THE EFFECT OF PREVIOUS GAMING EXPERIENCE ON GAME PLAY PERFORMANCE

by

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ABSTRACT

In this thesis, I looked at how the skills/knowledge gained from playing games from different genres can influence players' gameplay performance when playing a new game; this is critical as different genres provide players with different abilities. Although understanding players' gameplay behaviours and performance abilities is one of the growing areas of research, none of the previous research within this area has deeply investigated players' behaviours and its relation to knowledge/skills gained by playing specific genres. Knowing the details of the skills gained and their influence on performance of target audience's playing habits plays an important role in making informed decisions about game design. Since many game genres exist, to narrow it down I explored the influence of prior gaming experience, specifically with Role Playing and First Person Shooter games on players' ability to navigate and solve spatial puzzles in 3D games.

Keywords: Game user research; Game performance metrics; Game usability; Interactive entertainment; User gaming experience; Player modelling; Video games.

“To My Parents”

- *My deepest gratitude goes to my parents whom I have no suitable word to thank fully.*

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Interactive entertainment products, including games, are becoming increasingly popular. Statistics gathered by ESA (*Entertainment Software Association*) show that 67% of homes in America own a console and/or PC used to play computer or video games [1]. Figure 1.1 shows the age and gender distribution of game players [1]. Note that the average age of players is 34 years old and not the typical 18 year old reported by 2004 Kaiser Family Foundation [2].

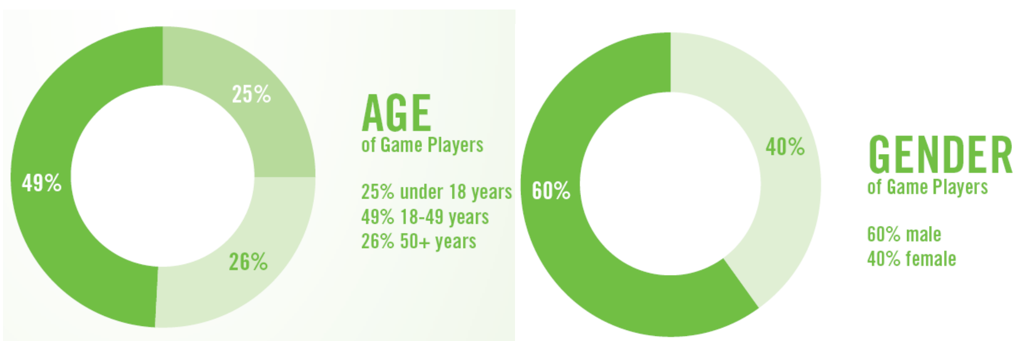


Figure 1.1: Age and Gender of Game Players [1]

There are many examples of early digital games dating back to the 1950s. Examples of such early digital games include: A) the *game of* '*NIM'* which is played on the NIMROD computer demonstrated at the 1951 Festival of Britain [3]. B) *OXO a tic-tac-toe Computer game* developed by Douglas in 1952 for the EDSAC —a unique computer built at the University of Cambridge in 1949 [4]. C) *Tennis for Two* is an interactive game engineered by Higinbotham in 1958 [5, 6]. D) *Spacewar!* Developed by MIT students Martin Graetz, Steve Russell, and Wayne Wiitanen's on a DEC PDP-1 computer in 1961 [7].

Since then, there have been several generations of games. The increase in the number of published video games was sparked by the invention of the game consoles [8]. The world's first video game console was *Magnavox Odyssey*, invented by Ralph Baer in 1972 [8]. The console operated through connection with a normal television set. Since then the popularity of digital games increased over time. Figure 1.2 shows the growth in the sales of digital games within the United States from year 1996 to 2009 [1].

Figure 1.2: U.S. Digital Game Dollar (in billions) Sales Growth [1]

With this increase, games have become part of popular culture [9] thus deserving of intellectual study. This is evident by the sheer amount of papers devoted to games within important areas, such as Science and Technology, Social Science, and Humanities. A quick search within ScienceDirect, Scopus, SpringerLink, ISI Knowledgebase, etc. yields an interesting trend showing a constant increase in the number of publications on games. Figure 1.3 shows an almost linear increase of game research in different fields since year 2000 (a search in ScienceDirect[1]). Additionally, a search on the topic of game research within the ISI Knowledgebase[2] shows a considerable percentage of papers within three major research areas: *Science & Technology, Social Sciences*, and *Arts & Humanities*, devoted to games. Specifically, I found 54.18%, 33.36%, and 12.82% of publications within these three areas, respectively, devoted to games; more detailed subject areas are: *Computer Science* (3,909 indexed articles), *Business & Economics* (3,641 indexed articles), *Psychology* (3,440 indexed articles), *Behavioural Sciences* (2,871 indexed articles), *Mathematics* (2,621 indexed articles). My research focuses on the area of game studies, specifically from an HCI (Human Computer Interaction) perspective.

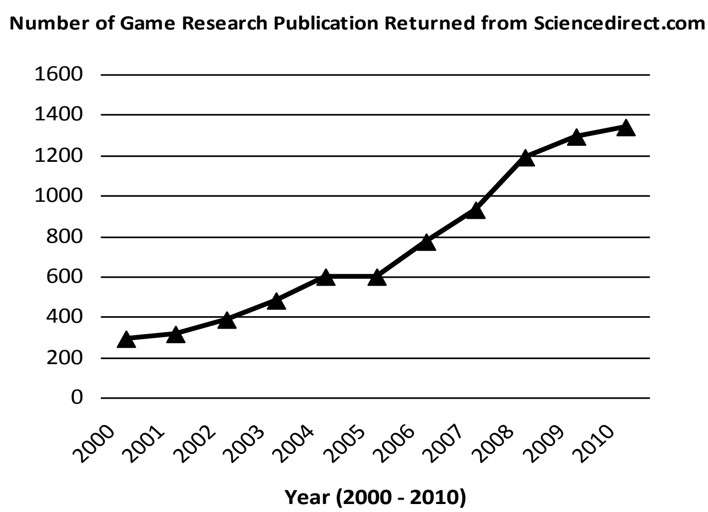


Figure 1.3: Number of Publications (journal articles, conference papers, and books) since 2000

Video games have been on the market since the 1980s. As a result, there are many skilled players, who have learned and internalized genre

[1] ScienceDirect, Retrieved on September 15, 2010 from http://redirectingat.com/
The query used is Title = ("game research" OR "game studies" OR "computer game" OR "video game" OR "digital game") Timespan= since year 2000.
[2] ISI Web of Knowledge, Retrieved on September 15, 2010 from http://isiknowledge.com
The query used is Title = ("game research" OR "game studies" OR "computer game" OR "video game" OR "digital game") Timespan=All Years.

conventions. On the other hand, due to the popularity of games and the increase in the market size (See Figure 1.1 by ESA), designers are challenged with the demanding task of creating games that can be appealing to different markets, accessible to different audiences, and enjoyable by a wide market composed of casual as well as hard-core gamers [12]. In other words, designers are now required to design one game for two different audiences: ones who have accumulated skills and knowledge through years of gameplay and are looking for new and challenging experiences and others who are either casual gamers or inexperienced and who may have never held a game controller [11]. This is a tough problem.

In my view, understanding the skills of the two audiences can alleviate this problem. Particularly, detailed knowledge about the internalized skills of different types of gamers will inform designers and enable them to better design their products to target such a wide market. This is the goal of this thesis.

Much work has been developed to study markets and players and understand their experience with the aim of informing or enhancing the design of next generation games. In terms of understanding player emotion, for example, Regan Mandryk published her dissertation [30] on understanding sports players' emotions using physiological data as they play against human vs. AI. She used fuzzy logic to model emotional states such as "boredom", "challenge", "excitement", "frustration", and "fun" during gameplay. Another interesting work of emotion in player experience is done by Lazzaro [32] from *XEODesign*. She deduced around thirty emotions from gameplay (not the story) using facial gestures, verbal comments and body language of participants where she categorized them in four classes of “Hard Fun”, “Easy Fun”, “Altered States”, and “People Factor”. The study showed that players play games not just for the game or the game experience, while they play to have “moment-to-moment experiences” e.g., solving a game challenge or escaping from everyday concerns. In terms of motivations, Lemay and Lessard [33], for example, questioned players’ and non-players’ attitude toward the videogame domain to get a better sense on engagement. Other researches such as Bateman and Boon’s [18] looked at personality and play styles in games. They offered four playing styles in their model by mapping the players’ type and a personality test. “Play styles” is a term used by the game industry and Game Developers Conference to refer to players’ behavioural trends; specifically, the types of activities that players tend to do in games/virtual worlds, such as hunting, collecting, goal achievement, etc.

In addition to these works, there are researchers [12, 22-24, 26, 27] who investigated the role of players’ background such as age, gender, family race/ethnicity, culture, social groups/group behaviour, or socioeconomic status on play style as way of understanding behaviour. Sandberg and Meyer-Bahlburg [27], for example, found a strong gender difference for middle childhood. For older subjects, participation of males in activities dominated by girls decreased, and vice versa for the girl participants. Parents’ educational level was not a significant factor. In addition, Chan found that “males play video games more hours per week compared to females, more frequently than females do, and they are more likely to self-identify as video gamers" [22]. Klimmt and Hartmann found that boys and girls often prefer different games, specifically, that "females disliked video games that lacked meaningful social interaction, had violent content, and had characters that were sexual stereotypes" [12]. None of this previous research, however, deeply investigated player behaviour and its relation to knowledge/skills gained by playing specific genres. In my view, different types of gamers, such as gamers who play only Role-Playing Game (RPG) or those who play only First Person Shooter (FPS), gain special knowledge and skills through their play. This thesis aims to take first steps to uncover this knowledge through an empirical study.

This topic is important. This is because knowledge gained from playing different genres influences players' game behaviours. Knowing the details of these skills and their influence on performance will allow designers to make informed decisions about their game design given knowledge about their target market. Games offer a variety of challenges that vary and, may be, distinctly different by genre [13]. Some genres focus on visual attention while others target strategic thinking. Some challenge users in navigational tasks, others concentrate on fighting enemies in a single closed space. This led me to investigate performance differences between experts in various game genres.

The study of game genre is still evolving, as games themselves are evolving. There have been efforts of game genre categorization at both the industry and academic levels. Several researchers and game analyst [14, 18-21] studied similarities and differences between characteristic and aspects of games to define classification systems for video game. Rollings and Adams [19-20] analyzed different games and genres and identified game elements or genre conventions based on the specific characteristic or mechanics of games. They defined nine genres: Action, Strategy, Role-Playing (RPG), Sports, Vehicles-Simulations, Construction-and-Management-Simulations, Adventure, Online-Games and Artificial-Life-Puzzle-games-and-others. They then defined subgenres, for example, they defined First Person Shooter (FPS) as a subgenre from Action Games. Ye investigated the relationship between certain movie genre conventions and their use to classify game genres [21]. In particular, he investigated the categorization of game genre based on “visual styles”, “interface metaphors”, “control schemes”, “interaction” and “user experience”, however he did not give a clear genre definition himself beyond that. In addition, Wolf [10] also defined a set of specific 42 genres where he might be too specific where he defined “Demos” and “Utilities” as game genres (the complete list will be introduced in Section 2.1). His classification was based on players’ interactivity or actions, “visual aesthetic” and “themes” and influenced by “moving imagery genre-form guide”.

Game genres are difficult to agree. This is due to many factors, including (a) it is hard to define hard boundaries to define genres with specific features, (b) there are many overlaps among them, and (c) as mentioned earlier, games are evolving [10]. However, some specific characteristics are emerging. For example, there are clear genres such as Sports, Role Playing Game (RPG), First Person Shooter (FPS), Action-Adventure, Simulation, and Strategy. These games are different and their mechanics are very different from each other. For the purposes of this thesis, I will concentrate on two genres: Role Playing Game (RPG) and First Person Shooter (FPS); the mechanics of these genres will be discussed in detail in Section 2.1. These genres have many underlying mechanics that differentiate them from each other. For example, FPS games involve shooting or ranged combat [15], while RPG games involve narrative and character development through game resources and statistics [16]. They both include exploration of 3D game world, gathering of items, completion of quests, and battling enemies [17]. However, the mechanics for doing these tasks and the pacing are different. Moreover, the target market is usually interested in one or limited numbers of genres. A quick look at the bestselling video games in year 2009 by genre distinction [1] might indicate that each genre has their own audiences (See Figure 1.4).

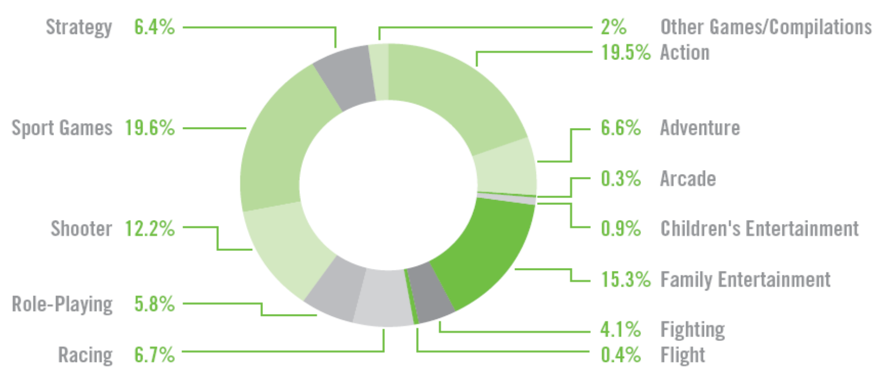


Figure 1.4: Best-Selling Video Game Super Genres by Units Sold, 2009 [1]

Players' abilities and skills are different depending on what genre they play the most. For example, some games concentrate on puzzle solving abilities, others on visual processing, and reaction times. Therefore, players' abilities and the skills they learn through the games will also be different and will mostly mimic the games they play. For instance, FPS games are usually characterized by tasks that require good eye/hand coordination, quick reaction time and precise timing of control inputs [19, 20]. RPGs, on the other hand, consist of tasks that are more related to logical thinking and problem solving. Thus, I would argue that difficulty in playing games is not only a problem for non-gamers, but it may also be a problem for different kinds of gamers when entering a space of gaming they have not played before. For example, RPG gamers trying to play an FPS game for the first time may confront many obstacles, as the tasks they learned in RPG games are different from the ones they confronted in FPS games. This topic is important as players' prior gaming experience or knowledge influences their game behaviour and preferences, and thus has an impact on game design and target audience.

Figure 1.5 demonstrates the general overview of my thesis and steps I took. As it shows, I started with reviewing various concepts and literatures from different game research areas: a) Game Genre, b) different methods within User Centred Design Methodologies, c) Gameplay Metrics (as well as Usability Metrics from HCI), d) studies on measuring players' gaming experience and e) studies investigated the role of players' background (e.g., age, gender, etc) on gameplay performance. However, since it was determined that there was a gap in the literature related to investigating prior gaming experience, a preliminary study was conducted to benefit from the design lessons and establish my research question. Within the studies, I collected data from two sources: a) the gameplay metrics and b) the survey questionnaires. I analyzed the data quantitatively and where necessary qualitative analyses were also applied. I then, outlined the results. Detailed explanation on my method will come in the following section.

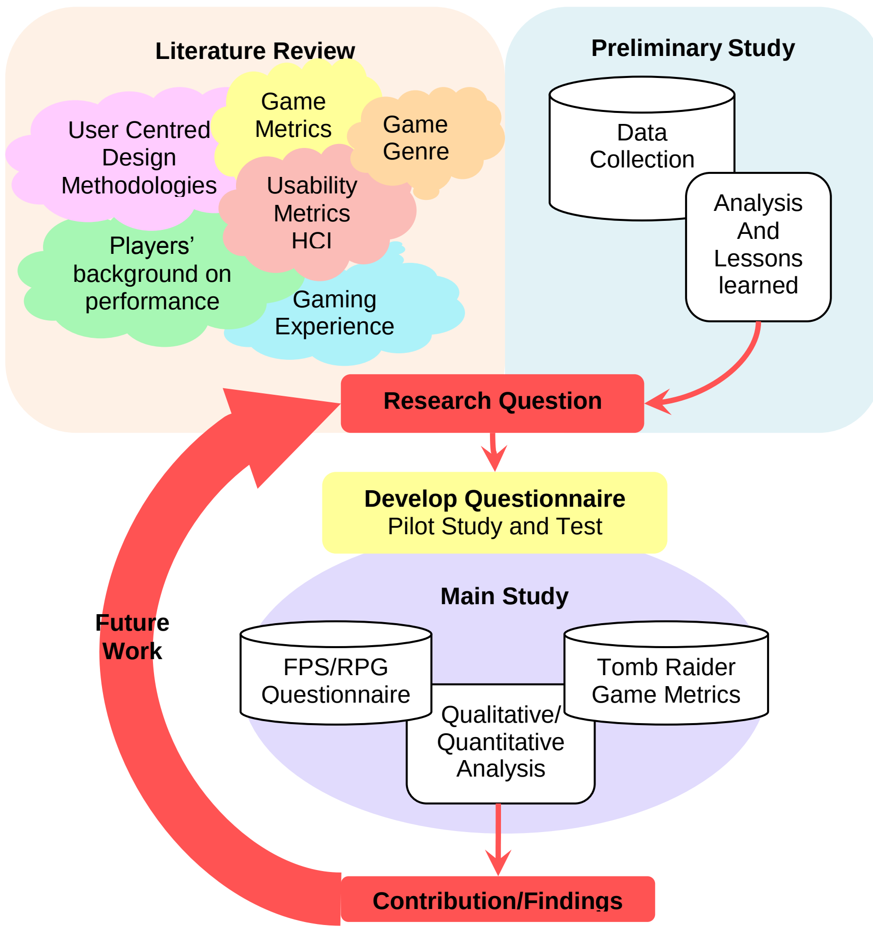


Figure 1.5: General Overview of my Thesis

1.1 Methodology, Research Question and Hypothesis

As it shows in Figure 1.5, I started with a preliminary study on game enjoyment, which assisted in redefining and redesigning of the main study based on its findings and limitations. Through the preliminary study as well as literature review, I learned several lessons that shaped my research question. I conducted this study with a team of researchers, including David Milam, Bardia Aghabeigi, Beth Aileen Lameman, and Tony Maygoli, supervised by Magy Seif El-Nasr. The objective of this study was to explore cooperative mechanics and its influence on engagement. We ran a study with 60 participants whose age ranged from 6 to 16 years old. We used a mixed methods approach [28-29], where we combined both quantitative and qualitative data. During the play session, we conducted several interviews gauging participants' backgrounds, playing habits and previous gaming experience. We also ran play-sessions that were all video taped and coded for later analysis. Observation notes, interviews, and video coded play performance were analyzed. I used data from this study to develop a video coding technique for measuring performance quantitatively, thus creating several quantitative gameplay performance metrics. These gameplay performance metrics included variables that would normally be in telemetry data (logs of game events or player actions usually collected by game companies), such as number of solved obstacles, death events, and time spent solving a puzzle. In this preliminary study, I explored the relationship between gameplay performance metrics on the one hand, and age, gender and prior gaming experience on the other. I used data from play sessions of three games: *Rock Band 2* (Harmonix Music Systems, 2008), *Lego Star Wars: The Complete Saga* (Traveller's Tales, 2007) and *Kameo*: *Elements of Power* (Rare, 2005).

Several lessons were learnt through it that influenced the design of the main study, which forms the contribution of my thesis. First, having youth as participants was not effective due to their lack of previous gaming experience.

Youth in the study typically reported playing a wide variety of games as they are still trying out different games and not really experts in any one genre. Second, the lessons I gained from performing the video coding and analysis were valuable. The method of using performance metrics (or telemetry like data) extracted through video coding was an effective method for studying or gauging players' performance.

Based on lessons learned from the preliminary study, I developed my thesis and formulated my research goal: Uncover the details of skills and knowledge gained through playing specific kinds of genre. For this thesis, I narrowed down the topic to the following research question:

> ***What are the performance differences between FPS, RPG, and non-gamers, when confronting a game that requires 3D navigation and 3D spatial puzzle solving?***

To explore this research question, I ran the main study using a mixed methods approach similar to the preliminary study. I had 35 participants (aged 21-25) and used a homogeneous participant group, as I was not interested in gender or age influences. I used *Tomb Raider: Underworld* (Eidos Interactive, 2008) as the game for this study. My choice was made based on several reasons. First, the game highly relies on 3D spatial puzzles and navigation for advancement; therefore, it is easy to measure 3D navigation and spatial puzzle solving by just measuring performance and advancement. Second, I needed the game to be fairly new to easily find participants who have not played it before. Third, the game should not be RPG or FPS but had some elements of both. Fourth, it should be a linear game with distinguishable obstacles for defining metrics. *Tomb Raider: Underworld* fit all these criteria.

To gauge the players' experience, I developed a survey instrument. The survey instrument includes background questions such as gender, age, etc. as well as game preference questions such as game genre, platform, etc. It also required participants to answer genre specific questions and recall specific details on FPS and RPG games they had played. These questions attempted to measure how familiar they are with RPG and FPS titles and thus allow me to categorize them as experts in one genre or the other.

I then constructed several performance metrics to measure 3D navigation and spatial puzzle solving. These metrics borrow from previous work on HCI, such as task completion: the number of obstacles solved and time to task completion. In addition, I constructed other metrics based on the *Tomb Raider* game, such as number of deaths (fall off, killing by enemies), number of events of shooting at enemies, etc. In addition to these quantitative metrics, I also used qualitative analysis to understand further the context behind these quantitative numbers. I used content analysis to represent the context of each spatial puzzle or obstacle, players' behaviour when faced by the puzzle and what they were doing inferring their goals, their breakdown issues, as well as noted when they asked for help and when they expressed (verbally or nonverbally) getting lost and frustration with controller.

Using their answers to the survey and the performance metrics, I performed statistical analysis to deduce the differences in performance between

RPG, FPS, and non-gamers. I then went back to the videos and coded the behaviours that participants were doing qualitatively to allow me to understand better the context within which they made their decisions. Such qualitative analysis added more to my understanding of the overall performance differences between participants.

1.2 Contribution

There are several contributions to this thesis. The first contribution is the novel methods used: (a) questionnaire developed to gauge and measure the gaming experience proved to be more adequate than previous methods, (b) the video coding technique for measuring players' performance behaviour and (c) the defined list of performance metrics. Next, the findings of the study uncovered specific differences between players who play FPS vs. RPG games and their skills in 3D navigation and spatial puzzle solution. In particular, I found that FPS players were faster in solving obstacles and solved more obstacles at a time. In addition, FPS gamers were faster in visually discriminating intractable surfaces, reacted much quicker, and thus excelled at solving spatial puzzles that relied on visual ability. The usefulness of the results lies on the implications to design and to our understanding of people or play behaviour. An uncovered design lesson, for instance, is that developers of games like *Tomb Raider* that rely on spatial puzzles may need to adapt the gameplay to accommodate other gamers, like RPG gamers.

1.3 The Structure of the Dissertation

The thesis is organized into six chapters:

Chapter 1 gives the reader an introduction of the research, setting the motivation and the contribution of this thesis.

