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THE EFFECTS OF USER INTERFACE TYPE ON PLAYER IMMERSION IN FIRST-PERSON SHOOTER GAMES

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ABSTRACT

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The effects of video games on player behaviour, especially on aggression, have been researched extensively in recent years, as well as the different factors that can affect user enjoyment and engagement in video games on a general level. There is still however a rather limited amount of academic empirical research on video game user interfaces used during gameplay, and how they may affect the player's sense of immersion. User interfaces of first-person video games can be divided into two different types, diegetic and non-diegetic user interfaces. These may influence the player's gameplay experience in differing ways. A better understanding of what user interface elements in first-person video games support an enjoyable and optimal gaming experience would be beneficial for both user interface and user experience researchers, as well as game developers themselves.

This thesis concentrates on the popular first-person shooter genre, and through the utilisation of mixed methods and A/B testing, it examines the level of immersion for two different types of user interface; diegetic and non-diegetic. The main findings show strong evidence that diegetic user interfaces are more difficult, and some support that expert players prefer them. However, there is insufficient evidence to make claims on the effect of user interface type on player immersion.

This master's research may have some implications for the ways in which user interfaces of video games are designed in order to achieve a desired player experience. Further implications can also be seen from the perspective of research on user interfaces in other related areas such as virtual reality.

Keywords: user interface, user experience, immersion, diegesis, video games, first-person shooter, FPS

TIIVISTELMÄ

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Videopelien vaikutuksia pelaajien käyttäytymiseen on tutkittu laajasti, kuten myös niitä tekijöitä jotka vaikuttavat pelaajien tyytyväisyyteen ja kiinnostukseen videopelejä kohtaan. Tästä huolimatta on puutetta julkisesti saatavilla olevasta empiirisestä tutkimuksesta, joka keskittyisi käyttöliittymän vaikutukseen pelaajan kokemaan immersioon pelin aikana sekä siihen, mikä käyttöliittymissä vaikuttaa immersion kokemuksen syntymiseen. Käyttöliittymät ensimmäisen persoonan kuvakulmasta olevissa videopeleissä voidaan jakaa kahteen eri tyyppiin, diegeettisiin ja epädiegeettisiin käyttöliittymiin. Nämä kaksi eri käyttöliittymätyyppiä saattavat vaikuttaa pelaajan kokemukseen eri tavoin. Parempi ymmärrys siitä, kuinka eri tyyppiset käyttöliittymät ensimmäisen persoonan videopeleissä tukevat nautittavaa ja optimaalista pelikokemusta olisi hyödyllistä käyttöliittymien ja käyttäjäkokemuksen tutkijoille, kuten myös videopelien kehittäjille.

Tämä tutkielma keskittyy suosittuun ensimmäisen persoonan ammuntapeligenreen, käyttäen monimenetelmätutkimusta ja A/B-testausta selvittääkseen kuinka diegeettiset ja epädiegeettiset käyttöliittymät vaikuttavat immersion kokemukseen. Tutkimuksen tulokset näyttävät, että diegeettiset käyttöliittymät lisäävät pelin haastavuutta, ja että kokeneet pelaajat suosivat diegeettisiä käyttöliittymiä jossain määrin noviiseja enemmän. Luotettavaa tai voimakasta todistusaineistoa siitä, että käyttöliittymätyyppi vaikuttaisi pelaajan immersioon ei kuitenkaan löytynyt.

Tällä tutkielmalla saattaa olla vaikutusta tapoihin, jolla pelien käyttöliittymiä suunnitellaan parhaalla mahdollisella tavalla eri tasoisille pelaajille, kuten ensikertalaisille tai vuosia pelanneille, sekä tutkijoille jotka keskittyvät videopelien käyttöliittymiin ja pelien kehittäjille.

Avainsanat: käyttöliittymä, käyttäjäkokemus, immersio, diegesis, videopelit, ensimmäisen persoonan ammuntapeli, FPS

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1 INTRODUCTION

Over the years, video games have evolved into a commonly accepted and immensely popular form of entertainment. Worldwide, the video game industry is a multi-billion-dollar business, rivalling the size of movie and music industries in revenue (Isbister, 2016). In a report by Entertainment Software Association (2016) 48% of American households were shown to own a video game console, and 65% of American households had a device upon which to play video games. In Finland the industry is experiencing steady growth after a start-up boom from 2011 to 2015 (Neogames Finland Association, 2017). There are dozens of different types of video games, each offering different experiences, from puzzle and adventure to shooters and strategy.

Video games have the power to deeply engage people in an experience they have no other way of obtaining. This occurs through acting in the place of a virtual character in a variety of extraordinary scenarios often unachievable in real life settings. This can result in players losing track of time during gameplay, and even foregoing basic needs such as eating. This experience has been referred to as immersion, or being immersed in the game (Huhtala, Isokoski & Ovaska, 2012; Jennett et al., 2008). The different elements that create a gameplay experience making video games enjoyable or satisfying to play have been studied extensively since the 1990s. Some of these elements include the feeling of being in control (Brockmyer et al., 2009), sense of immersion (Brown & Cairns 2004; Jennett et al., 2008), a sufficient amount of challenge (Cox, Cairns, Shah & Carroll, 2012; Desurvire & Wiberg, 2009), and social interactions (Hung, Chou & Ding, 2012). However, there has only been a relatively small amount of publicly available academic empirical studies concentrating specifically on how different user interfaces of video games affect the immersion a player feels during gameplay, and further empirical research is still needed (Iacovides, Cox, Kennedy, Cairns & Jennett, 2015; Peacocke, Teather, Carette & MacKenzie, 2015).

Video game user interfaces are constantly in flux, as new types of games are developed on different platforms. Existing interfaces are iteratively improved, and different devices utilising touch screens or motion controls that use alternative modes of input are created and introduced. More recently virtual reality headsets, and games created specifically for them have emerged on the market, with the backing of large companies such as Facebook and Valve. One of the most popular video game genres the past decade is the first-person shooter, with multiple highly selling franchises. Games played from this first-person perspective have been argued to be most immersive (Cairns, Cox & Imrad Nordin, 2014; Ermi & Mäyrä, 2005).

This master's thesis aims to further develop and increase the understanding of how user interfaces affect player immersion in video games. It more specifically attempts to further clarify and add to existing knowledge of how it can be affected by different types of in-game user interfaces. From cognitive science and human-computer interaction standpoints it is valuable to increase understanding regarding which aspects of the user interfaces in video games cause a player to experience a heightened sense of immersion. A reliable tool for measuring immersion could be used by developers to focus on how to improve the design of their games (Huhtala et al., 2012). This could also have benefits in other areas outside of video games as well, such as in the creation of more engaging educational software (Brown & Cairns, 2004).

To find answers, existing literature was reviewed, and an empirical study was conducted in order to discover how players reported immersiveness while using a diegetic and non-diegetic user interface in the same game. Two versions of the video game *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) were used to test the experiences by exposing one test group with standard visible user interface elements (non-diegetic) and a second group without any of these elements (diegetic). Immediately following the gameplay test the participants filled in a questionnaire designed to measure immersiveness. The results of the two groups were compared to each other, along with video recordings of the gameplay. No statistical significance was found between players playing diegetic and non-diegetic versions of the game through the quantitative data. Qualitative questions indicated varying preferences among players towards different types of interfaces and their elements. Participants' difficulties with controls are thought to have had a major negative impact on the immersiveness of the used video game.

Section 2 contains a literature review of existing research on immersion in video games, how this has been measured, and what other immersion related constructs exist. In section 3, different types of video game user interfaces are explored and explained in detail through a literature review to gain an understanding of how they can affect the gameplay. Section 4 describes the experiment and the methods of data collection and analysis. In section 5, the results of the collected data are analysed and presented. Section 6 contains discussion of the results, how they relate to the hypotheses and what they could mean. Finally, section 7 contains the concluding statements and recommendations for future research.

2 IMMERSION AND RELATED CONCEPTS

This thesis does not attempt to define the sense of immersion in a universal way, but rather explain and compare different existing definitions of the phenomenon in order to better understand what aspects of the gameplay experience support the achievement of this state. In this section research is explored which both try to define immersion, and give reasons for the sense of immersion emerging during gameplay. Other cognitive and experience related terms used in the context of video games are also discussed, and their relationship to immersion explored.

2.1 Immersion

The term immersion is commonly and colloquially used in the context of video games by game reviewers as well as players themselves to describe a state or experience during gameplay (Brown & Cairns, 2004). It is considered one aspect or quality of a good gaming experience (Cairns et al., 2014; Cox et al., 2012). However, the term has often been used quite loosely and has been explained briefly by players as a sense or feeling of being "in the game" (Cairns et al., 2014, p. 2; Jennett et al. 2008, p. 641). It is important to provide a clearer definition for exactly what immersion is. This will allow a better understanding of how it affects the overall gameplay experience, and how this state can be achieved. Even though the term is widely used, it has often been left completely undefined, making it unclear regarding what it is referring to, and has further been used as an empty buzzword by the video game industry in a marketing context (Ermi & Mäyrä, 2005; Fagerholt & Lorentzon, 2009).

In ludology (the study of games) several different definitions exist in relation to of what immersion is, and no universal definition has yet been accepted. In the video game context, Brown and Cairns (2004) first defined immersion as having three distinct levels through which immersion may be experienced. They described these levels of obtainable immersion in the order from least to most immersed as (1) engagement, (2) engrossment, and (3) total immersion. Brown and Cairns (2004) define being engaged as simply picking up the game and playing it, and having enough interest to do so. The following level of engrossment happens when the visuals, tasks and the plot in the game deepen the sense of immersion, and an emotional investment towards the game by the player increases. At the highest level of immersion, the player ignores outside impulses and feel cognitively that they were "in the game". However, Cairns et al. (2014) later clarify that this is not to mean that a player believes that they are spatially or socially located inside the game itself, but rather that they undergo a cognitive state of being highly concentrated in what they are experiencing. Cairns et al. (2014) also criticise some of the wording used by Brown and Cairns (2004), stating that the sense of presence does not correspond to immersion, which they also tested and found support for their hypothesis. Presence should therefore be thought of as a related, but a separate entity. Presence will be discussed in more detail later.

In addition to the depth or level of immersion experienced, the concept is at times also divided into dimensions or subcategories of immersion. This is the case with Ermi and Mäyrä (2005), who divide immersion into three dimensions of sensory, challenge-based and imaginative immersion, which they call the SCI-model. The sensory immersion refers to the audio-visual side, of how impressively the gameplay is presented, how large the screen being used is, and other similar sensory factors. They state challenge-based immersion emerges when a balance of challenges in the game and abilities of the player is achieved. Finally, the imaginative immersion deals with the game having elements that make the game character or world easy to identify with. Using their model Ermi and Mäyrä (2005) discovered that their test subjects found the game *Half-Life 2* (Valve Corporation, 2004), a first-person shooter (FPS), ranked the highest in all three of these dimensions amongst a total of 13 different games. However, it should be noted that *Half-Life 2* (Valve Corporation, 2004) was released one year before the study was made, and as such the standards regarding what could be considered immersive to the senses of players and gameplay-wise may have changed since that time. Ermi and Mäyrä (2005) themselves argue that a large difference in the sensory immersion between *Half-Life 2* (Valve Corporation, 2004) and an older game was found due to the graphical representation of the game.

What immersion is defined as also depends on the technologies that are being used. In the context of virtual environments or virtual reality, immersion has been associated with the technological aspects of the experience, such as how well the virtual reality headset restricts the user's visibility of the outside world, and how high a definition the screen has (Slater & Wilbur, 1997). As video games using virtual reality headsets now exist as consumer products the definition and understanding of what immersion is may be further complicated. It is therefore important to note that immersion could on the one hand be considered as a feeling and/or quality of experience, and on the other, as a purely technical aspect.

One of the more popular methods to divide the definition of immersion into categories is by Jennett et al. (2008), who broadly define immersion as a state where awareness of time and real world become diminished, and the player gains a sense of being involved in the virtual task environment. They assign immersion in video games five different components: Cognitive involvement, emotional involvement, real world dissociation, challenge, and control. Their definitions imply that while immersed a player should feel highly focused, interested in seeing how the game progresses, become less aware of their physical surroundings, for the game to have an optimal amount of difficulty, and to be so intuitive to control for the player to lose awareness of using a controller. These different components and concepts of immersion by Brown and Cairns (2004), Ermi and Mäyrä (2005) and Jennett et al. (2008) are discussed further below.

The way in which each person views immersion can vary considerably. Cairns et al. (2014) note that since immersion is a concept that is very subjective, a player may report feeling a high level of immersion simply because they had a good time while playing, rather than having experienced time passing faster, for example. Because of this it is important to separately measure the different elements that comprise immersion as defined by the researcher. In this way the understanding of immersion is consistent between both researcher and player.

Like movies and novels, the story elements contained within video games have been found to enhance the feeling of immersion in playtesting scenarios, as it gives motivation and context to the world that the player experiences (Desurvire & Wiberg, 2009; Ermi & Mäyrä, 2005). Sparking the imagination of the player therefore, can play a large part in providing an immersive experience. Related to story elements, Sánchez, Zea and Gutiérrez (2009) believe that one reason for the sense of immersion to occur is for the game to have socio-cultural proximity to the player. Ermi and Mäyrä (2005) also found indications that the characters and story in a video game gave more possibilities for players to identify with the events of the game, further enabling player immersion through their use of imagination. This is evident, as video games have often a specific target audience, such as younger men, and contain elements which are commonly popular within that target group. However, it should be noted that stories in many games take place in a variety of cultures, different times in history, and even fantasy worlds, but this does not seem to affect their popularity.

An often-discussed and emphasized aspect of video games is their graphical fidelity. Video games are constantly developed to appear more and more realistic, reflecting the advance in latest graphical processing technologies. However, a realistic representation of the game world is not strongly thought of as a necessity for the sense of immersion to emerge. There is evidence which suggests that games must instead have a consistent logic and react to the players' actions in a way that they would expect for an immersive experience (McMahan, 2003). Sánchez, Vela, Simarro, and Padilla-Zea (2012) believe that realism does have a direct influence on how immersive the game is considered, but still define it as not being tied to photorealism of the graphics, but rather the events of the game having to be believable for the player. In a more extreme view of this, Swink (2009) states that if the game world is not consistent in the same way we interact with the real world the sense of immersion can be broken. On the other hand, Ermi and Mäyrä (2005) argue that graphics have an important role in the creation of immersion, but that the preference of the graphical style may lean towards more cartoonish for some, which would imply that realism is not necessarily the most important aspect of the graphical quality. Cairns et al. (2014) found that there was no difference between the immersiveness of games that were two or three-dimensional, and suggest that this is due to players putting more emphasis on how the game plays than how it looks.

