additional work would also consist in developing studies with games of different genres. The two cases described were games of the First-person shooter genre. These games were specifically selected because of their *logging* characteristic (providing game metrics for posterior analysis). While game logging isn't essential, it does help to further explore the gameplay experience in terms of its interactive component (as defended in the proposed model).

Much of the statistical analysis presented in the empirical study focused essentially on two of the model dimensions – *Investments* and *Anticipations*. While the reasons for this approach were presented, in future work a more exhaustive analysis of other model dimensions would be considered. Moreover, it would also be valuable to analyse the extent to which the *Investments* and *Anticipations* would evolve according to a larger and more balanced sample (as referred above).

The statistical analysis carried out was done using a Gameplay Experience Questionnaire (GExQ) developed specifically for the needs of the model. Considering possible limitations of the GExQ, future work would be steered to further mature the questionnaire. As presented, this could consist in additional questionnaire items for all of the model characteristics, as well as control questions to further guarantee reliable answers.

5. Final Comments

Of the many plausible reasons why an individual may play games, ultimately, it is all about the experience. It is the experience of competitive gaming with friends; it is the experience of casual online play, just to pass the time; it is the experience of being crowned champion in a soccer tournament; or the experience of exploring a game world with detail to the extreme.

However, within these experiences, another takes form: the *gameplay experience*. This thesis has explored the development of a renewed look into the gameplay experience, through the development of a model proposal which characterizes the referred experience. The model considers the gameplay experience to be twofold: it is both a process and an outcome. It is a *process* in the sense that the form in which players *interact* with the game can define how they feel about the game – their emotional experience, the *outcome* of the game. However, this is seldom linear, considering that while playing a game, players' interactive experience influence their *current* emotional experience, which may also once more reflect on the interactive experience. It is this reciprocity which explains why players may feel excited or bored during the same game, as well as perform better or poorly. It is how players react in each of these moments that ultimately define their overall gameplay experience.

In fact, each player is different; unique in his *investments*, his *anticipations* and also his *background*. These three player-related dimensions are what govern how a player interacts, and posteriorly, how he feels in the end. Moreover, during game play, the three referred player dimensions will come together with the particularities of a video game, namely its *mechanics*, *interface* and *narrative*. These six dimensions, related to the player and video game, embody and define this new perspective on the gameplay experience. The impact and importance of each game dimension and supporting characteristics only depends on how it reflects on the multiple dimensions of the player.

Make great video games and create great experiences. Returning to the introductory premise of this study, it is felt that this study has contributed to further understanding how exactly this statement can be successful. If developers understand the fundamentals of video games and are conscious of the multiple player-related facets, they are one step closer to create a video game which provides a satisfying, compelling gameplay experience.

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APPENDICES

APPENDIX 1 – SPSS STATISTICAL RESULTS

APPENDIX 1A – RECYCLE STUDY

For a complete overview of the 'ReCycle' SPSS statistical results, please refer to the 'Appendix 1A - ReCycle Study' folder in the CD accompanying this document.

APPENDIX 1B – CSS*MOD* STUDY

For a complete overview of the 'CSS*mod*' SPSS statistical results, please refer to the 'Appendix 1B - CSSmod Study' folder in the CD accompanying this document.

APPENDIX 1C – RECYCLE VS. CSS*MOD*

For a complete overview of the 'ReCycle' vs. 'CSS*mod*' SPSS statistical results, please refer to the 'Appendix 1C - ReCycle vs. CSSmod' folder in the CD accompanying this document.

APPENDIX 1D – RECYCLE & EYE TRACKING

For a complete overview of the 'ReCycle' & Eye Tracking SPSS statistical results, please refer to the 'Appendix 1D - ReCycle & Eye Tracking' folder in the CD accompanying this document.

APPENDIX 1E – CSSMOD & EYE TRACKING

For a complete overview of the 'CSSmod' & Eye Tracking SPSS statistical results, please refer to the 'Appendix 1E - CSSmod & Eye Tracking' folder in the CD accompanying this document.

Appendix 2 – ReCycle Gameplay Results for Maps 1, 2 & 3

Appendix 2A – Map 1

For a summary of gameplay data metrics for Map 1 of ReCycle, please refer to the 'Appendix 2A - ReCycle Map 1' folder in the CD accompanying this document.

Appendix 2B – Map 2

For a summary of gameplay data metrics for Map 2 of ReCycle, please refer to the 'Appendix 2B - ReCycle Map 2' folder in the CD accompanying this document.

Appendix 2C – Map 3

For a summary of gameplay data metrics for Map 3 of ReCycle, please refer to the 'Appendix 2C - ReCycle Map 3' folder in the CD accompanying this document.