Chapter 2 reviews the related work. First, I discuss game genre in detail since my studies rely on a detailed understanding of game genres and their mechanics. Second, I discuss several approaches for measuring players' gaming experience. Although they do not measure exactly what I am looking at (prior gaming experience/knowledge of different game genres), they do measure a part of the gaming experience. Third, since my work builds on previous works' methods research, I will discuss methods developed by previous research to gauge players' experience and performance, including surveys and metrics. Forth, since I specifically investigated metrics as an approach of collecting players' behaviours, I discuss several previous works that targeted similar approaches or methods. Additionally, I will overview HCI methods that are similar to my work. Finally, I review studies that investigated the role of players' background, including age, gender, family race and ethnicity, and socioeconomic status on gameplay.

Chapter 3 is a chapter on methodology. In this chapter, I discuss the instruments I used for the study I present in this thesis. The instruments include a survey gauging players' previous experience in terms of game genre, a video coding approach to gauge performance metrics within a gameplay video. I will also address the limitations of these methods.

Chapter 4 discusses the preliminary study I conducted in collaboration with several researchers, including David Milam, Bardia Aghabeigi, Beth Aileen Lameman, and Tony Maygoli, supervised by Magy Seif El-Nasr. In discussing the study, I elaborate on the experiment design, data collection, and data analysis methods. I also discuss lessons learned from this study as well as how they motivated the work of my thesis.

Chapter 5 discusses the core study used to derive answers to my thesis. In discussing this study, I elaborate on the experiment design, data collection, and data analysis methods. I also discuss the findings.

Chapter 6 is a discussion and interpretation of the results.

Chapter 7 concludes the thesis. In this chapter, I will summarize the contribution of my research. I also outline future research direction and applications of the findings.

2 RELATED WORK

2.1 Game Genres

Recently, game genres accepted as a common communication tool for gamers, on one hand, and game designers, on the other hand. This is evidenced by using game genres by video gaming/media review website e.g., Gamespot[3] and Metacritic[4] to organize the reviews, and by game companies e.g., Electronic Arts and Ubisoft to cluster the games. Therefore, they assisted in forming genres although they have not proposed genres' definitions [89]. Several researchers [10, 18-21] studied similarities and differences between games, defining different game characteristics and models. Rollings and Adams [19, 20], for example, defined ten game genres by analysing and identifying core mechanics of many games that characterizes a game genre. The ten genres they defined were Action, Role-Playing, Strategy, Adventure, Sports, Puzzle, Artificial Life, Simulation (Vehicle as well as Construction and Management), and games for girls. They also defined subgenres, for example, they defined First Person Shooter as a subgenre of the Action Games genre. Additionally, Ye proposed another definition of genre based on “movie genre conventions” [21]. In particular, he investigated the use of “visual styles”, “interface metaphors”, “control schemes”, and “interaction” to classify different genre, but he did not give a genre classification himself. In addition to this work, Wolf also defined a set of

[3] http://www.gamespot.com/
[4] http://www.metacritic.com/games/

42 genres based on “interactivity”, players’ actions, “visual aesthetic” and “themes” [10]. His genres are “Adventure”, “Abstract”, “Catching”, “Driving”, “Management Simulation”, “Puzzle”, “Sports”, “Adaptation”, Chase, “Educational”, “Maze”, “Quiz”, “Strategy”, “Collecting”, “Escape”, “Obstacle Course”, “Racing”, “Table Top”, “Artificial life”, “Combat”, “Fighting”, “Pencil-and-Paper”, “Role playing”, “Target”, “Board games”, “Demo”, “Flying”, “Pinball”, “Rhythm and Dance”, “Text Adventure”, “Capturing”, “Diagnostic”, “Gambling”, “Platform”, “Shoot ‘em Up”, “Training Simulation”, “Card Games”, “Dodging”, “Interactive Movie”, “Programming”, “Simulation”, and “Utility”. Nevertheless, he might be too specific where he defined “Demos” and “Utilities” as game genres [10]. As it can be seen, there are many different game genre taxonomies. The most common categories are Sports, Role Playing Game (RPG), First Person Shooter (FPS), Action-Adventure, Simulation, and Strategy.

Game mechanics are different depending on genre [21], and thus the skills needed to excel at that genre would be different. For instance, FPS games are characterized by tasks that require good eye/hand coordination, quick reaction time and precise timing of control inputs [13, 21]. RPGs, on the other hand, consist of tasks that are more related to logical thinking and problem solving in a slow pacing environment compared to FPS. RTSs (Real Time Strategy) consist of tasks that require strategic planning [13]. The list goes on.

An in-depth look at all genres/subgenres is beyond the scope of my thesis. Since I have investigated the effect of prior gaming experience, in terms of experience in FPS and RPG games, on the play performance, specifically when faced with tasks like 3D navigation and spatial puzzle solving, I will briefly define these three game genres: First Person Shooters (FPSs), Role Playing Games (RPGs), and Action/Adventure Games (AAs). I will discuss these genres using specific examples, including: when discussing First Person Shooters, I will use *DOOM* (id Software, 1993), when discussing Role Playing Games, I will use *Fable* (Microsoft Game Studios, 2004), and when discussing Action-Adventure Games, I will use *Tomb Raider: Under World* (Eidos Interactive, 2008). Although each game within the genre add to the mechanics and is unique in so many ways, I will use these three examples to discuss the core mechanics of the genre.

First person shooter games are combat games [15] where gameplay revolved around weapons and enemies [19] e.g., *DOOM* (id Software, 1993), *Half-Life* (Electronic Arts, 2001) and *Call of Duty* (Activision, 2003). Players play the game through the first person perspective [19], i.e. players see the gameplay with their avatars' eyes and do not see the avatars' bodies [20]. The screen also displays their weapons/hands, with a Heads-Up Display (HUD) showing their health, ammunition and location details. I will use ***Doom*** as an example to discuss the genre in detail [36]. Figure 2.1 shows a screenshot of *Doom* [37]. The goal in each level is to find the exit door to the next room. As they navigate through the world, players are required to avoid the hazards e.g., pits or fallen ceilings, fight enemies, and solve obstacles e.g., open locked doors. The main interaction focus in the game is fighting group of enemies. The player can attack them through "throwing fireballs", "scratching", and "biting". Player's are rewarded within the gameplay by improving their weapons and power-ups e.g., “armour”, “first aid kits”, “night vision”, “computer maps”, “partial invisibility”, etc. There are also secret rewards e.g. health and ammo, in secret places of the game. [36]

Figure 2.1: A Screenshot from *DOOM* [37]

Role-playing games are focused on narrative and social interaction [16] and usually consists of a rich back-story with science-fiction/fantasy theme e.g., *Final Fantasy* (Square, 1987), *Fallout* (Interplay, 1997), and *Fable* (Microsoft Game Studios, 2004). Players control a character(s) through a third person perspective. Thus, the camera is usually positioned at an over the shoulder position showing the avatar’s body [20]. This is also a common camera position for Action-Adventure games [20]. While exploring an RPG game, players complete quests, battle enemies and gather items. I will use ***Fable*** as an example to discuss the genre in detail [34]. Figure 2.2 shows a screenshot of *Fable* [38]. Player plays as, *Hero*, and interacts with other people and in-game objects while battling enemies. The goal is to complete quests by progressing in the gameplay. There is two kind of quest: golden quests are required and silver quests are optional. By the gold from completing of quests, players can buy weapons and other items such as houses and furnishing them. In addition, players make choices include "moral" choices allowing them to play as good or evil within the game. [34]

Figure 2.2: A Screenshot from *Fable* [38]

In Action-Adventure games, challenges require physical skills and high reaction speed in a 3D world inhabited by numerous characters that players can interact with e.g., interaction needs well coordination and fast reaction time [17]. Games in that genre also have a storyline as well as combination of story elements that can affect the flow of the game based on the player's actions [35] as players can communicate with characters and collect items [20]. This genre includes games that have both first/third-person perspectives. Example games within this genre include *The Legend of Zelda* (Nintendo, 1986), *Prince of Persia* (Brøderbund, 1989) and *Tomb Raider: Underworld* (Eidos Interactive, 2008). I will use ***Tomb Raider: Underworld*** as an example here [19]. Figure 2.3 shows a screenshot from *Tomb Raider: Underworld* (retrieved from my second study). *Tomb Raider: Underworld* is a 3D platform game and is played through a third-person perspective. The player controls and interacts through the main character, *Lara Croft.* The player explores and navigates through different 3D worlds. The objective is to solve puzzles, mostly spatial puzzles to find treasures. The game consists of eight levels including a prologue. Dangers in gameplay include dangerous traps, firing areas and some enemies e.g., sharks underwater. In the main study for this thesis, I asked participants to play the first two levels: *Level 1 Prologue* and *Level 2 Mediterranean Sea* (See Section 5 for a closer look at the game). In these two levels, players actions include jumping across platforms, grabbing and jumping from one edge on the wall to the other, interacting with objects such as switches, and navigating underwater to find hidden keys [39].

Figure 2.3: A Screenshot from *Tomb Raider: Underworld* (from second study)

2.2 Measuring Gaming Experience

With the increasing popularity of videogames, a growing number of researchers have embarked on developing methods for evaluating game players' experiences. Although they do not measure exactly what I am looking at in this thesis, in particular prior gaming experience/knowledge gained from playing of different game genres, they are related, and thus I will briefly review them.

Several researchers proposed models for measuring players' satisfaction. These models include the GameFlow model [41], which is based on Csikszentmihalyi's work on Flow [40]. Flow, an "optimal experience", is an emotional state of doing an activity with the highest level of enjoyment. As Csikszentmihalyi defined himself, "An activity that produces such experiences is so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous (p. 71)" [40]. Applying the Flow theory to the digital games, resulted in the GameFlow model [41]. Sweetser and Wyeth [41] aimed to understand "enjoyment" in digital games by evaluating games based on eight elements of "Concentration", "Challenge", "Player Skills", "Control", "Clear Goals", "Feedback", "Immersion", and "Social Interactions". These elements were defined based on Csikszentmihalyi's eight components of Flow [40].

In addition to GameFlow model, Ermi and Mayra [25] proposed a gameplay experience model based mostly on immersion. The model called Sensory, Challenge-based and Imaginative model (SCI-model) where "Sensory immersion" refers to audio-visual aspects of game, "Challenge-based immersion" refers to abilities and skills of players to overcome the challenges of games e.g., puzzle solving or thinking strategically. Finally, "Imaginative immersion" refers to storyline of the game, the world and characters of gameplay that players engaged. Authors aimed to explain dynamic interaction between gamers and games by using “self-evaluation questionnaire”.

In addition to these models for measuring satisfaction, several researchers proposed a set of guidelines or heuristics that designers can use to evaluate the game experiences. For example, Desuvire et al. [11] proposed Game Approachability Principles (GAP) where they defined Game Approachability as “the level of helpfulness in a computer game for new and inexperienced players to be able to initiate and continue to play the game (p. 133).” Their assumption was game mechanics need to be easily understood by users, thus enabling them to continue and explore the game. Based on this assumption, they proposed guidelines to create “friendly, fun, and accessible” tutorials and introductory levels for casual and inexperienced players. They ran empirical usability sessions with four games to get the sense of playability/usability of them e.g., where problems happened in the game. To back up their claims they recorded number of players with difficulty in different parts of the game and their quotations. Nevertheless, their approach has several limitations. First, using only four games limits the generalizability of their results depending on the genres used. In addition, I believe that there are several categories of gamers, and not just non-gamers and gamers, but it is rather more complex, and thus the help and guidance unavoidably needed to be complex depending on the skills and knowledge that the player has. For example, an RPG gamer will have many different difficulties from a non-gamer when playing an FPS game. Thus, the topic needs more research. This thesis is a start in addressing this question and possibly extending the research in this area.

Lemay et al. [33] proposed a semantic differential (SD) approach to understand the players' various experiences regarding their attitudes. SD is defined as "a particular approach for probing the connotative meaning of objects through the use of a list of bipolar adjectives (p. 94)." Players' attitudes to games were investigated in the hope of exploring the issues behind game design. Authors argued that players' perception of a game/game genre would affect their performance when playing a game. They conducted an online survey to compare perceptions on videogame to other spare time activities. They used a "7-point Likert scale" for 26-paired adjectives to rate number of activities namely, reading, practicing music, and playing video games. The paired adjectives included "healthy/unhealthy", "affordable/costly", "peaceful/violent", etc. They found that reading, playing music and physical activities have positive perceptions (e.g., healthy). On the other hand, playing digital games, being online and watching TV have negative perceptions (e.g., useless and harmful). Additionally, non-gamers were more negative than gamers, where they reported games as stressful, difficult and costly and gamers reported them as exciting and pleasant.

In terms of satisfaction, some studies reported that mastering game tasks and challenges is connected to game enjoyment [43, 44]. Sherry and others [13, 42-44] stated that too easy video games result in boredom, and too hard games can be frustrating. This is not surprising but it confirmed Hunicke's observation that game companies lose players due to the mismatches between players' abilities and game challenges. In her thesis, she explored the development of a computational method for dynamic difficulty adjustment [42]. On the other hand, Klimmt et al. published findings from a study [43] showing that game enjoyment can change with increasing playing time. Unlike results of flow and attribution frameworks: moderate game difficulty lead to highest level of enjoyment in game, they found that game enjoyment could change depending on the length of playtime. High number of successes and few failures at the beginning (they had 10 minutes play sessions) of a new game could increase the enjoyment however that many easy successes could result in boredom when game experience improved. The authors also stated that switching to other sources of fun in games, when performance is bad, is a way to keep the enjoyment high.

2.3 Methods

Collecting players' feedback to access the gameplay experience is both "worthwhile" [51] and "challenging" [47]. There are many different methods proposed to address this issue, all have their own advantages and disadvantages. Some data collection methods proposed by the community are: player observation, ethnographic notes, video recordings of gameplay, and surveys [51]. Using these methods researchers will collect data, then they will analyse the data using several techniques, such as qualitative content analysis, statistical analysis, or visualization [49, 55]. Each of these methods has its strengths and limitations. In the following, I explain the most common methods in particular those used by game researches. I will pay particular attention to *instrumentation methods* and log analysis methods to derive *metrics* [45].

Some researchers advocate the use of playtesting as a method for evaluating games [47]. Playtesting method is a mixture of “survey methods” with laboratory quantitative data on player’s perception of game [47]. Few researchers augment playtesting methods with think aloud protocols, where players are asked to play a game while thinking out loud [46]. In a playtesting scenario, researcher observes, records and tracks the players’ actions and comments [45]. Although such methods, including usability tests and think aloud protocols, are useful in the design of games [47], they have several limitations. First, sample size is small, 10-20 people out of millions of players [45, 46]. Therefore, the findings are limited and cannot be generalized to all the population. Second, most often these studies are run in a lab setting within a very short testing time [45]. This does not let the researcher understand the experience as a whole, which may involve more than 40 hours of gameplay. Third, there is also the possibility that results could be tainted by interaction between the researcher and the participant. Forth, they need a working prototype [45].

There are also several advantages in using this kind of testing. Using this method, researchers can gauge the “players’ initial experience” and make sure that they can play a game as it is intended by designers [47]. They can also assist in finding game design issues and how they happen, e.g., players could find the right order of actions/items to solve puzzles during gameplay cost-effectively and fast [45-48]. Additionally, usability tests could investigate whether players have any difficulty with using game controls [47]. Overall, usability tests are good in terms of providing an in-depth source of feedback on behavioural information and attitudinal data from consumers about their gaming experience.

Surveys are another common method used in game research. In this method, many players can be involved with low cost and very little interaction with researcher [50]. Surveys are self-report data and therefore could be biased [47] e.g., based on the participant's interpretation of the questions. Since the quality of the surveys depend on the questions [45], the content validity and reliability of the questionnaire should be tested for generating more accurate responses before general use within an actual study. I tested my survey instrument within a pilot study I explained in Section 3.2.

Game *instrumentation* —or gameplay metrics or automatic tracking and logging of "player-game interaction"— has recently gained increasing attention in the game industry as a source of detailed information to gauge user behaviour and, consequently, to improve games [45, 52, 54]. Logging the gameplay events results in automatic recording of players' behaviours and usability metrics e.g., time completion which are detailed numerical data extracted from the interaction of the player with the game [53]. However, game telemetry is not always accessible to researchers. Thus, most of the work with telemetry either is done with very old games or spreads across very few researchers, who were able to gain access to such telemetry. In the next subsection, I will discuss the few research findings from this approach. One thing to note is that unlike qualitative data and survey-based methods, metrics are quantitative, precise, and are usually collected from thousands of players. Gameplay metrics provide the opportunity to address key development questions, such as whether any game world areas are over- or underused, if players utilize game features as intended, whether there are any barriers hindering player progression, and so forth. However, the kind of instrumentation data recorded is different pre vs. post launch due to the bandwidth issues, which limits the results and kinds of behavioural aspects that can be deduced or tracked.

While qualitative measures collect players emotional and cognitive responses to games through direct laboratory and field observation with methods such as think aloud [49], metrics assist in collecting players' quantitative measures and surveys gauge users' attitudinal data. Since all the methods are vital in any evaluation intended to improve a design, researchers often combine several methods, thus addressing the limitations. Example of this is TRUE system [45], where it combined game metrics, user feedback from surveys and other sources of data used in playability and usability testing. To understand the event fully, the “streams of data” and “attitudinal data” were attached to a video of the player's gameplay (“contextual data”) for further analysis. Briefly, combining existing methods e.g., surveys, logging, rich data of video could lead to a reliable tool while saving the time by using automatic logging tools and well-developed analysis tools.

2.4 Game Metrics

As briefly mentioned above, game metrics are formulated from telemetry data — a set of quantitative data of "player-game interaction" extracted from logs or databases [55, 56] such as the time each player logs in and the time each player logs off. The game metrics are recorded in various forms [53], including logs of keystrokes and button presses (low level) and different kinds of player behaviour: killing enemies, using a weapon, finishing a level, etc. Some metrics are specific to a game or genre e.g., killing methods or movement tracking as a function of time. The general framework for the gameplay metrics was shown in Figure 2.4 [56]. As it shows, participants provide a set of data by filling surveys, as well as playing a game, where the metrics are gathered either automatically by game engines or manually by video coding. Gameplay metrics and other data are then analysed and visualized to find the patterns of player behaviour.

Gameplay metrics = Player behaviour

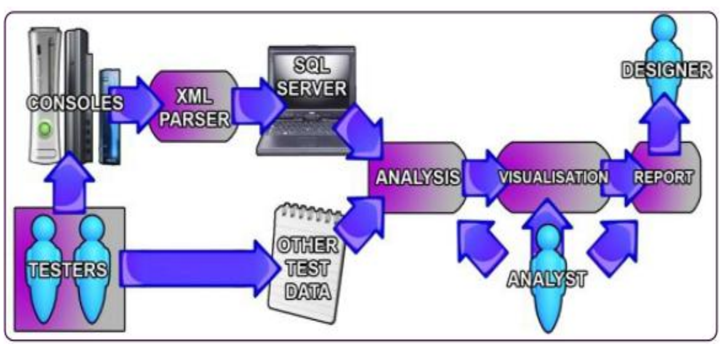


Figure 2.4: General Framework for the Gameplay Metrics [56]

As discussed in Section 2.3 gameplay metrics approach is novel and unfortunately costs resources and the data is normally considered confidential by game companies [55]. Several game studios are currently using metrics to gauge the game evaluation question. For example, Microsoft Game Labs did an extensive user testing of *Halo 3*, where they generated metrics-based analyses of player deaths and then visualized them by using heat maps [57]. Heat maps represent the gameplay statistics of the game world visually. Dark red areas in Figure 2.5, for example, shows the players kills/deaths in certain areas of Valhalla: a multiplayer level in *Halo 3* [57]. By analysing the heat maps, game designers were able to find and fix the pitfalls of their design.

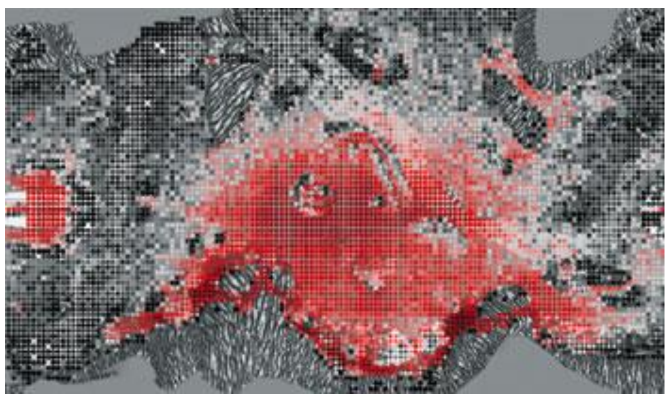


Figure 2.5: Heat-map of Valhalla: a Multiplayer Level in Halo 3 [57]

Swain [58] investigated metrics in the different contexts of game as a “measurement-based design technique” to define and measure play behaviour, enhance design and improve gameplay. He outlined metrics-based techniques such as using heat maps to track and quantify user experiences. Swain also notes that the creation of a good game requires an iterative process of prototyping, testing, and revision. Traditionally, this process relied on creative judgment and informal methods; however, Swain concluded that metrics-based techniques provide a scientific, quantitative approach upon which the testing process can be built.

Drachen and Canossa elaborated on using gameplay metrics to analyse gameplay spatially and non-spatially [55, 56]. They presented results of two case studies, *Kane & Lynch* and *Fragile Alliance*, which shows the usefulness of working with multiple variables and within spatial environments. They used visualization techniques and statistic data of players' "spatial" and "temporal" behaviour. In *Fragile Alliance*, for example, they used two data layers for the world map. One of them is for representing the whole area by four sub-areas: "spawning area", "subway area", "vault area", and "road/exit area". The next layer demonstrated the areas with high frequency of players' statistics e.g., character deaths with points. This way, designers visually analysed and noticed that the players' character deaths are almost the same as what they looked for in certain area of the map. In the next case study, *Kane & Lynch*, authors investigated players' movement and navigation to find the "trouble spots" i.e., the areas with the most difficulty (e.g., deaths/injuries) in the level. They recorded time-based or location-based vectors of players' navigation, health, crouches and covers as well as their type of movement (e.g., standing, running). This way they could map different kind of data to game level to analyse it visually.

Ducheneaut et al. used players chat logs in *Star Wars Galaxies* to infer patterns in social behaviour and how they were affected by the game structure within the MMOG domain [59, 60]. They investigate "player-to-player interactions" in the *cantina level* of the game for couple of months. They first built a parser to analyse the logs and find out subject i.e., "who interact with whom", communication ways i.e., "gesture or chat", location in the game e.g., "Coronet or

Theed", interaction ways e.g., "text chat or social command" and "date and time". Then, they analysed data to find some metrics of players e.g., number of days present in logs, number of visits to the *cantina*, length of stay. They finally formulated a set of recommendations for social activities specifically in MMOGs.

Moreover, gameplay metrics could employ in different ways; two examples are Thawonmas [62] and Mellon [49, 61]. Thawonmas et al. [62] used gameplay metrics to detect bots, or automatic agents, for different purposes in MMOGs e.g., gold farming purposes. Mellon [49, 61] applied a metrics approach to detect bots called "gold farmers" assist in gathering valuable items such as gold.