How an immersive experience in a game can affect the player afterward has also been a topic of some research. Immersion experienced by the player during a game can be a very powerful feeling, and may even affect the way a player can solve problems in the real world after being immersed in a virtual world. Jennett et al. (2008) noted that participants of their study who experienced higher amounts of immersion during gameplay found it more difficult to complete an unrelated task outside the game than those who did not experience immersion. There has been extensive amount of research into whether video games could have links to increased aggression or aggressive behaviour, which has been a topic of research in the past twenty years (Anderson et al., 2010; Sherry, 2001). Another negative effect may be contribution towards video game addiction. High event frequency may have a link to immersion, which could be considered an effect which can have negative consequences for people with addictive personalities (King, Delfabbro & Griffiths, 2009). This study will not consider the negative impacts of immersive experiences, but it is still an interesting observation to make, and may be worth noting in future studies of immersion.

Even seemingly minute aspects of gameplay can have an impact on the immersion a player feels. Giving too much explicit information to a player has also been observed to have a negative effect on the overall experience, if it means reducing the amount of self-reasoning a player needs to make to a significantly low a level (Fagerholt & Lorentzon, 2009). As an example, if the game explicitly informs the player where an enemy is located on a map, when the player would prefer it to be a mystery, the sense of exploration is broken and makes the experience boring, thus lessening the sense of immersion. More aspects of how user interfaces can affect the experience and their effects on immersion are discussed in section 3.

Several researchers believe challenge has a major role in immersion (Cox et al., 2012; Jennett et al., 2008; Ermi & Mäyrä, 2005). Cox et al. (2012) found evidence to show that expertise level of the player influences the amount of immersion a player experiences at different difficulty levels. They compared this balance of difficulty and expertise to the concept of flow, which is described in more detail further on. The SCI-model of Ermi and Mäyrä (2005) took challenge-based immersion as its own aspect of immersion, the aim of which was to balance the amount of challenge of the game and abilities of the player for the best effect. They noted that these challenges could be related to many different aspects of the game, like problem solving or motor skill based challenges.

Many video games can be played competitively or co-operatively, and the presence of and interactions with another person can enhance the positive feelings, or even cause negative ones. This social aspect can have a major impact on how a video game is experienced. The sharing of success or disappointment, losing or winning against an opponent will affect how a player feels about the experience afterwards, even if during the game they had fun and felt immersed in the experience. Ermi and Mäyrä (2005) use an example where a player achieves something within a game and feels the experience was fun, only to discover their friend achieved a better result and this experience instead turns into a feeling of wasted time. In cooperative games the presence of another player may also influence the experience by making it easier, which would affect the challenge that has been seen to have a role in immersion as well as discussed earlier. Indications have been found that playing together can make games more fun, but less immersive (Cairns et al., 2014). This would make sense, as the second player is someone who exists outside the game itself, and therefore the player would not consider them a part of the game or its world.

There are many other elements within a game that can also affect immersion negatively, which could be considered immersion breaking. Fourth wall, a term which is sometimes used in this context, refers to an imaginary boundary between the audience and the fiction taking place in front of them. This wall can be broken by a character in a play addressing a member of the audience, for example. In a video game this can happen by referring to the game elements through different means, such as a game character explaining game mechanics like saving the game or telling the player to "press R2 to shoot". These types of elements can be considered as affecting immersion in a negative way (Fagerholt & Lorentzon, 2009). These events directly refer to something physical that happens and exists outside the game world itself, which can lead to the player's focus shifting from the virtual environment to outside the game, thus breaking the immersion.

One important aspect of being immersed is considered to be the loss of awareness of passing time (Brown & Cairns, 2004; Jennett et al., 2008). Players are often seen saying how a game made them stay up until early hours of the morning without even realizing. Rau, Peng and Yang (2006) tested the perception of time by both expert and novice online game players, finding that novice players who had to learn the game felt time pass slower than those who were more experienced. This would indicate that a more experienced player can achieve a deeper level of immersion than new players, and as such the expertise level of players should be taken into consideration in the empirical research of video game related immersion.

As discussed above, immersion is complex, hard to define universally, and can comprise of several different elements, depending on the definition being used by the researcher. One way to better understand immersion is to measure the players' experiences (Iacovides et al. 2015; Huhtala et al., 2012;). Questionnaires have been used to measure the amount of immersion a player feels during gameplay. A varying set of conditions have been used to gain a measurement of immersion, for example Jennett et al. (2008) used a set of factors related to the person playing and ones relating to the game, which included emotional involvement, cognitive involvement, real world dissociation, challenge, and control.

Although this thesis concentrates on immersion in video games, it is not thought to be a cognitive experience only related to video games. Immersion is also experienced in activities such as watching a movie or reading a book, but these experiences will naturally lack the interactive elements of a video game, and instead follow a script (Cairns et al., 2014). The interactivity of video games makes immersion a separate concept from the ones in other mediums of entertainment (Ermi & Mäyrä, 2005). The different aspects of what are considered a part of immersive experience discussed here are only some of the many that exist. There is no universal definition of immersion. It is important to consider the different viewpoints and create a definition that can give more direction towards a universal definition.

2.2 Other related concepts

In addition to immersion there are several other terms and concepts within ludological research. Many of these have a close relation to the sense or concept of immersion, or have been researched in relation to it. They are briefly discussed here to clarify the distinctions and relations between these concepts.

2.2.1 Presence

Presence is a concept that is mentioned in most research articles concerning video game immersion. The sense of presence and immersion have in some cases been used synonymously with one another in research, but generally they are recognized as two separate entities. Brown and Cairns (2004) originally stated that the highest level of immersion is equal to presence, but later on Cairns et al. (2014) corrected that this was not the case. This confusion is understandable, as presence and immersion are closely related concepts. According to both Jennett et al. (2008) and Iacovides et al. (2015) one does not need to be immersed, or feel immersion, to experience a sense of presence in a virtual world. They state that a user doing a tedious task inside a simulation can still feel presence without being immersed in the experience. A video game can also feel immersive even when not eliciting a sense of presence, but may only be at its most immersive when sense of presence is also created (Jennett et al., 2008; Iacovides et al., 2015).

The concept of presence in relation to technology originates from virtual reality. Virtual reality related research most commonly attempts to measure the level of presence, or the sense of "being there" that a person feels while they are experiencing a virtual environment to gauge the effectiveness of the overall experience (Schuemie, Van Der Straaten, Krijn & Van Der Mast, 2001; Jennett et al., 2008). In a virtual reality related study by Bystrom, Barfield and Hendrix (1999) presence is described as a state of consciousness where the user achieves a psychological sense of being in a virtual environment. This is in contrast to their definition of immersion; a quantifiable measurement of the technology being used to create the virtual environment. This more technology related definition of immersion is commonplace in virtual reality related research, and considerably differs from those used in video game research.

Before the use of immersion as a concept in ludology the sense of presence was studied in a similar manner as with virtual reality. Ravaja et al. (2004) consider presence being the sense of having a mediated environment feel nonmediated. Their research found that a first-person shooter game elicited the highest feeling of presence from the test group in comparison to other types of games, such as puzzle and platformer. This makes sense, as the events of first-person games take place through the eyes of a virtual avatar, which is the standard with virtual reality. As presence is closely related to immersion, and can be arguably considered a part of it, it makes sense to use video games from the first-person perspective to experience highest amounts of immersion. As mentioned earlier, Ermi and Mäyrä (2005) also found a first-person shooter game the most immersive amongst several different types of games. Conversely Cairns et al. (2014) found no difference in the amount of immersion between two and three-dimensional games, although they themselves mentioned having difficulties manipulating factors influencing immersion.

In summary, presence appears to have a positive impact on immersion, which is more commonly experienced within first-person shooter games. Therefore, when attempting to measure immersion it is logical to use games from the first-person perspective to have the possibility of eliciting the highest amount of immersion.

2.2.2 Flow

A great amount of studies into video game related immersion refer to Mihaly Csikszentmihalyi's (1990) theory of flow. His theory defines flow as a state of being where a person is most satisfied with what they are experiencing, requiring a high amount of concentration combined with an appropriate amount of challenge and skill required for the task (Csikszentmihalyi, 1990). Since video games require both the skills and concentration to play them, and pose a challenge for the players to overcome this can be viewed as highly relevant in the medium. This balance of challenge and player skill has been noted to be important in various heuristic evaluations of video games (Desurvire & Wiberg, 2009; Ermi & Mäyrä, 2005; Hung et al. 2012). A person who is experiencing flow is said to experience time passing faster, or not be conscious about its passage, and even certain physical needs such as hunger can go ignored (Csikszentmihalyi, 1990). This and many elements of what are thought to create the sensation of immersion have similarities to flow. Sánchez et al (2012) actually define a game to have high level of immersion when there is a balance between challenge and capabilities of the player to surpass them. Their given definition directly correlates with Csikszentmihalyi's definition of flow, but considerably differs to ones discussed earlier on.

To experience flow while playing a video game a player may need to understand how the game is played beforehand. Rau et al. (2006) found that players who were more experienced with the game *Diablo 2* (Blizzard North, 2000) felt time passing quicker than novice players, although both experienced it to some extent. It can be extrapolated that a player who does not have a sufficient amount of experience will find the controls of the game more difficult to manage, and therefore not have as great an experience that would cause flow to be experienced. To support this, Rau et al. (2006) also found that novices experienced enjoyment and flow later into the experience than experts, taking up significantly more time than expert players to reach this point.

Isbister (2016) wrote that game designers are consciously wanting to generate flow in players, and that players descriptions of a good and bad experience use terms which are related to flow. These feelings were curiosity and excitement (positive) and frustration and confusion (negative). The feelings of anxiety and frustration are counter to what the state of flow is, and therefore causing these to be felt should be avoided (Brockmyer et al., 2009). While playing video games a player may experience these two feelings in many ways. For example, if a player must repeat the same task or section over and over due to too high a difficulty level or poor game design they may become frustrated, which prevents the state of flow from being achieved. In recent years video games have generally moved away from punishing the player extensively for failure, and increasing the number of checkpoints from where a player can continue their game in case they fail at a challenge, or removing certain challenge elements such as extra lives completely. These kinds of punishments can however also be desirable by some players, as they can create a sense of risk of losing something, such as progress, and increase challenge (Schell, 2008). Figure 1 by Chen (2007 p.32) below illustrates how challenge and abilities are supposed to be balanced for the optimal experience of flow, and to avoid boredom and anxiety caused by too high challenge or low abilities.

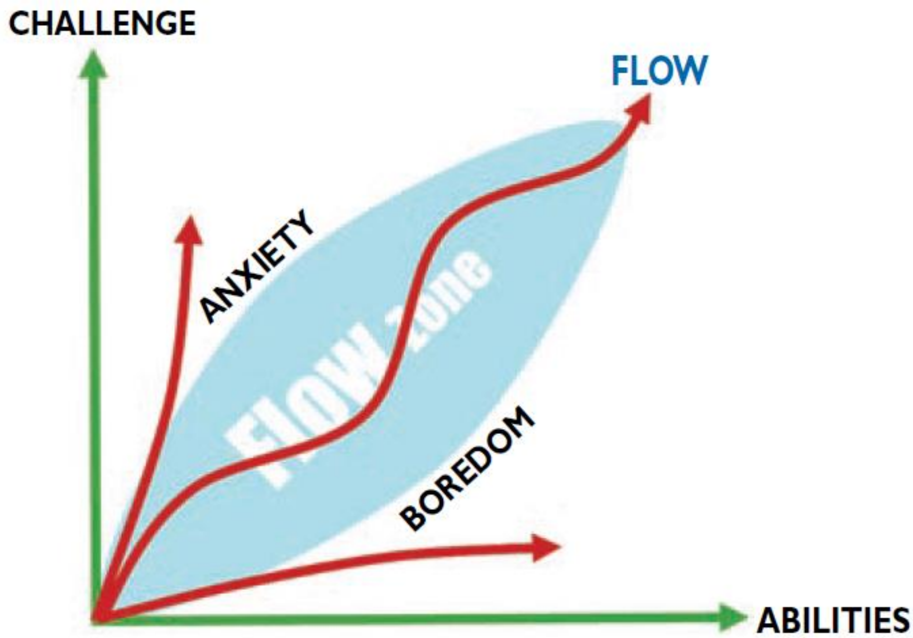

FIGURE 1: Illustration of Flow (Chen, 2007, p. 32)

Cowley, Charles, Black, and Hickey (2008) used the flow theory to develop a better understanding of how players interact with games, and to find mechanisms for making games more adaptable for individual players to help them achieve the state of flow. They found that the eight different elements of flow as described by Csikszentmihalyi (1990) were all found to be manifested in video games.

Just like presence, it is possible that flow can be more strongly experienced during certain types of games. Hung et al. (2012) used flow as part of their framework for the study of mobile game satisfaction, which combined the psychological flow measurements with more tangibly related usability metrics. Their findings indicated that certain genres of video games may cause a player to experience more flow than others, and that by improving the game in different areas would enhance the likelihood of flow being experienced. Interestingly Hung et al. (2012) counted immersion as being a contributing factor towards flow, including the time distortion, ignorance of surroundings and emotional responses that a game may cause. Since the concepts of flow and immersion are closely related, it has also been argued that flow is similar to the highest level of immersion achievable, which Brown and Cairns (2004) call being in a state of total immersion.

In comparing descriptions of flow and immersion there are many similarities, as well as significant differences. Brown and Cairns (2004) note, that flow has strong similarities to immersion, specifically the loss of sense of time and self, and presence of challenge which requires a highly concentrated state of mind. Jennett et al. (2008) consider flow something that can happen when a player is extremely immersed to the point they may forget where they are or what they should be doing, such as getting a bus in time. On the other hand, Swink (2009) considers that when a person states they are immersed in a game, flow is only a part of what they are feeling. Jennett et al. (2008) found indications that flow differs from immersion in one significant way; immersion as a state can be charged with more varied emotions, including negative ones, whereas flow is more akin to a state of serenity. Brockmyer et al. (2009) even consider flow creating an altered state of consciousness, and immersion as not having this same quality.

Flow is by itself a topic of research, and many studies have only concentrated on the relationship between flow and games (Chen, 2007; Cowley et al., 2008). However, when researching immersion in video games, the relation of flow must be considered either as a part of immersion or at least a closely related state. In the context of this thesis flow is understood as a state which can be achieved when immersion is at its strongest.