In addition to the use of metrics for evaluation, several researchers have used metrics to construct player models by finding the players' patterns of playing style. For example, Richard Bartle developed one of the first models by studying players playing Multi-User Dungeons (MUDs) [64]. He defined four approaches –"Achievers", "Socialisers", "Explorers", and "Killers"– of players based on two factors of "action versus interaction" and "world-oriented versus player-oriented". Although the model has lack of statistical data, he started the idea of exploring player motivations in online games and many designers of virtual worlds and sandbox games referred his model [64]. Another interesting player motivations model is defined by Yee [67]. He used empirical data of 30,000 players in Massively Multi-User Online Role-Playing Games (MMORPGs) such as online surveys. He then added his findings and motivation items to Bartle's taxonomy where he suggested "Achievement", "Relationship", "Manipulation", "Immersion", and "Escapism" for his model. Throughout another study, Bateman and Boon [18] created their model based on “psychological metrics”. They used data of questionnaire and a variety of games to map personalities to play styles. Their model suggested four different classes of players based on their main needs –“Conqueror”, “Manager”, “Wanderer”, and “Participant”.

Recently other researches discussed different approaches (game metrics [53, 55, 63], neural network [66], game AI for creating challenging opponents [65], etc) to construct models of the players. Houlette’s work [65] was an attempt to develop challenging game AI opponents using an automatic player's behaviour model. Charles and Black [66] utilized several “neural network” approaches to define a framework for creating adaptable games. Specifically they focused on first, tracking the influence of adaptation by statistically analysed players’ intention and frustration and second, to model dynamically gamers’ profiles using “concept drift” idea. Tychsen and Canossa [55] focused on creating a method for evaluating game design by figuring out a number of measures such as areas in the game level that challenges are extreme (too low/high), player has navigating issues, and if designers’ intentions were reached, by investigating several games within case studies. Drachen and Canossa [53] highlighted the benefits of using spatial analysis of gameplay metrics to locate where players have good or bad experiences in the games. In another work [63], they used an “unsupervised learning” to identify player types. The authors defined a set of six statistical characteristics, which form an input vector of an Emergent Self-Organizing Map (ESOM). The statistical characteristics –“completion time”, “number of deaths”, “number of Help-on-Demand actions”, as well as death events by “falling”, “action of computer-controlled opponents”, “hazards in the virtual environment”– were gathered using the high-level behaviours of 1365 players who finished the game. Finally four groups of play behaviour were deduced from analysis namely “Veterans”, “Solvers”, “Pacifists” and “Runners”. It found that the affordance space and flexibility in the game were also used as a strategy to progress in the game.

2.5 Performance Metrics: Usability

Much research has been done investigating the use and development of performance and task evaluation metrics. However, most of this work has been done in Human Computer Interaction (HCI) catering to software usability. Several researches have defined usability in various ways. According to the definition presented in ISO/IEC 9126 [68], that was generally accepted [72], (software) usability refers to “the capability of the (software) product to be understood, learned, used and be attractive to the user, when used under specified conditions.”

Usability analysts [69-71] gathered several metrics to test and measure usability through “effectiveness” (e.g., percentage of tasks completion), “efficiency” (time of tasks completion), and “user satisfaction” (e.g., average task satisfaction) [73]. It has been almost two decades since the HCI community started evolving diversity of techniques in User Centred Design (UCD) for qualitatively evaluating usability [74-76]. Data of “task performance”, "subjective assessment" and "physiological measures" has been considered as crucial features of the usability evaluation framework [74].

2.6 Age, Gender and Players' Background on Game Preference

The video game market is huge. Children and young people play quite a bit, but based on the ESA recent release *-2010 Essential Facts About the Computer and Video Game Industr*y- the average game of players is 34 years old and in 2010, 26% of gamers were over the age of 50 [1]. Figure 1.1 [1] shows the percentage of game players with different age range in a pie chart. Jesse Schell, instructor of entertainment technology at Carnegie Mellon University said, "There are games now for pretty much every age, every demographic. More and more women are going online. It comes down to everybody is playing games" [1]. Confirming this, ESA 2010 reported women age 18 or older represent a significantly greater portion of the game-playing population (33%) than boys age 17 or younger (20%) [1] .

Some studies have argued for the influence of gender and age on gameplay [12, 22-24, 26, 27, 77, 78]. Sandberg and Meyer-Bahlburg [27] investigated the influence of subjects' age, family race/ethnicity, and socioeconomic status on gameplay preferences. They found a strong gender difference for middle childhood. For older subjects, participation of males in activities dominated by girls decreased, and vice versa for the girl participants. Parents' educational level was not a significant factor. In addition, Chan found that "males play video games more hours per week compared to females, more frequently than females do, and they are more likely to self-identify as video gamers" [22]. Klimmt and Hartmann found that boys and girls often prefer different games, specifically, that "females disliked video games that lacked meaningful social interaction, had violent content, and had characters that were sexual stereotypes" [12]. In addition, Williams et al. found that female gamers tend to conform to activities that fit within their stereotypical gender role in MMORPGs [23]. Similarly, Jenson and De Castle argue that there is still a gender divide when it comes to games, even though several researchers discussed many examples of girls breaking into the gaming culture [24].

Lucas and Sherry found similar differences between gender and gameplay preferences [26]. However, they argued that it is not gender that determines performance, but that there are some underlying behavioural abilities that need to be examined. Along the same argument, Robin Hunicke, a game designer, stated: "The reason I don't play FPS [First Person Shooter] games is because I sucked at playing them" [42]. Her statement has successfully sent a challenge for designers to consider different user groups who may have different abilities and skills. In order to appeal to different user groups, research needs to be undertaken to examine the range of abilities as well as play preferences of different players. Unfortunately, few researchers have tapped into this area. The only research I found that targets skills and games was the work of Heubeck [79, 80], who was concerned with developing a policy for legal game playing and assessing skills depending on design. Unlike our study, he was more concerned with casino-type casual games and not video games.

3 METHODOLOGY

Here, I explain the philosophy of how this study should be conducted in general. My methodology includes several phases from literature reviewing, to conducting a preliminary study, to establishing my research question, to developing and testing proper instrument, to data collecting and analysing. In the first section, I explain my research design and methodology. The second section dedicated to the survey instrument as one of the research methods and one of the two sources of data I gathered. Specifically I explain the process of developing a questionnaire, that enable to capture their experience with FPS and RPG games, while consulting it with experts in the subject matter and testing it through conducting a pilot study. Third section describes the process of colleting game metrics that I defined as a method of measuring gameplay behaviour. Finally, I discuss the limitations of the approach.

3.1 Design

Various User Centred Design (UCD) Methodologies were explained through addressing their limitations and advantages in Section 2.3. Since a combination of several methods proved to create a powerful tool for improving design, I combined game metrics method and surveys method to answer my research question. Figure 3.1 demonstrates the steps I took for my thesis and the research roadmap. As it shows, I started with a review of the previous work on the concepts I used from different areas namely game genres, gameplay metrics and usability metrics from Human Computer Interaction (HCI), User Centred Design (UCD) Methodologies, studies on measuring players' gaming experiences, and studies investigating the role of players' background (e.g., age, gender, etc.) on their game performance. However, since it was determined that not many literatures specifically target prior gaming experience and there was a gap in the literature in this area, a preliminary study was conducted to benefit from the design lessons of the study. After analysing data from the preliminary study, I refined and redesigned the study based on the findings and limitations. Based on the learning I established my research question.

What are the performance differences between FPS, RPG, and non-gamers, when confronting a game that requires 3D navigation and 3D spatial puzzle solving?

To this end, I developed and tested a survey instrument through a pilot study (See Figure 3.1, I will explain the "Pilot Study" block in Section 3.2). Next step was to choose a game and define a set of performance metrics (See section 3.3). In the main study, I used a mixed methods approach and collected the data from two sources: a) the gameplay metrics of *Tomb Raider: Underworld (Eidos Interactive, 2008)* and b) the data from the survey questionnaires. Play-sessions were all video taped and then coded for later analysis. I used a video coding technique for measuring performance quantitatively, thus creating several quantitative gameplay performance metrics.

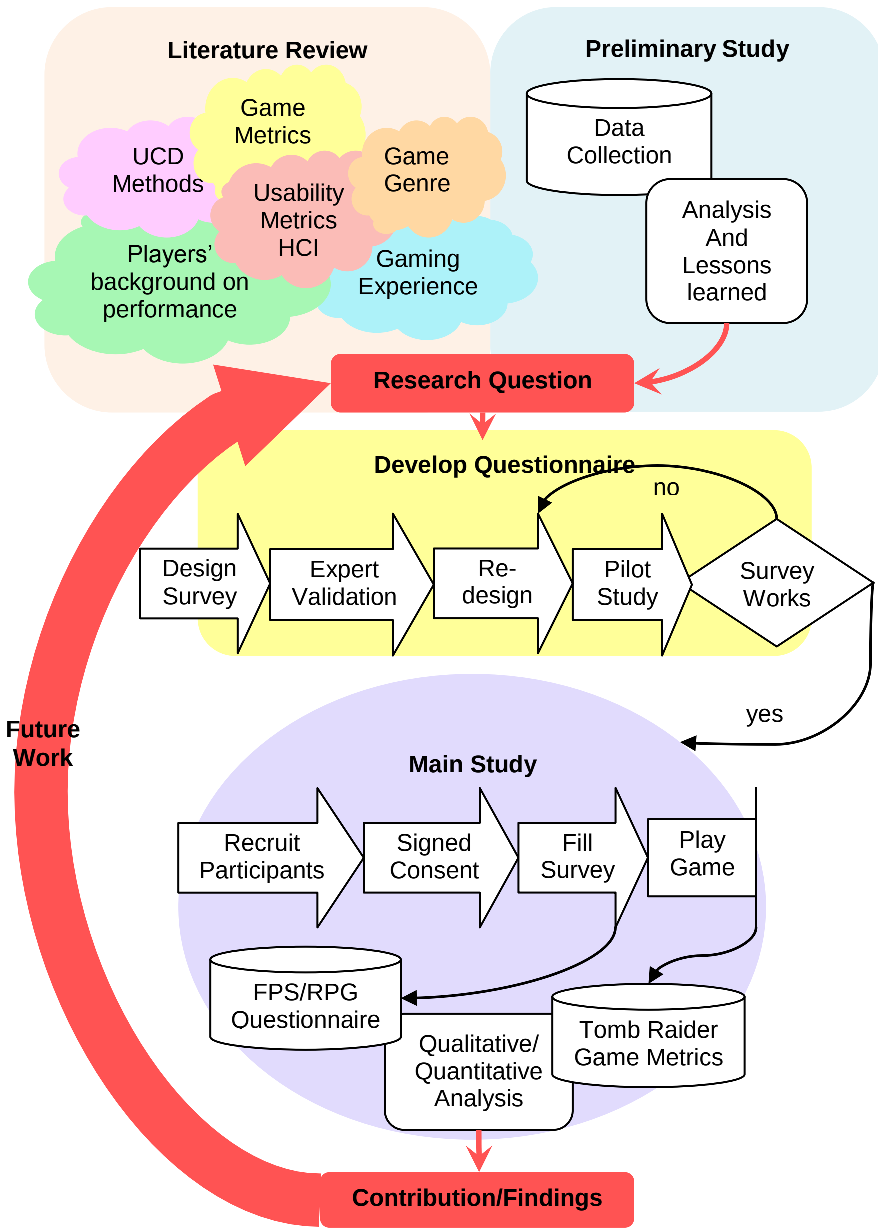


Figure 3.1: Overview of Steps Taken in my Thesis

3.2 Instruments

Questionnaires are the most common instruments used in game research. However, they are difficult to design and validate [81]. In this thesis, I developed and tested a questionnaire to gauge the players' experience. I used an iterative process to develop a survey instrument that can guide me in clustering players based on their experience with FPS and RPG games (See Figure 3.1, the “Pilot Study” block). First, I developed a version of the questionnaire based on my own experience and previous work. To ensure content face validity, I sent the survey to four experts from user experience and user research groups within the game industry. Their knowledge and insights were invaluable. Based on their feedback, I revised and produced a second version of the questionnaire. The final questionnaire consists of three parts (See Appendix C: FPS/RPG Questionnaire (Main Study) or [84] for the full questionnaire):

1. General questions (consisted of 14 questions, background questions and basic info such as gender, age, etc. as well as game preference questions such as game genre, platform, etc.)
2. FPS genre specific questions (5 questions including a table asking participants to recall specific details on FPS games they had played)
3. RPG genre specific questions (5 questions including a table asking participants to recall specific details on RPG games they had played)

Questionnaire had questions in both open-ended and closed-ended format. In the open-ended questions, respondents answered in their own words while in the closed-ended questions respondents chose from pre-selected answers. As previous research have shown, self report is an unreliable measure as people often underestimate the time they spent and misjudge their experience when asked to report it [23]. The questionnaire I developed tries to remedy that by asking participants about specific details on games they had played that gauge their experience; these questions were constructed based on advice from industry experts. Collecting data by questionnaires for the pilot study was performed online, and for the actual study was by self-administration and not interviewed. I would like to note that data collected from questionnaire in both the pilot study and the actual study will be kept confidential.

Once the development was complete, I investigated and tested the reliability and validity of questionnaire through a pilot study on the population group for whom the survey is intended, i.e. FPS gamers, RPG gamers, and non-gamers. For the pilot study, I asked a small number of participants (n = 10) to complete the questionnaire (posted online [84]). The participants were selected to be hard-core either FPS or RPG players. Specifically, I had three elite FPS gamers (i.e., people who considered themselves as experts in First Person Shooter genre), three elite RPG gamers (i.e., people who considered themselves as experts in Role Playing Game genre), and four non-gamers (i.e., people who considered themselves as video game novices). They were recruited from either contacts (online through email) or colleagues. Non-gamers acted as a baseline for my analysis. Participants' ages ranged from 21 to 25 years. My goal was to look at the results of the pilot and see if there is a gap between the responses to the survey, thus enabling me to distinguish between the two populations. The results are discussed in Section 5.1.

3.3 Performance Metrics

As discussed in the research roadmap above (See Figure 3.1, the "Main Study" block), once participants took the questionnaire they are then asked to play a video game. I video tapped their play session. I used the video tapped play session as the raw data to then video code the performance metrics. Thus, one typical method question within this research could be “how to code the video for performance metrics” and “what performance metrics will be important to address the research questions I had in mind”.

As mentioned before, I chose *Tomb Raider: Underworld* for this analysis. I developed a set of performance metrics to evaluate players’ behaviour and gameplay skills from game statistics and answer my research question. These metrics either borrowed from previous work on HCI e.g., task completion, which converted to the number of obstacles solved in the context of a game or defined based on the *Tomb Raider* e.g., 3D spatial navigation and puzzle solving. The performance metrics I developed were a set of time stamped quantitative variables using a list of time segments (beats list). The beat list consisted of a set of 15 obstacles (See Appendix D: Beats List for *Tomb Raider: Underworld*) through Level 1 (obstacle1-obstacle5) and Level 2 (obstacles6-obstacle15). The obstacles need players to jump and grab edges on the wall, interact with objects, navigate underwater, etc. These variables were in the form of:

- Numerical variables e.g., Number of solved obstacle, Number of deaths (fall off, killing by enemies)
- Categorical variables e.g., movement (fast, in-between, slow) which were taken from video coding

- For each beat in the game, where a beat is defined as a time segment within the game connected to specific obstacles the players need to overcome e.g., time to solve each obstacle (sec): Obstacle 1-15.

A complete list of metrics is available in Table 5.2. Collecting these metrics was done through manual video coding by one experimenter to keep the consistency. In addition, to understand these quantitative metrics and the differences between two groups, I used qualitative analysis. The analyses were done in the context of each spatial puzzle or obstacle, which assisted me in interpreting players' behaviour. [In particular when they were faced by the puzzle and what they were doing inferring their goals, their breakdown issues]. Field notes were done to recognise when and where the players asked for help and expressed (verbally or nonverbally) getting lost and frustration with controller.

3.4 Limitation of the Approach

The limitation of this approach is mostly the time commitment and labour intensive nature of the video coding analysis. Since I could not get a hold of the telemetry data from Square Enix, a Japanese game producer, I had to hand-code behaviours of interest. One experimenter has done the video coding process. However, it is important to separate objective metrics from subjective metrics. While some of the variables noted were objective to observe, such as time to solve obstacles, and thus does not require inter-rater agreement to establish reliability, some variables are subjective and required inter-rater agreement to establish reliability or accuracy of the results, such as frustration or movement. Although, having only one rater assists in keeping the consistency of the video coding, but for observation of variables such as frustration and movement it may not be enough to establish validity. More raters can assist in establishing an inter-rater reliability measure to make the results more conclusive.

4 PRELIMINARY STUDY: PLAY TOGETHER PROJECT

The first study I conducted with several researchers: David Milam, Bardia Aghabeigi, Beth Aileen Lameman, and Tony Maygoli. This research was funded by MITACS and Bardel Entertainment to specifically look at cooperative play of children within the same space. I used and discussed this study as a preliminary study upon which my research question was shaped. In particular, within this preliminary study I was interested in exploring the effect of age, gender and prior gaming experience on gameplay. We recruited 60 children (aged 8-12 with a handful of 6-7 and a few 14-16) who were invited for a three hour session to play three games: *Rock Band 2* (Harmonix Music Systems, 2008), *Lego Star Wars: The Complete Saga* (Traveller's Tales, 2007) and *Kameo*: *Elements of Power* (Rare, 2005). The findings from this study show a clear impact of age and gender on performance parameters: score, movement, frustrations, and abilities to progress within the game. The outcomes of the study in relation to gameplay performance were published in "*The effect of age, gender, and previous gaming experience on gameplay performance"* [77]. The outcomes in relation to customization activities were published in "*The Effect of Age, Gender, and Previous Gaming Experience on Customization activities within games"* [78] and the outcomes in relation to cooperative gameplay patterns were published in "*Cooperative game design patterns and their effect on players' behaviours"* [85].

The rest of this chapter is organized as follows. Section 4.1 is dedicated to the study design, including questionnaires used for data collection and data analysis methods. Section 4.2 discusses the results of the study. Since I could not effectively see the influence of prior gaming experience of different game genres in the study, I conclude this chapter with a discussion (Section 4.3) of why this was the case and the direction I took for my thesis.

4.1 Study Design

We ran 26 sessions in total with 60 participants. Each session was 2.5-3 hours long, where we invited 2-4 participants, friends or family, to play games. As participants came in, they were asked to sign consent forms. Two kinds of consent forms were prepared, one for parents and one for children. After they signed the consent forms, the parents were excused and the kids were then interviewed individually. The first interview conducted was a list of 33 questions (See Appendix A – Background Questions) developed to gauge the participants' background, previous experience, and play habits. After this initial interview, they were asked to engage in playing four different games for 10 minutes each. After each play session, participants were separated and each researcher took on a participant and interviewed him/her by asking him/her 18 questions (See Appendix A – Post Play Questionnaire) gauging their perception and experience within the play session. Finally, Participants were compensated with a $10 gift certificate to iTunes or FutureShop. See Table 4.1 for an overall schedule of a play session. All play sessions were video taped front and back as shown in

Figure 4.1. In addition, during play sessions, 2-4 researchers, including a professional psychologist, took observational notes for further analysis.

Table 4.1: Timing Schedule of Play Sessions

1	0-5 min	Consent Form
2	20 min	Interviewing Background Questionnaire
3	3-5 min	Training Mode of *Rock Band 2*
4	10 min	Playing *Rock Band 2*
5	15 min	Interviewing *Rock Band 2* Questionnaire
6	3-5 min	Break (Food/Beverage)
7	3-5 min	Training Mode of *Lego star Wars*
8	10 min	Playing *Lego star Wars*
9	3-5 min	Training Mode of *Kameo*
10	10 min	Playing *Kameo*
11	15 min	Interviewing *Lego star Wars* Questionnaires
12	15 min	Interviewing *Kameo* Questionnaires
13	3-5 min	Break (Food/Beverage)
14	3-5 min	Training Mode of *LittleBigPlanet*
15	10 min	Playing *LittleBigPlanet*
16	15 min	Interviewing *LittleBigPlanet* Questionnaire
17	3-5 min	Thank you and compensated with a Gift Card

Figure 4.1: Two shots from two video cameras used to video tape the play sessions

4.1.1 Participants

Most participants were recruited through family and friend contacts at Bardel Entertainment and Simon Fraser University. Other recruits were extended friends of those original primary contacts. The 60 participants were divided into 26 sessions. Of these 60 participants, 18 were females (average age = 9.81) and 42 were males (average age = 10.4). Of these 26 sessions, 11 were made up of participants who were friends, 11 were made up of family, and four were mixed. All participants played the games in the same order with 3-5 minutes break between each game session.

4.1.1.1 Gender and Age Distribution

Participants varied in age. They primarily ranged in age from 8-12 with a handful of 6 year olds, 7 year olds, a few 14 and 15 year olds, and one 16 year old. It was difficult to find children (2-4 friends or family) within the exact age group we wanted (8-12), who are willing to devote time to come to our sessions to play. As a result, we had several children who were younger and older than the target age range. The age distribution is shown in Figure 4.2.

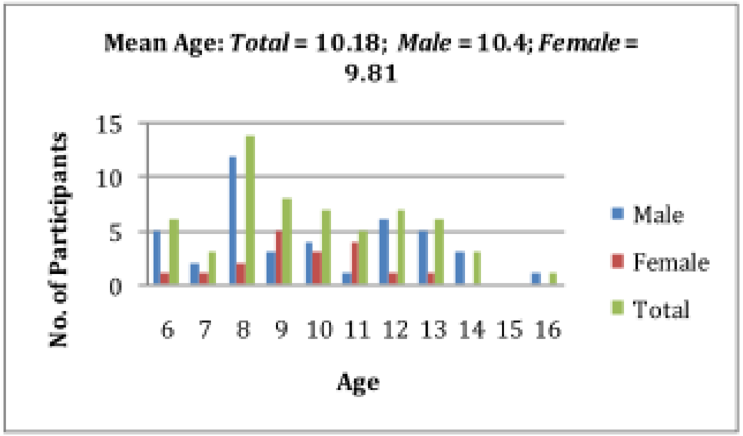


Figure 4.2: Age Distribution

Since we had several participants in the age range of 6 and 7, there were several developmental issues that we needed to take into consideration while interviewing as well as when evaluating and coding their interactions. Difficulty with the controller was an issue that came up with some of these participants. In addition, it was hard for them to concentrate for all the three hour-session. Thus, we added some more break times for younger participants. Additionally, many of the interview questions had to be explained and the parents were involved in interview sessions with younger kids, with an exception of one participant whose parents did not participate in the session. For all participants 9 and older, parents were asked to leave for the session.

4.1.1.2 Previous Gaming Experience

Part of the questionnaire was devoted to deducing the amount of time participants spend playing games and what kinds of games they play, thus formulating a measure of 'previous gaming experience'. In other words, I defined 'previous gaming experience' as a quantitative measure associated with the time and types of games they reported playing. I used 14 genre classifications to establish categories for game types: First Person Shooter (FPS), Role Playing Games (RPG), Massively Multiplayer Online Role Playing Games (MMORPG), Sports/Racing, Strategy, Board Games, Mobile Games, Puzzle, Platformer, Simulation Games, Expression Games, Online/Casual, Music/Rhythm, and Educational. During the interview, I asked them to report on their favourite games, the genre of games they enjoyed the most, the rate of play (hours/week), and the length of a typical play session. Based on these questions, I then computed the average time based on their reported time spent playing and the number of games they reported playing, assuming that they play an equal amount of time for all games. This measure is limited as participants often underestimate the self-reported time played in surveys [23]. The inaccuracy was considered as a noise in the data. However, other techniques for gauging time-spent game playing e.g., observational study over a period, have their own limitations.