2.2.3 Cognitive load

Playing a video game, like most activities, requires a certain amount of mental effort to be learned. This capacity to concentrate taken can be said to be the required cognitive load of the game. Sweller (1994) defined cognitive load as the amount of strain being put on the working memory of an individual to attain and learn new knowledge. Cognitive load has a high similarity to concentration, which is requirement for immersion to take place. The cognitive load theory posits that cognitive load is reduced as a person learns and develops their own cognitive schemata towards a complex task with many elements, and therefore from novice into an expert (Ke, 2008). By using working memory, the new concept is made into a schema by combining multiple elements into one, which helps make sense of problems (Sweller, 1994). Players should therefore be familiar with the way a game plays to be able to immerse themselves into the experience.

Presenting a player with a lot of information on screen is a possible element that may put off new players (Fagerholt & Lorentzon, 2009). In some video games most of the screen can be covered in different graphs, icons and numbers that need to be understood, which creates an intimidating first impression for new players. This could explain why Rau et al. (2006) found novices took longer to experience flow, as explained earlier. Peacocke et al. (2015) also found indications that having the amount of ammunition visible constantly in a first-person shooter game reduced the amount cognitive functions required by the game, as the player had to do less thinking to discern the amount of ammunition remaining. When used this way additional information may also reduce the cognitive load of a player. A high difficulty level in games has also been observed to require a higher amount of cognitive resources (Ravaja et al., 2004). Cognitive load can therefore be said to be influenced by challenge and concentration, which both correspond to immersion (Jennett et al., 2008).

FIGURE 2: World of Warcraft standard UI with many visual elements

Above is the standard user interface of the massively multiplayer online role-playing game (MMORPG) *World of Warcraft* (Blizzard Entertainment, 2004). This is a good example of a video game which shows a large amount of different icons and other complex information relating to the gameplay which must be parsed by the player in order to play the game most effectively, thus requiring more attention and therefore having a high cognitive load. For players who have the motivation to learn the game may become very immersive, but for those just starting it can act as a barrier to immersion.

In summary, cognitive load theory partially explains why a player can find a video game fun, as a proper amount of challenge adds to the amount of immersion a player can experience. Too much strain on the cognitive resources, especially at the start of the game, can however result in frustration and confusion, which work counter to both the desired immersion and flow.

2.3 Immersion in the context of this thesis

For the purposes of this master's thesis the term immersion will be defined as a combination of the player feeling a higher focus towards the game world than their physical environment, feeling emotionally connected to what is happening in the game, experiencing an optimal level of difficulty, enjoying the experience, and having the controls feel natural to the point they do not have to think about them. These are the measures used by Jennett et al. (2008) for their Immersive Experience Questionnaire (IEQ), which is utilized in the data collection. Flow is experienced at the highest levels of immersion, when the difficulty and abilities of players are optimally balanced. The characteristics given and measured by Jennett et al. (2008) in their Immersive Experience Questionnaire are basic attention, temporal dissociation, transportation, challenge, emotional involvement, and enjoyment. The factors used in the IEQ were influenced by previous research on flow, presence, cognitive absorption and the grounded theory of immersion by Brown and Cairns (2004).

3 VIDEO GAME USER INTERFACES

In this section, a variety of video game user interface types are explored and explained to give a better understanding of how they operate, how information is displayed visually within games, and how that information or lack thereof could affect the immersion of the player. As the user interfaces affect how the player interacts with the game, this can have an impact on the level of immersion a player experiences, which has also been acknowledged by video game designers (Iacovides et al., 2015).

Video game user interfaces can vary significantly depending on the type of game (also referred to as the genre) and the platform the game is created for. Games which use a touch screen, such as those on smart phones, will need to be optimised to use fingers as direct control inputs on a display, whereas motion controlled games generally require the player to move their body or limbs in some way to control what happens in the game. In this study the focus will be on first-person shooter video games controlled via a gamepad (or controller), and therefore other types of games and their interfaces will be discussed and explained only briefly.

The amount of information given to a player by the interface has been observed to affect their agency in a video game. Cowley et al. (2008) use the example of fog of war as part of the interface in real-time strategy video games. Fog of war is commonly used in real-time strategy games, so the player does not to see parts of the map where they have no influence (or units), thus encouraging exploration and expansion. The presence of fog of war makes the reaching of the goal more challenging as the enemy is not visible, and is theorized to increase the agency of the player (Cowley et al., 2008). Many small design choices such as this can have significant effects on the overall experience of the player. Similarly, in first-person shooters a player does not necessarily know where enemies are located, unless there is a visible map that makes their location known. As a player gains more experience and becomes accustomed to playing a certain type of game they may begin to feel that they require less explicit information, and may consider the experience to be better without certain user interface elements (Iacovides et al., 2015). This is one of the areas this thesis attempts to find answers to.

3.1 Diegesis in video games

Diegesis is a term which has been traditionally used to describe a style of narrative storytelling in films and literature. However, in recent years it has also gained meaning in video game user interface design to describe two different types of user interfaces, the diegetic and non-diegetic (Fagerholt & Lorentzon, 2009; Huhtala et al., 2012; Iacovides et al., 2015). The closest analogy to diegetic elements in video games comes from films. When an element of storytelling in a film is not seen, heard, or addressed by a character in the fiction it is considered non-diegetic. An example of this is music which plays during an action scene, where it exists only to create atmosphere for the viewers (Iacovides et al., 2015). A voiced narrator is also a non-diegetic element, which exists to make the narrative clearer for the viewer. On the other hand, when a character in a film plays a vinyl record, the music is considered to be a diegetic element of the story, since the character in the fiction is experiencing it along with the audience. In the same manner, a game may have music playing as part of the ambient soundtrack, or a character in the game can press play on a virtual music player and characters in the game may react to the music in the game world. The user interfaces of video games can also be considered diegetic or non-diegetic (Iacovides et al., 2015; Fagerholt & Lorentzon, 2009; Peacocke et al., 2015). If a character in a game looks at a wrist watch informing the player of the in-game time, it is considered diegetic information. On the other hand, if the time is displayed constantly in the corner of the screen, it can be seen as only informing the player and not be a part of the storytelling. This makes it non-diegetic.

There is a need for further clarity on how the diegetic and non-diegetic elements of game interfaces affect the player experience, and especially immersion during gameplay. There is evidence to indicate that user interface types can have an impact on the way a player fundamentally plays a game (Iacovides et al., 2015; Peacocke et al., 2015). Peacocke et al. (2015) found indications that if the player is not aware on how many bullets are left in the clip of a gun due to a constant on-screen indicator they may wish to use them more sparingly. This kind of change in information given to the player can affect the difficulty and therefore alter the experience of the game considerably. To find what is the optimal amount of information to pass onto the player for the best possible experience to be had is therefore one of the important goals in game design. These decisions of user interface design may affect the player's amount of immersion as well.

3.1.1 Non-diegetic user interface

The non-diegetic user interfaces in video games are more commonplace than diegetic (Fagerholt & Lorentzon, 2009). Games using non-diegetic interfaces contain user interface elements which are only acknowledged by the player, and exist to serve their needs rather than having a narrative purpose. Non-diegetic user interfaces are also often referred to as heads-up display, or HUD for short (Peacocke et al., 2015). This term is commonly used in first-person video games to describe the visible user interface elements on screen, usually located in the corners, where the player may look to gain additional information of the gameplay state. The HUD is used in most FPS games to display information that relates to the player character's state, such as health, items, and goals (Fagerholt & Lorentzon, 2009). In the context of films, subtitling is considered a non-diegetic element, as they act as an overlay to the movie by giving viewer information on what is being said, but exist outside the film and its fiction itself (Fagerholt & Lorentzon, 2009). Most video games with dialogue also include options for subtitles, which adds another non-diegetic element. It could be said that certain types of video games may essentially require the presence of a non-diegetic user interface to function. Strategy games need to display a variety of information about the state of battle to the player, sometimes in ways that may seem in appearance more like a graphical operating system user-interface than a video game. In first-person shooters information can usually however be integrated into the game world itself, thereby making it diegetic.

Iacovides et al. (2015) found indications that removing non-diegetic user interface elements influenced players' sense of immersion by increasing their sense of control and involvement in the game world. In addition, they claim that the realism of the FPS game may have increased due to removal of non-diegetic elements, although they did not define what exactly they mean by realism (Iacovides et al., 2015).

FIGURE 3: Deus Ex: Mankind Divided (Eidos Montréal, 2016) with non-diegetic UI

In the figure 3 above the video game *Deus Ex: Mankind Divided (*Eidos Montréal, 2016*)* is shown with the default user interface elements on, displaying the non-diegetic nature of the HUD in its default state. The top-right of the screen shows a radar displaying enemies as well as other non-player characters (NPCs) on a map for tactical and location assist purposes. The bottom-right panel displays health status of the player character and an ammo indicator to convey to the player their strength and capabilities to take part in a fight. The bottom-left corner displays character skills and a related energy bar, which are used to gain additional information or benefits, such as being able to see the enemies through walls. These elements give the player information that can make achieving goals significantly easier, but also to avoid frustration, which again has a negative effect to flow and immersion.

3.1.2 Diegetic user interface

The diegetic user interface is characterized by lack of any visible user interface elements or HUD on the screen (Peacocke et al., 2015). In some cases, the information which would otherwise be located on screen in form of a HUD is somehow integrated into the game world itself. This can be achieved by having a weapon which itself has a screen indicating the number of bullets left, a physical in-game map that the player character pulls out, tracking health state through amount of bruising or cuts on the player character, or by listening to the way they breathe.

There are indications that diegetic user interfaces increase the sense of immersion, and certain players have a preference towards them over non-diegetic user interfaces (Peacocke et al., 2015; Iacovides et al., 2015). However, there is still a need to understand why this is, and if the results would differ considerably between different types of video games, or even different video games of the same genre. The video game used in the experiment of this study is a first-person shooter, but it differs from ones used earlier in some considerable ways, which are explained later.

Previous empirical research has also indicated that players who classed themselves as experts benefitted somewhat from the removal of the HUD, whereas for novices it did not impact the experience in any noteworthy amount (Iacovides et al., 2015). In an experiment by Peacocke et al. (2015) the majority of participating players were found to prefer an ammo display that is shown in a diegetic manner on the weapon. Players found this more immersive and helpful than other tested ammo display methods, however no other types of UI elements such as those related to health status were tested.

FIGURE 4: Deus Ex: Mankind Divided (Eidos Montréal, 2016) with diegetic UI

Figure 4 above shows the game *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) with all user interface elements (or HUD) turned off. Playing this way, the player must base all of their understanding of what is happening within the game on what the character sees and hears, with no assisting information coming from visible interface elements.

However, in the case of a science fiction game such as *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) it could be argued that the visible user interface elements could be considered diegetic, as the main character is an augmented human who uses implants that enable him to see additional information about his surroundings. In a section of the game the main character must fix their implants to return the ability to see the non-diegetic user interface elements. Similarly, if the player uses a rifle with a crosshair it can be argued that the crosshair is diegetic, as the gun and its attached crosshair exist within the game world (Iacovides et al., 2015).

The third-person action role-playing video game *Nier: Automata* (PlatinumGames Inc., 2017) has also integrated the non-diegetic visual user interface into the story, making the usually non-diegetic elements arguably a part of the game world, and therefore diegetic. The player character is an android which can insert new computer chips into themselves which allow for new information about the game world and status to be seen in the form of HUD elements. Although one could say that a game from a third person perspective (outside the eyes of the player character) such as that in *Nier: Automata* (PlatinumGames Inc., 2017) are non-diegetic by default.

Perhaps a more interesting example of this is in the game *Dead Space* (EA Redwood Shores, 2008), where the HUD user interface exists in the game world itself as technology utilizing holograms perceivable by the characters within the game (Fagerholt & Lorentzon, 2009). This way the story of the game justifies the in-game use of HUD elements, making it harder to define whether the HUD could be considered a distracting non-diegetic element which could pull the player out of the immersive experience. It could even be argued that the user interface immerses the player more, as it provides information which requires more from the players' cognitive functions whilst providing an explanation of the interface existing within the game world.

3.1.3 Adaptive user interfaces

In recent years some video games have begun to use both diegetic and non-diegetic interfaces in unison, or in other words fluidly switching between the two. A video game may use an UI where no visible user interface elements appear on screen, being diegetic until a need for the information provided by them in the game arises.

This is the case with the third-person action adventure game *Horizon Zero Dawn* (Guerrilla Games, 2017), which contains no visible user interface until a combat scenario begins, and only then information about elements such as ammo and health become visible on the screen. The game itself refers to these as dynamic HUD elements. Certain parts of the gameplay could therefore be considered diegetic in nature, whilst others non-diegetic.

Iacovides et al. (2015) postulated that by having a visible HUD towards the beginning of the game may be useful to learn the game mechanics, but as the player becomes more accustomed to playing the game these visible elements can cause a distraction as they are no longer required. This could be a possible avenue for future research, to discover whether dropping amount of non-diegetic elements as the player reaches a certain degree of familiarity with the game would be beneficial for player immersion or engagement.

3.2 Control method

There are multiple related factors that can influence how a video game is experienced other than the user interface. A significant one to consider is how the game is controlled. Controls of a video game may differ considerably depending on the type of controller or the platform, and therefore people who have used to certain kind of controls may find adjusting to another difficult (Gerling, Klauser & Niesenhaus, 2011). User interfaces of video games should not be discussed without also acknowledging the physical interface used by the player to control the game, as one or both may have deficiencies which affect the other. The control method in the context of this thesis refers to the type of controller being used to interact with the game.

How natural a player considers the controller being has been found to positively affect both their enjoyment and presence (Skalski, Tamborini, Shelton, Buncher & Lindmark, 2011). There is also evidence to show that for the player to be able to get immersed with a video game they must have enough experience to become familiar on how the game controls to the point that they feel invisible to the player (Brown & Cairns, 2004). In a similar way Swink (2009) states that if a game has been designed well, the player will not notice the feel of the game, but it just feels right. The controls are designed by game developers, and therefore the responsibility lies on them to create control methods that feel intuitive and effortless for the player for the sense of immersion to occur.

Games of the same genre tend to use similar control schemes, or where the buttons are located for similar actions. Below is a comparison of controls on two popular competing first-person shooter games released the same year, *Call of Duty: Ghosts* (Infinity Ward, 2013) and *Battlefield 4* (EA DICE, 2013) using the Xbox One controller.