To gauge difference in terms of gaming experience and gender/age, I ran variance analysis on gender and age differences in regards to the total time the participants reported playing video games. I performed the Mann-Whitney U Test (See Table 4.2) for gender and ANOVA for age groups. As expected, *female participants reported significantly less time playing video games than male participants ($p < .05$).* This result confirms earlier work [23]. I also looked for any significant age differences and previous gaming experience between genders within our sample, but found no significant results.

Table 4.2: Test Statistics

Test Statistics	Male	Female
N	42	18
Mean	4.08	2.02
Median	2.37	1.25
Variance	17.417	3.977
Mann-Whitney U Test		
Z	-2.413	
Sig.	.016	

4.1.2 Games' Performance Metrics and Beats Lists

We asked participants to play four games. We chose games that span different co-op game genres, namely, 3D action/adventure, platformer, sandbox/platformer, and rhythm-based games. Co-op setting with 2-4 players was chosen as the results of the background questionnaire revealed that 77% of the participants would like to play games that embed both cooperative and competitive patterns. Thus, the performance of a study participant can be affected by the performance of the other team members although I observed this happening through a quantitative analysis but group composition could cause issues.

The identification of the games to play was done through a separate process. First, we identified over 215 co-op games; we then filtered this list based on unique mechanics and our age group to 10 co-operative games. From these 10 games, we then identified four popular games for the target group with moderate levels of competitiveness and task fulfilment that were known to be suitable for females [87] as well as rated "E" for Everyone. These games are: *Rock Band 2* (Harmonix Music Systems, 2008), *Lego Star Wars: The Complete Saga* (Traveller's Tales, 2007), *Kameo: Elements of Power* (Rare, 2005), and *LittleBigPlanet* (Media Molecule, 2008) for the Xbox 360, PlayStation3, and Nintendo Wii. In this thesis, I have reported on results from the *RockBand 2*, *Lego Star Wars,* and *Kameo* play sessions since these three games are more task oriented which is the type of games I concentrated on for my thesis. Since my thesis is concentrating on performance measures in relation to goals and missions, I eliminated *LittleBigPlanet* from my study because we concentrated on the level customization interaction within the game and thus it is of little relevance to my thesis. However, interested readers are referred to our paper [78] for findings of the customization study.

In the following sections I explain the mechanics of the games and metrics I defined to evaluate players' skill level. To develop a set of metrics for game performance or behaviour I considered usability and gameplay metrics from previous work discussed in Section 2.3 as well as my own metrics defined based on features specific to games. For instance, I divided the time of the session depending on the goals of each segment, which are connected to the obstacles that the players need to overcome in the case of *Lego Star Wars* and *Kameo*. I called this list of time segments the beats list (See Appendix B: Beats List for *Lego Star Wars* and *Kameo*). Accordingly, I defined a set of performance metrics e.g., required time for solving obstacle, number of obstacles, etc. which some of them related to the beats list.

4.1.2.1 Rock Band 2

One of the games used for this study is a rhythm-based game called *Rock Band 2* (Harmonix Music Systems, 2008), a screenshot shown in Figure 4.3. Rhythm-based games incorporate individual and group synchronized play of musical instruments. In *Rock Band 2*, players choose among different roles (singer, drummer, or guitarist) and work together as a band playing a song. The game allows up to four different players to play together. Players can strive for individual achievements and/or “save” their partner to keep the song going. The more in-sync the instruments are played, the higher the points. Table 4.3 shows a set of metrics I developed to evaluate participants’ skills in this game. The very first three metrics are the flexible ones and participants chose them through a 3-5 minutes training mode of *Rock Band 2*. After playing in a group session, participants were interviewed separately as discussed above (Post Play Questionnaire).

Figure 4.3: *Rock Band 2* [86]

Table 4.3: Metrics for measuring skill level for *Rock Band 2*

1	No. of Songs Played (new song or retry)
2	Instrument
3	Difficulty Level
4	Completeness (yes/no)
5	If song not completed: Percentage of Completeness
5	If song completed: Score Percentage
6	If song completed: Stars acquired by the group

4.1.2.2 Lego Star Wars

Participants played *Lego Star Wars: The Complete Saga* (Traveller's Tales, 2007), a screenshot of which is shown in Figure 4.4. *Lego Star Wars* is an action/adventure, platformer game that can be played by one or two players at a time. The game is composed of several levels with missions to solve and obstacles to overcome. Players often need to control Non-Player Characters (NPCs) who have special abilities that can help players get through certain obstacles. For example, in one of the levels, players need to possess a character named Jarjar who has the super-jump ability. This enables players to jump higher to get to the next part of the level. Table 4.4 shows a set of metrics I designed to evaluate players' skills in *Lego Star Wars*. As mentioned, I segmented the time of the session into segments depending on the goals of each segment, which in the case of *Lego Star Wars* is connected to the obstacles that the players need to overcome. Beats list for *Lego Star Wars* is available in Lego Star Wars.

Figure 4.4: *Lego Star Wars*: Screen shot from the play session shows Platform1 (*Jarjar* must "high jump" to bring the platform to where the *Jedi*'s can pass through)

Table 4.4: Metrics for measuring skill level in *Lego Star Wars*

1	Was the level finished
2	Total Time
3	Items Collected
4	Collected Points
5	Time to get used with controller in Cantina
6	Movement (slow, in-between, fast)
7	Number of Deaths (fall off, killing by enemies)
8	Frustration with Controller (low, medium, high)
9	Time to solve puzzles (according to the beat list): Obstacle1-Obstacle2

4.1.2.3 Kameo

In addition to playing *Lego Star Wars*, participants were also asked to play *Kameo*: *Elements of Power* (Rare, 2005) on the Xbox, a screenshot of which is shown in Figure 4.5. *Kameo* is an action/adventure 3D game. Similar to *Lego Star Wars*, it involves exploration of a game level and defeating enemies. *Kameo* has an added ability for each player to transform to different characters. In the level they played, each player had three characters with different looks and abilities: A) *Pummel Weed* is a plant like monster that can box and go into the ground. B) *Major Ruin* is a rock-back like creature that battles by rolling up into a ball and ramming into enemies. And C) *Chilla* is a creature that battles by throwing enemies on to his back, and can also freeze enemies and have the ability to climb walls. Assessing the abilities of each character enables players to bypass certain obstacles. Unlike *Lego Star Wars*, *Kameo* uses a split screen interface, thus players do not need to keep pace with one another. Table 4.5 shows a set of metrics I designed for measuring participants' skills in *Kameo*. As mentioned, I segmented the time of the session into segments depending on the goals of each segment, which in the case of *Kameo* is connected to the obstacles that the players need to overcome. Beats list for *Kameo* is available in Kameo. After these two play sessions, they were then interviewed again using the same question set in Post Play Questionnaire for both games.

Figure 4.5: *Kameo*: Screen shot from the play session shows Obstacle7 (Players must become the plant creature and use the special ability to punch enemy hiding under the shell)

Table 4.5: Metrics for measuring skill level within *Kameo*

1	Was the level finished
2	Total Time
3	Number of times reading the instructions
4	Number of times asking for help
5	Movement (slow, fast, in-between)
6	Frustration with controller (low, medium, high)
7	Number of Deaths (fall off, killing by enemies)
8	Time to solve each puzzle (according to the beat list): Obstacle1-Obstacle9

4.2 Results

4.2.1 Findings Regarding *Rock Band 2*

There were 60 participants (female *n* = 18; male *n* = 42) in the experiment. Before the study, we allowed participants to take 3-5 minutes to play the training mode of *Rock Band 2*. We did not enforce a structure to their play sessions. We allowed them to play the songs they wanted, as well as change songs, instruments, and difficulty levels.

4.2.1.1 Effect of Age and Gender on Song Completeness

Each participant played several times; I considered the best try for my analysis. Figure 4.6 shows the percentage of participants who could or could not complete the song by gender. Overall, 46 participants (female *n* = 11; male *n* = 35) could complete the song with mean age: 10.21, while 14 (female *n* = 7; male *n* = 7) failed with mean age: 8.28.

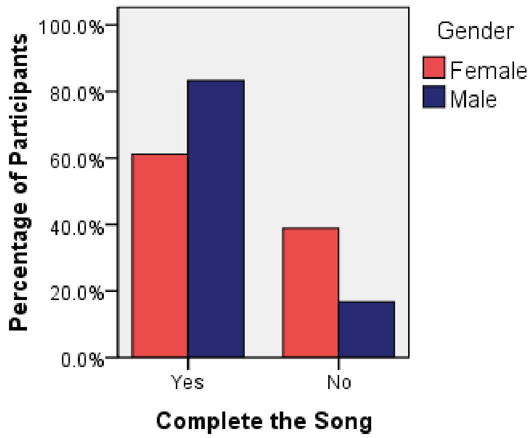


Figure 4.6: Rock Band 2: Effect of gender on completeness

Table 4.6: Rock Band 2: Effect of age and gender on Rock Band 2 performance

	Completed song			Could not complete		
	f	m	N	f	m	N
No. of participants	11	35	46	7	7	14
Mean Age	9.9	**10.31**	10.21	9.14	**7.42**	8.28
Score/Completeness	70.72	87.08	83.17	56.71	54.14	55.42
Difficulty mode	varied			Easy mode		
Instrument	varied			varied		
Mean No. of songs	2.6			2.64		

I further analysed the two groups—who completed vs. who did not complete the song, in terms of the age, score, instrument, and difficulty mode. Table 4.6 shows the results of the metrics for the two groups by gender (*f* for female, *m* for male and *N* for total). As it can be seen, participants who could not complete the song only tried the Easy mode. Also, there is a notable age difference between the two groups – for males, the average age for those who completed the songs was 10.31 vs. those who didn't complete the song was

7.42; for females the age was not that different between the two groups: 9.9 for those who could complete the songs and 9.14 for those who could not. ANOVA analysis reveals that *age plays a significant role for males playing Rock band 2 ($F(7,32) = 2.33$, $p < .05$) but not for females ($p>.05$).*

4.2.1.2 Effect of Age and Gender on Score or % Completeness

Table 4.6 also shows that there is a score difference between female and male participants, who completed the song. Females' average scores seem to be lower than males' scores. On the other hand, the percentage of completeness of songs was higher for females who could not complete the songs than males. I performed variance analysis for both completeness and scores to see if these results were significant. Results of the Mann-Whitney U Test indicate that there is a significant difference between genders for those who could complete the song ($p<.05$), but not for those who could not complete the song ($p>.05$). Therefore, I conclude that *for those who completed the song, females scored significantly lower than males.*

In addition, Figure 4.7 shows average score by age for those who completed the songs. There is a linear positive correlation between score and age for both genders. *Analysis shows there is a significant strong positive correlation between score and age for females $r = .746(7)$, $p(\text{two-tailed})<.05$. However, there is only a weak positive correlation for males $r = .478(33)$, $p(\text{two-tailed})<.01$.* I ran a similar analysis for participants who did not complete the song, but instead of using score, I used percentage of completeness. *There was a significant positive correlation between age and percentage of song* *completeness for males r = .896(5), p(two-tailed)<.01, but not for females r = .021(5) and (p = .800).* This is an interesting and unexpected result. I ran further qualitative investigations to deduce a reason for this finding. I found that females in my sample were more diverse in their game playing habits than males. I also had a smaller number of females than males.

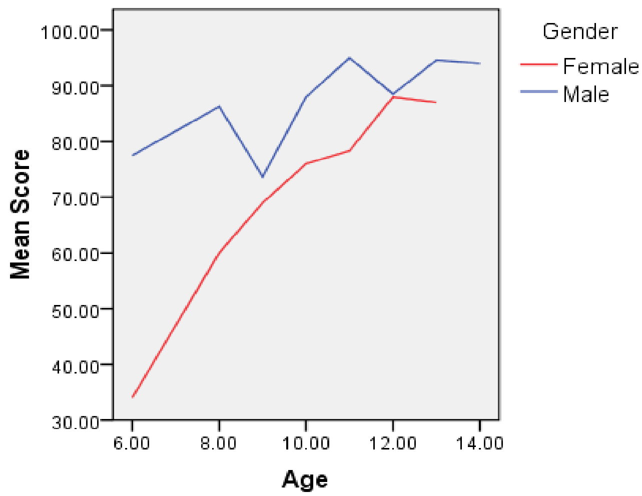


Figure 4.7: *Rock Band 2*: Correlation between mean score and age by gender distinction

4.2.1.3 Effect of Previous Gaming Experience on Score

I ran analysis to see whether there are any correlations between previous gaming experience and score or completeness, but there is no significant correlation. This was a surprising especially since I found differences on average. In particular, on average, FPS players had higher scores, but there was a lot of variance in the data to derive conclusive results. I followed up with other analyses on gender and age. Figure 4.8 shows time spent playing vs. score by gender. There is a positive correlation for males *r* = .351(35), p(two-tailed)<.05 while no significant correlation for females. *Therefore, I conclude that there is a* *positive correlation between time spent playing video games and score but only for males in our sample.*

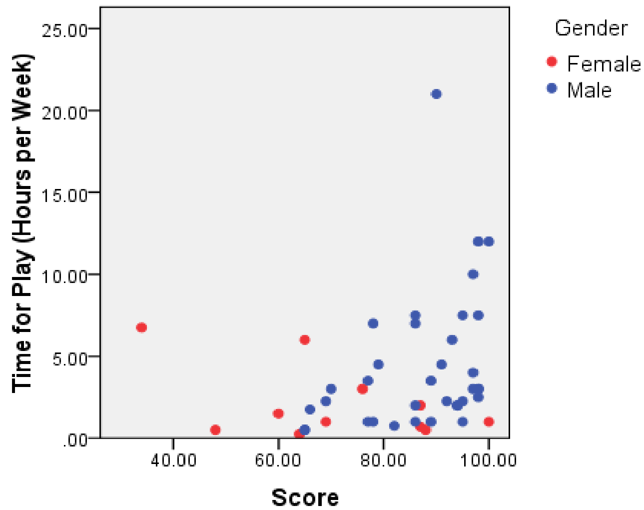


Figure 4.8: *Rock Band 2*: Time spent playing vs. Score by gender distinction

4.2.2 Findings Regarding *Lego Star Wars*

For this session, we did not have the full 60 participants. For each session, we invited 2-3 participants. *Rock Band 2* allows up to four players, while *Lego Star Wars (LSW)* allows a maximum of two players. Thus, in some sessions, one participant had to wait out, which resulted in 54 participants (female n = 16; male n = 38) for the 26 *LSW* sessions. They played for an average of 10:01 minutes. Only 27 participants could finish the level.

4.2.2.1 Effect of Gender on Level Completeness

Figure 4.9 compares percentage of participants who could and could not complete the level by gender. The results show that the *percentage of males who could finish the level is higher than that of females.*

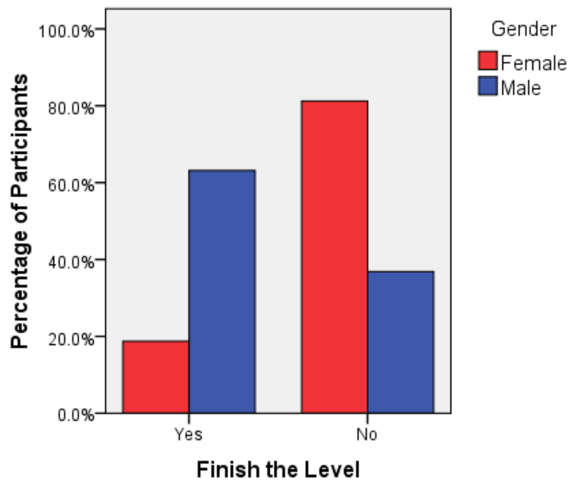


Figure 4.9: Lego Star Wars: Effect of gender on completeness

4.2.2.2 Effect of Age, Gender, and Previous *LSW* Experience on Level Completeness

It is obvious that previously playing *LSW* would have an impact on players' performance. Thus, I first isolated the participants who played the game before from those who did not. 28 (female n = 4; male n = 24) out of 54 participants have played the game before, while 26 (female n = 12; male n = 14) did not. Table 4.7 shows results of the relationship between age and gender. For males who have not played *LSW before*, only those aged 12-14 could complete the level. In addition, females who could finish the level were all older—10-13 years old.

Table 4.7: *Lego Star Wars*: Participants level completion

Gender	Finished	Played before	
		Yes (age groups)	No (age groups)
Female	Yes	2 (10, 13)	1 (11)
	No	2 (9)	11 (6-12)
Male	Yes	18 (6, 8-14, 16)	6 (12-14)
	No	6 (8-10)	8 (6, 8, 9, 12)

However, several participants, who had played *LSW,* could not complete the level. To gain a better understanding, I conducted a qualitative analysis for each session. Two of the female participants who completed the level had played it before, and one female has not played the game before. In the latter, as this is a co-op game, the partner (male who played the game before) led her through the level. However, two female participants could not finish the level but had played the game before. In these cases, they did not finish the level due to the influence of their partners, who had not played *LSW* before. For these exceptions, the partners' experience level greatly affected the female participants within my sample, but partners did not affect the performance of male participants. Note, as shown in the Table 4.7, male participants who did not play *LSW* before, but had cleared the level, were older (12-14 years old). *Therefore, I conclude that for males, age, and previous experience is a factor affecting their game performance, while for females, in addition to age and previous experience, partners also have an effect on their performance.* Of course, there are some limitations to the analyses discussed here. The sample size is very small to suggest conclusive results. In addition, I neglected to account for the time they spent playing *LSW* before. Additionally, the impact of playing games within the same genre would influence these results.

4.2.2.3 Relationship between Age, Gender, and Obstacle Resolution

There were 12 obstacles in the level, which the participants played. They played for an average of 10:01 minutes. Obstacles were either a) objects that should be moved by using special force ability or b) platforms that should be passed using special abilities, such as high jumps. The mean number of obstacles solved was 9.4 and the mean number of death was 6.4. Table 4.8 shows the influence of playing the game before and gender on the two parameters (number of obstacles solved and the number of death). *Results suggest that the number of obstacles solved and number of deaths is significantly higher for participants who played the game before ($p< 0.05$).*

Table 4.8: *Lego Star Wars*: Effect of gender and previous gaming experience on mean number of solved obstacles

	Gender	Played before			Overall
		Yes	No	Total	
Mean No. Solved Obstacles	Female	10.5	5.75	**6.94**	9.4
	Male	11.17	9.21	**10.45**	
	Total	**11.07**	**7.62**	**-**	
Mean No. of Deaths	Female	7.75	8.58	**8.38**	6.44
	Male	5.04	6.64	**5.63**	
	Total	**5.42**	**7.53**	-	

Moreover, my results also show that *gender plays a significant role in the number of death and obstacles solved ($p<.05$), with females solving less obstacles and dying more frequently.* To see whether this depends on playing the game before, I performed similar variance analysis on gender for the number of solved obstacles and number of deaths once for those with prior *LSW* experience and then for those without prior *LSW* experience. *The results show that females, who have not played the game before, solved less puzzles than males who have not played the game before ($p<.05$)*. Figure 4.10 shows the relationship between age and number of obstacles solved. *Significance analysis shows there is a significant positive correlation for males r = .396(38), p(two-tailed)<.05, but not for females.*

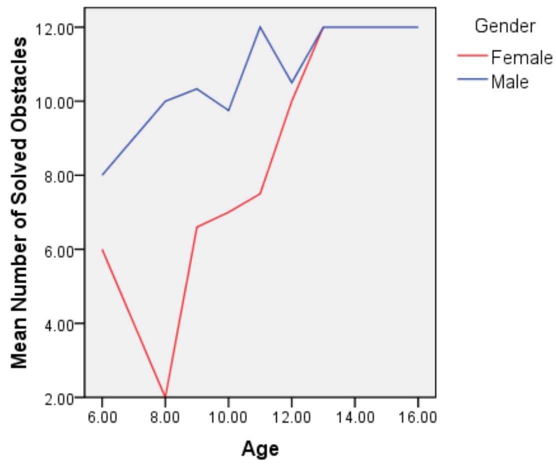


Figure 4.10: *Lego Star Wars*: Correlation between mean number of solved obstacles and age with gender distinction

I also measured obstacle completeness time. However, this measure proved to be an interesting and elusive metric. Obstacles within *LSW*, and other games, involve fighting enemies, solving puzzles, and collecting items. While players can go around obstacles with minimal fighting and collecting, their scores are dependent on these activities. Hence, there is a lot of variance in the time of obstacle completion as it is often a measure of different things, including play style and play preferences. Thus, I decided that this metric needs more supportive metrics to allow for a better analysis of skill and play style.

4.2.2.4 Relationship between Previous Gaming Experience, Level Completion and Obstacle Resolution

I performed different variance analyses to look for any correlations between time spent playing different game genres and level completion or obstacle resolution. Since I did not find any significant results, I believe this is due to the age of the participants. Participants reported playing a wide variety of games, and thus they may be trying different games and not really becomes experts in any one genre.

4.2.2.5 Effect of Gender, Age, and Previous Gaming Experience on (a)Movement and (b)Frustration with Controls.

I calculated movement (simulated character movement) and frustration with controls using video annotations and observer notes. There was only one rater to keep consistency of judgement. The movement was measured as slow, in-between, or fast. The rater made these judgements based on pacing of movement within the game. Similarly, the frustration was measured as low, medium, or high. It was based on how participants interacted with the controllers, i.e. if they had difficulty finding the right buttons, expressed frustration, or asked for help. Figure 4.11 shows the results of movement and frustration by gender distinction. I found that the majority of the female participants were slow or in-between, while the majority of male participants were fast. In addition, the majority of female participants had medium frustration with controls while male participants smoothly used the controllers. I also looked at the influence of age on movement and easiness with the controller. Not surprisingly older participants were faster and were more at ease with the controller.

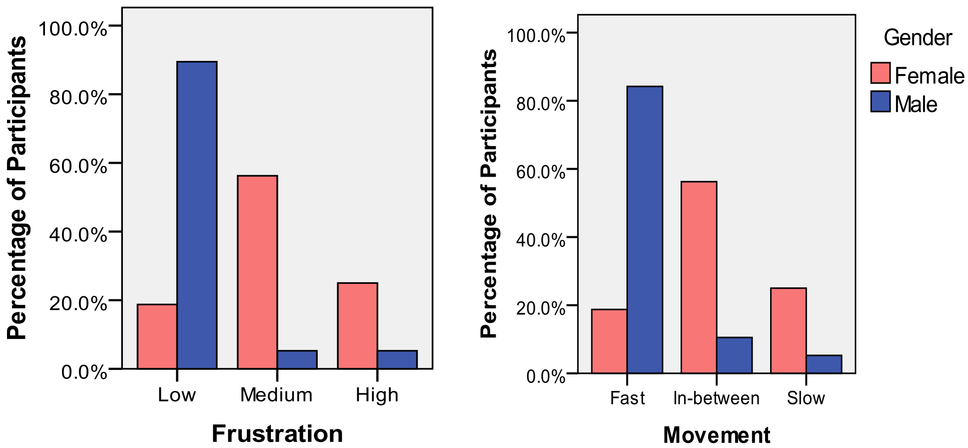


Figure 4.11: *Lego Star Wars*: Movement and frustration by gender

4.2.2.6 Effect of a) Movement and b) Frustration on Performance

Table 4.9 shows the number of obstacles solved and number of deaths, taking gender, movement, and frustration into account. Three-way ANOVAs were used to test for significant effects or interactions of (1) movement, (2) frustration with controller, and (3) gender on the number of obstacles solved and the number of deaths.

Table 4.9: *Lego Star Wars*: Effect of movement and frustration on performance

		Movement			Frustration		
		Fast	In-be	Slow	Low	Medium	High
SolvedObs	female	11	6.22	5.5	11	6.22	5.5
	male	11.22	6.75	5.5	10.91	5.5	7.5
Death	female	4	9.11	10	4	9.11	10
	male	4.19	10.75	18.5	4.21	10	25.5

The results are as follows:

a) I ran a three-Factor ANOVA test for the dependent variable: number of solved obstacles with the fixed factors: movement, frustration with controller and gender (See Table 4.10). It revealed a significant effect of movement, $F(2,45) = 6.49$, $p<.05$. *Therefore, I deduce that players with fast movement solved more obstacles.*

b) I ran a three-Factor ANOVA test for the dependent variable: number of deaths with the fixed factors: movement, frustration with controller and gender (See Table 4.11). It revealed a significant effect on the number of deaths, $F(2,45) = 22.14$, $p<.05$ and gender, $F(1,45) = 22.86$, $p<.05$. *Therefore, I deduce that players with low frustration have less number of deaths and females have a smaller number of deaths than males.* It should be noted that the number of deaths is not a direct measure of skill, as participants who got further in the level would die more, as they would encounter more enemies.

Table 4.10: *Lego Star Wars*: Analysis of variance for the three independent variables Gender, Movement and Frustration

Dependent Variable: Number of Solved Obstacles					
Source	df	F(df,45)	p*	η2	power
Gender	1	1.718	.197	.037	.250
Movement	2	6.491	**.003**	.224	.887
Frustration	2	2.750	.075	.109	.516
Gender*Movement	0	-	-	.000	-
Gender*Frustration	0	-	-	.000	-
Movement*Frustration	1	1.443	.236	.031	.217
Gender*Movement*Frustration	0	-	-	.000	-

***P** < .05. Significant effects are in bold.
Power is the ability to detect an effect (ranges: 0-1 where .95 means a 5% chance of failing to detect an effect that is there.)
Partial-Eta-squared (**η2**) is the proportion of total variability attributable to a factor.

Table 4.11: *Lego Star Wars*: Analysis of variance for the three independent variables Gender, Movement and Frustration

Dependent Variable: Number of Deaths					
Source	df	F(df,45)	p*	η2	power
Gender	1	22.866	**.00**	.337	.997
Movement	2	.340	.714	.015	.101
Frustration	2	22.140	**.00**	.496	1.00
Gender*Movement	0	-	-	.000	-
Gender*Frustration	0	-	-	.000	-
Movement*Frustration	1	4.668	**.036**	.094	.561
Gender*Movement*Frustration	0	-	-	.000	-

***P** < .05. Significant effects are in bold.
Power is the ability to detect an effect (ranges: 0-1 where .95 means a 5% chance of failing to detect an effect that is there.)
Partial-Eta-squared (**η2**) is the proportion of total variability attributable to a factor.

4.2.3 Findings Regarding *Kameo*

We had 56 (female *n* = 16; male *n* = 40) out of the 60 participants participate in this session. They played for an average of 9:17 minutes. Only seven participants (all male) could finish the level. Exploring the effect of age, I found that overall older participants tended to finish the level more than the younger. Yet, a small number of participants aged 8 and 9 were able to finish the level.

4.2.3.1 Effect of Age, Gender and Previous Experience on Level Completion

9 (male *n* = 9) out of 56 participants had played *Kameo* before, while 47 (female *n* = 16; male *n* = 31) participants had not. As it can be seen from Table

4.12, age is a factor on level completion. For males without game experience, only older ones 13-16 could finish the level.

Table 4.12: *Kameo*: Effect of gender, age, and previously playing the game on level completion

Gender	Finished	Played before	
		Yes (age groups)	No (age groups)
Female	Yes	0	0
	No	0	16 (6-13)
Male	Yes	3 (8, 9, 13)	4(13, 14, 16)
	No	6 (7, 8, 10, 12, 14)	27 (6-13)

4.2.3.2 Relationship between Age, Gender, and Obstacle Resolution

There were nine obstacles in the level. Participants were given 10 minutes to finish the level. Obstacles required participants to (a) know they can shift characters, (b) understand the different capabilities of each character, (c) shift to the appropriate character to overcome an obstacle, and (d) use the environment to jump to different sections of the level. The mean number of solved obstacles was 4.37 out of 9 and the mean number of deaths was 1.23.

Table 4.13 shows the effect of gender and game experience on the mean number of solved obstacles and the mean number of deaths. The results show significant difference between groups ($p<.05$) for the number of solved obstacles while there was no significant difference for the number of deaths ($p>.05$). *Therefore, prior experience with the game increases the number of obstacles solved but did not have an effect on the number of deaths.*

Moreover, there is a gender difference as shown in the table. Females within my sample tend to clear fewer obstacles. I performed the Mann-Whitney U Test to test for significance. The results show significant difference between gender groups ($p<.05$) for the number of solved obstacles while no significant difference for the number of deaths ($p>.05$). *Thus, the average number of obstacles cleared by females was significantly lower compared to males (2.25 vs. 5.22 obstacles, respectively).*

Table 4.13: *Kameo*: Effect of gender and previously playing the game on the number of solved obstacles and the number of deaths

	Gender	Played before			Overall
		Yes	No	Total	
Mean No Solved Obstacles	Female	0	2.25	2.25	4.37
	Male	7.11	4.68	5.23	
	Total	**7.11**	**3.85**	**-**	
Mean No of Death	Female	-	1.56	1.56	1.23
	Male	1	1.13	1.1	
	Total	**1**	**1.28**	**-**	

I also looked for correlations between the number of puzzles solved and age. Figure 4.12 shows the results for each gender. *There is a significant positive correlation between age and number of obstacles solved for both genders: males r = .587(40), p(two-tailed)<.01 and females r = .655(16), p(two-tailed)<.01.* In addition, I ran similar analysis for the number of deaths. *Results suggest there is a significant positive correlation between number of deaths and age for males r = .571(40), p(two-tailed)<.01, but no significant correlation for females.* This result means that the older the participant, the higher the number of deaths. This is because older participants solve more obstacles, and thus have more encounters with enemies.

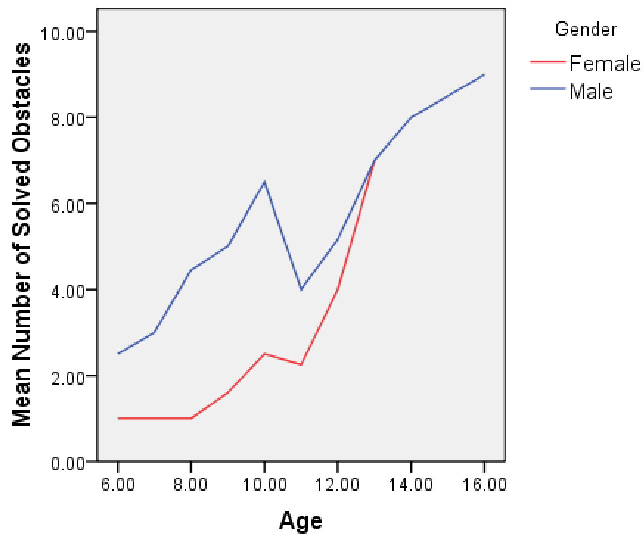


Figure 4.12: *Kameo*: Correlation between Mean number of solved obstacles and age with gender distinction

4.2.3.3 Relationship between Previous Gaming Experience, Level Completion and Obstacle Resolution

I did various analyses but could not deduce any significant relationships between previous gaming experience (with other game genres) and obstacle resolution. This was surprising, but as noted earlier the participants may be too young for such a variable to take an effect.

4.2.3.4 Effect of Previous Gaming Experience, Gender, and Age on a) Movement and b) Frustration with the Controls

I analyzed movement and frustration with the controls as was done with *LSW*. Figure 4.13 shows analysis of movement and frustration by gender. As shown, most males within our sample exhibited fast and in-between movement and with low and medium frustration, while most of the female participants were slow or in-between and had varied frustration.

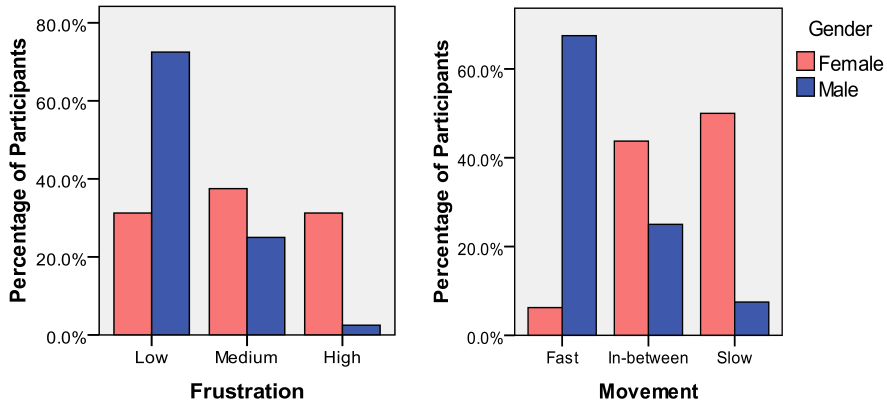


Figure 4.13: *Kameo*: Movement and frustration by gender

I also looked at the influence of age on movement and easiness with the controller. All participants age 12+ had fast/in-between movement and low/medium frustration. For participants with ages below 11, 19% of them were slow and 11% of them had high frustration. In addition, more than half of the participants with ages 6-7 were rated as in-between and the rest were rated as fast and low frustration. I performed some analysis exploring the influence of previous gaming experience on movement and frustration, accounting for age. I expected FPS players, for example, to have faster movement, but the results did not indicate any significant correlation.

4.2.3.5 Effect of a) Movement and b) Frustration on Performance

Similar ANOVA tests were done for *Kameo* as *LSW*. I had three independent variables i.e. 1) movement, 2) frustration and 3) gender. I performed a three-Factor ANOVA test on the number of solved obstacles and then the number of deaths. Table 4.14 shows that, all the players with fast movement and low frustration solved more obstacles but had more deaths.

Table 4.14: *Kameo*: Effect of movement and frustration on number of obstacles solved and number of deaths

		Movement			Frustration		
		fast	in	slow	low	medium	high
No SolvedObs	female	7	2.43	1.5	3.4	1.5	2
	male	6.44	3	1.67	6.14	3	1
No Deaths	female	2	1.29	1.75	1.8	1	2
	male	1.15	1	1	1.17	.9	1

Table 4.15: *Kameo*: Analysis of variance for the three independent variables Gender, Movement and Frustration

Dependent Variable: Number of Solved Obstacles					
Source	df	F(df,44)	p*	η2	power
Gender	1	.002	.962	.000	.050
Movement	**2**	**5.608**	**.007**	**.203**	**.834**
Frustration	2	.160	.853	.007	.073
Gender*Movement	2	.233	.793	.010	.084
Gender*Frustration	2	.350	.707	.016	.103
Movement*Frustration	2	.180	.836	.008	.076
Gender*Movement*Frustration	0	-	-	.000	-

***P** < .05. Significant effects are in bold.
Power is the ability to detect an effect (ranges: 0-1 where .95 means a 5% chance of failing to detect an effect that is there.)
Partial-Eta-squared (**η2**) is the proportion of total variability attributable to a factor.

The results are as follows:

a) I ran a three-Factor ANOVA test for the dependent variable: number of solved obstacles with the fixed factors: movement, frustration, and gender (See

Table 4.15). It revealed a significant effect of movement, $F(2,44) = 5.6$, $p<.05$. *Therefore, I deduce that players with fast movement solved more obstacles.*

b) I ran a three-Factor ANOVA test for the dependent variable: number of deaths with the fixed factors: movement, frustration, and gender (See Table 4.16). Results did not lead to any significant results.

Table 4.16: *Kameo*: Analysis of variance for the three independent variables Gender, Movement and Frustration

Dependent Variable: Number of Deaths					
Source	df	F(df,45)	p*	η2	power
Gender	1	.775	.383	.017	.138
Movement	2	.473	.626	.021	.122
Frustration	2	.202	.818	.009	.080
Gender*Movement	2	.145	.865	.007	.071
Gender*Frustration	2	.151	.860	.007	.072
Movement*Frustration	2	.620	.543	.027	.147
Gender*Movement*Frustration	0	-	-	.000	-

***P** < .05. Significant effects are in bold.
Power is the ability to detect an effect (ranges: 0-1 where .95 means a 5% chance of failing to detect an effect that is there.)
Partial-Eta-squared (**η2**) is the proportion of total variability attributable to a factor.

4.2.3.6 Reading Instructions and Asking for Help

In terms of reading instructions during gameplay, on average, 25 of the participants did not read any instructions, whereas the rest of them read once or more. Further investigation shows that the range of the number of participants who asked for help was 0-4; the first peak for both males and females was 0 while the next peak for females was 3 and males 1.

4.3 Discussion on Limitations: Motivation for 2nd Study

Here, I discuss the study where I looked into the impact of age, gender, and previous gaming experience on gameplay performance and skills of 60 children (aged 6-16). In this section, I discuss several reasons why I could not effectively see the influence of prior gaming experience of different game genres in the study. I believe the reasons for not seeing effectively the influence of prior gaming experience are the following limiting factors:

1. Although I performed different variance analyses to look for any correlations between the amounts of time spent playing different game genre and level completion or obstacle resolution, I did not find any significant results. I believed this is mostly due to the age of the participants (aged 6-16). I had a young, wide, challenging, and varied sample size. There are undeniable differences in cognitive and motoric skills of the children at these ages and their performances and abilities in general can be different. I dealt with several developmental issues that I needed to take into consideration while interviewing as well as when evaluating and coding the interactions. Difficulty with the controller was an issue that came up with some of these participants. Additionally, many of the interview questions had to be explained and the parents were involved in interview sessions with participants 6-8 years old, with an exception of one participant whose parents did not participate in the session. For all participants 9 and older, parents were asked to leave for the session.

2. However apart from having young participants, they were also from a wide variety of game genre backgrounds. Participants reported playing a variety of games, and therefore they may be trying different games and not really experts in any one genre.
3. Another limiting factor might be the short playtime for each game (restricted to only 10-15 minutes) which might not be enough to gauge participant feedback. However, the whole session was long (2.5-3 hours) because of the interview questionnaires and breaks.
4. Since it was a co-op setting, the performance of a participant can be affected by the performance of the other team members -although I observed this happening through a quantitative analysis but group composition could raise issues- and this may have affected the result although it is not directly related to prior gaming experience.
5. There were two sets of questionnaires, which accounted for much of the time spent in the session. I estimated several variables, including prior gaming experience based on participants' answers to interview questions. These answers are limited and are often biased as children do not usually know and cannot guess accurately how much time they spent playing a specific game. In addition, in some cases, parents were present during the interview, which might have influenced children's responses but may have also provided more precise and realistic answers. Gaming habits are difficult and sometimes unreliable to estimate from the interview questions although the best measurement presented seems to be the number of hours played weekly.

6. Finally, with five different researchers who interviewed participants, there might be some internal inconsistency in how they interpret some answers.

Since I believe these limitations influenced the results and based on the lessons I learned through this study, I developed another study, which benefited from several modifications. The next chapter elaborates on my thesis study. However, limitations aside, the methods, processes, and results from this study have helped to inform the main study of thesis (See Chapter 5).

5 MAIN THESIS STUDY

Based on the lessons I learnt through the first preliminary study, I shaped my research question and hypothesis for my thesis. I was not interested in gender or age influences and thus used a homogeneous participant group. I conducted a study with 35 college participants (aged 21-25) to explore the research question stated in the introduction, specifically:

> ***What are the performance differences between FPS, RPG, and non-gamers, when confronting a game that requires 3D navigation and 3D spatial puzzle solving?***

Since players with specific background game genres were desired, participants were narrowed specifically to only FPS (First Person Shooter) gamers, RPG (Role Playing Game) gamers and non-gamers. Due to measuring players' gameplay behaviour/skills like the ability to solve puzzles and navigate the space, I used *Tomb Raider: Underworld* (Eidos Interactive, 2008) for this purpose. Results show a difference between FPS gamers and RPG gamers as well as non-gamers. Details will be discussed in terms of task completion, movement in space, and navigation abilities in the following as well as the paper [88].

The rest of this chapter is organized as follows. Section 5.1 is dedicated to the result of pilot study I conducted to develop and validate the instrument. Section 5.2 discusses the study design while Section 5.3 outlines the results.

5.1 Pilot Study

As discussed in Section 3.1, I developed a survey instrument and tested it through a pilot study. Here, I argue how well the instrument measures the previous gaming experience in terms of FPS or RPG or lack of thereof. I had three groups based on their gaming experience in two game genres of FPS and RPG: three elite FPS gamers, three elite RPG gamers and four non-gamers. Participants' ages ranged from 21 to 25 years. My goal is to look at the results of the pilot and see if there is a gap between the responses to the survey, thus enabling me to distinguish between the two populations.

5.1.1 Result: Distinguishable Features of FPS-gamers and RPG-gamers

From the questionnaire, it was obvious that it is easier for specific gamers who are experienced with a specific genre to answer questions related to this genre (Appendix C: FPS/RPG Questionnaire (Main Study)). For example, when asked to enumerate the number and names of RPG and FPS games they had finished so far, Figure 5.1 shows that the difference in the mean number of RPG games of the two groups is greater than the difference in the mean number of FPS games of the two groups. In other words, *RPG gamers were playing FPS games more than FPS gamers playing RPG games.* As expected, there was a difference between average of maximum playtime per RPG game (or FPS game) in two groups. In the questionnaire, subjects were asked to fill the table with the details of games they have played as well as the amount of time they spent playing that game. Figure 5.2, shows the average of maximum hours reported playing an RPG game and FPS game with game genre distinction. *It indicates that RPG gamers spent more time than FPS gamers did.*

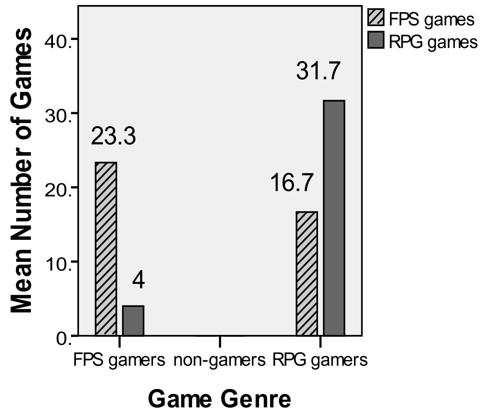


Figure 5.1: Average number of FPS vs. RPG games played for the different participant groups

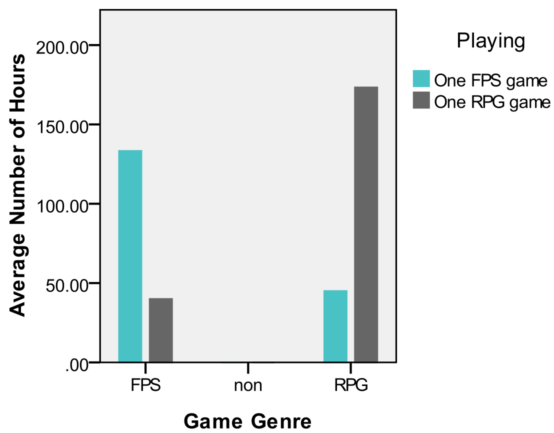


Figure 5.2: Bar graph compares average of maximum hours reported spend on playing one FPS game and one RPG game with game genre distinction

Results from another question revealed that *RPG gamers considered themselves as experts more than FPS gamers* (See Figure 5.3) did. It could be perhaps explained by the time investment playing RPG games cost them. Although it may not be as reliable but that was the only resource, I had. When asking the number of hours they spent playing video games per week, it showed RPG gamers (Mean = 17 h/w) slightly spent more time than FPS gamers (Mean = 15 h/w).

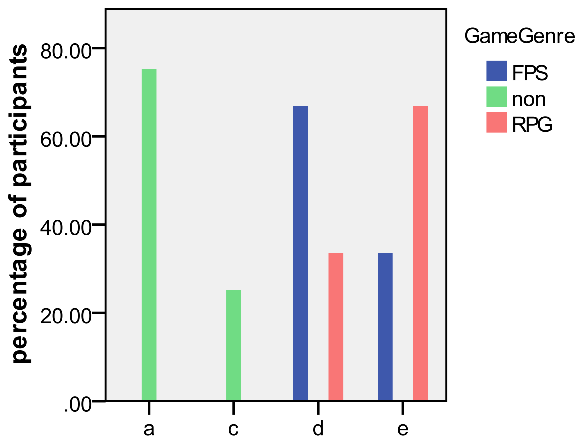


Figure 5.3: The percentage of participants in each game genre considered themselves as a. non-video game player, b. novice video game player, c. occasional video game player, d. frequent video game player, e. expert video game player

RPG gamers showed that they were more flexible in that they play more games in the other genre, specifically FPS games, than FPS players. To confirm this, I investigated the game genres they listed as their favourites by rank. FPS players listed RPG as their least played genre, while they preferred FPS, music, action the most. On the other hand, RPG gamers chose the ordered list of role-playing, action, strategy, FPS, etc. When asking about their typical play sessions, RPG gamers chose Single player Alone, Multiplayer on the internet, Co-operative and Multiplayer in the same room, Co-operative. FPS players chose Single player Alone, Single player with others in the room, and Multiplayer on the internet Co-operative. RPG players voted for Multiplayer more than FPS players did since many MMORPG games focus on Multiplayer on internet and RPG games focus more on social interaction. When I asked them about their Xbox Live (XBL) gamer tagger, PSN ID, or Steam ID, I noted that all of the FPS and RPG gamers and no non-gamer had one or more of Xbox Live gamer tag, PSN ID or Steam ID.

To put it briefly, the results of the test showed the instrument could clearly differentiate between elite FPS gamers and elite RPG gamers. However, some of the results were weak due to the small number of participants. The main differences between these two groups were that RPG gamers are more likely to play and finish single-player campaign of FPS game than FPS gamers to play or finish RPG game. In addition, RPG gamers spent more time playing than FPS gamers.

5.2 Study Design

In the "Call for Participation", I asked for FPS gamers, RPG gamers and non-gamers. Participants were invited individually to the lab to play the first two levels of *Tomb Raider: Underworld*. As the participants came in, they signed a consent form and filled the questionnaire for about 20 minutes. Then, they played the game for 30 minutes (See Table 5.1 for the timing schedule of a game session). Participants were compensated with extra course credit for their respective courses. During the experiment, I videotaped the screen to allow me to video code the play behaviour and performance for later analysis.