TABLE 1: Control schemes compared

	Call of Duty: Ghosts	**Battlefield 4**
Left stick	Movement	Movement
Left stick pressed	Sprint / Hold breath	Sprint
Right stick	Camera control	Camera control
Right stick pressed	Melee attack	Melee attack
A	Jump	Jump
B	Duck/crawl	Duck/crawl
X	Reload	Reload
Y	Change weapon	Change weapon
Left button	Tactical equipment	Throw grenade
Right button	Throw grenade	Spot enemies
Left trigger	Aim	Aim
Right trigger	Fire weapon	Fire weapon
D-pad	Use items	Accessory/fire mode

As can be seen when comparing the controls between the games they are mostly the same. This is to give players instant familiarity and to avoid the frustration of having to re-learn controls between different games. This lack of frustration also will enable players to become immersed in the game faster. In this study the Sony PlayStation 4 controller is used, which is similar to that of the competing Xbox One, but uses slightly different names and icons for the A, B, X and Y buttons.

The control scheme, players' familiarity with it and the controller itself therefore affect the rest of the experience. Optimally the controls should feel fluid and familiar to the point where the player does not have to specifically concentrate on them. The naturalness of controls no doubt affects many aspects of immersion, which has been considered in studies of it (Iacovides et al., 2015; Peacocke et al., 2015).

4 METHOD

This study aims to improve and add to the understanding of how user interfaces, or HUDs, affect the amount of immersion a player feels during gameplay. The two earlier chapters were a literature review on immersion, its related concepts and interface types and usability considerations. This section presents the methods used in this research, and explains why they were chosen. Based on the literature review and the results of a HUD related research by Iacovides et al. (2015) the following hypotheses were made after consideration of limitations and scope:

Hypothesis 1: First-person shooter video games with diegetic user interface elements are more difficult for the players

Hypothesis 2: First-person shooter video games with diegetic user interface elements are more enjoyable for expert players

Hypothesis 3: First-person shooter video games with diegetic user interface elements are more immersive

4.1 Experiment overview

The purpose of this study was to find out how diegetic and non-diegetic user interfaces affect player immersion. The method chosen for this was to have two randomly selected groups of players, one playing with diegetic and the other with non-diegetic user interface, and to measure their self-reported level of immersion afterwards. Every participant was only made aware of the type of user interface they were exposed to. An existing survey instrument for measuring immersion called Immersive Experience Questionnaire (IEQ) by Jennett et al. (2008) was used as the primary quantitative data collection method, as it has been shown to be valid and reliable in previous studies (Cairns et al., 2014;

Iacovides et al., 2015;). In addition, qualitative methods were used to gather data about players' preferences of user interface types. The rationale for the selection of the quantitative and qualitative methods is explored and discussed later.

4.2 Gameplay experiment

4.2.1 Selection of the video game

First, a video game had to be selected for the study. The game utilized for the study was carefully considered and selected. *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) was chosen to be used for the gameplay scenario, as it differs from video games used in previous studies in some interesting ways. Earlier research on video game user interfaces and their effects on immersion have studied games using a realistic war setting. In *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) the setting is a science fiction universe where the player character may have abilities to see and do more than regular people or soldiers. Additionally, the degree of freedom to approach obstacles and problems is vastly higher, allowing players in most cases to sneak instead of simply shooting their way forward.

An earlier study by Iacovides et al. (2015) utilized the same survey instrument by Jennett et al. (2008) called Immersive Experience Questionnaire (IEQ) with the video game *Battlefield 3* (EA DICE, 2011) to measure the differing effects on immersion between diegetic and non-diegetic interfaces. One reason for *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) being chosen was to avoid the possibility of using the exact same scenario as the previous research. Another reason was to observe if the resulting amount of immersion between the two games would be comparable to each other using the same instrument. Both games are similarly critically acclaimed, and have an average score of 88 out of 100 for *Battlefield 3* (EA DICE, 2011) and 84 out of 100 for *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) from the review aggregator site Metacritic. Naturally the preference of each individual for games will differ, and even one very negative or positive review can change the average by multiple points.

Despite both being first-person shooters the user interfaces of these two video games are considerably different in some ways. *Battlefield 3* (EA DICE, 2011) has only two non-diegetic user interface elements on screen at all times; the ammo display and a compass. This has been described as more immersive due to minimal usage of UI elements (Peacocke et al., 2015). *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) by comparison has both the ammo display and compass, and multiple additional non-diegetic UI elements. These include a radar screen, abilities-panel and an energy meter. There are also other visual UI elements in both games which appear on the screen when there are objects which the player can interact with. Based on this and considering the literature reviewed above, it could also be expected that the non-diegetic version of *Deus*

Ex: Mankind Divided (Eidos Montréal, 2016) would rate as considerably less immersive than *Battlefield 3* (EA DICE, 2011). *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) is strictly speaking not exclusively in first-person. This is due to the fact that when the game character takes cover behind an object the camera switches to that of being behind the player character. This was however, not seen as a problem, as only a very small portion of the gameplay would be seen from this angle, and some players may have even chosen not to use it.

It should also be noted that what can be considered to be diegetic in *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) is complex, as the player character is a cybernetically enhanced human. The visible user interface elements could therefore be considered by some to be diegetic, as they are what the character sees in the game. This characteristic is referenced in the early parts of the game, as the displayed UI elements "malfunction" and need to be repaired within the fiction of the game. However, the portion of the game chosen as the test scenario does not make this fact evident. This could however still affect players who have played this game before.

If a person plays the same game for long enough they could get to a level of mastery which makes the experience feel almost automated, and therefore less fun (Ermi & Mäyrä, 2005). The enjoyability of a game is also highly dependent on the preferences of the individual player, and their concept of what is good and bad gameplay develops over time as a player gains more experience (Ermi & Mäyrä, 2005). For these reasons, the players for the experiment should preferably have no prior experience of the game, but still know how a first-person shooter game is played in order to gain the most relevant knowledge of how they would experience the game for the first time. Players were therefore asked if they have played the game previously, but due to the expected low number of participants were not be turned away if they had.

4.2.2 Environment and conditions

The player immersion experiments were conducted at the user psychology lab of University of Jyväskylä. After a brief explanation of the purpose of the experiment the participants were given a consent form to sign. The ethical considerations are explained further on. Before beginning the game, each subject was given an identical instruction sheet to read. These contained the goal of the gameplay scenario as well as controls to the game. The instruction sheet can be found in appendix 8. Each participant was left after this in the room for 20 minutes to play the game, after which they filled a questionnaire.

The purpose of the experiment was not for the participants to pass the scenario, but by recording whether they succeed or fail it could be determined if being successful in the game has a connection with the sense of immersion emerging. The enjoyment people feel from playing a game has been shown not only to be because of succeeding in the game, but from challenge in the gameplay (Nacke & Lindley, 2008). Therefore, regardless of the participant having finished the goal of the gameplay scenario by the end of 20 minutes (they were marked as having not passed the task), they were still asked to fill in the questionnaire.

The first participant played the game without visible user interface elements (diegetic), and the second with all the standard user interface elements turned on (non-diegetic). This was alternated between all following participants in order to establish a sample of half the participants (one group) playing via a diegetic user interface and half (the other group) with a non-diegetic user interface. The participants were left in the room to play the game in peace, and were not observed during the experiment, as this could have made them more aware of their surroundings and therefore impacted their immersion negatively. The participants themselves were not recorded. The possible negatives of this were that participants could not ask for help if needed, or could possibly be doing something else than playing the game during the test. To avoid this the participants were told that even though they were not being observed the gameplay was recorded as a video file.

The participants could select their own preferred volume level on the television and turn the lights in the room on or off as they preferred. This was considered best practice, as the environment was intended to be as unobtrusive and relaxed as possible for the participants to immerse themselves into the experience. This was done in order to create as high ecological validity (Schmuckler, 2001) within the test environment as possible.

4.3 Questionnaire

The questionnaire dispersed after the experiment contained questions collecting both quantitative and qualitative data, therefore utilising a mixed methods concurrent triangulation approach (Creswell, 2009). The IEQ contained 31 questions to be answered on a Likert-type scale from 1 to 5. The IEQ can be found in the appendices at 5 in English and 6 in Finnish. In addition to the IEQ, four open ended questions were asked where the participants could write an answer in their own words.

An identical version of the IEQ was given to both groups – those who played the game using the fully visible interface (non-diegetic), and those who played via no visible interface elements (diegetic). However, the four additional questions differed somewhat to find answers to the players' preference of UI type. The separate questionnaires for diegetic and non-diegetic participants can be found at appendices 1 and 2. Any information gained through the qualitative open answer and game recordings would be used to support the results of the quantitative data.

Additional information requested in the questionnaire form included the age and gender of the participant, self-evaluation of skill level and time spent playing video games a week. The email address or phone number of participants was asked on a separate slip in case they wanted to take part in a raffle for a prize.

4.3.1 Quantitative (Likert-type)

The design of this experiment was based around that of Iacovides et al. (2015), who used a questionnaire by Jennett et al. (2008) to measure player involvement during diegetic and non-diegetic participants gameplay. The questionnaire used in this study is the same as that created by Jennett et al. (2008) called the IEQ. It measures immersion felt by players using 31 questions on a Likert-type scale from one to five. The answers of the IEQ are therefore meant to give statistical indications as to whether the players found the experience immersive. The questions are related to factors that together are referred to as immersion. These factors are basic attention (questions 1-4), temporal dissociation (questions 5-10), transportation (questions 11-16), challenge (questions 17-22), emotional involvement (questions 23-27) and enjoyment (questions 28-31) (Jennett et al., 2008). The themes of these questions were further divided into five constituent factors by Jennett et al. (2008) which were Cognitive Involvement, Real World Dissociation, Challenge, Emotional Involvement and Control, these themes were also utilised by Iacovides et al. (2015). Cairns et al. (2014) noted the good construct validity of the IEQ survey instrument. Huhtala et al. (2012) even suggests that a tool such as the IEQ could be useful for game developers to improve their games in areas that were lacking in immersiveness. However, Cairns et al. (2014) disagreed with the notion Huhtala et al. (2012) made about using it as a tool for quality improvement. It is hoped that this study further clarifies this situation.

The original IEQ is in English, but as a significant number of participants for this study were expected to be native Finnish speakers the questionnaire was translated (appendices 3 and 4). Although Finnish people widely understand English, some may not have the specific vocabulary to answer this questionnaire. When translating questionnaires, it is imperative to pay attention to the quality of the translations to get reliable results (Harkness, 2008). No intentional changes were made to the translated questions, but their meaning may have changed to some small extent during the translation, as the exact words do not exist in Finnish for all questions. Due to this the Finnish participants may also interpret the questions in various unexpected ways. The participants who did not speak Finnish were presented with the original English language version.

4.3.2 Qualitative 1: Open questions

Four open-ended questions were presented to be answered in writing on the same form as the IEQ (see appendix 1 and 2). These questions were presented on the first page, before the IEQ. Similarly phrased, but slightly altered questions were asked from the diegetic and non-diegetic participants. The questions asked related to the gameplay experience and the test environment, the type of interface being used, difficulty, and enjoyment. These questions were designed to find answers to the hypotheses presented at the beginning of this chapter.

The term immersion was not used in the questionnaire itself, as it could be interpreted in various ways by the participants (Cairns et al., 2014). The elements of immersion including balance of difficulty and enjoyability regarding the user interface type were inquired about, as well as what kind of changes in the user interface would have improved the experience of the participant.

4.3.3 Qualitative 2: Gameplay video recordings

In addition to the questionnaire, the gameplay of each participant was recorded as a video file onto the hard drive of the PlayStation 4 console used in the experiment. The questionnaires were marked with the date and time, so the video recordings could be connected to the corresponding questionnaires. These gameplay videos were used to cross-reference with the questionnaire results, to see if there were indications of an immersed or non-immersed state in the gameplay itself. In this way, any problems that a player may experience could also be analysed together with the questionnaire. This counts as additional qualitative data which could improve the understanding of why a player found the game to be immersive, or vice versa.

This method of video recording and analysis was used by Jennett et al. (2008), who noted that players who experienced high immersion appeared to show better ability in controlling the game, whereas several low immersion participants made mistakes such as bumping into walls. Other similar observations could therefore possibly be made about aspects or style of gameplay which may affect the immersion of the players.

4.3.4 Pilot study

To discover any problems that may exist in the design of an experiment a pilot study should be conducted before the actual data collection takes place (Dijkstra, 2008). A pilot study was organised using two male volunteers (ages 19 and 32, one expert and one novice), both of whom played the game and filled the questionnaire. During the pilot testing some criticisms towards the IEQ (appendix 5) came forward from the test subjects. One of the participants noted that question 9 regarding the awareness of the environment did not specify whether it refers to the real-world environment, or the virtual in-game environment. The other participant noted that questions 15, 18, 26 and 27 were posed as yes or no questions despite being on a Likert-type scale of 1 to 5. These issues were however not seen to be serious enough to warrant a change, as the test subjects still understood the questions. Changing the questions would have also likely affected the results, and therefore comparison to earlier research using the IEQ. It is still important to note this for any future development of the IEQ or a similar instrument to measure immersion, as other researchers should consider re-wording the questions in the future for added clarity.

One of the greatest challenges of the experiment design was to make the gameplay experience sufficiently challenging, without being frustrating or angering to the test subjects. As explained previously, for the player to achieve flow state in the highest levels of immersion requires a balance of skills and difficulty. During the pilot study the default difficulty of the gameplay scenario was found to be too high for both participants (one self-reported expert and one novice), and so the in-game difficulty level was dropped to the lowest setting. This difficulty level was found to be more appropriate for the purposes of this study. However, a problem with an easier difficulty is that an expert player could still find the game too easy. The level of difficulty a player may experience in the game can be affected by how many times they replay the scenario or if they have played other similar types of games (Cowley et al., 2008). To incorporate the flow theory discussed earlier (Cowley et al., 2008; Hung et al., 2012), a balance between the capabilities of the participant and the difficulty of the game needs to be achieved for possibility of highest amount of immersion, or flow, to be experienced.

4.4 Analysis

To analyse why a game is immersive the use of a quantitative survey instrument is not enough. The IEQ with a Likert-type scale created by Jennett et al. (2008) can reveal to what extent the player feels the different elements of immersion, yet it does not necessarily give nuanced answers to the specific game elements that may contribute to or against achieving that state. Iacovides et al. (2015) conducted short interviews with subjects at the end of a gameplay experiment where both a diegetic and a non-diegetic version of the same game were played one after another. This will have given more insight into how to interpret the results of the IEQ. However, the results of these interviews were only shortly mentioned, and the answers only related to directly comparing the two different user interfaces. In this study the questions are analysed in more depth. The Likert-scale type questions may also suffer from a central tendency bias, which would cause participants to select a middling response, rather than the extremes (Brill, 2008). This effect has been minimized in the IEQ by having separate statements with positive and negative expressions.