Table 5.1: Timing Schedule of Play Sessions

1	0-5 min	Consent Form
2	5-20 min	Questionnaire
3	20-50 min	Playing *Tomb Raider: Underworld*

5.2.1 Participants

I ran the study with 35 participants, each scheduled in a 50 minutes session. Participants were recruited from various classes at Simon Fraser University, School of Interactive Arts and Technology. Only data of the individuals who were rated as either FPS, RPG or non-gamer based on the questionnaire were analysed. In addition, those who played *Tomb Raider: Underworld* before were excluded. Thus, I ended up with 13 FPS gamers (average age = 22.7), nine RPG gamers (average age = 24.6), nine non-gamers (average age = 23.4), and four outliers who either played the game before, or had little experience in RPG/FPS, or were experts in other game genres. I did not consider outliers in the statistical analysis to keep the consistency of the data. Thus, I analysed n = 31 participants out of the 35 I received. As I was not interested in gender or age influences, I used a homogeneous participant group: over 80% of the participants were male. Participants were aged 21-25, with only four between 27 and 32.

5.2.2 *Tomb Raider: Underworld* Performance Metrics and Beats List

I chose *Tomb Raider: Underworld* for the study after investigating several games. I had several requirements for the game. First, since I was interested in measuring performance in terms of 3D spatial puzzles and navigation, I narrowed the list to 3D games. Second, since I wanted this to be the first experience of participants to play the game, I needed the game to be fairly new to decrease the chances of having participants who have played it before. Third, the game should have some elements of RPG and FPS but not specifically fall into these genres.

Fourth, to be able to define metrics afterward, it should be a linear game with distinguishable obstacles. *Tomb Raider: Underworld* fit them all.

As I mention in Section 2.1, *Tomb Raider: Underworld* is played in a third-person perspective. The player explores and navigates in the role of Lara Croft, the main character, through 3D spatial puzzles to find treasures. The game consists of eight levels. In my testing sessions, participants played the first two levels: Level 1 Prologue and Level 2 Mediterranean Sea. I developed a set of performance metrics to get a detailed picture of the player behaviour and performance from game statistics (See Table 5.2).

Table 5.2: Performance metrics for measuring skill level in *Tomb Raider: Underworld*

1	Total time (min)
2	Number of solved obstacles
3	Number of deaths (fall off, killing by enemies)
4	Read the lines/instructions on the screen (yes/no)
5	Number of checking tutorials/maps
6	Ask for help/hint (yes/no)
7	Items collected such as health/diamond (yes/no)
8	Skip the cinematic between two levels (yes/no)
9	Number of shooting at enemies
10	Movement (fast, in-between, slow)
11	Frustration with controller (low, medium, high)
12	Time to solve each obstacle (sec): Obstacle 1-15

Collection of these metrics was done through manual video coding by one experimenter to keep the consistency. Similar to my previous study, I defined the beats list based on a list of time segments. Accordingly, I collected some metrics related to the beat list. The beat list consisted of a set of 15 obstacles (See Appendix D: Beats List for *Tomb Raider: Underworld*) through Level 1 (obstacle1-obstacle5) and Level 2 (obstacles6-obstacle15). The obstacles involved jumping on the platforms, grabbing/interacting with objects e.g., edges on the wall and switches, navigating underwater and dark places to find hidden keys, etc. The player encounters a few enemies, e.g., sharks, underwater.

5.3 Results

5.3.1 Results of Questionnaire

Results from the questionnaire confirmed the earlier result of the pilot study. In this experiment the dependent variables are *average time spent on playing video games* (hours/week), *number of RPG games played*, *maximum playtime per RPG game*, *number of FPS games played*, and *maximum playtime per FPS game* (Each participant inserted the total number of hours played per each FPS/RPG game in the tables of the questionnaire. For each participant the greatest number considered as *maximum playtime per game;* although it may not be as reliable but that was the only resource I had). The independent variable was the *prior gaming experience*, established as belonging to one of the three groups of FPS gamer, RPG gamer, or non-gamer. The data was analysed using ANOVA for three groups of participants. Since the significant difference between non-gamers with other two groups is obviously expected, I present statistical results of the two groups: FPS and RPG gamers through the Mann-Whitney U Test (See Table 5.3).

Table 5.3: Mann-Whitney U Test on the grouping variables Game Genre

	Mann-Whitney U	**Z**	**Asymp. Sig. (2-tailed)***
Time spent on playing video games (h/w)	41.5	-1.142	.254
No. of RPG games played	15.0	-2.916	**.004**
No. of FPS games played	41.0	-1.180	.238
Max playtime per RPG game	15.5	-2.891	**.004**
Max playtime per FPS game	49.0	-.638	.523

*p < .05. Significant effects are in bold.

Analysis showed that RPG gamers (Mean = 21 h/w) spent slightly more time playing than FPS gamers (Mean = 17 h/w), but this difference did not reach significance (p>.05). Figure 5.4 compared the average number of FPS/RPG games played between three groups. While RPG players played significantly more RPG games than FPS shooters, they did not differ for FPS games they played. Also, as expected ANOVA results showed that non-gamers were significantly different $F(2,24) = 9.18$, $p<.05$ in terms of number of FPS/RPG games. *I concluded that RPG gamers play more FPS games than FPS gamers play RPG games*. Additionally, Figure 5.5 compares the average of maximum playtime per FPS/RPG games between the three groups. I found that there was a significant time investment difference between FPS gamers and RPG gamers for playing an RPG game (RPG gamers played more, p<.05) but there is no significant difference between two groups for playing an FPS game (p>.05). Results from another question revealed that RPG gamers considered themselves as experts more than FPS gamers did; it could perhaps be explained by the higher time investment.

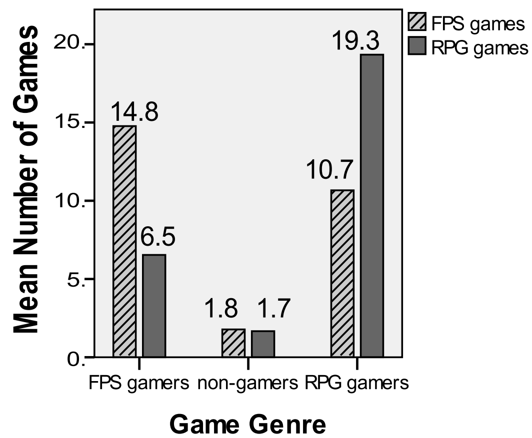


Figure 5.4: Average number of games played

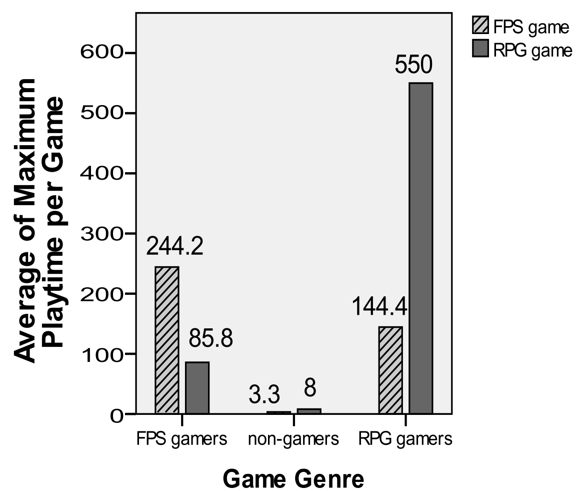


Figure 5.5: Average of maximum playtime per FPS vs. RPG games

When questioned about the preferred game genres, FPS gamers chose the ordered list of FPS, action, strategy and music while RPG gamers chose role-playing, casual and strategy games. Figure 5.6 shows results regarding the platform they use: PC, Console (PS2/PS3, Xbox, Wii), Portable (Cell phone, Ds, PSP). All FPS and RPG gamers reported using PCs while 50% of FPS and 60% of RPG gamers reported using consoles and 23% of FPS and 60% of RPG gamers reported using portables. Since many RPG games are usually from Japan and came on Xbox 360, more RPG gamers reported using a console.

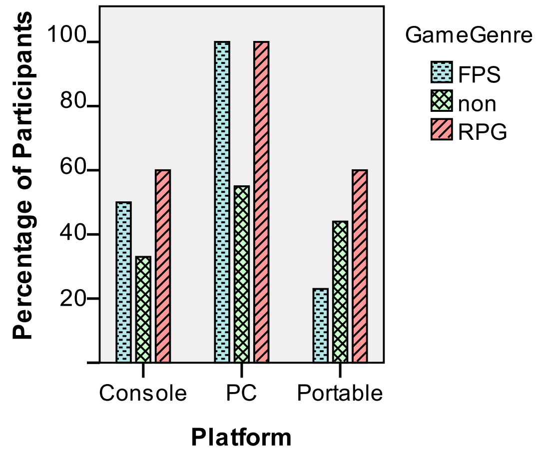


Figure 5.6: Players' Platform: PC, Console, and Portable

When asked about their game tagger (Xbox Live/XBL gamer tagger, PSN ID, or Steam ID) the result shows 85% of FPS, 44% of RPG and none of non-gamers have at least one. *Steam ID received the majority of the votes from both FPS and RPG gamers*. When asked about different genres of RPG (Japanese RPG, Western RPG, Pen and Paper RPG, Sandberg, Bio RPG, others, no preference), the majority voted for Japanese RPG, and then Western RPG while the rest had no preference. When asked about their preferred kind of FPS game (Sci-Fi shooters, Historic shooters, Real World shooters, others, no preference), the majority voted for Real World shooters and then Sci-Fi shooters while the rest had no preference.

5.3.2 Results of Game Metrics

In this experiment, the dependent variables were the numerical variables from the *game metrics* (See Table 5.4). The independent variable was the *prior gaming experience*, established as belonging to one of the three groups of FPS gamer, RPG gamer, or non-gamer. Figure 5.7 compares the average number of solved obstacles and deaths for players.

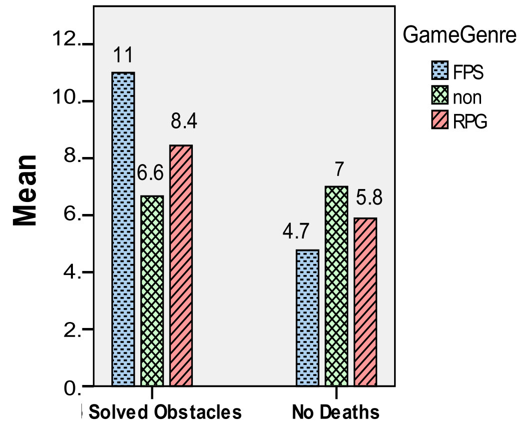


Figure 5.7: Average number of solved obstacles and deaths

Table 5.4: ANOVA for the independent variable prior gaming experience (three groups of game genre: FPS gamers, RPG gamers and non-gamers)

Dependent Variable	**F(2,28)**	**P***	**η2**	**power**
No. of solved obstacles	8.535	**.001**	.379	.948
No. of checking maps/tutorials	4.024	**.029**	.223	.670
No. of deaths	1.592	.221	.102	.308
No. of shooting at enemies	1.119	.341	.074	.227

***P** < .05 Significant effects are in bold.
Power is the ability to detect an effect (ranges: 0-1 where .95 means a 5% chance of failing to detect an effect that is there.)
Partial-Eta-squared (**η2**) is the proportion of total variability attributable to a factor.

The data was analysed using one-Factor ANOVAs for the ratio dependent variables. Statistical results are presented in Table 5.4. There was a significant difference for the number of solved obstacles between FPS gamers and the other two groups, $F(2,28) = 8.53$, $p < .05$. A Post-hoc test (Tukey test was performed since the population variances are equal) confirmed *FPS players were able to solve more obstacles than RPG players and as expected non-gamers* while there was no significant difference between RPG players and non-gamers.

Although analysis showed no significant differences for number of deaths (p>.05), non-gamers had the most deaths and FPS gamers had the least.

Comparing the average amount of time (sec) players took to solve each obstacle; it was found that *FPS gamers spent less time than RPG gamers did in solving obstacles* (See Figure 5.8), *although this was not significant for all obstacles*.

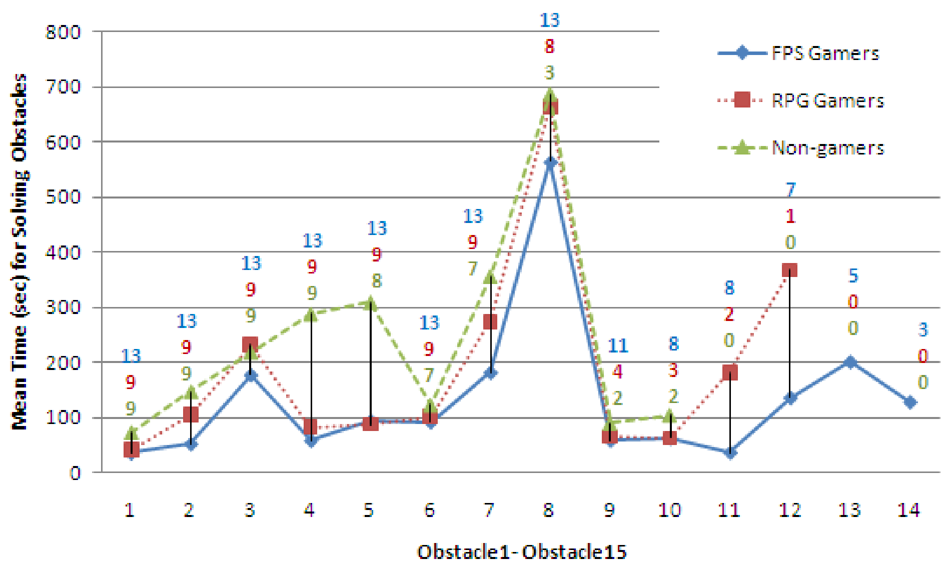


Figure 5.8: Average time for solving Obstacle1-15 and number of players in each group

Table 5.5: ANOVA for the independent variable prior gaming experience (three groups of game genre: FPS gamers, RPG gamers and non-gamers)

Dependent Variable	F(2,28)	P*	η2	power
Obstacle 1	4.317	**.023**	.236	.703
Obstacle 4	4.539	**.02**	.245	.726
Obstacle 5	5.434	**.01**	.287	.803

***P** < .05. Significant effects are in bold.
Power is the ability to detect an effect (ranges: 0-1 where .95 means a 5% chance of failing to detect an effect that is there.)
Partial-Eta-squared (**η2**) is the proportion of total variability attributable to a factor.

In this test, the dependent variables were the *amount of time* spent solving each obstacle. The independent variable was the three groups in *game genre/prior gaming experience*. First, the data was analysed using one-Factor ANOVA for obstacles 1-10 (only a number of FPS and RPG players made obstacles 11-12). ANOVA showed there was significant difference between non-gamers and other two groups for obstacles 1, 4, and 5 ($p<.05$). Significant effects are presented in Table 5.5. Then I focused on FPS and RPG gamers and performed Mann-Whitney U Test. Results showed there was a significant difference in the mean time of FPS and RPG players on obstacle 4, $z = -1.905$, $p<.05$ and obstacle 11, $z = -2.155$, $p<.05$. I then investigated this aspect qualitatively to describe the context behind these numbers and uncover the differences I found between these puzzles and the reason(s) why some produced significant results while others did not. In the interest of space, I will discuss obstacles that produced large variations in behaviour using *Tomb Raider Underworld* walkthrough [39]. Moreover, I brought three figures for the three groups of FPS gamers, RPG gamers and non-gamers to demonstrate the patterns of players' gameplay separately. They show how much time each player spent on obstacles and how many of players could pass them. Figure 5.9 shows the average time (sec) for FPS gamers to solve obstacles. Figure 5.10 shows the average time (sec) for RPG gamers to solve obstacles. Figure 5.11 shows the average time (sec) for non-gamers to solve obstacles.

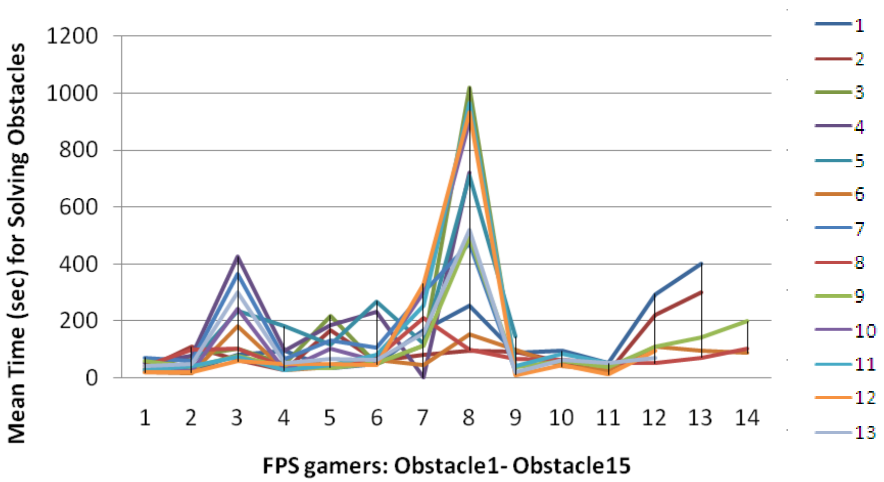


Figure 5.9: Average time (sec) for **FPS gamers** to solve Obstacle1-Obstacle15

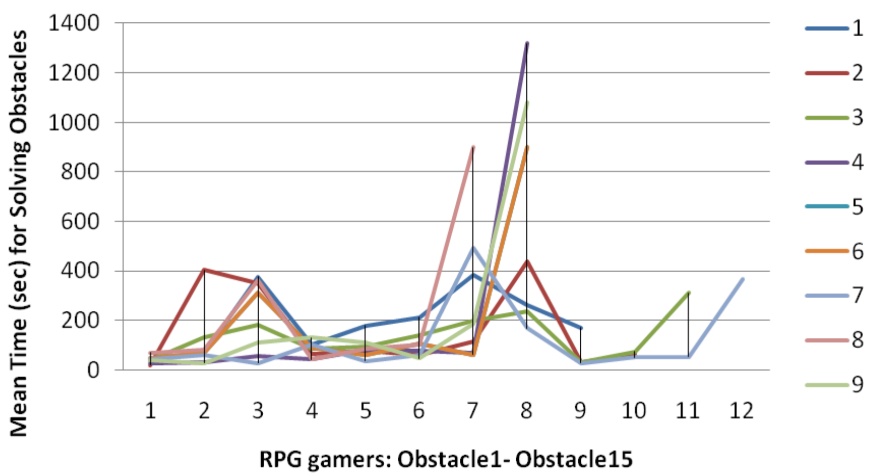


Figure 5.10: Average time (sec) for **RPG gamers** to solve Obstacle1-Obstacle15

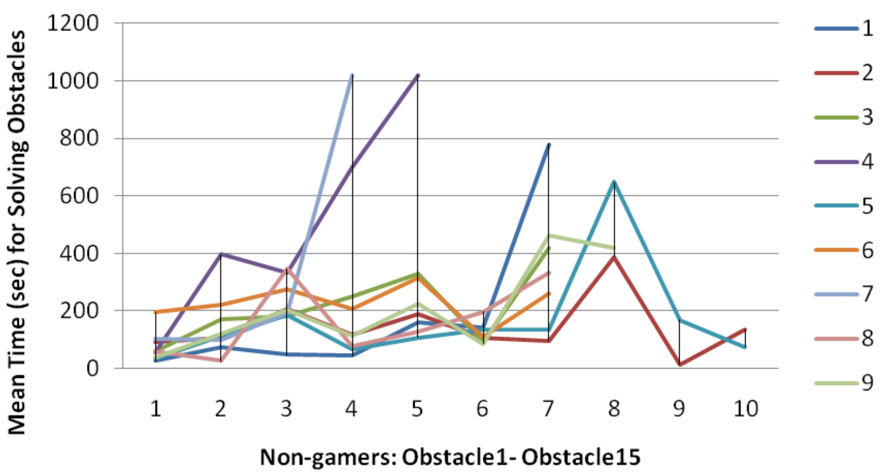


Figure 5.11: Average time (sec) for **non-gamers** to solve Obstacle1-Obstacle15

Obstacle 1 requires players to move forward and get around two corners while avoiding flames that can hurt them. They are then required to climb on a ledge, use a switch to open the nearby door and go through it [39]. Non-gamers spent more time getting used to the controllers, the game environment and the abilities. In contrast, FPS and RPG gamers just passed through this phase with no difficulty. Therefore, there was a time difference for getting through this puzzle between FPS, RPG players on one hand and non-gamers in the other, as shown in Figure 5.8.

Obstacle 2 requires players to crouch beneath beams in front of them. Then climb on the ledge above the stones and use the Grapple to catch the ring on the door to drop it down and go through the next obstacle [39]. The majority of players did not see the ledges to climb on right away. One RPG gamer asked for help after spending 6-7 min on this as well as two non-gamers. The mean times (sec) for FPS, RPG and non-gamers, which were 52.3, 104.7and 146.7 respectively (See Figure 5.8), show the variations among the groups.

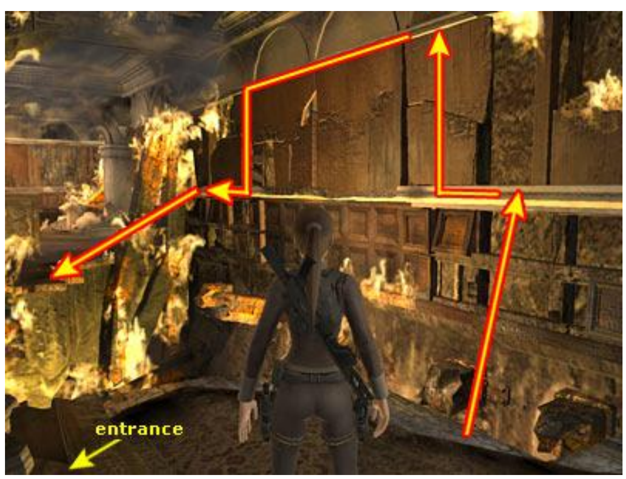


Figure 5.12: Obstacle 3 [31]

Obstacle 3 is a flaming hallway with deep pit (See Figure 5.12). This obstacle was challenging and involved new game mechanics for all the groups. Players need to get close to the edge of the pit to jump and grab the narrow ledge on the wall. Then traverse and jump to grab the ledge above and similarly the ledge below. Finally, jump back to land on the floor [39]. Many participants reported the ledges were unclear and unnoticeable which explains the peak for obstacle 3 in Figure 5.12. This was evident especially with, 23% of FPS gamers, 25% of RPG gamers and 67% of non-gamers asked for help from the observer after spending a good amount of time on obstacle 3. However, majority of FPS and RPG gamers tended to figure out the puzzles by themselves which overall, resulted in FPS gamers being faster: The mean times (sec) for FPS, RPG and non-gamers were 177.4, 231.7 and 235 respectively. The observer believes that this could also be because FPS gamers' attitude tended to be more risky and impatient. For example, I observed FPS gamers jump toward the wall or the pit while they still did not find the ledges. It shows their attempt and risk to look for something although they have not found it yet.