In this study, the IEQ by Jennett et al. (2008) is used in combination with direct questions about the experience itself. This mixed methods concurrent triangulation strategy in data collection allows for collection of both quantitative and qualitative information concurrently, in a relatively short amount of time (Terrell, 2011; Creswell, 2009). The answers to the qualitative questions and video recording of the gameplay can be used to support or indicate contradictions in the quantitative data for a better analysis during discussion (Creswell, 2009). The complementary information from the open-ended questions and video recording can therefore be used to clarify what interpretations of phenomena are valid (Hammersley, 2008). The combination of both the quantitative and qualitative research methods can help expand the understanding of the research problems, and the strengths of both can be combined while offsetting weaknesses (Creswell, 2009).

Naturally possible problems exist relating to this method, one of which is a high requirement of understanding and expertise in both methods of data collection and analysis (Creswell, 2009). Certain unresolvable discrepancies can also emerge when the two different types of data are compared with one another (Creswell, 2009).

To analyse the open questions, grounded theory was utilized (Charmaz & Henwood, 2008). A constructive grounded approach was chosen due to the fact that this study was a theory lead investigation, upon which clear hypotheses were formed. Yet, due to the inquisitive nature of the present research, there was an openness to understand whether or not previous studies have in fact identified all issues pertaining to the relationship between diegesis and immersion, or whether greater insight could be raised through positing open questions. After the data collection the hand-written answers of the participants to each of the four questions were inspected, notes were made and relevant answers that linked to each other were coded and sorted into categories which could answer the hypotheses. This method allows to challenge existing ideas and interpretations of data (Charmaz & Henwood, 2008). This method is usually done iteratively by collecting more data after an initial collection and analysis (Kalaian, 2008), but the initial data already exists from previous studies and is expanded upon here.

Problems with this approach can include the lack of familiarity by the researcher to the phenomenon being studied, lack of analytically fractured data, or the lack of theoretical sampling (Charmaz & Henwood, 2008). If the researcher does not have sufficient nuanced familiarity with the topic it can lead to simplified and superficial results that do not take into consideration the various answers that could emerge when looked at from different perspectives. In this case this was not seen as a possible threat due to the familiarity and experience of the subject. Numerous problems exist with questionnaires. Questions need to be worded in a clear way to avoid their meanings changing from person to person (Trobia, 2008).

4.5 Recruitment

Information about the experiment was sent to two University of Jyväskylä and a single JAMK University of Applied Sciences student emailing lists a week before they were due to begin. This was done to gain participants who knew their schedule for the following week. The message was repeated on the day the tests began to remind registered participants and others. Posters and fliers were also distributed at the University of Jyväskylä campuses during the five days the data collection took place. These posters gave details about the topic of the research, the test itself, and the time and date. The participants of a study have to be applicable to that particular type of research (Julien, 2008). The messaging used therefore informed that participants had to consider themselves to possess at least novice-level experience in first-person shooter games, and be familiar with using a PlayStation 4 controller. Participants could reserve a time slot using an online booking system. A link to the reservation form was included in the messaging. To encourage participation two participants would win five lunch tickets as a prize through a raffle.

4.6 Ethical considerations

Since new data needed to be gathered from participants the ethics of this data collection needed to be taken into consideration. To give an understanding of what the participants are agreeing to they need to be explained the procedure and what is done with any data collected in its duration, and to have their informed consent (Sullivan & Riley, 2012). The participants were informed of the basic purpose of the research orally as they arrived, and given consent forms to read and sign so they understood and consented to the type of research and data collection. Every participant was told they have the right to withdraw from the experiment and leave at any time with no questions asked. Personal information gathered included the gender, age, and email address of the participants. The email addresses were gathered on separate paper slips and only used for a raffle, after which they were destroyed. The participants were made aware that all information that is collected about them is anonymised, and that the data and identities of participants will be protected. The gameplay of each participant was recorded as a video file, but this only included what was seen by the participants on the TV screen. The participants themselves were not recorded or observed during the experiments. The gameplay video data was therefore not considered to be identifiable information.

To make sure the study was ethical, any physical harm or mental stress possibly caused to the participants needed to be considered (Sullivan & Riley, 2012). The experiment involved the participants sitting down to play a video game and fill in a questionnaire afterwards. The participants were therefore not put in any kind of risk of physical or mental harm. If there was anything the participant did not want to do within the video game, they had the ability to refuse to do it, or immediately drop out of the experiment completely. All participants chose to stay for the whole duration of the experiment and filled the questionnaires, although some chose not to give their age or gender.

The use of rewards or prize draws are incentives used to attract additional participants, which have their own ethical considerations such as the prize being so great in value that it would make participants likely to take part in something they would otherwise not consider (Sullivan & Riley, 2012). A prize draw was used as an incentive to take part in the experiment. All participants who chose to give their email addresses on the separate slips of paper took part in the prize draw, and two were selected and rewarded with five lunch vouchers each. Additionally, the participants were offered free coffee and biscuits after the tests were complete. These were considered minor incentives of a low monetary value, and were therefore considered to have no effect on the results.

4.7 Other considerations

The participants played the game on a Sony PlayStation 4 using the standard bundled controller. Participants were informed of this during the recruitment phase, as the type of controller can affect how usable a player feels the game to be (Gerling et al., 2011). Iacovides et al. (2015) had to disqualify seven players due to their lack of familiarity with the controls. They did not clarify whether the reason for this was the control method or the skill level of the participants. No participants were disqualified in this study for their lack of skill or otherwise due to the low number of participants.

A self-reported average amount of time of FPS video games played a week was recorded to see whether the amount of play correlated with the self-reported measure of expertise. It was expected that participants who consider themselves novices would play less and experts to play more in a week on average. In addition, the self-reported expertise level of the players was recorded to see if there were significant differences within players using the same HUD. In the literature review of section 2 and 3 the issues of expertise and challenge have been discussed in length.

5 RESULTS

In this section the analysed results of the data collection detailed in section 4 are reported. Details about the participants of the experiments are presented, and the results of the IEQ and qualitative data are analysed using previously explained methods.

5.1 Participants

A total of 22 participants took part in the study, of which fifteen were men and five women. Two of the participants did not report their gender. The number of women taking part in video game immersion related questionnaires has similarly been lower than men in previous observed studies. In the case of Jennett et al. (2008) only 14 (5.7 percent) of the 244 people answering an online questionnaire were female. Similarly, Iacovides et al. (2015) had seven women out of 24 participants and Peacocke et al. (2015) had four women out of twenty participants. Yee (2017) reported on a survey that showed statistics of what genres of games female gamers played. The results showed that only seven percent of FPS players were female, whereas in Match 3 type puzzle games the female representation was 69 percent. A lower number of female participants could therefore be expected.

The ages of the participants ranged between 21 and 34, with an average of 24 (SD = 3.7). The same two participants who did not report their gender also did not report their age. As expected, a majority of 20 out of the 22 participants were Finnish, and answered the questionnaires in their native language. Eight participants reported being novices and fourteen experienced. Among the eleven participants who played the diegetic version of *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) there were eight self-reported experts and three novices. The eleven non-diegetic playing participants consisted of six experts and five novices.

Individual participants are referred to in the results as P1-P22. Odd numbered participants played in the diegetic condition, and even numbered in the non-diegetic. None of the participants reported having played this specific video game before, although three participants did mention having played earlier games in the same series. It is possible that other players may have also played previous entries in the series, but this was not asked about in the questionnaire form and so remains unclear.

Participants who reported playing more hours of video games weekly were somewhat more likely to report themselves to be experienced in FPS games. One experienced participant did not mark down their average amount of video games played each week. The results were codified as 1 (1-4 hours), 2 (4-8 hours) and 3 (9+ hours). The average for novice players was 1.5 and 2 for experienced players. The difference was not however statistically significant at $p = 0.177$.

5.2 Results of the IEQ

The quantitative results of the IEQ are discussed in this section. Overall the quantitative data did not contain any statistically significant results, and cannot therefore be used to discern whether the two versions of the game were strongly different. However, some individual questions were notable in other ways.

The hand-written results of the 22 participants' IEQ forms were manually typed up into an Excel table as columns, with separate columns for diegetic condition and self-reported expertise. This resulted in 24 columns, one for each question, one to show the diegetic condition of the participant and one for expertise. Questions 6, 8, 9, 10, 18 and 20 of the IEQ used negative marking (Jennett et al., 2008). The results of these negatively marked questions were negated back to positives.

A factor analysis using direct oblimin rotation was conducted using IBM SPSS Statistics 24.0. No statistical significance was found connecting the 31 questions with the six expected factors measuring basic attention, temporal dissociation, transportation, challenge, emotional involvement, and enjoyment of the players. Factor analysis did not reveal the five components used by Iacovides et al. (2015) either. This may indicate that either the questions were not measuring the same factors, or that the number of participants was too low to find a clear factor structure in this case. It is also possible the translation affected the answers somewhat. The results of the factor analysis can be found in appendix 10.

Although the collected data had no expected statistical significance the methods used by Iacovides et al. (2015) to further analyse the data were applied. Following the factor analysis, the averages of each scale were counted up, and a two-sample t-test assuming unequal variance was conducted in Microsoft Excel. Again, no statistical significance was found in the data ($p = 0.736$).

TABLE 2: Immersion scores

	Diegetic	Non-diegetic
	85	90
	93	95
	95	99
	107	100
	109	101
	110	102
	114	106
	119	113
	123	119
	123	123
	132	123
Average	110	106,45
Variance	13,72	10,86

The immersion scores shown above in table 2 were calculated by counting together the sum of all the answers of each participant, as instructed by Jennett et al. (2008). The results are presented from smallest to largest for both diegetic and non-diegetic participants. The results indicate a slightly higher variance and average in experience of immersion for the diegetic condition. A two-sample t-test assuming unequal variances was conducted in Microsoft Excel. Again, no statistical significance was found in the data (p = 0.529).

To compare the two groups that were split between novices and experts the averages of each six groups of questions were calculated and a two-way ANOVA was performed using IBM SPSS Statistics 24.0. These six groups are basic attention (questions 1-4), temporal dissociation (questions 5-10), transportation (questions 11-16), challenge (questions 17-22), emotional involvement (questions 23-27) and enjoyment (questions 28-31) (Jennett et al., 2008). Again, no statistical significance was found between diegetic condition and expertise levels. The closest to this was in questions regarding the emotional involvement of the participants, shown below in table 3.

TABLE 3: Tests of Between-Subjects Effects: Emotional Involvement

Dependent Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2,296[a]	3	0,765	1,448	0,262	0,194
Intercept	232,400	1	232,400	439,658	0,000	0,961
D	0,953	1	0,953	1,803	0,196	0,091
E	0,151	1	0,151	0,286	0,599	0,016
D * E	1,431	1	1,431	2,708	**0,117**	0,131
Error	9,515	18	0,529			
Total	271,600	22				
Corrected Total	11,811	21				

a. R Squared = ,194 (Adjusted R Squared = ,060)
D = diegetic condition, E = expertise level

The only result that was very close to being statistically significant ($p = 0.064$) was found in question 27 concerning the emotional involvement of the player when comparing diegetic and non-diegetic participants. Those playing in the diegetic condition were considerably more likely to talk out loud to the game, with an average of 3.45 (out of 5) than players playing non-diegetic version with the average 2.18 (out of 5) on the Likert-type scale. However, a similar variance or statistical significance did not exist when comparing expertise levels of participants. The closest to statistical significance after question 27 when comparing diegetic conditions was question 7 ($p = 0.186$), which asked to what extent the player forgot their everyday concerns.

Question 15 inquired about player awareness of using a controller, with 1 being very aware and 5 not being aware. The novices had an average score of 1.63 ($SD = 0.74$) and experts 2.21 ($SD = 1.19$). Diegetic participants had an average of 2.09 ($SD = 1.22$) and non-diegetic 1.90 ($SD = 0.94$). This was the lowest average score out of all the questions for all groups. Both diegetic condition groups reported being very aware of using a controller, most likely indicating that the controls were found to be difficult, or at least that they took a significant amount of cognitive resources.

5.3 Qualitative results

The results of the qualitative question analysis are found here. The analysis was done by reading through the answers of each participant, coding and sorting the answers into categories, and comparing the results between groups. Most of the quotes in the results have been translated from Finnish into English, as only P1 and P4 wrote their answers in English.

5.3.1 Irritants of the gameplay experience

The first question inquired as to whether the participants found anything that would have affected the experience negatively either in the game itself or the test environment. As discussed in section 3, players may experience a game differently depending on their previous experiences or lack thereof playing a certain type or genre of game. All participants of the study reported to have at least novice experience or above in first-person shooter video games. Despite this, a slight majority of 13 participants (three novices, ten experts) reported having experienced difficulties with the controls of the game. Nine participants (P1, P2, P3, P6, P8, P9, P14, P15, P17, P18), five of which played in the diegetic condition, expressed that they needed some time to get used to the controls due to the control scheme being different from other first-person shooter games.

> P8: *Controlling the character was challenging at first. The controls differed from similar games.*

> P18: *New controls and mechanics caused difficulties at first, but I got used to them quite fast.*

Three players (P10, P12, P22), all in the non-diegetic condition, reported about finding the use of gamepad controls difficult due to being used to mouse and keyboard controls in first-person shooter games. Participants were told in advance that a PlayStation 4 controller would be used in the study. Because of this pre-study information, participant preference in controller type was not inquired about specifically. Other participants may have had similar preferences, but simply not reported them.

> P10: *Playing an FPS game on a console using a gamepad felt unfamiliar.*

One expert player (P5) playing in the diegetic condition simply expressed that the controls felt sluggish, and that the game character moved in a very clumsy manner. This could indicate a latency or accuracy issue with the game or setup itself.

The test environment was not criticised by the participants, but P11 reported as to having heard some noises from outside the room, and having felt some stress due to the time limit. Some answers indicated that the gameplay scenario chosen was not clear to all the participants.

> P4: *I thought the people in front of me were allies at first, since they were not doing anything hostile.*

P7: *I found it strange that an enemy walked directly at me and did not shoot, this does not usually happen in video games.*

This could have been remedied by having chosen a clearer scenario where the enemy is already acting hostile towards the player character.

5.3.2 User interface type and degree of difficulty

The second question inquired whether the game would have been easier or harder with or without the user interface. A total of 18 participants gave indications of agreeing with this statement. Ten experts (P3, P8, P9, P12, P13, P15, P18, P19, P21, P22) and eight novice players (P1, P4, P5, P6, P7, P10, P16, P20) expressed that they thought the game was or would be more difficult to play without a user interface. Seven of these played the game in the diegetic condition, and eleven in non-diegetic. Several participants did seem to enjoy the diegetic condition, but would have preferred for the game to communicate what the different buttons do.

P3: *In some situations [playing] without UI is better, but the player must be told somehow what items they can use.*

P5: *It was a refreshing experience, but learning and remembering functions [of buttons] was a headache.*

5.3.3 Enjoyability of the game with/without UI

Third question attempted to answer if the participant preferred the type of user interface they were exposed to. A total of five expert players playing in diegetic condition (P3, P11, P13, P19, P21) indicated in writing that they enjoyed the game more using diegetic user interfaces in some situations, such as when looking for a challenge.

P11: *[Playing without UI] was surprisingly enjoyable. I thought while playing that I may play games more often this way to add challenge to them.*

P13: *[Playing without UI] was actually more fun, since you had to think for yourself about how to act in the situation.*

Interestingly, two novices (P10, P17) also wrote that the game was or would be more enjoyable in the diegetic condition. Conversely, five novices (P1, P4, P6, P7, P16) expressed preference towards non-diegetic user interfaces. Two experts (P15, P22) also said they would prefer to play with a non-diegetic user interface. Multiple novice players expressed frustration while playing in the diegetic condition.

> P1: *[Playing with diegetic UI was] less enjoyable. It was a bit frustrating to always lose so quickly.*

> P7: *It was frustrating, and I wanted to already during the game to stop, since I had to start over so many times.*

These answers indicate that the experience of P1 and P7 were very strongly counter to desired effects of immersion and flow as stated by the theory (Brockmyer et al., 2009).

5.3.4 Factors for improvement

The fourth question inquired as to whether the participant could think of anything that would have made the gameplay experience more enjoyable. The most common theme was for more visible user interface elements by participants (P5, P7, P13, P15, P17, P19) playing in the diegetic condition.

> P7: *There should at least be a crosshair visible, otherwise it was quite good like this.*

> P15: *Make the number of bullets and the map visible.*

> P19: *I'd wish the number of bullets was visible. I think it's too much to ask from a player to count the number of bullets in a stressful shooting scenario.*

On the other hand, three participants (P10, P14, P18) playing in the non-diegetic condition would have preferred less UI elements visible.

> P18: *There was a lot of information on the screen the whole time, some elements could have been simplified, like the indicators and prompts of staying in cover.*

Five participants (P1, P2, P3, P4, P5), three in the diegetic condition, would have preferred visible hints about what the different buttons do.

> P1: *Short hints at what things (buttons) do.*

> P3: *At least tell how I could use the grenades.*

One participant playing in the diegetic condition (P11) expressed that they wanted to have some visible UI elements to begin with, but also enjoyed having no visual user interface. This seems to imply a preference for an adaptive user interface. Two participants in the non-diegetic condition (P6, P8) mentioned again that the controls should have been clearer. A single participant (P12) in the non-diegetic condition expressed that the game should have been technically more impressive, with a higher frame per second count and a wider field of view (higher amount of the game world visible on screen simultaneously).

Some participants reported having completely the opposite preferences to one another, even amongst the groups of experts and novices. This was the case with P14 and P15, who were both self-reported experts.

> P14: *It's always good to have a health indicator!*
>
> P15: *Seeing the health status would have not mattered that much.*
>
> P14: *The map felt unnecessary, the game would have been more immersive without it.*
>
> P15: *A map would have made it easier to understand where to go.*

Of the experts, P14 and P18 indicated preferring smaller amounts of user interface elements, but still preserving some. P18 stated that they preferred to start a game with visible user interface elements and reduce them as they got familiar and wanted more of a challenge.

5.3.5 Gameplay video analysis

For unknown reasons two of the gameplay recordings made by the PlayStation 4 console were corrupted during the saving process, and one recording was reduced to less than a minute in length, making them unusable for analytical purposes. The gameplay videos of the three most immersed and three least immersed players (based on their immersion scores) were viewed for analysis. Similar indications to those of Jennett et al. (2008) were found.

Players who had the lowest immersion scores made more mistakes in controlling the game by bumping against walls and appearing to find the aiming of guns difficult. Additionally, the least immersed players died more often and had to spend a longer period of the twenty minutes watching a loading screen, which would explain their frustrations. The least immersed players tried to advance mostly by shooting their way through to the goal.

The most immersed players tried different solutions when one way of approaching did not work, and appeared to find the controls less difficult by moving in the environment in a more controlled and fluid manner. These participants tended to sneak around enemies rather than attacking them directly. Two of the most immersed players passed the task, whereas none of the least immersed did. Only the gameplay that the participants themselves viewed was recorded to a hard drive, and as the participants themselves were not recorded no analysis could be made of their body movements or expressions during gameplay.

6 DISCUSSION

Initially the results of this study were planned to be compared to those of Iacovides et al. (2015), but a difficulty was found with the classification of the IEQ questions. Iacovides et al. (2015) divided the questions into five constructs of cognitive involvement, emotional involvement, real world dissociation, challenge and control, which were also described by Jennett et al. (2008). However, neither of these studies explained which questions related to these five components, and the factor analysis did not find indications of these five factors either. This can be taken to criticise the lack of description in the articles by Iacovides et al. (2015) and Jennett et al. (2008) and should be considered by future studies using the IEQ.

Another issue with the IEQ is that there is no defined threshold of when a person is or is not immersed. Brown and Cairns (2004) defined immersion as having three levels, but after answering the IEQ participants could not necessarily be placed into any of these levels. The IEQ simply gives numeric indications of how strong the sense of immersion of a player is, or if one player is more immersed than another. Lower immersion scores indicate lesser immersed and higher scores more immersed players, but it is not clear when a player can be said to have experienced immersion. There should possibly be a direct Likert-type scale question on how immersed the player considered themselves to be or another type of spectrum to see how well this aligns with the calculated immersion score. This could expose as to whether or not a player with a higher immersion score would truly consider themselves to be more immersed than a player with a lower immersion score, or vice versa. To add complexity to this, it may be considered that the definition or parameters of immersion can vary among players, as stated earlier (Cairns et al., 2014).

It is similarly not clear if any participant of this study experienced flow, which should be experienced during the highest amounts of immersion. The highest immersion score in this study was 132, with the maximum possible score being 155 (31 questions with a maximum of 5 on Likert-type scale). It can be said this appears to indicate a highly immersed player, but the state of flow cannot be construed by this number alone.

Question five of the IEQ concerns the extent that the player has lost their sense of time, which is a key component of flow. Three participants in this study reported strongly having lost their sense of time by answering 5 on the Likert-type scale to question five. The immersion scores of these three participants were 95, 109 and 123. One of these immersion scores places comparatively high, and another low against all other participants. The participant with the highest immersion score of 132 in this study selected 4 on question five, indicating that they may have not experienced flow despite being numerically more immersed than all the other participants. Perhaps some questions should have a higher influence and importance when calculating the immersion score to indicate whether a player experienced a state of flow. This may also indicate that flow is not necessarily experienced at the highest levels of immersion, and is a separate entity altogether.

The participants who played the video game by avoiding and sneaking past enemies rather than shooting at them fared better in the game, and were also the only ones to pass the given task. It may be that *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) was designed first and foremost to allow for various approaches to different situations, and the use of guns should be used as a last solution. Based on the video recordings most of the participants appeared to approach the game by shooting first and exploring afterwards if at all, perhaps adding to their frustration and difficulty. From the video data in combination with the immersion scores it can be extrapolated that players who were more imaginative in their approach and tried doing things differently when one solution did not work had the capability to become more immersed.

The controls were not found to be intuitive by a slight majority of the participants, which may have had a knock-on effect for the rest of the experience as the participants had to concentrate on how to control the game rather than getting immersed in the gaming experience (e.g. narrative, goal, graphical fidelity). Mastering difficult controls is an aspect to some video games where executing something complex, such as a trick in a skateboarding game or a combo in a fighting game is an intended part of the experience. This however, is not the case with *Deus Ex: Mankind Divided* (Eidos Montréal, 2016). Game designers should therefore, probably be careful when deviating too much from popular and established control scheme standards, while still allowing for some changes so evolution of these standards can happen.

A possible solution to the majority of the reported control issues may have been to use a different control scheme. *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) offered three different control scheme settings, one of which was emulating more common first-person shooter scheme. The default control settings were used instead. The participants were shown the controls to the game before beginning, and were given as much time to study them as they felt was needed. It is possible some felt under pressure and did not study them well, or that the controls were too complex to remember. Many players reported having these problems only towards the beginning, and it may be that a longer exposure to the controls may have allowed them to feel more familiar and allowed for immersion to emerge. This is supported by the fact that players who had earlier experience of the game series appeared to fare better and have higher immersion scores. The difficulties in controlling the game explain why many participants could not get immersed in the experience, and thus the IEQ results were quite homogenous between the two groups of diegetic and non-diegetic players.

6.1 Hypotheses

As there were no statistically significant results found from the IEQ to test the hypotheses of immersion, the emphasis of importance was mostly placed on the analysis of qualitative data. Answers to three individual questions from the IEQ did, however, prove to be somewhat useful.

6.1.1 Hypothesis 1

The first hypothesis of this study is that first-person shooter video games with diegetic user interface elements are expected to be more difficult for the players. The results of the IEQ give no statistically significant results to answer this, possibly because the controls of the game were themselves found problematic. The chosen scenario was also not clear for all participants, which may have made finishing the task feel insurmountable.

The results of the qualitative analysis of written answers however give strong support for the difficulty hypothesis. Eighteen out of the 22 participants of the study, including all eleven who played in the diegetic condition expressed finding playing without UI elements more difficult. These results were expected, since none of the participants had earlier experience in playing the video game. Any information about the state of the character and environment conveyed to the players by the game through its user interface would therefore be a helpful addition. It is important to note that higher difficulty would not mean the experience would be worse, since especially the more experienced players may prefer a more challenging experience. The answer to this was to be answered through the following hypothesis.

6.1.2 Hypothesis 2

The second hypothesis of this study expects that the video game would be more enjoyable for expert players in the diegetic condition. Again, the results of the IEQ gave no indication of a statistically differing amount of enjoyment. The written answers gave some clear indications. Five experts and two novices expressed preference towards a diegetic user interface, whereas five novices and two experts preferred non-diegetic interfaces. Both experts and novices, therefore, had some exceptions which went against the hypothesis, and not every participant gave a clear answer of which type of user interface they would prefer. Eight participants did not indicate in any clear way a preference for either type of user interface, or simply stated that it did not matter or that it would depend on the game. The qualitative results would therefore appear to give support for the second hypothesis, with the caveat that a greater number of expert players prefer the diegetic condition than novices and vice versa. A larger sample size would be needed for more conclusive results.

Many of the participants had preference for certain user interface elements to be visible or invisible. This varied from person to person like those of P14 and P15 whose preference about the map and health indicators were opposite to each other. Thus, it cannot simply be said that experts prefer diegetic user interfaces and novices non-diegetic. Two participants (P11, P18) stated that the game would have benefitted from having non-diegetic user interface elements to begin with and lessen their amount as the game progressed. This indicates possible player preference towards adaptive user interfaces.

6.1.3 Hypothesis 3

The third hypothesis is that the game is expected to be more immersive in the diegetic condition. Only question 27 of the IEQ was very close to statistical significance, and was related to the likelihood of the player speaking out loud to the game while playing. Those in the diegetic condition were more likely to speak to the game. The game had no voice recognition capabilities, and would not therefore, react to players in any way. There are at least two reasons players would speak out loud to the game. The players may have indeed been more immersed, or they may have found the game to be frustrating to a degree where they spoke out to vent anger or irritation, as shown in the results.

Another indication of the immersive condition would be the differences in the immersive score between the diegetic and non-diegetic condition groups. There was however, no statistically significant difference, which may have been due to the high difficulty of the scenario, difficulties in controlling the game, or that the players simply had a similar experience. The single highest immersion score of 132 was by an expert player in the diegetic condition, but this result was an outlier, as it was nine points higher than any other participant. The immersion scores of other participants were evenly spaced between 85 and 123 points.

The answer to this hypothesis is difficult to infer out of the qualitative data, as all of the qualities of an immersive experience were not all described by any of the participants. With the data collected in this study it cannot be conclusively stated either way whether the game was more immersive in the diegetic state. In a future study this could be qualitatively probed through structuring an interview around these qualities.

6.2 Limitations

The unedited but translated IEQ survey instrument by Jennett et al. (2008) was used as the only quantitative data collection method. In retrospect some additional quantitative questions may have helped in the analysis of the results, such as directly inquiring about the difficulty of the controls or self-reported level of overall immersion. It is also possible that the language used in the translated IEQ was not specific enough, and may have affected the answers given. One Finnish participant asked clarification on the meaning of a single question when filling in the questionnaire, and preferred to see the original English version. It is not known if this was an isolated case, or if other participants found similar difficulties when filling the questionnaire.

Participants who expressed having experience of previous games in the *Deus Ex* series fared better, and appeared to have been more immersed in the experience based on their immersion score. It was not considered beforehand that participants may have had experience of other games in the same series, as the questionnaire only inquired about previous experience of the used video game. It is also a possibility that previous knowledge of the story elements of the game series may have enabled these players to become more immersed in its world. It is highly likely that this previous familiarity with the game mechanics helped them surpass the challenge. Jennett et al. (2008) made similar observations with players who had previous experience of a video game.

The participants were classed as self-reported novices and experts, but what constituted a novice and expert player was not defined to the participants. A novice could, therefore, be somebody who has only played FPS video games for a few hours in their entire life, or plays them regularly but considers their skills as average. Similarly, a self-reported expert could play many FPS video games, but be average in skill level, or even play them professionally in tournaments. These two player types may need further definition for proper self-reported classification. A solution to this could be to have a player answer a series of questions where the level of their experience could better be discerned. The questions could be related to the time of games played per week, hours in total, years of experience, difficulty level chosen in video games, and so forth.