In obstacle 4, players need to push a chest towards the wall and climb on it, jump and grab the handhold on the wall. They are then required to traverse, jump and approach the door by jumping over a flaming pit [39]. The mechanics used for this obstacle are the same as for obstacle 3. Thus, FPS and RPG gamers did not differ much, but compared to non-gamers there was a big difference in the average time to complete this obstacle. This is because FPS and RPG gamers are used to learn the tricks from playing games and use the mechanics again, and thus their learning time can be much quicker than non-gamers can. In addition, judging from the behaviour of non-gamers, some of them got lost in this obstacle. Similar behaviour can be observed for obstacle 5.

Level 2: Mediterranean Sea begins on a boat and mostly takes place underwater. There is a 2-minute cinematic between the two levels. Interestingly, 15% of FPS gamers, 11% of non-gamers, and none of RPG gamer skipped it. This is probably because RPG gamers are interested in stories and cinematic as judged by their RPG game choice, which is characterized by the heavy use of story and narrative.

Obstacle 6 requires players to jump into the water and swim down until they reach the bottom, where there are some rock structures. While exploring, they may encounter sharks [39]. Facing sharks under water, they can either escape or shoot at sharks; 85% of FPS gamers, 66% of RPG gamers and 56% of non-gamers shot at the attacker sharks. This difference is due to FPS gamers being used to shooting within the games they play.

The first puzzle is the door puzzle started with obstacle 7 and continued through obstacles 8 and 9. Players' behaviours were almost the same for obstacle 7-9 for those who could get through (eight FPS gamers, three RPG gamers and two non-gamers). The majority of players mentioned they got lost underwater especially in obstacles 7 and 8, where they believed game design could be improved through using more efficient lighting and maps. The obstacles need players to navigate underwater to find two keys [39]. Although the first key is on a pedestal at the bottom of the door, only twelve FPS gamers, eight RPG gamers and three non-gamers were able to make it to obstacle 8. Obstacle 8, which is about finding the second key, was a huge challenge for most players. They struggled to make their way through the structures and return to the door puzzle. One FPS gamer, four RPG gamers and one non-gamer got lost here. To solve the door puzzle in obstacle 9, players need to rotate all keys/mechanisms. The middle mechanism has one common piece with the left (first) and one common piece with the right (second) mechanism to create an "opened eye" design [39]. None of the participants noticed the "opened eye" and those who entered rotated the keys randomly. They were mostly unclear about how many times they needed to rotate the keys to open. Over all, eight FPS gamers, three RPG gamers and two non-gamers could get through.

I will skip to obstacle 11 where the differences between FPS and RPG gamers started to appear. In obstacle 11, a combination of jumping and climbing to find the right path is required. It requires players to navigate in a dark room to find a door. This is where I found differences between FPS and RPG gamers. FPS gamers generally spent less time and were able to navigate with little problem, although one FPS player out of a total of eight who made it to this obstacle got lost. RPG players, on the other hand, spent more time and one RPG player out of two got lost in this puzzle. Since one of the two RPG gamers spent about 5 minutes here before getting lost, the average is higher for RPG gamers as shown in Figure 5.8. This may have happened due to their navigational abilities. Obstacle 12 requires players to jump to grab the upper ledge and traverse around the corner, then release twice to grab the handholds below [39]. Two FPS gamers and the last RPG gamer could not make any further. Finally, only FPS players could make it to Obstacle 13 (five players) and Obstacle 14 (three players).

As I discussed above there were two obstacles with significant time difference between FPS and RPG gamers (Obstacles 4 and 11). Further investigation shows there were 5 obstacles with significant time difference between FPS and non-gamers (Obstacles 1, 2, 4, 5, and 6) while there was only one obstacle that yielded significant differences between RPG and non-gamers (Obstacle 5). Thus, *non-gamers' behaviour was more similar to RPG gamers than FPS gamers;* in terms of the time it took them to solve the puzzles. This could be due to the learning curve of FPS players. This showed up when participants faced new game mechanics, FPS players learned faster and were able to apply them to the next obstacles than RPG players and non-gamers. Additionally, navigation could be another element where FPS and RPG gamers differed, e.g., navigating underwater or a dark room. [Thus, I believe visual search and/or the actual learning abilities cause these differences between the two groups.]

Figure 5.13 shows the results for the dependent variables movement (fast, in-between, slow) and frustration with controller (low, medium, high) using video annotations and observer notes, which were collected throughout the play session. The annotation was done through a video coding process. To keep consistency of judgment, one rater did the measures, pacing of movement within the game and frustration based on how participants interacted with the controllers. The rater was able to compare them through videos. Although quantitative analysis showed some of the FPS gamers claimed they were PC gamers, and thus had no experience with the game controller, the differences captured through qualitative observations among FPS gamers were minimal. Thus in terms of smoothness in movement and control, there was no difference between FPS players who played on PC only and others who played on the console. For RPG gamers the difference between PC gamers and those who are used to controllers was more pronounced. As expected and indicated in Figure 5.13, a difference in movement and frustration with controller between non-gamers and the other two groups was seen. Non-players showed by far the highest frustration level and the slowest movement, whereas all FPS gamers showed the lowest frustration level and the fastest movement. 77% of RPG gamers had low frustration level and the rest of them had medium level; for movement 66% of them were fast and the rest of them were in-between. The observer also noticed that *FPS gamers were faster, impatient and more risky.*

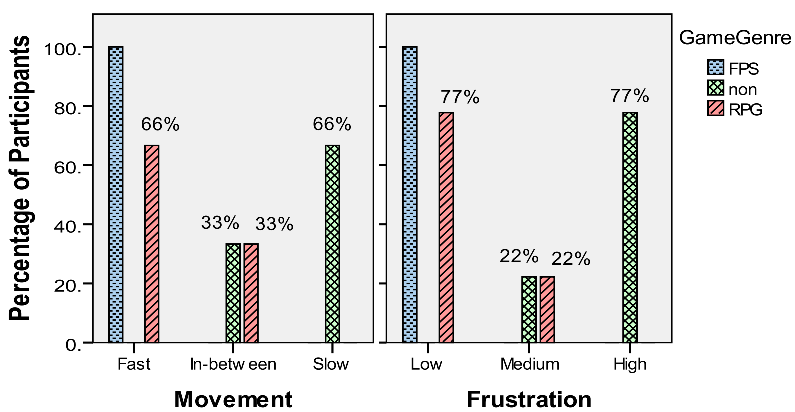


Figure 5.13: Movement and Frustration with controller

5.3.3 Correlating Game Metrics and Questionnaire Data

To determine if the numbers of FPS games or RPG games had any effect on players' progress through the game, I did other correlations. *Analysis showed* *there was a significant strong positive correlation between the number of FPS games played and the number of solved obstacles r = .548(31), p(two-tailed)<.01 but not with number of RPG games played* (See Figure 5.14).

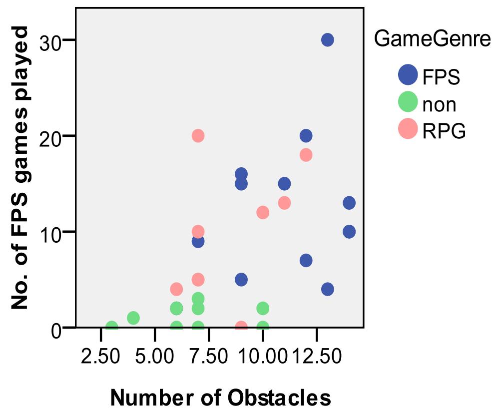


Figure 5.14: No. of FPS games played vs. No. of solved obstacles

Since I was interested to see if the amount of time (h/w) for playing a video game affected the number of solved obstacles, I did a correlation between the two. I used the amount of time they reported they have played, although it may not be as reliable but that was the only resource I had. *Analysis showed a significant strong positive correlation between hours spent weekly on playing video games and the number of solved obstacles r = .443(31), p(two-tailed)<.05* (See Figure 5.15).

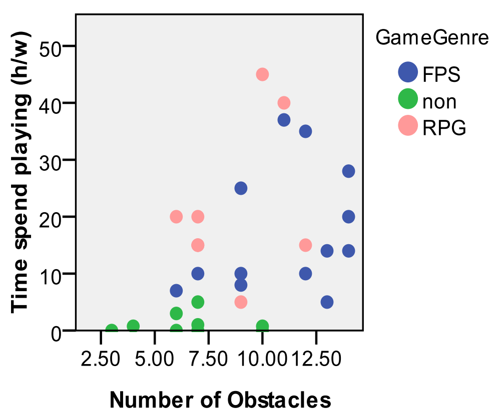


Figure 5.15: Time spend playing vs. No. of solved obstacles

6 DISCUSSION

Chapter 6 is a discussion around the main study, investigating the impact of previous gaming experience on gameplay performance and skills of 31 participants (aged 21-32) with background in specific game genres: FPS (First Person Shooter) gamers, RPG (Role Playing Game) gamers and non-gamers. I discuss the results that I found through the studies by providing the meaning and interpretation of them. However, I outlined some methodological issues before theoretical discussion. This is a difficult research area and although I tried to keep the limitations of the study low, there are some. In order to understand a player's previous experience as well as how it affects gameplay there are many factors involved, some of which are difficult to measure or control. As discussed in Section 5.3.2, FPS players tended to solve the obstacles in less time than RPG players did. It is important to note that the participants in the study were given a time limit of 30 minutes to play during the sessions and their behaviour for puzzle solving were measured by that time. Thus using time completion to discuss FPS gamers', RPG gamers' and non-gamers' behaviour might be affected. In addition having only one rater for observation of subjective metrics such as frustration and movement may not be enough to establish validity. More raters can assist in establishing an inter-rater reliability measure to make the results more conclusive. Additionally, the number of participants needs to be higher to establish generality in behaviour. However, the number of hours it took to video code and number of hours of video needed to be video coded (overall 31 half-hour videos and each needed around four/five hours to be coded) overcame this desire to get more participants.

Throughout this study, I learned several lessons. First, it was surprisingly hard for me to get a population of RPG players. This may be due the time investment needed to play RPG games and students could not usually spend that much time. The results showed that RPG gamers (Mean = 21 h/w) spent slightly more time playing than FPS gamers (Mean = 17 h/w), however, this difference did not reach significance. Section 5.3.2 and Figure 5.8, elaborated on the fact that FPS players tended to solve the obstacles in less time than RPG players did, in particular:

- In Obstacle 2, RPG players have more difficulty figuring out the ledges as a place to climb on.
- In Obstacle 3, although many FPS players as well as RPG players questioned how to pass the obstacle and stated the ledges were unclear and unnoticeable however, the overall result shows FPS players were faster. In solving this obstacle, FPS players' attitude tended to be more risky and impatient. For example, they jumped toward the wall or the pit while they still did not find the ledges. It shows their effort to look for something and to try them out although they have not found it yet.
- Obstacles 7-9 needed players to navigate underwater.
- Obstacle 11-12 needed players to navigate and figure out the puzzles in dark rooms.

I noticed that FPS and RPG players were quite the same in terms of the amount of time for their learning curve, which is evident in obstacle 4 and obstacle 5. However, non-gamers' behaviour, in terms of navigation and 3D spatial puzzle solving, were more similar to RPG players than FPS players were. FPS players solved significantly more obstacles than RPG players did and as expected non-gamers, while there was no significant difference between RPG players and non-gamers. In addition, FPS players needed significantly less time to solve obstacles; there were five obstacles with significant time difference between FPS and non-gamers while there was only one obstacle between RPG and non-gamers.

Another interesting finding was that the more FPS games they played the more obstacles they solved; this was not true for RPG games. On the other hand, RPG players played significantly more RPG games than FPS shooters. Participants did not differ in the number of FPS games they played. Thus, RPG players showed that they were more flexible in playing games, as they played other genres.

These results show that players are different based on the game genre they used to play. Although here I looked at players' gameplay performance and puzzle solving skills in the context of 3D navigational game, I also acknowledge that players play for different reasons and motivations, and it is not always about having good skills. The results confirm that not all genres provide players with the same capabilities. I believe game genres can be used as a way to classify the huge audience of video games including experienced players, casual gamers and new audiences. This will help designers to overcome the challenges they face for classifying players based on their ability and create games that are appealing, accessible, and usable to a rather different audience.

From the perspective of game design, the results show that there is a difference between the performance of FPS and RPG players. Even though I present some results here, further research is needed to investigate the conclusiveness of these results as well as uncover all the possible skills and performance differences between FPS and RPG players as well as other genres' experts. By uncovering these skills and their connections, further theories can be developed to guide developers into designing more accessible and innovative games tailored by their intended audiences. On the other hand, the educational games for training studies are also growing and knowing these details can help in designing games that are more proper for educational and training purposes. The findings of this study uncovered specific differences between players who play FPS vs. RPG games and their skills in 3D navigation and spatial puzzle solution. In particular, FPS gamers were faster in visually discriminating intractable surfaces, reacted much quicker, and thus excelled at solving spatial puzzles that relied on visual ability. This confirms results from previous studies, which seem to suggest advantages of video game players over non-players in terms of visual attention and visual search tasks [90, 91, and 92]. In particular, Hubert-Wallander et al. [90] stated, "video game players have been documented to outperform novices in a variety of visual attentional capabilities, including attention in space, in time, and to objects." I further believe that more studies on visual attention and search tasks for different experience video gamers are also important. It will reveal, as I have alluded to here through my experimental results and qualitative analysis discussed in section 5.3.2 that different kind of gamers acquire or have different abilities. Such studies are important. The community can benefit from these results to creating better guidelines for designing games. In section 7.1 and 7.2, I discuss the contribution of my study as well as how my results could be useful in the future.

7 CONCLUSIONS

This chapter is a conclusion to the dissertation. I review the explained ideas in the dissertation and summarize the contribution of this research. I then define the direction of the future work, and the next steps within this research.

7.1 Contributions

I discussed, in my study, the effect of previous gaming experience in terms of First Person Shooter (FPS) and Role Playing Game (RPG) experience on gameplay behaviour and performance. I believe prior gaming experience is critical in gameplay skills and performance, especially in shifting the focus from meeting the desires of hard-core gamers, to casual and inexperienced gamer. Additionally, with this variety in contemporary digital games and genres, teaching gamers and non-gamers to start playing new game and balancing game difficulties in order to keep the players engaged, becomes a major concern for designers. Following this idea, classifying players by the skills gained from playing different genres is a way to have a better understanding of the audiences. There are many game genres and genre conventions. In my view, detailed knowledge about the internalized skills of different types of gamers is a useful source to inform designers in better designing their products for such a wide market. Since there is no such work before, I narrowed the study to look at two groups: FPS gamers and RPG gamers with a baseline of non-gamers.

There are several contributions of the thesis. The first contribution is the novel methods used: (a) questionnaire developed to measure and to gauge the gaming experience, (b) the defined list of performance metrics based on video coding of player behaviour in the context of a specific game. This could be defined for any game regarding the specific game mechanics. Next, the findings of the study uncovered specific differences between players who play FPS vs. RPG games and their skills in 3D navigation and spatial puzzle solution. In particular, it found that FPS players were faster in solving obstacles and solved more obstacles at a time. In addition, FPS gamers were faster in visually discriminating intractable surfaces, reacted much quicker, and thus excelled at solving spatial puzzles that relied on visual ability. The usefulness of the results, however, lies in the implications for design, and our understanding of people or play behaviour. A design lesson, for instance, is that developers of games like *Tomb Raider* that rely on spatial puzzles may need to adapt the game play to accommodate other gamers, like RPG gamers.

7.2 Future Work

This research has been done in the hope of better understanding the characteristics of the gameplay experience by looking at how the abilities and knowledge that players gain through pre-play of specific genres could affect their gameplay within a new game. This research is a starting point of a future model of players' skills that would take the variety of game genres and contemporary digital games into account. I have presented one simplified version here, looking specifically at Role Playing gamers and First Person Shooter gamers, while acknowledging the need for more research. Additionally, the games presented here represent only a fraction of the diversity of contemporary games. In terms of genres and different tasks within games, further research is required; specifically analysing in depth one genre through different games, and comparing what kind of tasks and information are required. Ideally, by collecting all the tasks of different game genres, a model of these tasks and abilities can be created for targeting different audiences. However, defining the evaluation criteria gets tricky once the model grows by adding more genres.

In a sense, since this research is a starting point in this area, it opened up more questions than it could answer. Even though the results show clear differences between the two groups, more research is needed to uncover all the possible skills and performance differences between FPS and RPG gamers. In particular, to investigate what abilities give FPS gamers the observed navigational difference? Could it, for example, be related to improved visual attention, visual search, reaction time, or do they just know better where to look and what to do? Moreover, to have a conclusive determination on the impact of game genre, other future research directions could investigate players with other game genre backgrounds: explore the differences between players' behaviour with other game genre backgrounds such as sport, strategy, etc. To answer questions such as: What kind of previous experiences and abilities the player has with any genre? How these prior experiences and expectations within a certain genre affect the gamelay experience with the new game? And to what degree?

What other differences exist in terms of skills in 3D games between different types of players?

In terms of methods, in this thesis, there proved to be several useful methods and observations to address the research questions of this kind, which can be applied into the study of gameplay. I combined several methods into a tool to address the limitations and obtain better information. Metrics and survey-based methods assisted me in collecting players' quantitative measures. On the other hand, I also used direct laboratory and field observation as well as qualitative analysis to analyse players' responses and behaviours. A more time efficient method can be developed using game telemetry. In addition, other methods, like eye tracking, can also provide useful insights on the visual attention question and may uncover navigational issues that may have otherwise not been discovered by the study discussed here. However, future research could benefit from the methodology proposed and lessons learned here. They could redesign, fine-tune and test the proposed questionnaire once addressing other genres.

APPENDICES

Appendix A: Bardel Play Together Questionnaire

Background Questions

Session ID	
Participant ID	
age	
gender	
INTRO QUESTIONS	**RESPONSE**
1. Do you have access to video games?	y/n?
1a. Computers and video game consoles?	device type
1b. How many?	count (#device)
1c. Are they in your room?	Location of each device
2. What kind of games do you enjoy mostly? (genre) a. FPS b. RPG c. MMORPG d. Sports e. Strategy f. Board games g. Mobile games h. Puzzle i. Platformer j. Other, explain	A-J choice
3. Name 5 examples of favourite games	examples
3a. Why do you like those games? You can Qualify with: • For story • For challenge • For Fantasy: i.e. being in a different world • For social experience • For being able to customize the world or the characters • Sensory: visual/audio • Just to pass the time	comment
4. On average: Frequency of play/week	count (day)
5. On average: Length of play	count (hr)

6. Which setting do you typically play video games? a. Arcade b. Home c. Friends' house d. Computers in an internet café e. Consoles at a gaming store? f. Other, specify	A-F choice
7. Who do you typically play with? a. Alone b. Alone but on the internet or over Xbox live or Sony Home c. Friend or a group of friends (how many?) with brother, she didn't remember but she sometimes plays d. With a friend near by who may or may not be playing but is involved in the activity, explain.	A-D choice
8. How many different video games in any form have you played:	A-D choice
9. What is your preferred Gaming platform? a. PC b. PS2 or PS3 c. Xbox or Xbox360 d. Wii e. DS f. PSP g. Cell phone h. Other, specify	A-H choice
10. How much do you spend on online gaming or other gaming monthly, explain?	amount ($)
11. How old were you when you played your first video game? a. Never b. Before kindergarten c. Kindergarten – grade 1 d. Grade 2 – grade 4 e. Grade 5 – 6 f. Junior high school	A-F choice
11a. Tell me about it. Is this how you started playing games, tell me more	comment
12. Are playing for online subscriptions?	y/n?
12a. If you are playing for online subscriptions for what games?	comment
13. What is the longest time you have spent playing online in one session?	count (#hr)
14. How do you select games to play?	comment
15. Imagine you can make a game, what would it look like?	comment
16. What is the best game you ever played?	comment
17. What are features you hate in games?	comment
18. Is there any game that you hate in particular?	comment
19. Do you prefer to play alone or in a group?	alone/group/both?
19a. (what size)?	count
19b. Competitive or co-operative games?	comp/co-op/both?
20. Describe a normal weekday for you.	comment
21. Describe a normal weekend for you.	comment
22. Do play games for entertainment or education?	edu/ent/both?

22a. Do any of your parents have a say on the games you play	y/n?
22b. Do any of your parents have a say on the games you play (comments)?	comment
23. Are there benefits of playing games on your learning and skill abilities	y/n?
23s. What are the benefits of playing games on your learning and skill abilities?	comment
24. Is anyone against you playing games?	y/n?
24a. why?	comment
25. Do you play video games whenever you want?	y/n?
26. Do you have any online friends?	y/n?
26a. Comments	comment
27. Have you ever talked about video games for more than 10 minutes?	y/n?
27a. If so, where and with whom?	comment
28. Are you ever tired the next day because you stayed up too late playing video games?	y/n?
28a. Comments	comment
29. Would you rather play video games than watch a movie?	y/n/depends?
30. Is playing video games in your top three things that you like to do?	y/n/same/not sure?
31. Do you like to play video games more than most of your friends?	y/n/sometimes?
32. How many friends do you have?	count (#friends)
32a. What do you typically do with friends?	comment
33. Have you played Rock Band 2 (y/n)?	y/n?
33a. Have you played LSW (y/n)?	y/n?
33b. Have you played Kameo (y/n)?	y/n?
33c. Have you played LBP (y/n)?	y/n?

Post Play Questionnaire

Game (i.e. Rock Band 2)	RESPONSE
1. Is this like any game you played before (y/n)?	y/n?
1a. Tell me about it.	comment
2. What were you trying to do and why?	comment
3. Did you like/dislike the game?	liked/disliked
3a. What did you like or did not like. Give examples.	comment
4. Would you improve elements?	y/n?
4a. How would you improve the elements that you did not like?	comment

5. Why would anyone play this game? • For story • For challenge • For Fantasy: i.e. being in a different world • For social experience • For being able to customize the world or the characters (not the cloths) • Sensory: visual and audio • Just to pass the time	comment
6. Was it difficult for you to play?	y/n?
6a. Comments	comment
7. Would you give this game as a gift?	y/n?
7a. Who would you give it to?	person
7b. Why?	comment
8. I felt that the other player(s) responded to my actions?	never/sometimes/ always
9. I communicated well with the other participants (never/sometimes/always)?	never/sometimes/ always
10. I helped the group reach the goal (never/sometimes/always)?	never/sometimes/ always
11. The group co-operated well (never/sometimes/always)?	never/sometimes/ always
12. The other players made helpful comments that allowed me to catch up?	never/sometimes/ always
13. The other players were hindering my progress or slowing me down (y/n)?	y/n?
14. I understand what to do exactly (never/sometimes/always)?	never/sometimes/ always
15. I was well matched with the other player(s) (disagree/agree/strongly agree)?	disagree/agree/str ongly agree
16. I felt pressure to lead the progress (never/sometimes/always)?	never/sometimes/ always
17. Did you do anything that helped or hurt the other player(s)?	y/n/sometimes?
17a. Explain and give examples.	comment
18. Did you share goals with the other players?	y/n?
18a. How did that impact your play?	comment
Please rank the games played today from your favourite to least favourite	

Appendix B: Beats List for *Lego Star Wars* and *Kameo*

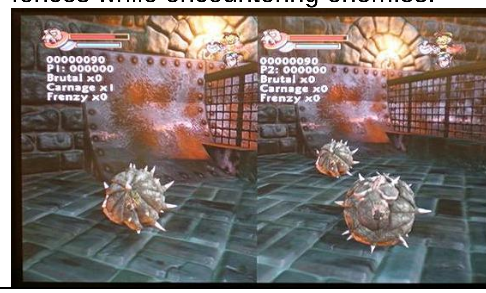
Lego Star Wars

Cantina - Practice using the controller (attack, jump, use force, switch character, move around) 	**Obstacle 1**: Use force to move tree 
Obstacle 2: Use force to move orange machine object. If the player is too close to the obstacle they die when the obstacle explodes) 	**Obstacle 3:** Use force to create bridge for Jedi's to cross 
Platform 1: Jarjar must "high jump" to bring the platform to where the Jedi's can pass through. 	**Platform 2**: Jarjar must "high jump" to bring the platform to where the Jedi's can pass through. 
Platform 3: Behind Platform 5 is an enemy. 	**Obstacle 4**: Jedi's use force to create Lego Bridge for the team to cross. 
Obstacle 5: Jedi's use force to drop wooden bridge for the team to cross.	**Optional Obstacle**: Jedi must use force on fallen trees to enter room with coins.

	
Obstacle 6: Jarjar must high jump on ledge and walk around to another ledge to allow the Jedi's to pass 	**Platform 4**: Use force to assemble robot (extra money) 
Optional Bonus: Use force to assemble robot (extra money) 	

Kameo

Obstacle 1: Climb upwards on the wall covered by ice while avoiding enemy fire. 	**Obstacle 2**: Get to the door either by rolling up the long ramp or boosting up the short ramp. 
Obstacle 3: Once passing through the entrance, one player must complete the special ability to advance inside the castle. The Rolley Polley creature is the only creature that can smash through the doors.	**Obstacle 4**: Once inside, they are inside a spherical chamber with no help scroll. Players must remain the rolley polley creature and follow the arrows marked on the floor to boost through this section into another hole.

	
Obstacle 5: Players must remain the rolley polley creature and boost over a consecutive fences while encountering enemies. 	**Obstacle 6:** Players must remain the rolley polley creature and boost over a consecutive fences while encountering enemies. 
Obstacle 7: The player must become the plant creature and use the special ability to punch the enemy hiding under the shell. 	**Obstacle 8:** rolley polley creature must boost over ramp to enter elevated passage. Through the elevated passage the player can cross the chamber. 
Obstacle 9: Player must use rolley polley creature to knock ball enemy into the hole 	

Appendix C: FPS/RPG Questionnaire (Main Study)

Please read each question carefully and answer as accurately as possible. If you have any questions, please ask the experimenter. Please highlight or write the answers.

Name: ________________ Age: _______ Gender: ______

Zip code: _________ Email address: ________

1. I consider myself as:
   a) Elite FPS gamers
   b) Elite RPG gamers
   c) Non-gamers

2. Have you played *Tomb Raider: Underworld* before? (Yes/No) _____

3. If you have any Xbox Live (XBL) gamer tag, PSN ID, or Steam ID please name it? ____

4. Do you consider yourself to be an active video game player? (Yes/No)
   I consider myself:
   a) A non-video game player
   b) A novice video game player
   c) An occasional video game player
   d) A frequent video game player
   e) An expert video game player

5. During an average week, how many hours do you spend playing video games? (days/week * hours/session = hours/week)

6. Compared to five years ago:
   a) I play video games more frequently now.
   b) I play video games less frequently now.
   c) There has been little change in the frequency of my video game playing.

7. Please rank the different game genres (if you have more than one preference write them in order of preference for playing).
   I play: ________________________

a) Strategy video games *(e.g., Starcraft, Warcraft, Command and Conquer, Age of Empires, Civilization, Sim City)*
b) FPS video games *(e.g., Bioshock*, *The Orange Box*, *Call of Duty, Left 4 Dead*, *DOOM, Quake, Halo, Half-Life)*
c) Action video games *(e.g., Prince of Persia)*
d) Casual video games *(e.g., Card games, Puzzle games, Word games, Board games)*
e) Role-playing video games *(e.g., Final Fantasy, Fallout, Zelda, Fable, The Elder Scrolls)*
f) Sports video games *(e.g., NBA Live, Madden NFL, FIFA Soccer, SSX, Tony Hawk)*
g) Music video games *(e.g., Rock Band, Guitar Hero*
h) Others
i) No preference

8. How do you typically play? (check all that apply)
   a) Single player Alone
   b) Single player with others in the room
   c) Multiplayer in the same room Co-operative
   d) Multiplayer in the same room Competitive
   e) Multiplayer on the internet Co-operative
   f) Multiplayer on the internet Competitive

9. What platform do you use?
   a) PC
   b) Console (PS2/PS3, Xbox, Wii)
   c) Portable (Cell phone, Ds, PSP)

10. When you start playing a new game, do you appreciate hints and tutorials? (Yes/No)

11. How much time with a new game do you need before you feel that you are mastering the controls? (On a scale from 1= 'I basically struggle all the way through' to 5= 'It works for me from the beginning')?

    1 2 3 4 5

12. Do you normally feel overwhelmed by the challenges during the first couple of hours of playtime with a new game?

13. What is the best game you ever played? ____________________
    Why?____

14. Please list your five favourite video games:
    a) ____________________
    b) ____________________
    c) ____________________
    d) ____________________
    e) ____________________

FPS Game Genre Experience

1. Do you consider yourself an elite FPS gamer? (Yes/No)

2. Have you finished the single-player campaign of any FPS game? (Yes/No)

3. How many games you have played so far in this genre? (a number) ______

4. Please rank your favourite kind of FPS game (if you have more than one preference write them in order of preference for playing).
   I play: ________________________

   a. Sci-Fi shooters
   b. Historic shooters
   c. Real World shooters
   d. Others
   e. No preference

5. Name as many as FPS games you played and then for each example describe whether it is multi/single player, whether you finished the game, how long you spend time playing and the number of times you played the game:

#	Finished (y/n)	Name of Game	Single/Multi player	No of times played as different roles in Multi player (if applicable)	Hours Playing
1					
2					
…					
30					

RPG Game Genre Experience

1. Do you consider yourself an elite RPG gamer? (Yes/No)

2. Have you finished any RPG game? (Yes/No)

3. How many games you have played so far in this genre?(a number) _____

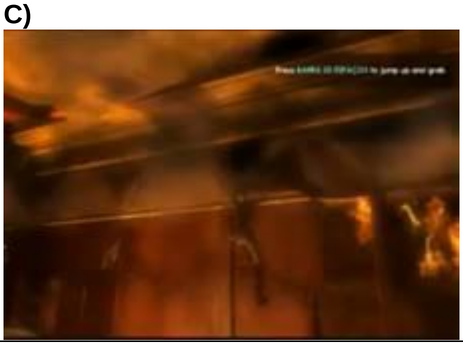
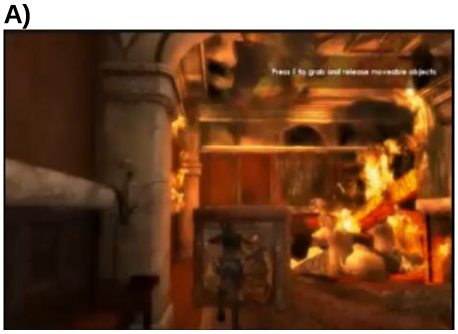
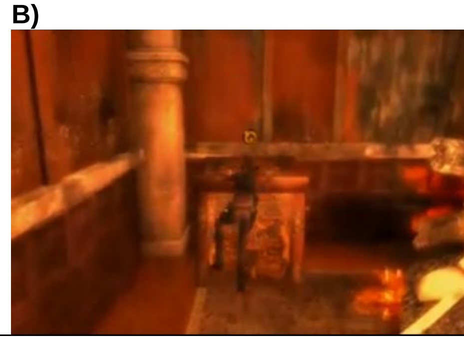
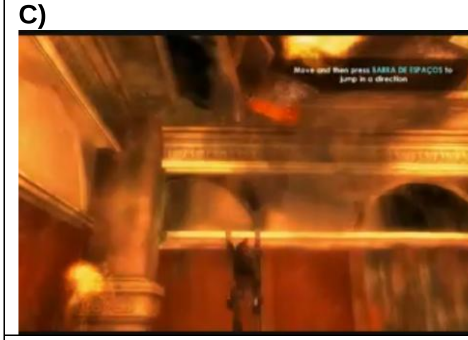
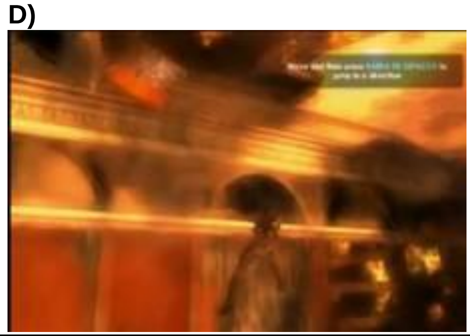
4. Please rank the different kind of RPG's genre (if you have more than one preference write them in order of preference while playing).
   I play: _______________________
   a. JRPG
   b. Sandberg
   c. Western RPG
   d. Pen and Paper RPG
   e. Bio RPG
   f. Others
   g. No preference

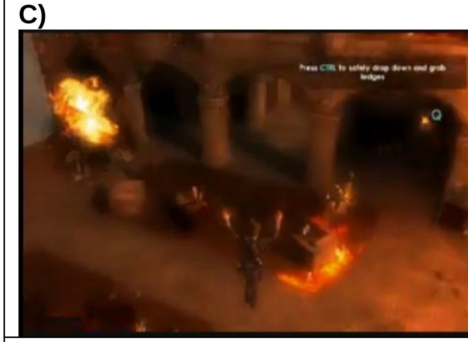
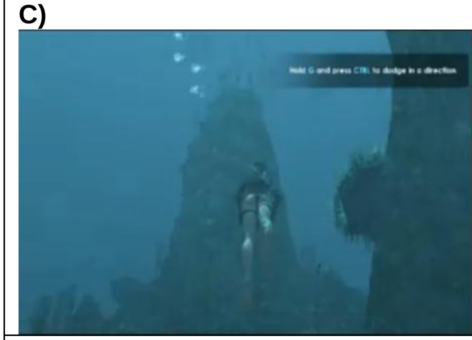
5. Name as many as RPG games you played and then for each example describe the Genre of RPG's you played, whether you finished the game, the main character and hours you spent playing that game:

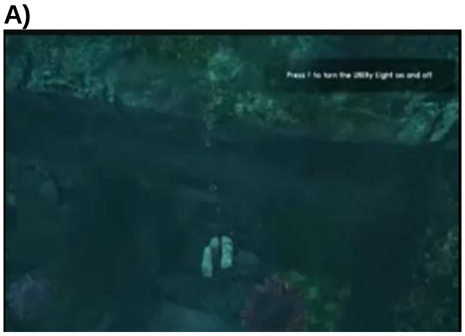
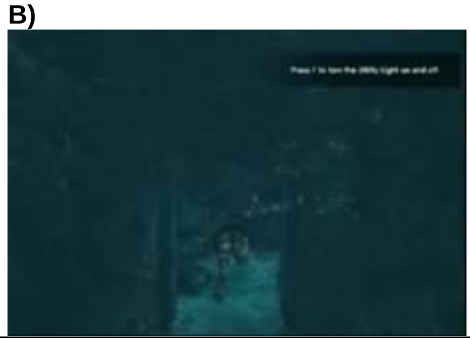
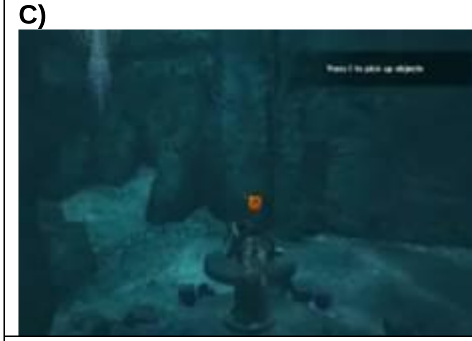
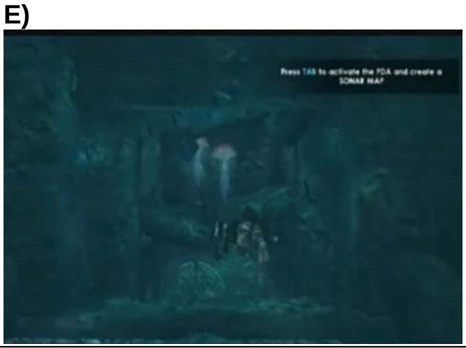
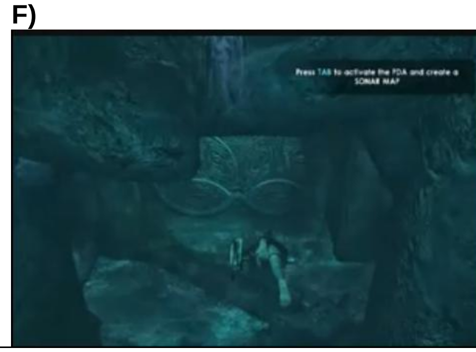
#	Finished (y/n)	Name of Game	Name of RPG's Genres	Name of the Main Character	Hours Playing
1					
2					
…					
30					

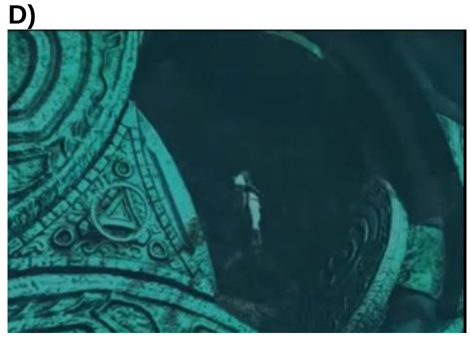
Appendix D: Beats List for *Tomb Raider: Underworld*

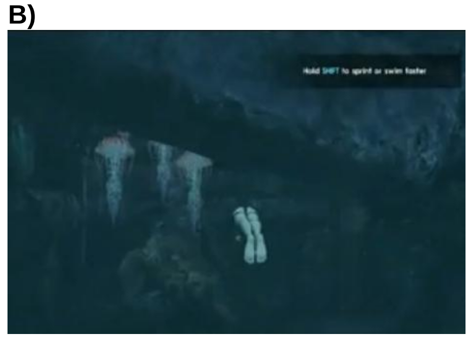
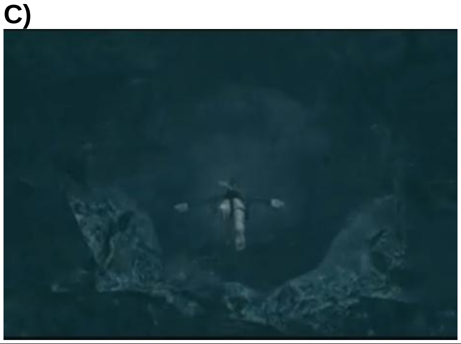
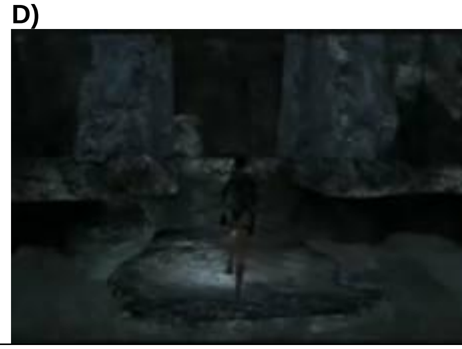
Level 1 Prologue	
Obstacle 1	
A) Press A to jump and grab; makes Lara jump straight up. Where there is something for her to grab, she'll grab it automatically. 	**B)** Press Y to interact with objects; Lara needs to manipulate switches and levers to pass the doors. 
Obstacle 2	
A) Press B to crouch; Used alone, Lara will crouch. Hold Crouch and use the direction keys or Left Stick to creep forward. 	**B)** Press A to jump and grab. 
C) Press X to fire the grapple; Lara's grapple can attach to certain objects in the environment. Generally, Lara will automatically aim at the nearest viable target. 	
Obstacle 3	
A) Press the directional key (or press on the Left Stick) in the direction you want Lara to go and simultaneously press A for Jump.	**B)** Press the directional key (or press on the Left Stick) in the direction you want Lara to go and simultaneously press A for Jump.

	
C) 	**D)** 
Obstacle 4	
A) 	**B)** 
C) 	**D)** 
Obstacle 5	
A)	**B)**

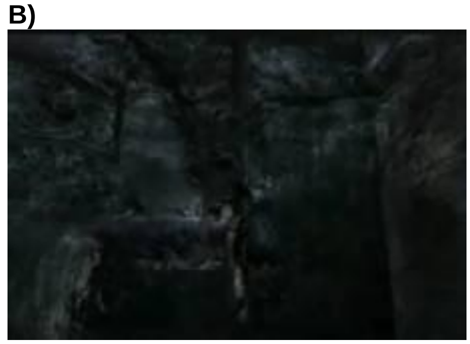
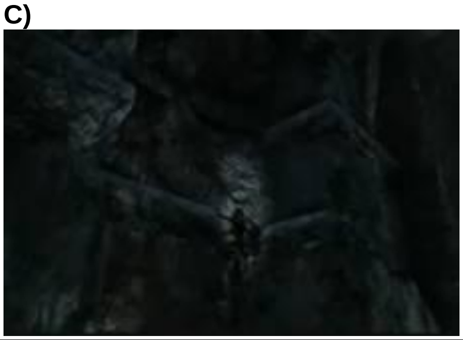
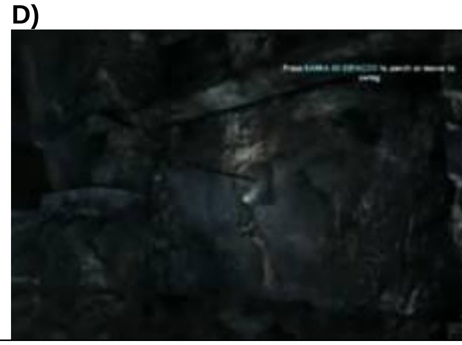
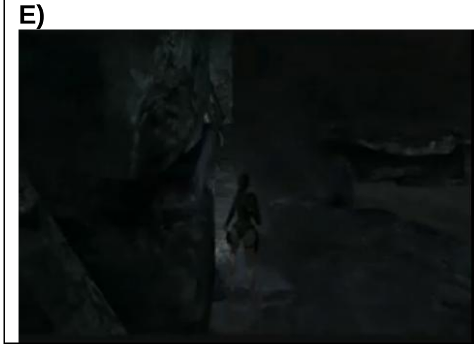
	
C) 	
Level 2 Mediterranean Sea	
Obstacle 6	
A) Press B to duck. 	**B)** 
C) 	
Obstacle 7: Find and Rotate First Key	
A)	**B)**

	
C) 	**D)** 
Obstacle 8: Find and Rotate Second Key	
A) 	**B)** 
C) 	**D)** 
E) 	**F)** 

Obstacle 9: Rotate All Keys to Open the Hall	
A) Rotate first key for the first door 	**B)** Rotate second key for the second door 
C) Rotate third key for the third door. 	**D)** 

Obstacle 10: get out of water	
A) 	**B)** 
C) 	**D)** 

Obstacle 11	
A)	**B)**

	
C) 	D) 
Obstacle 12	
A) 	B) 
C) 	D) 
E) 	

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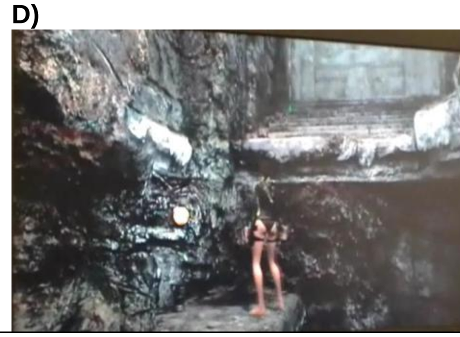</td></tr>
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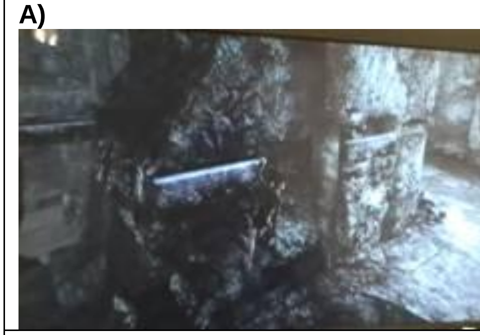
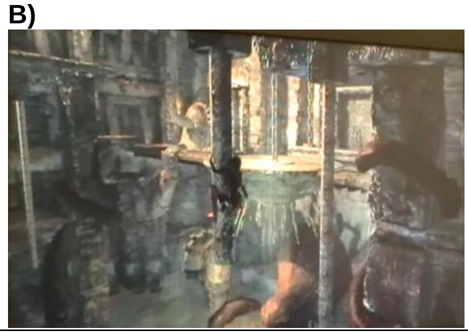
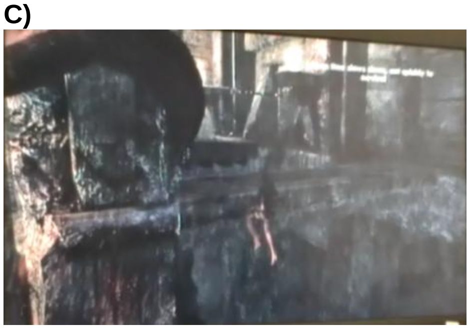
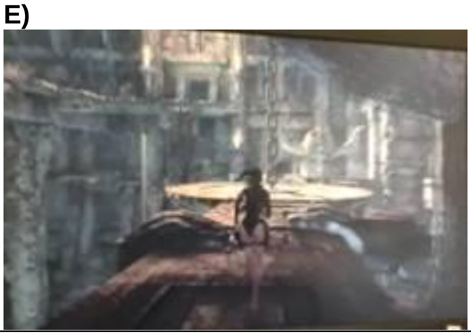
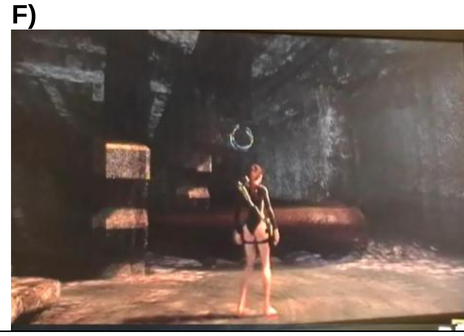
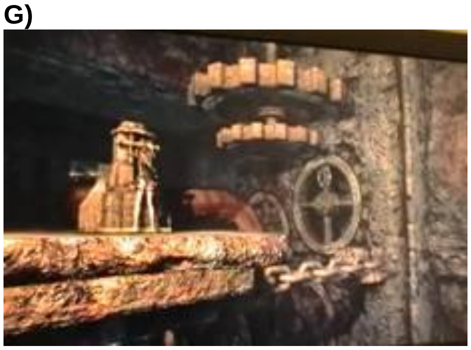
A) 	**B)** 
C) 	**D)** 
E) 	**F)** 
G) 	**H)** 

I) 	**J)** 
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