A PlayStation 4 and the standard bundled controller was used for the immersion experiment. One participant expressed having been dissatisfied with the graphical fidelity, and some others with the controller due to having preference for mouse and keyboard controls. These factors may have affected their immersion score negatively. In the future, similar studies should consider using a PC version of the game with more satisfactory graphical processing capabilities and a choice of gamepad or mouse and keyboard control.

The video recording only included the gameplay of the participants, and not their faces or body movements. This data could have given more clarity as to whether the players who were most likely to speak out loud to the game were indeed immersed or frustrated with the experience. The decision of not recording participants themselves or having them monitored was made so they would be more at ease and less self-conscious. In hindsight it may have been better to gather this data regardless of it possibly affecting the participants in other ways.

It is highly likely that the selected gameplay scenario and control scheme had some problems which reflected negatively on the experience of the participants, and will have affected their chances of experiencing immersion while playing the game. Only three participants finished the given task, indicating that the task was very difficult to overcome in the 20-minute time frame, and therefore the challenge level of the scenario was high. It is possible that *Deus Ex: Mankind Divided* (Eidos Montréal, 2016) was not an appropriate video game for the experiment, as the various ways of approaching problems allow for players to wander, not attack the enemies, or even get lost by heading in the wrong direction.

7 CONCLUSIONS

This master's thesis intended to add to the knowledge of how two different types of user interfaces (diegetic and non-diegetic) in first-person shooter video games affected the immersion a player experiences, and what creates an immersive experience in video games. A literature review of immersion, its related concepts and user interfaces of FPS video-game was conducted. Based on the literature review three hypotheses were made.

The Immersive Experience Questionnaire by Jennett et al. (2008) was used as the primary quantitative survey instrument, but no statistically significant results were found from the 22 participants. However, additional qualitative questions found strong evidence to support the hypothesis that players experience video games with diegetic user interfaces as more difficult than those with non-diegetic interfaces. It could be extrapolated that more experienced players who want a higher challenge would prefer diegetic user interfaces.

The second hypothesis was that expert players would prefer diegetic user interfaces. There was some support to this, as more experts indicated clear preference towards diegetic user interfaces than non-diegetic, and novices indicated preference in similar amounts to non-diegetic user interfaces. However, out of both expert and novice participants some preferred the opposite to what was expected.

The third and final hypothesis expected the games with diegetic user interface elements to be more immersive. There was no conclusive evidence found in either the qualitative or quantitative data to support this statement.

This study had some flaws which became apparent only after the data collection. It is likely there were no statistically significant differences in how the participating players perceived the gameplay of this specific video game, as the difficulty with controls impaired the ability to experience immersion. Those who were familiar with the game series from earlier experience may have been more likely to experience immersion, as they appeared to fare better in the game and had a higher overall immersion score from the IEQ. Most participants found the difficulties with controls an obstacle that most likely affected their overall experience and chance to achieve an immersed state in a strongly negative way. Future studies should consider giving participants a certain amount of time to get used to the controls beforehand.

7.1 Future research

There appears to be no user experience studies of video games that use both diegetic and non-diegetic user interfaces depending in the context of what is happening in the game (also called adaptive user interfaces or dynamic HUDs). Video games such as the third-person action game *Horizon Zero Dawn* (Guerrilla Games, 2017) have received praise for the use of adaptive user interface design. It would be beneficial to see how the immersiveness of using a combination of both diegetic and non-diegetic user interfaces compares to those using only one or the other. The assumption has also been that first-person games have the capacity to be the most immersive, but whether or not that is actually the case still remains unknown.

Future research should also consider the importance of the storyline and characters in relation to the sense of immersion. The experiment for this study did not consider the importance of story elements, which has been by Ermi and Mäyrä (2005) considered to be a large contributing factor to immersion. The participants of the study who had earlier experience of *Deus Ex: Mankind Divided (*Eidos Montréal, 2016*)* may have been able to immerse themselves more deeply due to their previous understanding of the game world. The problem with such a study would of course be the amount of time taken, since players may require many hours to get a sense of the game world and its characters.

The results of this study indicate that difficult controls may have had a major negative impact on the overall experience. The impact of different control schemes on immersion could be tested by using the same game with multiple different control schemes to see if there is a significant negative impact in other areas than controls when using the IEQ, or other instrument measuring immersion.

The relationship between video game user interfaces and immersion is still a fresh area of study, and requires further research. The existing studies (including this) have had a fairly low number of participants, which has made analysis and interpretation of the results difficult and mostly indicative. The differences between groups appear to be very minute in all cases. All of these studies have also focused only on FPS video games, with the assumption that they offer the highest likelihood of eliciting immersion. How different types of user interfaces affect player immersion in games which are not in the first person is an area which still needs further clarity, since the current research has mostly concentrated on games displayed from the first person.

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APPENDIX 1: SURVEY IN ENGLISH (DIEGETIC)

Gender
Male Female

Age

How many hours of video games do you usually play in a week on average?
1-4 4-8 9+

How skilled would you say you are with first-person shooter games?
Novice Expert

Had you played the game before?
Yes No

Was there anything in the game or the test environment that negatively impacted on your gameplay experience? Please explain what in detail.

You played the game without visible user interface, such as health, ammo, minimap, and button prompts. Do you think it would have been easier or harder if you could see those things? Why?

Do you think playing without visible user interface was more or less enjoyable? Why?

What could be changed in the interface that would improve your experience?

APPENDIX 2: SURVEY IN ENGLISH (NON-DIEGETIC)

Gender
Male Female

Age

How many hours of video games do you usually play in a week on average?
1-4 4-8 9+

How skilled would you say you are with first-person shooter games?
Novice Expert

Had you played the game before?
Yes No

Was there anything in the game or the test environment that negatively impacted on your gameplay experience? Please explain what in detail.

You played the game with a user interface showing health, ammo, minimap, and button prompts. Do you think it would have been easier or harder if you could not see those things? Why?

Do you think playing with a visible user interface was more or less enjoyable? Why?

What could be changed in the interface that would improve your experience?

APPENDIX 3: SURVEY IN FINNISH (DIEGETIC)

Sukupuoli
Mies Nainen

Ikä

Kuinka monta tuntia videopelejä pelaat keskimäärin viikossa?
1-4 4-8 9+

Kuinka hyvä arvioisit olevasi first-person shooter peleissä?
Noviisi Kokenut

Olitko pelannut peliä ennen?
Kyllä En

Oliko pelissä tai koeympäristössä jotain mikä haittasi pelikokemustasi? Kerro mitä.

Pelasit peliä ilman käyttöliittymää joka näyttäisi pelihahmon terveyden, panosten määrän ja kartan. Olisiko peli ollut helpompi vai vaikeampi niiden kanssa? Miksi?

Oliko peli enemmän vai vähemmän nautinnollinen ilman näkyvää käyttöliittymää? Miksi?

Mitä pelin käyttöliittymässä voitaisiin muuttaa, jotta kokemuksesi olisi parempi?

APPENDIX 4: SURVEY IN FINNISH (NON-DIEGETIC)

Sukupuoli
Mies Nainen

Ikä

Kuinka monta tuntia videopelejä pelaat keskimäärin viikossa?
1-4 4-8 9+

Kuinka hyvä arvioisit olevasi first-person shooter peleissä?
Noviisi Kokenut

Olitko pelannut peliä ennen?
Kyllä En

Oliko pelissä tai koeympäristössä jotain mikä haittasi pelikokemustasi? Kerro mitä.

Pelasit käyttöliittymällä, joka näytti pelihahmon terveydentilan, panosten määrän ja kartan. Olisiko peli ollut helpompi vai vaikeampi ilman niitä? Miksi?

Oliko pelin pelaaminen näkyvän käyttöliittymän kanssa enemmän vai vähemmän nautinnollista? Miksi?

Mitä pelin käyttöliittymässä voitaisiin muuttaa, jotta kokemuksesi olisi parempi?

APPENDIX 5: IMMERSIVE EXPERIENCE QUESTIONNAIRE (ENGLISH)

1. To what extent did the game hold your attention?
Not at all 1 2 3 4 5 A lot

2. To what extent did you feel you were focused on the game?
Not at all 1 2 3 4 5 A lot

3. How much effort did you put into playing the game?
Very little 1 2 3 4 5 A lot

4. Did you feel that you were trying your best?
Not at all 1 2 3 4 5 Very much so

5. To what extent did you lose track of time?
Not at all 1 2 3 4 5 A lot

6. To what extent did you feel consciously aware of being in the real world whilst playing?
Not at all 1 2 3 4 5 Very much so

7. To what extent did you forget about your everyday concerns?
Not at all 1 2 3 4 5 A lot

8. To what extent were you aware of yourself in your surroundings?
Not at all 1 2 3 4 5 Very aware

9. To what extent did you notice events taking place around you?
Not at all 1 2 3 4 5 A lot

10. Did you feel the urge at any point to stop playing and see what was happening around you?
Not at all 1 2 3 4 5 Very much so

11. To what extent did you feel that you were interacting with the game environment?
Not at all 1 2 3 4 5 Very much so

12. To what extent did you feel as though you were separated from your real-world environment?
Not at all 1 2 3 4 5 Very much so

13. To what extent did you feel that the game was something you were experiencing, rather than something you were just doing?
Not at all 1 2 3 4 5 Very much so

14. To what extent was your sense of being in the game environment stronger than your sense of being in the real world?
Not at all 1 2 3 4 5 Very much so

15. At any point did you find yourself become so involved that you were unaware you were even using controls?
Not at all 1 2 3 4 5 Very much so

16. To what extent did you feel as though you were moving through the game according to your own will?
Not at all 1 2 3 4 5 Very much so

17. To what extent did you find the game challenging?
Not at all 1 2 3 4 5 Very difficult

18. Were there any times during the game in which you just wanted to give up?
Not at all 1 2 3 4 5 A lot

19. To what extent did you feel motivated while playing?
Not at all 1 2 3 4 5 A lot

20. To what extent did you find the game easy?
Not at all 1 2 3 4 5 Very much so

21. To what extent did you feel like you were making progress towards the end of the game?
Not at all 1 2 3 4 5 A lot

22. How well do you think you performed in the game?
Very poor 1 2 3 4 5 Very well

23. To what extent did you feel emotionally attached to the game?
Not at all 1 2 3 4 5 Very much so

24. To what extent were you interested in seeing how the game's events would progress?
Not at all 1 2 3 4 5 A lot

25. How much did you want to "win" the game?
Not at all 1 2 3 4 5 Very much so

26. Were you in suspense about whether or not you would win or lose the game?
Not at all 1 2 3 4 5 Very much so

27. At any point did you find yourself become so involved that you wanted to speak to the game directly?
Not at all 1 2 3 4 5 Very much so

28. To what extent did you enjoy the graphics and the imagery?
Not at all 1 2 3 4 5 A lot

29. How much would you say you enjoyed playing the game?
Not at all 1 2 3 4 5 A lot

30. When interrupted, were you disappointed that the game was over?
Not at all 1 2 3 4 5 Very much so

31. Would you like to play the game again?
Definitely not 1 2 3 4 5 Definitely yes

APPENDIX 6: IMMERSIVE EXPERIENCE QUESTIONNAIRE (FINNISH)

1. Missä määrin peli piti huomiotasi?
Ei yhtään 1 2 3 4 5 Paljon

2. Missä määrin tunsit olevasi keskittynyt peliin?
En yhtään 1 2 3 4 5 Paljon

3. Kuinka kovasti yritit pelatessasi peliä?
En yhtään 1 2 3 4 5 Paljon

4. Tunsitko yrittäväsi parhaasi?
En yhtään 1 2 3 4 5 Yritin parhaani

5. Missä määrin menetit ajantajusi pelatessasi?
En yhtään 1 2 3 4 5 Paljon

6. Kuinka vahvasti olit tietoinen olevasi tosimaailmassa pelatessasi?
En yhtään 1 2 3 4 5 Todella vahvasti

7. Missä määrin unohdit arkiset huolesi?
En yhtään 1 2 3 4 5 Paljon

8. Kuinka tietoinen olit itsestäsi ympäristössäsi?
En yhtään 1 2 3 4 5 Erittäin tietoinen

9. Missä määrin olit tietoinen asioista, jotka tapahtuivat ympärilläsi?
En yhtään 1 2 3 4 5 Paljon

10. Tunsitko missään vaiheessa halua lopettaa pelaamista ja katsoa mitä ympärilläsi tapahtuu?
En yhtään 1 2 3 4 5 Paljon

11. Miten vahvasti tunsit olevasi vuorovaikutuksessa pelin ympäristön kanssa?
En yhtään 1 2 3 4 5 Paljon

12. Kuinka vahvasti tunsit olevasi erossa tosimaailman ympäristöstäsi?
En yhtään 1 2 3 4 5 Paljon

13. Kuinka vahvasti tunsit pelin olevan jotain mitä koet pelkän tekemisen sijaan?
En yhtään 1 2 3 4 5 Paljon

14. Kuinka vahvasti koit olevasi pelin ympäristössä enemmän kuin oikeassa maailmassa?
En yhtään 1 2 3 4 5 Paljon

15. Koitko missään vaiheessa olevasi niin uppoutunut pelin tapahtumiin, että et ollut tietoinen käyttäväsi peliohjainta?
En yhtään 1 2 3 4 5 Paljon

16. Missä määrin tunsit liikkuvasi pelissä oman tahtosi mukaan?
En yhtään 1 2 3 4 5 Paljon

17. Kuinka haastava koit pelin olevan?
En yhtään 1 2 3 4 5 Todella vaikea

18. Oliko pelin aikana hetkiä jolloin halusit luovuttaa?
Ei yhtään 1 2 3 4 5 Paljon

19. Kuinka motivoituneeksi tunsit itsesi pelatessasi?
En yhtään 1 2 3 4 5 Todella motivoituneeksi

20. Kuinka helpoksi koit pelin?
En yhtään 1 2 3 4 5 Todella helpoksi

21. Missä määrin tunsit eteneväsi pelissä loppua kohti?
En yhtään 1 2 3 4 5 Paljon

22. Kuinka hyvin koit suoriutuneesi pelissä?
Huonosti 1 2 3 4 5 Todella hyvin

23. Missä määrin koit tunteita pelin tapahtumia kohtaan?
En yhtään 1 2 3 4 5 Paljon

24. Kuinka kiinnostunut olit nähdä miten pelin tapahtumat etenevät?
En yhtään 1 2 3 4 5 Paljon

25. Kuinka paljon halusit ”voittaa” pelin?
En yhtään 1 2 3 4 5 Paljon

26. Tunsitko jännitystä siitä voitatko vai häviätkö pelissä?
En yhtään 1 2 3 4 5 Paljon

27. Koitko missään vaiheessa olevasi niin kietoutunut pelin tapahtumiin, että halusit puhua pelille ääneen?
En yhtään 1 2 3 4 5 Paljon

28. Kuinka paljon nautit pelin graafisesta tyylistä ja laadusta?
En yhtään 1 2 3 4 5 Paljon

29. Kuinka paljon sanoisit nauttineesi pelistä?
En yhtään 1 2 3 4 5 Paljon

30. Kun peli keskeytettiin, olitko pettynyt pelin päättymisestä?
En yhtään 1 2 3 4 5 Paljon

31. Haluaisitko pelata peliä uudelleen?
En yhtään 1 2 3 4 5 Ehdottomasti kyllä

APPENDIX 7: GAMEPLAY TEST INSTRUCTIONS (ENGLISH)

Please put your phone on silent mode!

Please do not try to access menus through the "Options" button or attempt to change any settings during gameplay. Do not save your game!

Your gameplay will be recorded as a video file. You will not personally be observed or recorded during this experiment, you have the right to leave and withdraw from the process by walking out of the door any time you want.

Controls:

Instructions:
Directly ahead of you is a barricade of police officers. Your task is to get past them and recover a set of evidence from the floor above. If you can recover this evidence the experiment is over and you have won, otherwise the experiment will be over after 20 minutes after you have started.

Open doors and pick up bullets from enemies using the square (■) button.

If your character dies simply press X on the menu which comes up to try again.

Good luck!

APPENDIX 8: GAMEPLAY TEST INSTRUCTIONS (FINNISH)

Laita puhelimesi äänettömälle!

Älä yritä avata valikoita “Options” painiketta painamalla tai yritä muuttaa mitään asetuksia pelin aikana. Älä tallenna peliä!

Pelitapahtumat tallennetaan videotiedostoksi. Sinua ei henkilökohtaisesti tarkkailla tai nauhoiteta tämän kokeen aikana. Sinulla on oikeus poistua ja vetäytyä kokeesta kävelemällä ulos huoneesta koska tahansa.

Kontrollit:

Ohjeet peliä varten:

Suoraan edessäsi on poliisien eristämä alue. Sinun tehtäväsi on päästä heidän ohitseen ja saada todistusaineistoa ylemmästä kerroksesta. Jos saat noudettua todistusaineiston olet voittanut ja peli päättyy. Muussa tapauksessa koe päättyy 20 minuutin kuluttua kokeen aloituksesta.

Ovien avaaminen ja panosten poimiminen vihollisilta tapahtuu painamalla neliö-painiketta (■).

Jos pelihahmosi kuolee paina ruksia (X) valikosta joka ilmestyy hetken kuluttua ja yritä uudelleen.

Onnea haasteeseen!

APPENDIX 9: PARTICIPANT DETAILS

P1: woman, age 34, novice
P2: woman, age 27, expert
P3: man, age 23, expert
P4: man, age 25, novice
P5: gender not specified, age not specified, expert
P6: man, age 23, novice
P7: woman, age 33, novice
P8: man, age 21, expert
P9: man, age 22, expert
P10: man, age 21, novice
P11: woman, age 24, expert
P12: gender not specified, age not specified, expert
P13: man, age 23, expert
P14: man, age 21, expert
P15: man, age 25, expert
P16: man, age 22, novice
P17: woman, age 21, novice
P18: man, age 21, expert
P19: man, age 25, expert
P20: man, age 29, novice
P21: man, age 23, expert
P22: man, age 22, expert

APPENDIX 10: RESULTS OF FACTOR ANALYSIS

Correlation Matrix[a]

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Correlation	Q1	1,000	0,556	-0,093	-0,193	0,266	0,105	0,246	0,140	0,250	0,603	0,111	0,154	0,445	0,499	0,000	-0,187
	Q2	0,556	1,000	-0,265	-0,437	0,085	0,220	0,231	0,291	0,215	0,453	0,028	0,470	0,398	0,503	0,000	-0,120
	Q3	-0,093	-0,265	1,000	0,473	0,373	0,038	0,216	-0,144	-0,261	-0,157	0,270	-0,166	-0,099	-0,192	0,078	0,056
	Q4	-0,193	-0,437	0,473	1,000	0,026	0,126	-0,121	-0,153	-0,223	-0,113	0,146	-0,371	-0,263	-0,510	-0,226	0,140
	Q5	0,266	0,085	0,373	0,026	1,000	0,186	0,079	0,045	0,060	0,156	0,045	0,092	-0,010	0,053	-0,052	-0,041
	Q6	0,105	0,220	0,038	0,126	0,186	1,000	0,304	0,588	0,343	0,044	0,356	0,380	0,477	0,259	0,133	-0,063
	Q7	0,246	0,231	0,216	-0,121	0,079	0,304	1,000	0,469	0,410	0,280	0,247	0,248	0,358	0,316	0,234	0,161
	Q8	0,140	0,291	-0,144	-0,153	0,045	0,588	0,469	1,000	0,628	0,266	0,272	0,695	0,512	0,673	0,266	-0,012
	Q9	0,250	0,215	-0,261	-0,223	0,060	0,343	0,410	0,628	1,000	0,354	0,283	0,297	0,357	0,485	0,088	-0,188
	Q10	0,603	0,453	-0,157	-0,113	0,156	0,044	0,280	0,266	0,354	1,000	0,056	0,135	0,000	0,310	0,000	0,041
	Q11	0,111	0,028	0,270	0,146	0,045	0,356	0,247	0,272	0,283	0,056	1,000	0,310	0,379	0,248	0,169	0,465
	Q12	0,154	0,470	-0,166	-0,371	0,092	0,380	0,248	0,695	0,297	0,135	0,310	1,000	0,556	0,699	0,450	0,195
	Q13	0,445	0,398	-0,099	-0,263	-0,010	0,477	0,358	0,512	0,357	0,000	0,379	0,556	1,000	0,730	0,556	0,155
	Q14	0,499	0,503	-0,192	-0,510	0,053	0,259	0,316	0,673	0,485	0,310	0,248	0,699	0,730	1,000	0,387	-0,014
	Q15	0,000	0,000	0,078	-0,226	-0,052	0,133	0,234	0,266	0,088	0,000	0,169	0,450	0,556	0,387	1,000	0,487
	Q16	-0,187	-0,120	0,056	0,140	-0,041	-0,063	0,161	-0,012	-0,188	0,041	0,465	0,195	0,155	-0,014	0,487	1,000
	Q17	-0,321	-0,302	0,223	0,111	-0,054	0,088	-0,206	-0,241	0,008	-0,531	0,320	-0,232	-0,097	-0,215	-0,425	-0,296
	Q18	0,447	0,310	-0,099	-0,146	0,182	0,177	0,049	0,299	0,173	0,364	-0,183	0,149	0,351	0,320	0,273	-0,126
	Q19	0,603	0,400	0,314	-0,079	-0,005	0,182	0,449	0,323	0,301	0,321	0,389	0,261	0,595	0,604	0,321	0,061
	Q20	-0,171	-0,342	0,373	0,413	0,148	0,058	-0,051	-0,242	0,094	-0,351	0,333	-0,302	-0,105	-0,220	-0,351	-0,169
	Q21	0,168	0,401	-0,020	-0,426	-0,061	-0,049	0,137	0,042	-0,235	-0,034	-0,302	0,249	0,334	0,247	0,403	0,027
	Q22	0,262	0,346	0,261	-0,316	0,270	-0,154	0,135	-0,111	-0,249	0,265	-0,103	-0,011	0,233	0,213	0,398	0,188
	Q23	0,023	0,060	-0,077	-0,470	-0,126	-0,004	0,333	0,162	0,329	0,129	0,005	0,120	0,134	0,308	0,258	-0,107
	Q24	0,430	0,224	0,196	0,252	-0,102	0,084	0,249	0,035	-0,055	0,538	0,234	0,032	0,144	0,251	-0,108	0,178
	Q25	0,228	0,043	0,161	0,176	-0,009	-0,022	0,146	0,051	0,215	0,302	0,232	-0,181	0,011	0,083	-0,151	0,027
	Q26	-0,004	-0,298	0,088	0,105	-0,039	-0,063	0,087	-0,168	-0,151	-0,068	0,172	-0,121	0,083	-0,101	0,205	0,187
	Q27	-0,072	-0,316	0,014	-0,020	0,028	0,101	0,229	0,183	0,302	-0,027	-0,017	0,016	0,261	0,137	0,384	-0,007
	Q28	0,332	0,131	-0,061	0,027	0,045	-0,309	-0,176	-0,504	-0,171	0,310	-0,087	-0,213	-0,033	-0,149	0,177	0,118
	Q29	0,516	0,389	-0,065	-0,192	-0,234	-0,016	0,266	-0,037	0,130	0,295	0,135	0,017	0,570	0,349	0,464	0,239
	Q30	0,181	0,289	0,199	0,024	0,375	0,439	0,351	0,374	0,318	0,295	0,242	0,140	0,311	0,385	-0,033	0,105
	Q31	0,670	0,532	-0,143	-0,316	-0,044	0,299	0,506	0,397	0,415	0,513	0,200	0,321	0,713	0,701	0,257	-0,030

		Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31
Correlation	Q1	-0,321	0,447	0,603	-0,171	0,168	0,262	0,023	0,430	0,228	-0,004	-0,072	0,332	0,516	0,181	0,670
	Q2	-0,302	0,310	0,400	-0,342	0,401	0,346	0,060	0,224	0,043	-0,298	-0,316	0,131	0,389	0,289	0,532
	Q3	0,223	-0,099	0,314	0,373	-0,020	0,261	-0,077	0,196	0,161	0,088	0,014	-0,061	-0,065	0,199	-0,143
	Q4	0,111	-0,146	-0,079	0,413	-0,426	-0,316	-0,470	0,252	0,176	0,105	-0,020	0,027	-0,192	0,024	-0,316
	Q5	-0,054	0,182	-0,005	0,148	-0,061	0,270	-0,126	-0,102	-0,009	-0,039	0,028	0,045	-0,234	0,375	-0,044
	Q6	0,088	0,177	0,182	0,058	-0,049	-0,154	-0,004	0,084	-0,022	-0,063	0,101	-0,309	-0,016	0,439	0,299
	Q7	-0,206	0,049	0,449	-0,051	0,137	0,135	0,333	0,249	0,146	0,087	0,229	-0,176	0,266	0,351	0,506
	Q8	-0,241	0,299	0,323	-0,242	0,042	-0,111	0,162	0,035	0,051	-0,168	0,183	-0,504	-0,037	0,374	0,397
	Q9	0,008	0,173	0,301	0,094	-0,235	-0,249	0,329	-0,055	0,215	-0,151	0,302	-0,171	0,130	0,318	0,415
	Q10	-0,531	0,364	0,321	-0,351	-0,034	0,265	0,129	0,538	0,302	-0,068	-0,027	0,310	0,295	0,295	0,513
	Q11	0,320	-0,183	0,389	0,333	-0,302	-0,103	0,005	0,234	0,232	0,172	-0,017	-0,087	0,135	0,242	0,200
	Q12	-0,232	0,149	0,261	-0,302	0,249	-0,011	0,120	0,032	-0,181	-0,121	0,016	-0,213	0,017	0,140	0,321
	Q13	-0,097	0,351	0,595	-0,105	0,334	0,233	0,134	0,144	0,011	0,083	0,261	-0,033	0,570	0,311	0,713
	Q14	-0,215	0,320	0,604	-0,220	0,247	0,213	0,308	0,251	0,083	-0,101	0,137	-0,149	0,349	0,385	0,701
	Q15	-0,425	0,273	0,321	-0,351	0,403	0,398	0,258	-0,108	-0,151	0,205	0,384	0,177	0,464	-0,033	0,257
	Q16	-0,296	-0,126	0,061	-0,169	0,027	0,188	-0,107	0,178	0,027	0,187	-0,007	0,118	0,239	0,105	-0,030
	Q17	1,000	-0,591	-0,213	0,769	-0,329	-0,346	0,107	-0,087	0,179	0,202	0,130	-0,241	-0,332	0,074	-0,176
	Q18	-0,591	1,000	0,388	-0,458	0,249	0,407	-0,327	0,024	0,035	-0,289	-0,055	0,234	0,405	-0,054	0,334
	Q19	-0,213	0,388	1,000	-0,180	0,373	0,380	0,202	0,492	0,317	-0,068	-0,041	-0,066	0,700	0,374	0,629
	Q20	0,769	-0,458	-0,180	1,000	-0,641	-0,360	-0,134	0,008	0,293	0,175	0,213	0,131	-0,323	0,041	-0,152
	Q21	-0,329	0,249	0,373	-0,641	1,000	0,627	0,376	0,008	-0,025	0,135	0,093	-0,172	0,491	0,140	0,252
	Q22	-0,346	0,407	0,380	-0,360	0,627	1,000	0,217	0,132	0,186	0,151	0,135	0,265	0,496	0,274	0,312
	Q23	0,107	-0,327	0,202	-0,134	0,376	0,217	1,000	-0,044	0,060	0,447	0,553	-0,249	0,146	0,303	0,263
	Q24	-0,087	0,024	0,492	0,008	0,008	0,132	-0,044	1,000	0,419	0,045	-0,120	0,111	0,409	0,454	0,593
	Q25	0,179	0,035	0,317	0,293	-0,025	0,186	0,060	0,419	1,000	0,073	0,231	0,051	0,236	0,289	0,222
	Q26	0,202	-0,289	-0,068	0,175	0,135	0,151	0,447	0,045	0,073	1,000	0,682	0,122	0,100	-0,010	0,092
	Q27	0,130	-0,055	-0,041	0,213	0,093	0,135	0,553	-0,120	0,231	0,682	1,000	0,037	0,033	0,145	0,190
	Q28	-0,241	0,234	-0,066	0,131	-0,172	0,265	-0,249	0,111	0,051	0,122	0,037	1,000	0,322	-0,393	0,124
	Q29	-0,332	0,405	0,700	-0,323	0,491	0,496	0,146	0,409	0,236	0,100	0,033	0,322	1,000	0,160	0,684
	Q30	0,074	-0,054	0,374	0,041	0,140	0,274	0,303	0,454	0,289	-0,010	0,145	-0,393	0,160	1,000	0,463
	Q31	-0,176	0,334	0,629	-0,152	0,252	0,312	0,263	0,593	0,222	0,092	0,190	0,124	0,684	0,463	1,000

a. This matrix is not positive definite.